unionGas
A Spectra Energy Company

December 1, 2014

Ms. Kirsten Walli
Ontario Energy Board
2300 Yonge Street, 27th Floor
Toronto, ON
M4P 1E4

Dear Ms. Walli:

Re: EB-2014-0273 - Union Gas Limited - 2013 Disposition of Demand Side Management Deferral and Variance Accounts

Enclosed is the application and evidence submitted by Union Gas Limited ("Union") concerning the final disposition and recovery of certain 2013 year-end deferral and variance account balances.

Union proposes that the impacts which result from the disposition of the deferral and variance account balances be implemented on April 1, 2015 to align with other rate changes implemented through the Quarterly Rate Adjustment Mechanism.

Union requests confidential treatment of the verification reports provided in Exhibit B, Tab 1, Appendix L, M, O and P. Customer names and sensitive commercial information have been redacted from these reports and Union requests the Board maintain these documents as confidential per the Practice Direction on Confidential Filings. Confidential copies of the reports will be provided to the Board under separate cover. Intervenors wishing to view these unredacted documents must execute a Declaration and Undertaking and forward it to Union.

If you have any questions concerning this application and evidence please contact me at (519) 436-5334.

Yours truly,

[*Original Signed by*]

Vanessa Innis
Manager, Regulatory Initiatives

cc Alexander Smith (Torys)
EB-2014-0145 Intervenors

EB-2014-0273

ONTARIO ENERGY BOARD

IN THE MATTER OF the *Ontario Energy Board Act, 1998*, S.O. 1998, c.15 (Schedule. B);

AND IN THE MATTER OF an Application by Union Gas Limited for an order or orders clearing certain non-commodity related deferral accounts;

APPLICATION

1. Union Gas Limited ("Union") is a business corporation, incorporated under the laws of Ontario, with its head office in the Municipality of Chatham-Kent.

2. Union conducts an integrated natural gas utility business that combines the operations of selling, distributing, transmitting and storing gas within the meaning of the *Ontario Energy Board Act, 1998* (the "Act").

3. In EB-2011-0210, Union applied to the Ontario Energy Board (the "OEB") for an order approving or fixing just and reasonable rates and other charges for the sale, distribution, storage and transmission of gas by Union effective January 1, 2013. The Board approved Union's request. In doing so, the OEB approved the continuation of certain deferral accounts.

4. Union applies for the approval of final balances for all 2013 DSM deferral accounts as listed in Exhibit A, Tab 4, Schedule 1 and an order for final disposition of those balances.

5. Union also applies to the OEB for such interim order or orders approving interim rates or other charges and accounting orders as may from time to time appear appropriate or necessary.

6. Union further applies to the Board for all necessary orders and directions concerning pre-hearing and hearing procedures for the determination of this application.

7. This application is supported by written evidence. This evidence may be amended from time to time as required by the OEB, or as circumstances may require.

8. The persons affected by this application are the customers resident or located in the municipalities, police villages and First Nations reserves served by Union, together with those to whom Union sells gas, or on whose behalf Union distributes, transmits or stores gas. It is impractical to set out in this application the names and addresses of such persons because they are too numerous.

9. The address of service for Union is:

Union Gas Limited
P.O. Box 2001
50 Keil Drive North
Chatham, Ontario
N7M 5M1
Attention: Vanessa Innis
Manager, Regulatory Initiatives

Telephone: (519) 436-5334

Fax: (519) 436-4641

- and -

Torys LLP
Suite 3000, Maritime Life Tower
P.O. Box 270
Toronto-Dominion Centre
Toronto, Ontario
M5K 1N2
Attention: Alexander Smith

Telephone: (416) 865-8142

Fax: (416) 865-7380

DATED: December 1, 2014

UNION GAS LIMITED

[Original signed by]

Vanessa Innis
Manager, Regulatory Initiatives

2013 DEMAND SIDE MANAGEMENT DEFERRAL AND VARIANCE ACCOUNT DISPOSITION

Requested Approvals

Union Gas ("Union") is applying to the Ontario Energy Board ("Board") for approval to dispose of its 2013 balances in its Demand Side Management ("DSM") deferral and variance accounts. Please see Table 1 below for the DSM deferral accounts and corresponding balances.

Table 1
2013 DSM Deferral Accounts and Balances

Account No. and Name	**Balance ($000s)**
179-75 Lost Revenue Adjustment Mechanism ("LRAM")	$2,800
179-111 Demand Side Management Variance Account ("DSMVA")	$1,198
179-126 Demand Side Management Incentive Deferral Account ("DSMIDA")	$7,784
Total 2013 DSM Deferral Account Balances	$11,782

The net balance in these accounts is a $11.782 million debit to ratepayers, which can be found at Exhibit A, Tab 4, Schedule 1. The Shared Savings Mechanism ("SSM") deferral account has no balance, and Union requested closure of this account in its 2015 Rates Evidence (EB-2014-0271). Union's Audit Committee ("AC") reached consensus on Union's 2013 DSM results and the audited results are presented in Exhibit A, Tab 4, Schedule 1. The allocation and disposition of the DSM deferral and variance account balances is provided in Exhibit A, Tab 5, Schedule 1. Union is also seeking approval of the disposition of the account balances through the first available QRAM after Board approval.

The deferral and variance account balances above relate primarily to DSM activities in 2013.[1] The deferral and variance account balances related to DSM activities in 2012 were considered in the 2012 Earnings Sharing & Disposition of Deferral Accounts and Other Balances ("2012 Deferrals proceeding"), EB-2013-0109. In this proceeding Union provided updated evidence schedules on November 4, 2013 showing the final, audited balances in the accounts. The Board-approved Rate Order for EB-2013-0109 reflecting the disposition of deferral and variance account balances related to DSM activities in 2012 became effective July 1, 2014. Union is not proposing any changes to the deferral and variance account balances related to DSM activity in 2012 and requests the Board's final approval of these amounts.

The evidence supporting the requested approvals is organized as follows:

Exhibit A

Tab 1	Requested Approvals
Tab 2	Union's Response to 2012 Deferrals Proceeding Decision
Tab 3	2013 Verification and Audit Process

---

[1] The LRAM account balance includes volume variances related to 2012 audited results at 2013 rates. This is discussed in further detail in Exhibit A, Tab 4.

Tab 4	DSM Deferral and Variance Account Balances
Tab 5	Allocation and Disposition of DSM Deferral and Variance Account Balances
Exhibit B	
Tab 1	Final DSM 2013 Annual Report
Tab 2	Independent Audit of 2013 DSM Program Results
Tab 3	Audit Committee Summary Results and Responses to the Audit of Union’s 2013 DSM Annual Report

GLOSSARY OF TERMS

The glossary is intended to serve as a reference for the benefit of stakeholders in their overall understanding of the DSM terminology in Union’s evidence. It is intended to provide guidance to a broad audience, recognizing that more detailed definitions may apply to specific terms when used by DSM practitioners.

Adjustment Factor	The adjustment factor reflects the percentage of savings being claimed. Typically, adjustment factor inputs include the percentage of participants who installed a prescriptive measure (and kept it installed) which is determined by conducting verification studies.
Audit	The Audit is an annual process to validate Union’s DSM results. A third party auditor is hired to conduct the Audit. While hired by Union, the auditor is independent and ultimately serves to protect the interests of ratepayers with respect to Union’s DSM claims.
Audit Committee (“AC”)	The AC consists of four members: three intervenor members selected by the DSM Consultative and one representative from Union. The goal of the AC is to ensure that there is, each year, an effective and thorough audit of the utility’s DSM results. The AC establishes the standard scope of the annual audit, provides input and guidance to the Auditor, and recommendations through a AC Report submitted to the Board.
Base Case	The base case is a projection of the future without the effects of the utility’s DSM program. The difference between the base case and the energy efficient case represents the saving attributable to the energy efficient measure.
Capital Equipment Project	A capital equipment custom DSM project refers to a project where natural gas savings are derived from the purchase and installation of a new piece of equipment or system (e.g. a high efficiency boiler). Custom DSM projects are categorized at Union as either Capital or Operations & Maintenance (O&M) Projects.

Custom DSM Project	A custom DSM project is a natural gas savings project that is based on customer-specific information and considerations, and includes new capital equipment and O&M energy savings measures. DSM projects available to Union's larger customers are categorized as either "custom" or "prescriptive".
Custom Project Savings Verification ("CPSV")	The annual process by which the cumulative gross savings estimates of Union's custom DSM projects are verified. A statistically significant sample of low-income, commercial/industrial, and large volume projects are verified by a third party consultant.
Demand Side Management ("DSM")	DSM is the modification in end-use customer demand for natural gas through conservation programs. While the focus of Union's DSM is natural gas savings and the reduction in greenhouse gases emissions, it may also result in the saving of a number of other resources such as electricity, water, propane, and heating fuel oil.
DSM Consultative	The group of stakeholder organizations/intervenors who Union engages to consult on DSM activities. Members of the DSM Consultative include representatives of ratepayer and environmental organizations.
Demand Side Management Incentive Deferral Account ("DSMIDA")	The account to record the shareholder incentive amount earned by Union as a result of its DSM programs.
Demand Side Management Variance Account ("DSMVA")	The account used to track the variance between actual DSM spending by rate class versus the budgeted amount included in rates by rate class. Union may record in the DSMVA in any one year, a variance amount of no more than 15% above its DSM budget for that year.
Direct Access ("DA") Budget Mechanism	The DA budget mechanism is offered to Union's largest industrial customers (Rate T2 and Rate 100). It provides each customer dedicated access to the customer incentive budget they pay in their rates to support energy efficiency projects and studies on an annual basis.
DSM Incentive	The incentive available to Union for achieving Board-approved performance targets.

Effective Useful Life ("EUL") EUL is the length of time that a piece of equipment or measure is anticipated to last and perform as expected.

Evaluation, Measurement & Verification ("EM&V") The activities undertaken to assess the implementation and performance of a program.

Free Ridership Free riders are program participants who would have installed the energy efficient measure without the influence of Union's DSM programs. Free ridership is not a binary concept and consequently, different levels of free ridership exist.

Pure or Total Free Riders: These customers would have installed exactly the same quantity and type of equipment in the absence of the utility.

Partial or Deferred Free Riders: These customers would have installed some equipment on their own, but:

1. a smaller number of units and/or
2. at a lower efficiency level and/or
3. at a later point in time.

The utility had some impact on the quantity, efficiency and timing.

Non-Free Riders: These customers would not have installed any equipment in the absence of the utility.

Free rider rates are estimated based on research, market penetration studies or through negotiations in prior evaluation processes. The free rider rates are applied to the gross program savings results to derive savings generated by the program.

Incentive An incentive is a payment from Union to DSM participants to encourage participation in a DSM program.

Incremental Cost The incremental cost is the difference in price between the high efficiency case and the base case.

Input Assumptions Assumptions such as operating characteristics and associated units of resource savings for a list of DSM technologies and measures. These cover a range of typical DSM activities, measures and technologies with residential, commercial and industrial applications.

Integrated Energy Management Systems ("IEMS") A custom program offered to customers to assess, implement, and utilize an integrated system to manage a facility's energy costs, consumption and intensity.

Lifetime Cumulative cubic meters ("cumulative m^{3}") Total natural gas savings over the effective useful life of a DSM measure. Frequently used at the measure or program level and can also summarize the benefits of an entire portfolio.

Lost Revenue Adjustment Mechanism ("LRAM") The LRAM is the Board's approved method by which utilities recover the lost distribution revenues associated with DSM activity. These lost revenues are calculated for each rate class impacted by DSM energy efficiency programs.

Market Transformation Market Transformation facilitates fundamental changes that lead to greater market shares of energy efficient products and services.

Measure A measure is any particular energy efficient technology (e.g. a low-flow showerhead, an energy recovery ventilator, condensing boiler, etc).

Net-to-Gross Ratio Gross impacts are the program impacts prior to accounting for program attribution effects. These attribution effects are free ridership and spillover. Net impacts are the program impacts once program attribution effects have been accounted for. The net-to-gross ratio is defined as 1 – (free ridership ratio) + (spillover ratio).

Offering A DSM offering exists where there are either bundles of energy efficiency measures or performance/maintenance based enhancements to existing measures marketed together (e.g. energy savings kits, home retrofit measures, custom equipment/process/O&M) or where support is delivered through a suite of services (e.g. customer engagement, site energy assessments, etc.).

Operations & Maintenance ("O&M") Project An O&M custom DSM project is any project where natural gas savings are derived from the repair, replacement, or optimization of an existing piece of equipment or

	system (e.g. steam leak/trap repair). Custom DSM projects are categorized as either O&M or Capital projects.
Participants	The units used by Union to measure participation in its DSM programs. Participant units of measurement include customers, projects and measures or technologies installed. Not all participants result in energy savings.
Persistence	Persistence is the extent to which a DSM measure remains installed and performing as originally predicted. Persistence of DSM savings takes into account how long a DSM measure is kept in place relative to its useful life, the net impact of the measure relative to the base case scenario, and the impact of technical degradation.
Prescriptive Offering	A prescriptive DSM offering is a natural gas savings measure/technology that is based on previously substantiated and pre-approved inputs. Prescriptive DSM measures apply to all of Union's customer market segments including residential (eg. low flow showerheads), low-income, commercial (eg. condensing gas water heater) and industrial (e.g. infrared heaters).
Program	A program is the utility specific approach to providing one or more DSM offerings to customers.
Program Costs	Costs incurred by Union in designing, delivering and promoting its DSM programs, and in confirming its program results.
Program Evaluation	Program evaluation refers to activities related to the collection, analysis, and reporting of data for purposes of measuring program impacts from past, existing or potential program impacts.
Realization Rate	A realization rate is the ratio that compares verified and audited savings to the savings originally calculated for custom projects. Realization rates are used to extrapolate audited savings from a sample of projects on to all projects.
Resource Acquisition	Programs that seek to achieve direct, measurable savings customer-by-customer through the incenting/promotion of specific energy efficiency upgrades.
Spillover	Spillover effects refer to customers that adopt energy efficiency measures because they are influenced by a utility's program-

related information and marketing efforts, but do not actually participate in the program.

Technical Evaluation Committee ("TEC") The TEC consists of seven individuals: three intervenors members selected by intervenors, a representative from Union, a representative from Enbridge, and two independent members with technical and other relevant expertise. The goal of the TEC is to establish DSM technical and evaluation standards for natural gas utilities in Ontario. The TEC makes recommendations to the Board on the annual Technical Reference Manual ("TRM") update.

Technical Degradation Technical degradation accounts for a reduction in equipment performance over time (e.g. wear and tear).

Total Resource Cost Test ("TRC") The TRC Test provides a measure of the benefits and costs that accrue as a result of the installation of a DSM measure.

UNION'S RESPONSE TO 2012 DEFERRALS PROCEEDING DECISION

In the 2012 Earnings Sharing and Disposition of Deferral Accounts and Other Balances proceeding, EB-2013-0109 ("2012 Deferrals proceeding"), Union followed its historical practice to true-up its DSM deferral and variance account balances to reflect 2011 audited amounts and to provide 2012 DSM deferral balances based on unaudited results. Intervenors expressed two chief concerns regarding Union's 2011 audited results for custom projects: the baseline, effective useful life ("EUL") and persistence assumptions used by Union to calculate the results achieved for large volume industrial custom projects and the interpretation of what is included in free ridership.

Union submitted that it works with customers to assess the baseline, EUL and persistence assumptions on a project-by-project basis. For each project, base case, EUL and persistence were reviewed by Union's technical experts, verified internally by professional engineers and then further reviewed, verified and audited independently. Union also submitted that the free rider adjustment which is applied to the applicable portfolio of custom projects includes all free ridership.

On March 27, 2014, the Ontario Energy Board ("Board") issued its Decision in the 2012 Deferrals proceeding, finding that Union's 2011 Total Resource Cost ("TRC") amount related to large industrial custom DSM projects (Rate T1/Rate 100) should be reduced by 25%.   In its EB-2013-0109 Decision the Board found:

> *"assessing the benefits of DSM projects involves considering what would have happened if the DSM project had not occurred (baseline); the effective useful life of the DSM measure (repairs, new equipment, etc.); and the period in which the DSM measure will actually be in operation, which may or may not be as long as the effective useful life (persistence)."*[1]

and

> *"Union did not exercise the requisite due diligence in considering base case, effective useful life and/or persistence."*[2]

Union carefully considered the record of the 2012 Deferrals proceeding and the Board's Decision. Union has provided additional evidence in this proceeding to support its due diligence activities, including process improvements as detailed on pages 16-18 of this evidence. Accordingly, Union has not reflected a reduction to the 2013 audited results related to large volume custom DSM projects.

The purpose of this evidence is to provide a clearer and more complete explanation of its DSM practices to the Board and to stakeholders to demonstrate that Union has and does exercise due diligence in considering base case, EUL and persistence. Union must also maintain its ongoing continuous improvement approach to the DSM Custom Project Savings Verification ("CPSV") and audit processes and communicate these process improvements more effectively.

---

[1] EB-2013-0109 Decision and Order, page 38.
[2] EB-2013-0109 Decision and Order, page 39.

To ensure the Board has the required information and context in this proceeding for Union's custom DSM results, Union has provided a description of the following below:

Custom DSM Program Savings Methodology

Internal Technical Assessment Process

Third Party Technical Assessment Process

CUSTOM DSM PROGRAM SAVINGS METHODOLOGY

Union's custom DSM project savings are determined based on the evaluation of energy use for each customer specific project. Savings are determined by considering a high efficiency option compared against a lower efficiency base case option. The program is focused on supporting continuous improvement with respect to energy use through long-term relationships with customers, and is not structured as a "one-and-done" model for delivery of individual projects. Incentives are provided to customers based on estimated annual gas savings. Custom DSM program offerings are available to Union's Commercial and Industrial customers. The programs are structured as: 1) Commercial/Industrial; 2) Commercial Low-Income; and 3) Large Volume – including Rate T1 customers, and a Direct Access budget mechanism for Rate T2/Rate 100 customers. Custom DSM savings are calculated for each project based on the lifetime savings for the project. The free rider adjustment and custom realization rate is then applied to the applicable portfolio of custom projects. This is represented by the following formula:

$$\text{Lifetime Natural Gas Savings } (m^3) = \underbrace{(X - Y)(EUL)}_{\text{Project Level}}\underbrace{(1\text{-}FR)(RR)}_{\text{Portfolio Level}}$$

Where;

X = Base case annual gas consumption

Y = High efficiency case annual gas consumption

EUL = Effective useful life (years)

FR = Free ridership rate

RR = Realization rate

Each of these elements, as well as Union's treatment of persistence, is described below. For each of these elements, with a focus on continuous improvement, Union has used ongoing feedback from the verification and audit process (discussed further in Exhibit A, Tab 3) to refine the amount of documentation included in the DSM project application files to support the approach taken.

Base Case

The base case reflects a projection of the customer's energy usage without the effects of Union's DSM program. The difference between the base case and the high efficiency case represents the savings attributable to the energy efficient measure/project. Base cases are established individually for each custom DSM project. The base case for each custom project is determined based on what that customer would commonly and reasonably have chosen to do as an alternative to the higher energy efficiency option. Given the unique business processes and requirements associated with custom projects, the approach must consider customer-specific circumstances.

Custom DSM project application files identify the base case equipment for each project with supporting documentation. Examples of supporting documentation include equipment specification sheets, historical site production/performance records, and engineering estimates provided.

Base case determination considers a number of factors, including the following:

1. Existing (legacy) equipment that is currently in operation and its related gas usage;
2. Market availability of lower efficiency (generally less expensive) new equipment and its estimated gas usage;
3. Estimated gas usage for minimum standard design or other “compliance” requirements (e.g. high performance building construction built to meet an existing building code or standard);
4. Production levels and energy intensity for existing manufacturing processes (e.g. energy use/product produced); and,
5. Operating conditions for existing processes (e.g. control system set points and equipment/system operating temperature and pressure).

High Efficiency Case

The high efficiency case for custom projects reflects what the customer implemented through DSM program participation. High efficiency case determination considers the following:

1. New equipment efficiencies and estimated gas usage;
2. Actual site/equipment metered performance and cumulative savings analysis;
3. Production levels and energy intensity for new manufacturing processes (e.g. energy use/product produced); and,
4. Operating conditions for new/enhanced processes (e.g. control system set points and equipment/system operating temperature and pressure).

The custom DSM project application files identify the high efficiency case equipment with supporting documentation (e.g. product specification sheets, site production/performance records, engineering estimates).

Effective Useful Life ("EUL")

EUL considers the length of time (in years) that the high efficiency measure put in place will perform as estimated (or demonstrated, through metered performance and cumulative savings analysis). Union considers the most appropriate factors when estimating EUL for a specific custom project:

1. Industry reported equipment useful life (e.g. ASHRAE);
2. Project specific new equipment;
3. Customer expectations of existing legacy equipment/ process life;

4. Manufacturer expectations for new equipment performance;
5. Actual equipment/process performance in similar applications; and,
6. EUL assumptions as filed in input assumptions filings with the Board.[3]

Free Ridership Rate

The free ridership rate reflects the extent to which participants would have undertaken an efficiency upgrade or action even if the DSM program did not exist. Free ridership rates are applied to gross savings results to derive the net savings attributable to the program. This adjustment reduces the lifetime savings claim by a specified amount for all customers participating in Union's custom program offerings.

The free ridership rate applied to Union's Commercial/Industrial and Large Volume programs is based on empirical measurement of Union's project-specific free ridership findings as calculated in the Custom Projects Attribution study performed by Summit Blue Consulting ("Summit Blue") in 2008. Summit Blue's comprehensive study assessed free ridership including both total free riders and partial free riders. Total free riders are customers who would have installed exactly the same quantity and type of equipment in the absence of Union's program intervention at the time of program participation. Partial free ridership adjusts for Union's influence on the efficiency type, quantity of unit installations, and acceleration of the timing of the project as shown in Table 1 below.

---

[3] Most recently in EB-2013-0430, New and Updated DSM Measures Joint Submission from Enbridge Gas Distribution and Union Gas Limited.

Table 1
Components of Partial Free Ridership

Component	Description
Efficiency Type	Accounts for the likelihood that customers would have installed the same or similar level of energy efficiency absent Union's program assistance.
Quantity of Installations	Accounts for the quantity of energy efficient equipment that would have been installed absent Union's program assistance.
Acceleration	Accounts for customers who, at some point, would have implemented the high efficient case, but Union's program persuaded them to install it sooner than otherwise originally planned.

Summit Blue calculated the free ridership rate for five segments. The free ridership rate was adjusted to a single free ridership rate of 54% in the 2009 audit (as a result of an audit recommendation), and is reflected as one aggregate portfolio-level value for the custom portfolio.

The free ridership rate is applied consistently to all customers and all claimed DSM savings across Union's entire custom DSM portfolio, regardless of customer sophistication and whether clearly demonstrated influence for a savings claim is made apparent by the utility. Union does not apply a customer-specific free ridership rate as it is applied at a portfolio-level.

The application of an empirical free ridership rate to Union’s custom portfolio has been a longstanding practice that has been filed annually with the Board (most recently in the “New and Updated DSM Measures” filing EB-2013-0430). In addition, the Auditor annually reviews that the free rider rate has been appropriately applied to Union’s custom portfolios pre- and post-audit. As per the Joint Terms of Reference on Stakeholder Engagement for DSM Activities, the Technical Evaluation Committee (“TEC”) has accountability to produce and maintain an annual work list, establish evaluation priorities, and to determine, by consensus, the design and implementation of evaluation studies to be carried out. A new Net-to-Gross (“NTG”) study has been initiated at the TEC, which will deliver an updated NTG ratio for Union’s Commercial and Industrial Custom Program.

Union’s 2013 Auditor, Evergreen Economics, stated in the Auditor’s Report that “going through the sample of evaluated projects and removing savings for those projects that might be considered free riders would result in an over-correction for free ridership, as a free ridership adjustment is already being applied to the entire sample of projects. Since the free ridership adjustment is being applied to the entire group, no additional project-level adjustment is needed.” Union’s Audit Committee (“AC”) agreed with the Auditor’s recommendation that adjustments on a per-project basis are not appropriate as this application would inappropriately compound the reduction.

Realization Rate

Custom Project Savings Verification ("CPSV") is the process used to determine project and portfolio specific realization rates. The realization rate is the ratio that compares verified savings to the savings originally assessed, based on best-available information at the time of CPSV. Six separate realization rates are calculated for cumulative gas savings, annual gas savings, EUL, annual electricity savings, annual water savings, and incremental cost. They are then applied to each of the Commercial/Industrial, Large Volume Rate T1, Large Volume Rate T2/Rate 100, and Low-Income custom program portfolios.

The realization rates extrapolate verified savings from a sample of projects representative of the project portfolio and apply them to the complete project portfolio. The methodology for selecting the sample was established by Navigant Consulting in 2012 and endorsed by the TEC. This methodology ensures the sample of projects to be verified is statistically representative of the custom project population for each of the Commercial/ Industrial, Large Volume Rate T1, Large Volume Rate T2/Rate 100, and Low-Income custom program portfolios. The sample is designed to be statistically significant for natural gas savings only.

Union's third party CPSV consultants conduct on-site verification for the sample projects, and based on their findings determine if adjustments to the original savings claims are warranted. Any adjustments, both positive and negative, are factored into the calculation to determine the custom realization rates for the program year. These realization rates are then applied to each of the four applicable custom project portfolios in order to provide a high degree of confidence[4] that the final verified savings reported by Union reflect best-available information.

An independent Auditor reviews the reasonableness of the CPSV consultant's reports, including all inputs that impact these reports. This may result in adjustments to the sample verified savings. Union's AC reviewed all draft and final CPSV reports starting in the 2013 audit.[5] The AC works collaboratively to reach consensus on the Auditor's findings. Final audited realization rates are calculated based on these audited results.

Persistence

Persistence is the extent to which a DSM measure remains installed and is performing as originally predicted. Persistence of DSM savings takes into account how long a DSM measure is kept in place relative to its useful life, the net impact of the measure relative to the base case scenario, and the impact of technical degradation. Union recognizes that economic and market driven factors can also influence project savings, and reflects these market realities based on the best available information at the time of project processing.

---

[4] The sampling methodology achieves a 90/10 confidence level.
[5] In 2012 the AC reviewed final CPSV reports.

Where Union identifies changes within customer facilities that would impact the savings claim for a given program year, Union adjusts its DSM results to reflect the change. For example, where Union becomes aware that a customer who has undertaken a custom project in the program year is closing down a plant and as a result the project savings will not materialize as expected, Union removes the project from its DSM results. Similarly, where it is established a plant is increasing or decreasing production, savings will reflect the best information made available by the customer.

Where adjustments are identified within the program year, the changes are applied to the individual project. Where adjustments are identified after-the-fact within the project sample through the CPSV process, they are reflected in the overall realization rate, and applied to the overall custom project portfolio. Through this process Union ensures the custom DSM results represent best available information at the time of the audit. However, neither Union nor its customers are able to predict all future changes which would increase or decrease project savings (for example the date at which a currently profitable plant may close or expand production). Under these circumstances, economic and market driven factors cannot realistically be reflected. The TEC, which sets evaluation priorities, has not prioritized a study of post-audit savings persistence to date.

Another determining factor in quantifying persistence is technical degradation. This refers to the potential for a DSM measure’s performance to decrease as it gets closer to the end of its useful life. Technical degradation is accounted for on a per-project basis.

As outlined above, Union considers equipment efficiencies, operating conditions and the operating life of similar or demonstrated equipment/process performance when assessing the high efficiency case and EUL, relative to the base case, to ensure the savings claim is accurate.

INTERNAL TECHNICAL ASSESSMENT PROCESS

Though individual project decision factors vary, as outlined above, Union carefully considers base case and EUL in calculating lifetime natural gas savings for each custom project. The assessment is conducted by Union's Account Managers and Project Managers in consultation with the customer and based on what the customer would commonly or reasonably have chosen. Union's DSM team has developed and maintains a long-term business relationship with Union's large commercial, industrial and agricultural customers. As a result of this long-term relationship and their expertise they are in a position to assess customer-specific considerations and develop the DSM project application based on the unique energy needs and decision process of the customer. Energy conservation is one of many considerations customers are faced with. Union's value proposition to its customers is to provide technical expertise and guidance with respect to energy-related decision making and business justifications, including financial incentives. Union's guidance and incentives help customers to prioritize energy efficiency projects against their own internal competing factors (such as those activities which are deemed more business critical) and demonstrate the competitive advantage customers can gain through efficiency upgrades. The savings claims are subsequently assessed through Union's internal quality assurance/quality control process to validate the project results. A description of Union's technical assessment process, and the internal stakeholders engaged, is provided below.

Account Managers

Union employs an account management strategy for dealing with its approximately 500 larger "contract sized" commercial and industrial customers. The Account Manager assigned to each of these customers is responsible for providing and administering the full range of applicable services within the Union service portfolio, including DSM offerings. The Account Manager's role is to work with assigned customers to gain in-depth knowledge of their business plans, particularly with respect to their energy use and needs. As Account Managers typically interact with multiple departments within the customer's organization (e.g. purchasing/procurement, plant operations, technical/engineering functions), they are uniquely positioned to identify customer-specific information which is a critical input into the assessment of project savings opportunities.

Project Managers

Account Managers engage Union's Project Managers with specific customers as needed to assist customers in recognizing, identifying and developing specific energy efficient natural gas based solutions to customer business problems. Union's eight Project Managers are all engineers with a Professional Engineering designation (in

Ontario) and have many years of engineering experience, including previous external commercial or industrial experience. The Project Manager works together with the Account Manager as well as third party engineers, equipment manufacturers and service providers as necessary to complete the DSM application and confirm the appropriate base case, high efficiency option and EUL for the project. Union's Project Managers effectively become energy conservation and/or technology subject matter experts with respect to the customer businesses as required. Union's experienced staff supports these customers in identifying best-practice energy conservation solutions that meet their requirements. They also support customers as required throughout the project implementation process.

Internal Quality Assurance/Quality Control ("QA/QC")

Each custom project is assessed by Union's internal project review and verification QA/QC team prior to the external verification and audit. The review is conducted by engineers within the Commercial/Industrial Energy Efficiency Programs ("CIEEP") team. CIEEP reviews and confirms the calculated savings through evaluation of project and customer-specific factors, including:

- Reasonableness of base case assumptions;
- Confirmation of high-efficiency case assumptions;
- Reasonableness of project life assumptions (EUL);

- Confirmation of "other" factors affecting gas demand (e.g. production and weather); and,
- Confirmation of customer project costs.

Project savings calculations are based on the best information available at the time of review. CIEEP works directly with Project Managers and Account Managers to clarify assumptions and confirm/revise calculated savings as required. Projects submitted that are not deemed eligible for an incentive are rejected by the CIEEP team.

THIRD PARTY TECHNICAL ASSESSMENT PROCESS

Each year, Union's custom DSM results are subject to rigorous third party verification and an audit. With each DSM Framework cycle, the Board has continued to refine the DSM verification process. In addition, Union, in consultation with stakeholders, has continued to enhance the evaluation, verification and audit process beyond the Board's minimum requirements.

2013 represents the second year of the current DSM Framework, which provided for the establishment of the Terms of Reference on Stakeholder Engagement to lead to greater objectivity on DSM technical standards and improved efficiency and effectiveness of engagement with stakeholders. In alignment with the Terms of Reference, the TEC and AC process has been followed to ensure accurate reporting and calculation of DSM deferral and variance accounts balances. The 2013 Audit process is described in further detail in Exhibit A, Tab 3.

In addition to the establishment of the TEC and AC to streamline both the process to update input assumptions and the audit process, other changes were made to provide greater scrutiny and confidence in the calculation and reporting of DSM deferral and variance account balances. These changes included updates to the CPSV process as well as the auditor selection process.

The changes implemented for the 2012 CPSV process were as follows:

- Increase in the number of custom projects that were verified to improve statistical significance.[6]
- Alignment between Union and Enbridge on the CPSV Terms of Reference to increase scrutiny and input on the requirements of CPSV.
- Requirement of on-site visits for all projects selected for CPSV. This led to increased examination and transparency for the custom projects selected for CPSV.[7]

---

[6] The 2012 TEC Endorsed Sampling Methodology is designed to achieve 10% precision at a 90% one-sided confidence level. In years preceding, the former sample design achieved 15% precision at 90% confidence.

[7] In exception cases, the CPSV Consultant can determine that an on-site visit is not required but a rationale must be provided. For example, adequate on-site measurement has already been conducted or the cost of additional on-site measurement is calculated to be disproportionately high relative to the benefits.

- Improved CPSV reporting transparency with the Auditor. The Auditor received all draft and final reports, and had the opportunity to provide comments, at the same time as the utility.
- Improved reporting transparency with AC. In 2012, the AC received the final CPSV reports, along with final versions of all other verification reports. In addition, the audit tool was provided with active links. In 2013, the AC received all draft and final CPSV reports.

The changes implemented for the Auditor selection process are identified below. Collectively, these changes increased the level of review in identifying Auditor qualifications and ultimately ensured that the Auditor selection process and expectations were more clearly defined.

- Development of Request for Qualification ("RFQ") for audit firms with AC.
- Use of a bidder's list of audit firms developed jointly by Union and the AC.
- Increased collaboration on the development of the Auditor Request for Proposal ("RFP") with Enbridge and the utilities' respective ACs.
- Change in consensus requirement for Auditor selection, with intervenor members selecting the Auditor where consensus is not reached within the AC.

Union's audited DSM results go through several levels of review, and have benefitted from the continual evolution of the evaluation, verification and audit process within the current DSM Framework.

CONCLUSION

In accordance with the prescribed process, Union exercises robust and appropriate due diligence when determining custom DSM savings. The base case, high efficiency case and EUL for each project are thoroughly assessed by Union's internal technical resources, and an empirically-measured free rider rate is applied to the custom portfolio. Persistence adjustments are applied based on best available information as required. The custom portfolio is then subject to third party verification, followed by a robust audit in consultation with stakeholders.

Consistent with many aspects of DSM practice, the custom program has adopted continuous improvement processes to ensure it continues to evolve, with consideration of the input of customers and Union's DSM Consultative stakeholders. The custom DSM program offering meets the complex needs of a broad range of customers while also complying with the Board's direction and established process to confirm DSM results.

2013 VERIFICATION AND AUDIT PROCESS

The deferral account balances presented in Exhibit A, Tab 4, Schedule 1 are the product of Union's DSM activities in 2013. While Exhibit A, Tab 2 addresses concerns raised in the 2012 Earnings Sharing and Disposition of Deferral Accounts and Other Balances proceeding, EB-2013-0109 ("2012 Deferrals proceeding"), this section of evidence describes the 2013 verification and audit process that ultimately led to Union reaching consensus on its 2013 DSM results with its Audit Committee ("AC").

For the 2013 audit, Union's DSM Consultative elected three intervenor members to serve as representatives on Union's AC: Consumers Council of Canada, Green Energy Coalition and Canadian Manufacturers and Exporters.

Union hired Michaels Energy, Byron Landry & Associates and Diamond Engineering as the Custom Project Savings Verification ("CPSV") consultants to undertake CPSV reviews of the Union's Low-Income, Commercial/Industrial and Large Volume custom projects. Union consulted the AC on the prospective bidders list and sought input to the selection of the firms. The reports prepared by the CPSV consultants are included as Appendices N, O and P in the final DSM 2013 Annual Report attached at Exhibit B, Tab 1. These reports have been redacted as necessary to protect confidential customer information.

The following table outlines the verification work undertaken to support the 2013 DSM audit.

Table 1
Verification Supporting the 2013 DSM Audit

Program Type	**Program Name**	**Verification Consultant**	**Primary Objectives**
Prescriptive	Energy Savings Kit (“ESK”) Residential Program	Beslin Communications Group Inc.	- Verify measure installation - Verify continued use of the measure - Verify percentage of showering under the efficient showerhead - Verify water heater type
	Low-Income Free Showerhead Installation Initiative (Multi-Family)	Seeline Group Ltd.	
	Commercial/Industrial - Impact Evaluation Hot Water Conservation(“HWC”) Program (Multi-Family)	Seeline Group Ltd.	
Custom	Low-Income	Michaels Energy	- Verify date of installation of equipment - Determination of whether the natural gas savings calculations in the application were reasonable based on information available at the time of verification - Review of the assumptions used in calculations - Discussion of the difference between the utility’s savings estimate and the verifier’s estimate - Recommend adjustments to the savings claim based on verification findings
	Commercial/Industrial	Byron Landry & Associates	
	Large Volume	Diamond Engineering	

Note: for the Residential ESK Install Initiative and Low-Income Helping Homes Conserve program, adjustment factors from 2012 were used since each of these programs had fewer than 260 participants in 2013

Union completed a draft 2013 DSM Annual Report to provide a compilation of the results achieved during the program year. This report outlined the budget expenditure, the results achieved and the verification results. The draft report was provided to the DSM Consultative in May 2014.

Consistent with section 6 of the Terms of Reference[1], Union and the AC retained Evergreen Economics ("Evergreen") to complete a thorough audit of Union's 2013 DSM results. Union and the AC were in consensus on the Auditor selection. Evergreen was charged with providing an independent opinion on whether the Lost Revenue Adjustment Mechanism ("LRAM"), DSM Variance Account ("DSMVA") and DSM Incentive calculations were appropriate and calculated correctly. In developing its independent opinion, Evergreen was provided Union's draft 2013 DSM Annual Report, all drafts and final CPSV reports, prescriptive verification reports and the 2013 audit tool with active links. The AC was also provided the same documents.

Evergreen performed a review of all elements involved in the calculation of DSM Incentive, LRAM, DSMVA, as well as all programs presented in the Annual Report. For prescriptive measures, the auditor confirmed the measure level inputs were appropriate, reviewed the participant data and confirmed the savings were calculated appropriately.

---

[1] Joint Terms of Reference on Stakeholder Engagement for DSM Activities by Enbridge Gas Distribution Inc. and Union Gas Limited, November 4, 2011.

This included reviewing the manner in which all impact evaluation results applicable to prescriptive savings were applied as required.

For custom savings, the auditor reviewed the reasonableness of the CPSV consultant's reports, including all inputs that impact these reports. Over the course of the 2013 audit process, the Auditor was involved in a total of 18 meetings; nine meetings were focused on discussing CPSV reports given that custom projects consist of specialized equipment, upgrades, and technology for which savings calculations are developed on a project by project basis. Particular items discussed included validation of equipment installation and confirmation of operating conditions, as well as direct measurement of key site, equipment and/or operating characteristics. Evergreen and the CPSV consultants were all aware of the Board's Decision in Union's 2012 Deferrals proceeding to adjust Union's 2011 DSM results when completing their work relating to 2013.

After extensive review and consultation, Evergreen reached the opinion that the LRAM, DSMVA and DSM Incentive figures were "calculated correctly using reasonable assumptions, based on data that has been gathered and recorded using reasonable methods and accurate in all material respects, and following the rules and principles set down by the Ontario Energy Board that are applicable to the 2013 DSM programs of Union Gas Limited".[2] The report entitled "Independent Audit of 2013 DSM Program

---

[2] Evergreen Independent Final Audit Report, p. i.

Results Final Report Submitted by Evergreen Economics" is provided at Exhibit B, Tab 2.

Evergreen's recommendations were subsequently reviewed by the AC. The summary of recommendations begins at page 34 of Evergreen's report. The AC's response to the recommendations are set out in the 'Audit Committee Summary Results and Response to the Audit of Union's 2013 DSM Annual Report' provided at Exhibit B, Tab 3. With the audit complete, Union was able to finalize its 2013 DSM Annual Report. This report is provided at Exhibit B, Tab 1.

Once the comprehensive 2013 verification and audit process was complete, Union's AC reached consensus on Union's 2013 DSM results. Union sent the reports attached at Exhibit B to its DSM Consultative for support and endorsement. Interested parties endorsed Union's 2013 audited DSM results, with the exception of APPrO.[3]

Union filed its Independent Audit of 2013 DSM Program Results report prepared by Evergreen on October 15, 2014 to meet Union's requirement under Section 2.1.12 of the Board's Reporting and Record Keeping Requirement Rule. Union filed the 2013 Annual Report and 'Summary of Results and Response to the Audit of Union's 2013 DSM Annual Report' with the Board on December 1, 2014.

---

[3] IGUA took no position.

DSM DEFERRAL AND VARIANCE ACCOUNT BALANCES

Account No.179-75 Lost Revenue Adjustment Mechanism ("LRAM")

The LRAM deferral account has a debit balance of $2.800 million. This balance includes volume variances related to 2012 audited full year demand side management ("DSM") activities at 2013 rates and the audited volumes related to 2013 DSM activities.

Exhibit A, Tab 4, Schedule 2, page 1 provides the breakdown of the LRAM deferral account balance for 2012 and 2013. Exhibit A, Tab 4, Schedule 2, pages 2 and 3 provide the LRAM volumes and the corresponding revenue impacts related to 2012 and 2013 DSM activities respectively.

The calculation for lost revenues for 2013 reflects the EB-2011-0327 Settlement Agreement (page 34) which states that for each measure implemented in any given month, the volumetric reductions for that month and the remaining months of the year will be calculated on a rate class basis. The volumetric reductions will be multiplied by the volumetric distribution rate per m^3 for the rate class for that year. For example, the natural gas savings implemented in March 2013 have ten months of LRAM calculated based on the average rate for that rate class for the year whereas natural gas savings implemented in November have two months of LRAM calculated based on the average rate for that rate class for the year.

The amount Union proposes to dispose of for 2012 is a debit balance of $1.662 million (Exhibit A, Tab 4, Schedule 2, page 2, line 19, column (c)) which represents lost revenues from audited 2012 volume savings for the year of 137,438 $10^3 m^3$ at 2013 rates.

In 2013, the variance is a debit balance of $1.138 million (Exhibit A, Tab 4, Schedule 2, page 3, line 19, column (c)), comprising of total monthly forecasted volume savings of 126,542 $10^3 m^3$.   The 2013 variance represents the volumetric reductions for the month the forecasted volume savings were realized and for the remaining months of the 2013 year.

There were no 2013 DSM volumes included in 2013 rates. Union is proposing to dispose of the LRAM balance related to audited, 2013 DSM activities. Since this is a different process than in previous applications, there will be no true-up amount between unaudited and audited amounts to be captured in the deferral account for future disposition.

Account No.179-111 Demand Side Management Variance Account ("DSMVA")

This account records the difference between actual DSM costs incurred and the DSM budget included in rates. The debit balance of $1.198 million (Exhibit A, Tab 4, Schedule 3, line 14, column (c)) represents the difference between actual 2013 DSM expenditures of $32.839 million and $31.641 million included in rates.

Union has followed the methodology filed in the Settlement Agreement approved by the Board in the EB-2011-0327 Decision and Order dated February 21, 2012. Union has tracked the variance between actual DSM spending by rate class, relative to the DSM budget included in rates by rate class, in the DSMVA. With the exception of low-income costs, all program costs were allocated by program and assigned by rate class based on the percentage allocation of the actual customer incentive costs. All portfolio-level costs were allocated to a rate class based on the percentage allocation of the program costs by rate class, as outlined on page 36 of the Settlement Agreement.

The variance spent on low-income DSM programming has been allocated in proportion to the most recent Board-approved distribution revenue by rate class, as outlined in Appendix C of the Settlement Agreement. The overall 2013 low-income budget spend of $8.897 million, which includes the allocated portfolio costs, is allocated in proportion to the 2013 distribution revenue (EB-2011-0210).

In addition, as per Section 10.2 of the Settlement Agreement, Union is eligible to recover up to an additional 15% above its annual Board-approved DSM budget through the DSMVA as long as Union has achieved its overall weighted scorecard target on a pre-audited basis for one or more of its scorecards, provided the funding was spent on program expenses.

The additional expenditure over the 2013 DSM Budget included in rates is $1.197 million. This expenditure was allocated to two of the four scorecards – the Resource Acquisition and Low-Income scorecards. Both scorecards achieved pre-audit results above the weighted scorecard targets required for the 15% overspend to be accessed. The pre-audit, scorecard results are summarized below, in Table 1.

Table 1
2013 DSM Scorecard Results (Pre-Audit)

Scorecard	**Total Scorecard Target Achieved**
Resource Acquisition	142%
Low-Income	155%

Budget Transfers between Programs (DSM Guidelines for Natural Gas Utilities issued June 30, 2011, EB-2008-0346)

Page 4 of the Board's DSM Guidelines for Natural Gas Utilities, EB-2008-0346, issued on June 30, 2011, states that the utilities should inform the Board and stakeholders in the event that cumulative fund transfers among Board-approved DSM programs exceed 30% of the approved annual DSM budget for an individual natural gas DSM program. Union did not transfer more than 30% between programs.

Union has adhered to all budget provisions outlined in the EB-2011-0327 Settlement Agreement, filed on January 31, 2012.

Evaluation Budget (Settlement Agreement Section 2.5)

The Evaluation budget of $1.187 million was used solely for Evaluation expenditures as outlined in Section 2.5 of the Settlement Agreement. The difference of $0.283 million between the Evaluation budget and the actual $0.905 million spent on Evaluation is credited to the DSMVA.

Resource Acquisition Program – Integrated Energy Management Systems ("IEMS") (Settlement Agreement Section 6.1)

The $0.631 million budget associated with IEMS was allocated according to the provisions in section 6.1 of the Settlement Agreement. The actual spend for IEMS activities in 2013 was $0.182 million. Union shifted $0.300 million of the IEMS budget to other programs, which is permitted under the Settlement Agreement. Therefore, the 2013 Resource Acquisition targets were not adjusted. The unspent $0.149 million of the IEMS budget is credited to ratepayers in the DSMVA.

Resource Acquisition Program – Restrictions on rate class allocations (Settlement Agreement Section 6.4)

Shifts in the Resource Acquisition budget did not result in increases of greater than 100% of the amount allocated to each rate class, as indicated in Exhibit A, Tab 4, Schedule 3.

Large Volume Rate T1, Rate T2 and Rate 100 Program (Settlement Agreement Section 7)

As outlined in Section 2, page 14, of the Board-approved 2013-2014 DSM Plan for Large Volume customers (EB-2012-0337), Union adhered to the maximum program budget transfer rules between Rate T1, Rate T2 or Rate 100 to Rate T1, Rate T2 or Rate 100 respectively. The overall under spend of $0.018 million for the Large Volume Program is credited in the DSMVA. In addition, as per the Settlement Agreement, Union did not transfer budget dollars from any other part of the overall DSM budget into Rate T1, Rate T2 or Rate 100 rate classes.

Account No. 179-126 Demand Side Management Incentive Deferral Account ("DSMIDA")

This account has a debit balance of $7.784 million related to 2013 audited DSM activity. Exhibit A, Tab 4, Schedule 4 provides the breakdown of the DSMIDA by rate class.

The DSMIDA was established in 2012, in accordance with the mechanism approved by the Board in the EB-2011-0327 proceeding, to record any shareholder incentive earned by Union related to DSM activities, including Resource Acquisition, Low-Income, Large Volume and Market Transformation.

The 2013 DSM Incentive Union achieved for each scorecard is presented in Table 2 below.

Table 2
Summary of 2013 Incentive Results by Scorecard

DSM Incentive			
Scorecard	Plan (100% Target)	Actual Results	Max Payout
Resource Acquisition	$2,237,786	$3,143,206	$5,594,465
Large Volume T2/T1/R100	$723,506	$1,362,407	$1,808,765
Low-Income	$1,091,400	$2,728,501	$2,728,501
Market Transformation	$220,104	$550,259	$550,259
Total	$ 4,272,796	$ 7,784,373	$ 10,681,990

A. *Resource Acquisition Scorecard*

Resource Acquisition programs seek to achieve direct, measurable savings customer by customer, via the installation of energy efficient equipment. The Resource Acquisition scorecard included three performance metrics that support and incentivize technologies that drive deeper and longer savings for all customers. Union achieved 113% on the overall Resource Acquisition scorecard and is claiming a $3.143 million DSM incentive based on the 2013 scorecard targets[1] and corresponding incentives. The 2013 Resource Acquisition scorecard is presented below in Table 3.

---

[1] EB-2011-0327, Settlement Agreement, Section 6, p.16.

Table 3
2013 Resource Acquisition Scorecard

Metrics	**Metric Target Levels**			**Weight**	**Achievement**	**% of Metric Achieved**	**Weighted % of Metric Achieved**
	Lower Band	**Target**	**Upper Band**				
Cumulative Natural Gas Savings (m^3)	639,840,620	853,120,826	1,066,401,033	90%	920,774,950	116%	*104.3%*
Deep Savings – Residential	120	160	200	5%	203	154%	*7.7%*
Deep Savings - C/I	9.36%	10.36%	11.36%	5%	8.97%	31%	1.5%
						Total Scorecard Target Achieved	***113%***
						Scorecard Incentive Achieved	***$ 3,143,206***
						% of Maximum Incentive Achieved	***56%***

B. *Large Volume Rate T1, Rate T2 and Rate 100 Scorecard*

The Large Volume scorecard measures the cumulative m^3 savings of participants within the Rate T1, Rate T2 and Rate 100 rate classes.

The 2013 Large Volume Rate T1/Rate T2/Rate 100 program achieved a DSM incentive of $1.362 million. This incentive amount is based upon achieving the targets approved by the Board in the 2013-2014 DSM Plan for Large Volume Customers proceeding (EB-2012-0337). The 2013 Large Volume scorecard results are provided below in Table 4.

Table 4
2013 Large Volume Scorecard

Metrics	**Metric Target Levels**			**Weight**	**Achievement**	**% of Metric Achieved**	**Weighted % of Metric Achieved**
	Lower Band	**Target**	**Upper Band**				
Rate T2/R100 Cumulative Natural Gas Savings (m^3)	821,502,546	1,095,336,728	1,369,170,910	40%	1,664,166,592	204%	*81.5%*
Rate T1 Cumulative Natural Gas Savings (m^3)	150,477,098	200,636,131	250,795,164	60%	180,388,329	80%	*47.9%*
				Total Scorecard Target Achieved			***129%***
				Scorecard Incentive Achieved			***$ 1,362,407***
				% of Maximum Incentive Achieved			***75%***

C. *Low-Income Scorecard*

Similar to the Resource Acquisition program, the Low-Income program seeks to achieve direct measurable savings by the installation of energy efficient equipment focusing on the needs of the low-income market segment. The 2013 Low-Income program achieved the maximum DSM incentive of $2.729 million. This incentive amount is based upon exceeding the performance goals as outlined by the approved Low-Income scorecard. The overall 2013 Low-Income scorecard results are provided below in Table 5.

Table 5
2013 Low-Income Scorecard

Metrics	**Metric Target Levels**			**Weight**	**Achievement**	**% of Metric Achieved**	**Weighted % of Metric Achieved**
	Lower Band	**Target**	**Upper Band**				
Single Family Cumulative Natural Gas Savings (m^3)	19,500,000	26,000,000	32,500,000	60%	40,236,650	210%	*125.7%*
Multi Family Cumulative Natural Gas Savings (m^3)	13,200,000	17,600,000	22,000,000	40%	15,267,883	73%	*29.4%*
				Total Scorecard Target Achieved			***155%***
				Scorecard Incentive Achieved			***$2,728,501***
				% of Maximum Incentive Achieved			***100%***

D. *Market Transformation Scorecard*

In 2013, Union completely focused its Market Transformation activity on the New Home Efficiency offering, branded Optimum Home.

Union achieved 166% on the overall 2013 Market Transformation scorecard resulting in a $0.550 million DSM incentive. The 2013 Market Transformation results are provided in Table 6.

Table 6
2013 Market Transformation Scorecard

Metrics	**Metric Target Levels**			**Weight**	**Achievement**	**% of Metric Achieved**	**Weighted % of Metric Achieved**
	Lower Band	**Target**	**Upper Band**				
New Participating Builders	6	8	15	60%	8	100%	*60.0%*
Prototype Homes Built	20%	30%	40%	40%	63%	266%	*106.3%*
				Total Scorecard Target Achieved			***166%***
				Scorecard Incentive Achieved			***$550,259***
				% of Maximum Incentive Achieved			***100%***

The process to finalize DSMIDA related balances includes an external audit of Union's DSM Annual Report, review by the Audit Committee and communication to the DSM Consultative as outlined in the Joint Terms of Reference on Stakeholder Engagement for DSM Activities dated November 4, 2011[2], as described in further detail in Exhibit A, Tab 3.

---

[2] EB-2011-0327, Joint Terms of Reference on Stakeholder Engagement for DSM Activities by Enbridge Gas Distribution Inc. and Union Gas Limited, Attachment A.

UNION GAS LIMITED
Deferral Account Balances
Year Ending December 31, 2013

Line No.	Account Number	Account Name	Filed Balance ($000's)
	DSM Accounts:		
1	179-75	Lost Revenue Adjustment Mechanism	2,800
2	179-111	Demand Side Management Variance Account	1,198
3	179-115	Shared Savings Mechanism	-
4	179-126	Demand Side Management Incentive	7,784
5	Total DSM Accounts (Lines 1 through 4)		11,782
6	**Total Deferral Account Balances**		**11,782**

UNION GAS LIMITED
Lost Revenue Adjustment Mechanism
Breakdown of 2013 LRAM Deferral Account Balance

Line No.	Particulars ($)	Amounts by DSM Plan Year 2012(1)	Amounts by DSM Plan Year 2013 (2)	Total Amount in LRAM Deferral Account
		(a)	(b)	(c)
	South			
1	M1 Residential	154,511	86,465	240,976
2	M1 Commercial	161,807	70,144	231,951
3	M1 Industrial	2,656	3,094	5,749
4	M2 Commercial	316,235	255,814	572,050
5	M2 Industrial	104,156	49,340	153,496
	Industrial			
6	M4	124,769	54,541	179,311
7	M5	188,948	263,985	452,933
8	M7	8,609	5,625	14,234
9	T1	6,366	4,817	11,183
10	T2	4,354	5,550	9,904
11		1,072,411	799,374	1,871,785
	North			
12	Residential 01	84,839	36,254	121,093
13	Commercial 01	125,968	63,710	189,677
14	Commercial 10	221,626	157,644	379,270
15	Industrial 10	80,955	37,530	118,486
	Industrial			
16	Rate 20	37,216	19,638	56,854
17	Rate 100	38,666	23,983	62,650
18		589,270	338,760	928,030
19	Total	1,661,681	1,138,134	2,799,814

Notes:

(1) EB-2014-0273, Exhibit A, Tab 4, Schedule 2, page 2 of 3, column (c).

(2) EB-2014-0273, Exhibit A, Tab 4, Schedule 2, page 3 of 3, column (c).

UNION GAS LIMITED
Lost Revenue Adjustment Mechanism
2012 - Audited Full Year at 2013 Rates

Line No.	Particulars	2012 Audited Volumes (1) 10³ m³	2013 Rates $/10³ m³	Net LRAM Deferral Account Balance Proposed for Disposition ($)
		(a)	(b)	(c) = (a) * (b)
	South			
1	M1 Residential	4,052	38.136	154,511
2	M1 Commercial	4,243	38.136	161,807
3	M1 Industrial	70	38.136	2,656
4	M2 Commercial	6,897	45.850	316,235
5	M2 Industrial	2,272	45.850	104,156
	Industrial			
6	M4	13,048	9.562	124,769
7	M5	8,589	21.998	188,948
8	M7	2,737	3.146	8,609
9	T1	8,944	0.712	6,366
10	T2	55,769	0.078	4,354
11		106,620		1,072,411
	North			
12	Residential 01	707	119.989	84,839
13	Commercial 01	1,107	113.744	125,968
14	Commercial 10	2,847	77.842	221,626
15	Industrial 10	1,114	72.680	80,955
	Industrial			
16	Rate 20	6,949	5.355	37,216
17	Rate 100	18,093	2.137	38,666
18		30,818		589,270
19	Total	137,438		1,661,681

Notes:

(1) Audited Demand Side Management 2013 Annual Report.

UNION GAS LIMITED
Lost Revenue Adjustment Mechanism
2013 Audited

Line No.	Particulars	2013- Monthly Audited, Volumes (1) $10^3\ m^3$	2013 Delivery Rates $\$/10^3\ m^3$	Revenue Impact ($)
		(a)	(b)	(c) = (a) x (b)
	South			
1	M1 Residential	2,267	38.136	86,465
2	M1 Commercial	1,839	38.136	70,144
3	M1 Industrial	81	38.136	3,094
4	M2 Commercial	5,579	45.850	255,814
5	M2 Industrial	1,076	45.850	49,340
	Industrial			
6	M4	5,704	9.562	54,541
7	M5	12,000	21.998	263,985
8	M7	1,788	3.146	5,625
9	T1	6,765	0.712	4,817
10	T2	71,148	0.078	5,550
11		108,249		799,374
	North			
12	Residential 01	302	119.989	36,254
13	Commercial 01	560	113.744	63,710
14	Commercial 10	2,025	77.842	157,644
15	Industrial 10	516	72.680	37,530
	Industrial			
16	Rate 20	3,667	5.355	19,638
17	Rate 100	11,223	2.137	23,983
18		18,293		338,760
19	Total	126,542		1,138,134

Notes:

(1) Based on Audited 2013 DSM evaluation results. The monthly volumetric reductions for the month the measure is implemented and the remaining months of the year is calculated based on the Settlement Agreement in EB-2011-0327 (page 34).

UNION GAS LIMITED
Demand Side Management Variance Account

Line No.	Particulars ($000's)	2013 DSM Costs in 2013 Rates[1]	2013 Actual DSM Costs [2]	2013 Account Balance	Variance
		(a)	(b)	(c) = (b) - (a)	
	South				
1	M1	10,450,635	10,333,194	(117,442)	(1.1%)
2	M2	3,895,641	4,772,607	876,966	22.5%
3	M4	1,607,005	2,729,864	1,122,859	69.9%
4	M5	2,682,639	2,757,127	74,488	2.8%
5	M7	905,621	487,495	(418,127)	(46.2%)
6	T1	1,800,914	1,820,057	19,143	1.1%
7	T2	2,608,553	2,770,207	161,654	6.2%
		23,951,008	25,670,550	1,719,542	7.2%
	North				
9	Rate 01	3,731,553	2,992,512	(739,041)	(19.8%)
10	Rate 10	1,186,222	1,361,335	175,113	14.8%
11	Rate 20	974,496	1,343,800	369,304	37.9%
12	Rate 100	1,798,000	1,470,730	(327,270)	(18.2%)
13		7,690,270	7,168,376	(521,894)	(6.8%)
14	Total	31,641,278	32,838,927	1,197,648	3.8%

Notes:

(1) DSM in 2013 rates as per EB-2011-0210 Board-approved Cost Study.

(2) Allocated as per the Settlement Agreement issued January 31, 2012 and the Decision and Order on the Settlement Agreement EB-2011-0327 issued on February 21, 2012.

UNION GAS LIMITED
DSM Incentive Deferrral Account
Based on 2013 Audited Results

Line No.	Particulars ($)	2013 Amount Amount Based on 2013 Audited Results (1)
		(a)
	South	
1	M1	3,323,745
2	M2	1,045,315
3	M4	459,787
4	M5	462,424
5	M7	78,035
6	T1	439,804
7	T2	588,821
		6,397,931
	North	
8	Rate 01	567,478
9	Rate 10	275,787
10	Rate 20	209,395
11	Rate 100	333,782
12		1,386,442
13	Total	7,784,373

Notes

(1) The DSM incentive for 2013 is calculated and allocated to rate classes using the mechanism approved by the Board in EB-2011-0327.

ALLOCATION AND DISPOSITION OF DSM DEFERRAL AND VARIANCE ACCOUNT BALANCES

The purpose of this evidence is to address the allocation and disposition of 2013 DSM-related deferral and variance account balances identified at Exhibit A, Tab 4, Schedule 1.

The allocation of 2013 DSM-related deferral and variance account balances to rate classes appears at Exhibit A, Tab 5, Schedule 1. Exhibit A, Tab 5, Schedule 2 provides the unit rates for disposition to Union's in-franchise rate classes. Exhibit A, Tab 5, Schedule 3 provides the impact of the proposed disposition for general service customers in Union South and Union North.

The allocation of 2013 DSM-related deferral and variance account balances to rate classes is consistent with the allocation methodologies approved by the Board in EB-2013-0109 (Union's 2012 Earnings Sharing and Deferral Account Disposition proceeding).

DSM-related Deferral Accounts

Union proposes to allocate the balance in the Lost Revenue Adjustment Mechanism Deferral Account ("LRAM") (179-75) to rate classes in proportion to the margin reduction attributable to DSM activities appearing at Exhibit A, Tab 4, Schedule 2, page 1.

Union proposes to allocate the balance in the Demand Side Management Variance Account ("DSMVA") (179-111) to rate classes in proportion to the actual DSM spending by rate class in 2013, with the exception of low-income spending which is allocated in proportion to the most recent Board-approved distribution revenue by rate class. This allocation methodology is consistent with the methodology approved by the Board in the EB-2011-0327 (2012-2014 DSM Plan) Settlement Agreement.

Union proposes to allocate the balance in the Demand Side Management Incentive Deferral Account ("DSMIDA") (179-126) to rate classes in proportion to the actual DSM spending by rate class in 2013. This allocation methodology is consistent with the methodology approved by the Board in the EB-2011-0327 (2012-2014 DSM Plan) Settlement Agreement.

Disposition of 2013 DSM-related Deferral Account Balances

For General Service M1, M2, Rate 01 and Rate 10 customers Union proposes to dispose of the net 2013 DSM-related deferral and variance account balances prospectively over the April 1, 2015 to September 30, 2015 time period. The prospective refund / recovery approach proposed for M1, M2, Rate 01 and Rate 10 customers is consistent with how Union disposed of 2012 deferral account balances in EB-2013-0109.

For in-franchise contract rate classes, Union is proposing to dispose of the net 2013 DSM-related deferral and variance account balances as a one-time adjustment with April

2015 bills customers receive in May 2015. This one-time adjustment approach is consistent with the methodology used for the disposition of 2012 deferral account and earnings sharing balances in EB-2013-0109.

General Service Bill Impacts

General Service customer impacts are presented at Exhibit A, Tab 5, Schedule 3. For a residential customer in Union South with annual consumption of 2,200 m^3, the charge for the period April 1, 2015 to September 30, 2015 is $3.10. For a residential customer in Union North with annual consumption of 2,200 m^3, the charge for the period April 1, 2015 to September 30, 2015 is $0.33.

UNION GAS LIMITED

Allocation of 2013 DSM Deferral Account Balances

			Union North					Union South														
Line No.	Particulars	Acct No.	Rate 01 ($000's)	Rate 10 ($000's)	Rate 20 ($000's)	Rate 100 ($000's)	Rate 25 ($000's)	M1 ($000's)	M2 ($000's)	M4 ($000's)	M5A ($000's)	M7 ($000's)	M9 ($000's)	M10 ($000's)	T1 ($000's)	T2 ($000's)	T3 ($000's)	M12 ($000's)	M13 ($000's)	C1 ($000's)	M16 ($000's)	Total (1) ($000's)
		(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)	(t)	(u)
	Delivery Related Deferrals:																					
1	Lost Revenue Adjustment Mechanism (2)	179-75	311	498	57	63	-	479	726	179	453	14	-	-	11	10	-	-	-	-	-	2,800
2	Demand Side Management Variance Account (3)	179-111	(739)	175	369	(327)	-	(117)	877	1,123	74	(418)	-	-	19	162	-	-	-	-	-	1,198
3	Demand Side Management Incentive (4)	179-126	567	276	209	334	-	3,324	1,045	460	462	78	-	-	440	589	-	-	-	-	-	7,784
4	Total Delivery-Related Deferrals		139	949	636	69	-	3,685	2,648	1,762	990	(326)	-	-	470	760	-	-	-	-	-	11,782

Notes:

(1) EB-2014-0273, Exhibit A, Tab 4, Schedule 1.
(2) EB-2014-0273, Exhibit A, Tab 4, Schedule 2, page 1, column (c).
(3) EB-2014-0273, Exhibit A, Tab 4, Schedule 3, column (c).
(4) EB-2014-0273, Exhibit A, Tab 4, Schedule 4, column (a).

Filed: 2014-12-01
EB-2014-0273
Exhibit A
Tab 5
Schedule 2
Page 1 of 2

UNION GAS LIMITED
General Service Unit Rates for Prospective Recovery/(Refund) - Delivery
2013 DSM Deferral Account Disposition

Line No.	Particulars	Rate Class	Deferral Balance for Disposition ($000's) (a)	Forecast Volume (10^3m^3) (1) (b)	Unit Rate for Prospective Recovery/(Refund) (cents/m^3) (c) = (a/b)*100
1	Small Volume General Service	01	139	194,537	0.0716
2	Large Volume General Service	10	949	94,216	1.0069
3	Small Volume General Service	M1	3,685	618,966	0.5953
4	Large Volume General Service	M2	2,648	316,592	0.8364

Notes:

(1) Forecast volume for the period April 1, 2015 to September 30, 2015.

UNION GAS LIMITED
Contract Unit Rates for One-Time Adjustment - Delivery
2013 DSM Deferral Account Disposition

Line No.	Particulars	Rate Class	Deferral Balance for Disposition ($000's) (a)	2013 Actual Volume (10^3m^3) (b)	Unit Rate (cents/m^3) (c) = (a/b)*100
	Union North				
1	Medium Volume Firm Service (1)	20	101	103,259	0.0976
2	Medium Volume Firm Service (2)	20T	535	547,703	0.0976
3	Large Volume High Load Factor (2)	100T	69	1,926,556	0.0036
4	Large Volume Interruptible	25	-	214,641	-
	Union South				
5	Firm Com/Ind Contract	M4	1,762	475,054	0.3709
6	Interruptible Com/Ind Contract	M5	990	522,767	0.1893
7	Special Large Volume Contract	M7	(326)	172,399	(0.1890)
8	Large Wholesale	M9	-	63,052	-
9	Small Wholesale	M10	-	266	-
10	Contract Carriage Service	T1	470	451,964	0.1040
11	Contract Carriage Service	T2	760	4,295,830	0.0177
12	Contract Carriage- Wholesale	T3	-	273,597	-

Notes:
(1) Sales and Bundled-T customers only.
(2) T-service customers only.

Filed: 2014-12-01
EB-2014-0273
Exhibit A
Tab 5
Schedule 3

UNION GAS LIMITED
General Service Bill Impacts

Line No.	Particulars	Rate Component	Unit Rate for Prospective Recovery/(Refund) (cents/m^3) (1)	Volume (m^3) (2)	Bill Impact ($)
			(a)	(b)	(c) = (a x b) / 100
1	Rate 01	Delivery	0.0716	468	0.33
2		Commodity	-	468	-
3		Transportation	-	468	-
4			0.0716		0.33
5	Sales Service				0.33
6	Direct Purchase Bundled T				0.33
7	Rate 10	Delivery	1.0069	26,039	262.19
8		Commodity	-	26,039	-
9		Transportation	-	26,039	-
10			1.0069		262.19
11	Sales Service				262.19
12	Direct Purchase Bundled T				262.19
13	Rate M1	Delivery	0.5953	521	3.10
14		Commodity	-	521	-
15			0.5953		3.10
16	Sales Service				3.10
17	Direct Purchase				3.10
18	Rate M2	Delivery	0.8364	17,228	144.09
19		Commodity	-	17,228	-
20			0.8364		144.09
21	Sales Service				144.09
22	Direct Purchase				144.09

Notes:
(1) EB-2014-0273 Exhibit A, Tab 5, Schedule 2, page 1, column (c).
(2) Average consumption, per customer, for the period April 1, 2015 to September 30, 2015.

FINAL
Demand Side Management
2013 Annual Report

November 4, 2014

uniongas
A Spectra Energy Company

Table of Contents

Glossary of Terms

Adjustment Factor	The adjustment factor reflects the percentage of savings being claimed. Typically, adjustment factor inputs include the percentage of participants who installed the measure (and kept it installed) which is determined by conducting verification studies.
Audit	Informed by the processes agreed to in the Stakeholder Engagement Terms of Reference, a third party auditor is hired annually by Union. While hired by Union, the auditor is independent and ultimately serves to protect the interests of ratepayers with respect to Union's DSM claims.
Avoided Costs	Avoided costs are a measurement of the reduction in the delivered costs of supplying all resources (natural gas, electricity and water) to customers as a consequence of a program.
Base Case	The base case is a projection of the future without the effects of the utility's DSM program. Base cases are required for each DSM scenario. The difference between the base case and the energy efficient case represents the saving attributable to the energy efficient measure.
Building Envelope	The building envelope refers to the exterior surfaces (such as walls, windows, roof and floor) of a building that separate the conditioned space from the outdoors.
Channel Partner	A Channel Partner is a company that, in the course of its business, can influence consumers to choose gas over competing fuels. Examples of Channel Partners include: appliance retailers; HVAC contractors; engineers; and architects.
Cost Effectiveness	Cost effectiveness refers to the analysis to determine whether or not the benefits of a project/measure are greater than the costs. It is based on the net present value of savings over the equipment life of the measures.
Demand Side Management	("DSM") The modification of perceived consumer demand for a product through various methods such as financial incentives, education and other programs. While the focus of Union's DSM is natural gas savings and the reduction in greenhouse gases emissions, it may also result in the saving of a number of other resources such as electricity, water, propane, and heating fuel oil.

Demand Side Management Variance Account (“DSMVA”)	An account used to track the variance between actual DSM spending by rate class versus the budgeted amount included in rates by rate class. A natural gas utility may record in the DSMVA in any one year, a variance amount of no more than 15% above its DSM budget for that year. The natural gas utility should apply annually for disposition of the balance in its DSMVA, together with carrying charges, after the completion of the annual third party audit.
Direct Access Budget	Each Rate T2 and Rate 100 customer has dedicated access to the customer incentive budget they pay in their rates.
Discount Rate	The interest rate used to calculate the [net] present value of expected yearly benefits and costs. The Ontario Energy Board (“the Board”) directed the Utilities to use a rate equal to the approved weighted average cost of capital (“WACC”).
DSM Incentive	The incentive available to Union to encourage the aggressive pursuit of DSM savings and recognize exemplary performance.
Free Ridership	Free riders are program participants who would have installed the energy efficient measure without the influence of Union’s DSM programs. Free rider rates are estimated based on research, market penetration studies or through negotiations in prior evaluation processes. The free rider rates are applied to the gross program savings results to derive actual savings.
Incentive	An incentive is a transfer payment from the utility to DSM participants. The incentive encourages participation in a DSM program.
Input Assumptions	Assumptions such as operating characteristics and associated units of resource savings for a list of DSM technologies and measures. These cover a range of typical DSM activities, measures and technologies with residential and commercial applications.
Incremental Cost	The incremental cost is the difference in price between the efficient technology or measure and the base case technology. In some early retirements and retrofits, the full cost of the efficient technology is the incremental cost.
Lifetime Cumulative cubic meters (“cumulative m^3”)	Total natural gas savings over the life of a DSM measure. Frequently used at the measure or program level and can also summarize the benefits of an entire portfolio.

Lost Revenue Adjustment Mechanism ("LRAM")	*The* LRAM is the Board's approved method by which utilities recover the lost distribution revenues associated with DSM activity. These lost revenues are calculated for each rate class impacted by DSM energy efficiency programs.
Market Transformation	Market Transformation facilitates fundamental changes that lead to greater market shares of energy efficient products and services and on influencing consumer behaviour and attitudes that support reduction in natural gas consumption.
Measure	A measure is any particular energy efficient technology (e.g. a low-flow showerhead, an energy recovery ventilator, condensing boiler, etc).
National Account	National Account customers are those customers that have multiple property locations and are similar in design and use. National Account customers include retail chains, property management firms and foodservice chains.
Net Present Value ("NPV")	The NPV is the sum of the discounted yearly benefits arising from an investment over the life-time of that investment.
Net-to-Gross Ratio	Gross impacts are the program impacts prior to accounting for program attribution effects. Net impacts are the program impacts once program attribution effects have been accounted for. The net-to-gross ratio is defined as 1 – (free ridership ratio) + (spill-over ratio).
Offering	An offering exists where there are either bundles of energy efficiency measures or performance/maintenance based enhancements to existing measures marketed together (e.g. energy savings kits, home retrofit measures, custom equipment/process/O&M) or where support is delivered through a suite of services (e.g. customer engagement, site energy assessments, etc.).
Part 3 Building	The Ontario Building Code lists a Part 3 Building as exceeding 600m^2 in building area or greater than three storeys in height. Classified as assembly occupancies, care or detention occupancies, high hazard industrial occupancies, residential occupancies, business and personal services occupancies, mercantile occupancies, or medium and low hazard industrial occupancies.
Part 9 Building	The Ontario Building Code lists a Part 9 Building as three or fewer storeys' in building height and having a building area not exceeding 600m^2. Classified as residential occupancies, business and personal services occupancies, mercantile occupancies, or medium and low hazard industrial occupancies.

Participants	The units used by Union to measure participation in its DSM programs. Participant units of measurement include customers, projects and measures or technologies installed. Not all participants result in energy savings.
Persistence	Persistence is the extent to which a DSM measure remains installed and performing as originally predicted. Persistence of DSM savings takes into account how long a DSM measure is kept in place relative to its useful life, the net impact of the measure relative to the base case scenario, and the impact of technical degradation.
Program	A program is the utility specific approach to providing one or more demand-side options to customers. A program includes the combination of various offerings available to a definable target market within a program type.
Program Costs	DSM program include the following components: • Development and Start-up • Promotion • Incentives • Delivery • Evaluation, Measurement and Verification (“EM&V”) and Monitoring • Administration Of the above costs, only start-up, promotion, incentives, delivery, and a portion of the evaluation and verification costs are applicable to individual programs. Other costs related to the design and deliveries of DSM programs are appropriately considered at the DSM portfolio level. These include development, a portion of the evaluation costs, monitoring, tracking and administration costs.
Program Evaluation	Program evaluation refers to activities related to the collection, analysis, and reporting of data for purposes of measuring program impacts from past, existing or potential program impacts.
Realization Rate	Realization rate is the ratio that compares actual savings to claimed savings. Realization rates are estimated parameters used to extrapolate audited savings from a sample of projects on to all projects.
Research Costs	Research costs are Union’s costs associated with the research and evaluation of DSM programs. They are not included in direct costs because they may affect more than one program.

Resource Acquisition	Programs that seek to achieve direct, measurable savings customer-by-customer through the incenting/promotion of specific energy efficiency upgrades.
Social and Assisted Housing	Residential social housing includes all non-profit housing developed, acquired or operated under a federal, provincial or municipally funded program including shelters and hostels.
Total Resource Cost Test ("TRC")	The TRC Test provides a measure of the benefits and costs that accrue to society as a result of the installation of a DSM measure. The TRC test has a provision allowing externality benefits, when quantified, can be included in the result.
Trade Allies	Trade allies include organizations (e.g. architectural and engineering firms, building contractors, appliance manufacturers and dealers, and banks) that influence the energy-related decisions of customers who might participate in DSM programs.

Executive Summary

The year 2013 represents Union Gas' seventeenth year of delivering natural gas savings to its customers through cost effective Demand Side Management ("DSM") programs. Union Gas' DSM programs support residential, low-income, commercial and industrial customers to realize energy savings and environmental benefits by providing energy efficiency education, awareness and incentives. To date, Union Gas' commitment to DSM initiatives has translated to approximately 1.293 billion m3 of annual natural gas savings, equivalent to more than $2.618 billion in net Total Resource Cost benefits. As the second year within the constructs of EB-2011-0327, 2013 represented opportunities to drive deeper savings for customers.

A noteworthy change in 2013 was to Union's Large Industrial program. Union's Large Industrial DSM program filed in the 2012 – 2014 Demand Side DSM Plan Settlement Agreement ("Agreement") in EB-2011-0327 applied for 2012 only. As part of the Agreement, Union committed to file a new application and evidence with the Ontario Energy Board ("the Board") supporting a Large Industrial Rate T1 and Rate 100 DSM plan for 2013 and 2014. A decision on this Large Volume DSM Plan (EB-2012-0337) was rendered on March 19, 2013 approving 2013-2014 DSM programming for Large Volume customers. As a result of this decision a key fundamental shift was towards a direct access budget mechanism. In lieu of an aggregate pool approach, at the beginning of the year these customers each have direct access to the customer incentive budget they pay in rates.

Key evaluation priorities at the Technical Evaluation Committee (TEC) include the development of the Technical Reference Manual as well as the implementation of the custom net-to-gross impact evaluation study, which contribute to the continual improvement of DSM technical and evaluation standards for natural gas utilities in Ontario.

As Union continues to evolve its approach to DSM to optimize the opportunities that the new framework presents, the company is pleased to report that the 2013 DSM portfolio generated 2.821 billion m^3 of cumulative natural gas savings, earning a Utility Shareholder Incentive of $7.784 million. Program spend was $32.839 million, which was 3.79% over the 2013 DSM budget of $31.641 million.

Union celebrates the success of its 2013 DSM programs and the associated significant energy reductions that ratepayers have realized.

1. Introduction

This Demand Side Management (DSM) Annual Report presents a retrospective of Union's energy efficiency initiatives and results in terms of scorecards, budget spend, DSM Incentive, and Lost Revenue Adjustment Mechanism (LRAM) for 2013. It also provides an avenue for Union to benchmark the results in this second year under the 2012-2014 multi-year DSM plan, highlight successes and lessons learned, and summarize evaluation work conducted.

Union's 2013 DSM portfolio included programs directed towards Residential, Commercial/Industrial, Low-Income, Market Transformation and Large Volume Rate T1, Rate T2[1]/R100 customers as listed below:

Residential Program

- Energy Savings Kit Offering
- Home Reno Rebate Offering

Commercial/Industrial Program

- Prescriptive and Quasi-Prescriptive Offering
    - Water Heating Initiatives
        - Condensing Gas Water Heaters
        - Ozone Laundry Equipment
    - Space Heating Initiatives
        - Air Curtain Technology
        - Condensing Boilers
        - Condensing Make-up Air Units
        - Destratification Fans
        - Energy Recovery Ventilators and Heat Recovery Ventilators
        - High Efficiency Non-Condensing Boilers
        - Infrared Heaters
    - Commercial Kitchen Initiatives
        - Cooking Equipment – Energy Star Fryers
        - Demand Control Kitchen Ventilation
        - Energy Star Dishwashers
- Custom Offering
    - Customer Engagement – Communication and Education
    - Engineering Feasibility and Process Improvement Studies
    - Operation and Maintenance
    - New Equipment and Processes
    - Energy Management

Low-Income Program

- Helping Homes Conserve Offering
- Affordable Housing Conservation Offering

---

[1] Rate T1 was split into two rate classes to address diversity between smaller and larger customers within the T1 rate class, see section 2.1.

Large Volume Program

- Custom Offering
    - Customer Engagement – Communication and Education
    - New Equipment and Processes
    - Operations and Maintenance
    - Process Improvement Studies
    - Engineering Feasibility Studies
    - Steam Trap Surveys
    - Boiler Tune-ups
    - Infrared Anti-Condensate Polyethylene Plastic

Market Transformation Program

- Optimum Home

Major cumulative m^3 drivers for the 2013 DSM efforts are outlined in Figure 1.0.

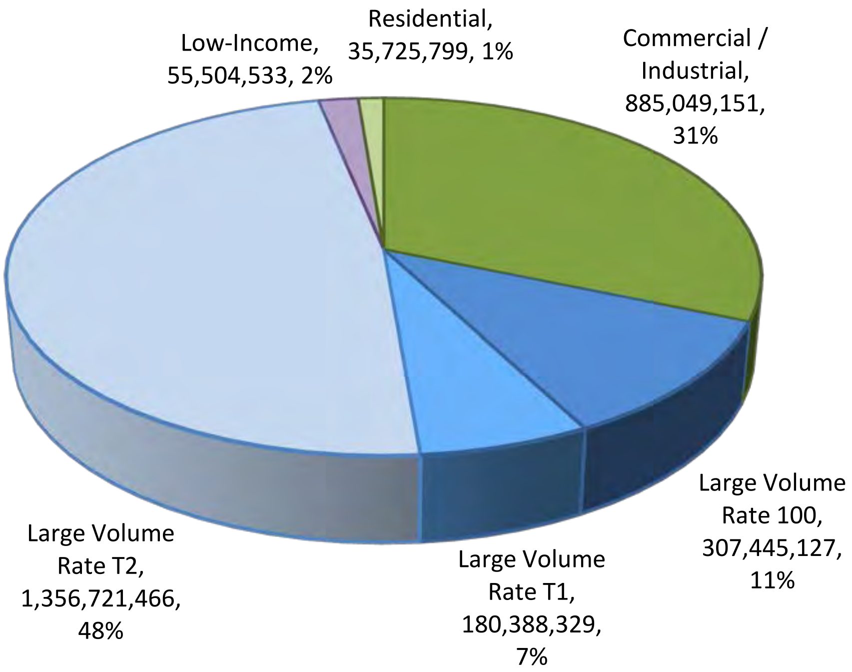


Figure 1.0, Major Drivers in Natural Gas Savings (Cumulative m^3 and Percentage)

2. Demand Side Management Framework

2.1 Union Gas' 2012 – 2014 DSM Plan

In 2013, Union entered the second year of the EB-2011-0327 multi-year 2012 – 2014 DSM Plan which was filed on September 23, 2011 in accordance with the Board's Demand Side Management Guidelines for Natural Gas Utilities ("Guidelines") EB-2008-0346 and subsequently entered into a settlement process with all intervening parties.

On January 31, 2012, Union filed its Settlement Agreement and on February 21, 2012, the Board approved Union's 2012-2014 DSM plan based on the terms outlined in the Agreement.

Union's Large Industrial DSM program filed in the 2012 – 2014 DSM Plan Settlement Agreement ("Agreement") in EB-2011-0327 applied for 2012 only. As part of the Agreement, Union committed to file a new application and evidence with the Board supporting a Large Industrial Rate T1 and Rate 100 DSM plan for 2013 and 2014. A decision on this Large Volume DSM Plan EB-2012-0337 was rendered on March 19, 2013 approving 2013-2014 DSM programming for Large Volume customers, as described in section 6.1.

In Union's 2013 Cost of Service Application EB-2011-0210, it was proposed to split Rate T1 into two rate classes to address diversity between smaller and larger customers within the T1 rate class. This rate change was effective as of January 1, 2013.

Union's DSM activities are continuing to drive market change through focused efforts on delivering natural gas savings and related customer benefits.

2.2 Terms of Reference for Stakeholder Engagement

As part of the Guidelines, the Board recommended that Union and Enbridge consult with their stakeholders with respect to their DSM plans and develop joint Stakeholder Engagement Terms of Reference (ToR) for the purpose of outlining a stakeholder engagement process. Following a series of joint utility stakeholder consultation sessions, a joint ToR was developed and filed with the Board.

The ToR goes beyond the minimum requirements for consultation as presented in the Guidelines, Section 16.1. In addition to two plenary Consultative meetings and two Low-Income Consultative meetings each year, the objective and purpose of the ToR is to clarify and define the roles and responsibilities of intervenors, other stakeholders, the utilities, and the Board with respect to participating in the DSM stakeholder engagement process. These include processes relating to program design, DSM measure input assumptions, evaluation research, and the audit of DSM program annual results.

As described in the ToR, the stakeholder engagement process includes the establishment of a common Technical Evaluation Committee (TEC) and a separate Audit Committee (AC) for each utility.

2.3 Technical Evaluation Committee

The goal of the TEC is to establish DSM technical and evaluation standards for natural gas utilities in Ontario.

As described in the ToR, the TEC will endeavor to:

- Make recommendations to the Board on the annual Technical Reference Manual (TRM). This manual will document measure savings assumptions and all other cost effectiveness screening data;
- Produce and maintain a prioritized annual work list (by consensus);
- Establish evaluation priorities and specify future evaluation studies to be undertaken – execution of all work defined by the TEC is subject to the utilities' resource constraints (such as funding, personnel resources, time limitations); and
- Review and reach consensus on the design and implementation of evaluation studies.

The TEC is comprised of three intervenor representatives, representatives from both natural gas utilities, and two independent members. The 2013 TEC members were as follows: Jay Shepherd (School Energy Coalition), Julie Girvan (Consumers Council of Canada), Chris Neme (Green Energy Coalition), Ravi Sigurdson (Enbridge Gas), Tina Nicholson (Union Gas), Ted Kesik (Ph.D., professor of building science at University of Toronto), and Bob Wirtshafter (Ph.D., DSM planning and evaluation, market research and program design expert).

In the first quarter of 2013, the TEC identified several evaluation priorities that would be undertaken. The details of these efforts are outlined in Section 9.

2.4 Audit Committee

The purpose of the AC is to ensure that there is, each year, an effective and thorough audit of the utility's DSM results.

The AC's scope of work includes:

- Establish the standard scope of the annual audit for the term 2012 to 2014 – goals versus tasks;
- Utilize the standard scope for the 2012 to 2014 term as part of the Request for Proposal (RFP) and the AC may alter the scope annually based on consensus;
- Provide the auditor with input and guidance; and
- Make recommendations on the Audit Report regarding the utility's claims regarding DSM results and DSMVA, LRAM and utility incentives and any target adjustments through the AC Report submitted to the Board.

The AC consists of four members; three intervenor members and one utility representative. The 2013 AC members are as follows: Vince DeRose (Canadian Manufacturers and Exporters), Julie Girvan (Consumers Council of Canada), Kai Millyard (Green Energy Coalition) and Tina Nicholson (Union Gas).

2.5 Program and Portfolio Design

As prescribed in the Guidelines, Union's DSM program activities fall within three program types:

- Resource Acquisition;
- Low-Income; and

- Market Transformation.

Resource Acquisition programs seek to achieve direct, measureable savings for an individual customer and involve the installation of energy efficient equipment.

Low-Income programs are similar in nature to Resource Acquisition programs, but are treated independently to recognize the unique needs of this customer base and that they may result in lower TRC net savings than non low-income programs.

Market Transformation programs focus on facilitating fundamental changes that lead to greater market shares of energy efficient products and services. They influence consumer behaviour and attitudes in support of reducing natural gas consumption.

2.6 Cost Effectiveness Screening

The Board mandates cost effectiveness screening as the means for determining the economic value of a DSM program. As per the Guidelines, the Total Resource Cost (TRC) test is used to screen for cost effectiveness at the program level. TRC benefits include the avoided costs associated with natural gas, electricity, and water savings over the life of the energy efficient equipment. TRC costs include the incremental equipment costs[2] associated with the energy efficient equipment in relation to its less-efficient equivalent, as well as any program, administrative, and evaluation costs attributed directly to the program. [3] Resource Acquisition programs are considered cost effective if the ratio of the *present value of the TRC benefits* to the *present value of the TRC costs* exceeds 1.0. To recognize that low-income natural gas programs may result in benefits not captured by the TRC test, these programs are screened using a TRC threshold of 0.7. Market Transformation programs are assessed on their own merits based on the objectives of the program.

2.7 Program Evaluation

There are two broad categories of evaluations: impact evaluation and formative evaluation. Impact evaluations focus on participation and related savings resulting from DSM programs, while formative evaluations focus on the effectiveness of program design and delivery, and assess why program outcomes occur.

One of the guiding principles of the TEC is to provide stakeholder input to the development of evaluation priorities for the natural gas utilities. From a broader DSM framework perspective, program impact and formative evaluation activities as well their associated budgets are managed by the utilities. As part of Union's commitment to DSM, impact evaluation studies are performed annually to examine the accuracy of claimed savings. Impact evaluations undertaken in 2013 are presented in Section 8 of this report.

---

[2] Incremental costs include capital, cost of removal less salvage value, installation, operating and maintenance and/or fuel costs.

[3] By definition of the TRC test, incentive costs provided to program participants are not included as TRC costs.

2.8 Audit of the 2013 DSM Annual Report

To substantiate Union’s DSM Portfolio results, this DSM Annual Report is subject to an independent external audit. The AC selected Evergreen Economics to conduct the audit for the 2013 program year. The intention of the audit is to confirm to stakeholders that claimed DSM savings are correct and that the DSM Incentive and LRAM calculations are appropriate. The Auditor provides a final opinion on whether the claimed DSM Incentive amount, LRAM, and Demand Side Management Variance Account (DSMVA) have been correctly calculated using reasonable assumptions. As described in Section 2.4, Union’s 2013 AC plays an advisory role throughout the audit to facilitate the achievement of the audit objectives.

3. Overall 2013 DSM Program Results

With spending in the amount of $32,838,926, Union's DSM program generated 2,820,834,405 cumulative m³ in natural gas savings for customers. As illustrated in Figure 3.0, the Large Volume program delivered the largest portion of savings in 2013, followed by the Commercial/Industrial, Low-Income and Residential programs respectively.

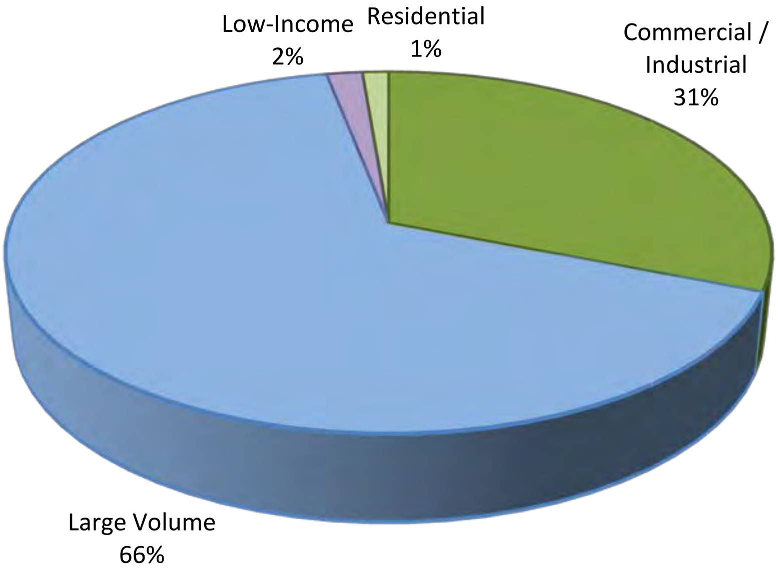


Figure 3.0, 2013 Cumulative Gas Savings by Program (Percentage)

Table 3.0 summarizes Union's DSM results by program for 2013, including annual and cumulative natural gas savings, number of units, expenditures, and the associated net TRC and TRC ratio. Figure 3.1 shows the total Union incentive achieved broken down by scorecard.

Table 3.0 – 2013 Program Results

Program	Annual Net Gas Savings (m^3)	Cumulative Net Gas Savings (m^3)	Units	Expenditures	Net TRC	TRC Ratio
Residential	3,162,690	35,725,799	43,285	$3,372,157	$12,832,397	4.40
Commercial / Industrial	51,833,431	885,049,151	7,056	$12,587,008	$66,604,696	2.01
Low-Income	2,551,934	55,504,533	12,303	$8,042,873	-$2,305,267	0.77
Large Volume	122,418,509	1,844,554,921	484	$4,738,953	$252,262,463	8.74
Optimum Home	0	0	0	$944,661	$0	NA
Program Total	**179,966,564**	**2,820,834,405**	**63,128**	**$29,685,652**	**$329,394,289**	**3.93**
Portfolio Costs				**$3,153,274**		
Total 2013 Spend				**$32,838,926**	**$326,341,359**	**3.83**

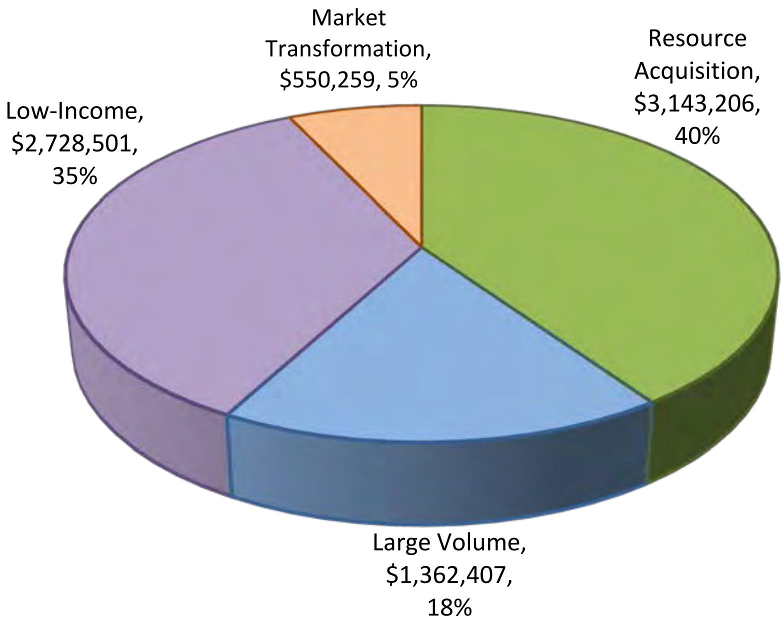


Figure 3.1, Scorecard Contribution to Union Incentive Achieved

DSM costs are detailed on a program level in Table 3.1.

Table 3.1 – 2013 Direct DSM Program Costs

Program	Administration	Evaluation	Promotion	Incentives	2013 Total
Residential	$484,214	$60,350	$1,803,033	$1,024,560	$3,372,157
Commercial/ Industrial	$2,554,405	$127,592	$1,491,586	$8,413,425	$12,587,008
Low-Income	$768,319	$219,938	$853,703	$6,200,913	$8,042,873
Large Volume	$750,796	$32,045	$38,899	$3,917,213	$4,738,953
Optimum Home	$365,383	$0	$211,078	$368,200	$944,661
Program Total	**$4,923,117**	**$439,925**	**$4,398,299**	**$19,924,311**	**$29,685,652**
Portfolio Costs					
Research					$835,349
Evaluation					$464,788
Administration					$1,853,137
Portfolio Total					**$3,153,274**
Total 2013 Spend	**$4,923,117**	**$439,925**	**$4,398,299**	**$19,924,311**	**$32,838,926**

Net annual and cumulative savings[4] are provided in Table 3.2.

Table 3.2 – 2013 Net Natural Gas Savings

Program	Offering	Annual Net Gas Savings (m^3)	Cumulative Net Gas Savings (m^3)
Residential	Energy Savings Kit	2,859,018	29,652,362
	Home Reno Rebate	303,672	6,073,437
Residential Total		**3,162,690**	**35,725,799**
Commercial/ Industrial	Prescriptive	14,207,995	272,204,417
	Custom	37,625,436	612,844,734
Commercial/Industrial Total		**51,833,431**	**885,049,151**
Low-Income	Affordable Housing Conservation	933,333	15,267,883
	Helping Homes Conserve	1,618,601	40,236,650
Low-Income Total		**2,551,934**	**55,504,533**
Large Volume	Rate 100	20,020,746	307,445,127
	Rate T1	10,488,841	180,388,329
	Rate T2	91,908,922	1,356,721,466
Large Volume Rate T1, Rate T2, and Rate 100 Total		**122,418,509**	**1,844,554,921**
Optimum Home		0	0
Optimum Home Total		**0**	**0**
Portfolio Total		**179,966,564**	**2,820,834,405**

---

[4] Gross annual and cumulative gas savings total 370,473,690m^3 and 5,752,390,292m^3 respectively. Gross savings refer to the results of Union’s 2013 DSM programs without the exclusion of free riders.

4. Resource Acquisition Scorecard

Union has three performance metrics on its Resource Acquisition Scorecard with results attributable to programs addressing the residential and commercial/industrial markets. Resource acquisition programs are programs that seek to achieve direct, measureable savings for customers through the installation of energy efficient equipment and/or energy management systems, as well as identifying and implementing process improvements and/or operation and maintenance activities.

For residential customers, these programs are oriented toward rebates for installing energy efficient water or space heating equipment or building envelope upgrades to new and existing homes.

Programs designed for commercial customers include incentives to invest in energy efficient technologies geared for new and existing commercial buildings such as the purchase and installation of efficient heating, ventilating and air conditioning (HVAC) systems, and custom solutions specific to the customer's building and/or process needs. Due to the unique nature of industrial customers, solutions for these customers tend to be custom designed and engineered to meet the requirements of the customer's facility.

Union recognizes the inherent value contained in the educational content of its programs and continues to develop and refine the customer awareness and educational components of the resource acquisition programs.

Table 4.0 presents the results of the Resource Acquisition Scorecard, which illustrates an achievement of 113% of the overall scorecard target, resulting in an incentive of $3.143 million.

Table 4.0 – 2013 Resource Acquisition Scorecard Results

Metrics	**Metric Target Levels**			**Weight**	**Achievement**	**% of Metric Achieved**	**Weighted % of Scorecard Achieved**
	Lower Band	**Target**	**Upper Band**				
Cumulative Natural Gas Savings (m^3)	639,840,620	853,120,826	1,066,401,033	90%	920,774,950	116%	104%
Deep Savings – Residential	120	160	200	5%	203	154%	7.7%
Deep Savings - C/I	9.36%	10.36%	11.36%	5%	8.97%	31%	2%
						Total Scorecard Target Achieved	**113%**
						Scorecard Incentive Achieved	**$3,143,206**

As outlined in the Settlement Agreement, for the purpose of the Residential Deep Savings scorecard metric, homes have only been included if they a) achieve a minimum gas savings of 11,000 cumulative m^3 (based on HOT2000 software used in EnerGuide mode), and, b) implement a minimum of two major measures. In addition, the aggregate of all of the homes counted towards the Residential Deep Savings metric must have achieved, on average, at least a 25% reduction in annual gas usage for space and water heating (also based on HOT2000 software used in EnerGuide mode). Free ridership and spillover have not been included in the calculations for this metric. The current major measures are:

- Heating system replacement
- Water heating system replacement
- Attic insulation
- Wall insulation
- Basement insulation
- Air sealing (minimum reduction of at least 10% as measured by a blower door test)
- Window replacements
- Drain water heat recovery

Commercial/Industrial Deep Savings calculations are based on the percentage of baseline consumption achieved within all Commercial/Industrial custom projects undertaken in the program year. Union has calculated this metric by comparing the forecast weather normalized annual gas savings for all Commercial/Industrial custom projects against the actual consumption of the participants in those projects for the immediately preceding year. Actual 2012 consumption data for commercial customers with weather sensitive loads has been weather normalized for this calculation, whereas industrial process demands do not fluctuate as a result of weather and therefore have not been weather normalized. For any customer who completed a commercial/industrial custom project and also had a prescriptive measure installed, the savings relating to the prescriptive measure have also been included for the purpose of calculating the normalized annual gas savings. Savings associated with custom projects for new construction were not included in this metric.

Table 4.1 presents the results of the Residential and Commercial/Industrial Resource Acquisition programs. The total spend includes all program costs including incentives.

Table 4.1 – 2013 Resource Acquisition Program Results

Program	**Offering**	**Units**	**Annual Net Gas Savings (m^3)**	**Cumulative Net Gas Savings (m^3)**	**Total Spend**	**Net TRC**	**TRC Ratio**
Residential	Energy Savings Kit	43,078	2,859,018	29,652,362	$ 3,372,157	$ 12,832,397	4.40
	Home Reno Rebate	207	303,672	6,073,437			
Commercial/ Industrial	Prescriptive	6,558	14,207,995	272,204,417	$ 5,830,100	$ 22,058,811	2.37
	Custom	498	37,625,436	612,844,734	$ 6,756,908	$ 44,545,885	1.89
2013 Resource Acquisition Total		**50,341**	**54,996,121**	**920,774,950**	**$ 15,959,165**	**$ 79,437,093**	**2.14**

4.1 Residential Program

Residential programs are designed to achieve savings related to space and water heating for Union Gas' residential individually metered residences. These programs are marketed to residential customers and are delivered through a variety of channels including: retail partnerships, builders, and third party delivery agents. Strategic efforts to cost effectively promote energy efficiency within Union's residential customer base included working with new partnerships, existing trade allies and partners, as well as direct-to-customer promotions. In 2013, Union focused on the Energy Saving Kit (ESK) offering (Section 4.1.1) and the Home Reno Rebate (HRR) offering (Section 4.1.2).

Table 4.2 shows the results of the Residential program and Table 4.3 breaks down the total spend into its components.

Table 4.2 – 2013 Residential Program Results

Program	Offering	Units	Annual Net Gas Savings (m3)	Cumulative Net Gas Savings (m3)	Total Spend	Net TRC	TRC Ratio
Residential	Energy Savings Kit	43,078	2,859,018	29,652,362	$ 3,372,157	$ 12,832,397	4.40
	Home Reno Rebate	207	303,672	6,073,437			
2013 Residential Total		**43,285**	**3,162,690**	**35,725,799**	**$ 3,372,157**	**$ 12,832,397**	**4.40**

Table 4.3 – 2013 Residential Program Spend

Item	Total
Incentives	$ 1,024,560
Administration	$ 484,214
Evaluation	$ 60,350
Promotion	$ 1,803,033
2013 Total Residential Program Spend	**$ 3,372,157**

Table 4.4 shows the calculation of the Residential program’s TRC ratio. With a TRC ratio of 4.40, the Residential program’s net TRC benefits are over four times greater than its net TRC costs.

Table 4.4 – 2013 Residential Program Cost-Effectiveness

	TRC Benefits (a)	TRC Costs (b)	Net TRC (c)=(a-b)	TRC Ratio (d)=(a/b)
Measures	$ 16,611,300	$1,431,306	$15,179,994	11.61
Administration		$484,214		
Evaluation		$60,350		
Promotion		$1,803,033		
Residential Program Total	**$ 16,611,300**	**$3,778,903**	**$ 12,832,397**	**4.40**

4.1.1 Energy Savings Kit Offering

Energy Savings Kits (ESKs) have been distributed to Union’s residential customers since 2000. In 2013, Union distributed 43,078 ESKs, a decline from 62,641 in 2012. As the market gets saturated, the focus has been to reduce, but not eliminate this offering to ensure that the residential market as a whole continues to have access to energy efficiency measures.

ESKs are pre-packaged measures designed to reduce a customer's energy demand and water consumption. Each ESK contains the following components:

- Energy efficient showerhead (1.25 GPM)
- Energy efficient kitchen aerator (1.50 GPM)
- Energy efficient bathroom aerator (1.0 GPM)
- Pipe wrap (two 1 meter lengths)
- 1 roll of Teflon tape for ease of showerhead installation
- ESK Installation Guide and MyAccount paperless brochure
- $25 Programmable Thermostat rebate coupon

Target Market

The ESK offering is targeted to Union residential customers in detached, semi-detached and individually metered row townhouses who have a natural gas water heater. Customers must have a natural gas furnace to be eligible for the programmable thermostat.

Market Incentive

All water saving measures in the ESK are provided at no cost to the customer. A $25 coupon for the programmable thermostat is also included in the ESK.

Market Delivery

In 2013, the primary delivery approach for the ESK offering was the ESK door-to-door initiative, supported by a combination of other channels that included: Account Manager ESK distribution, pick-up depots, HVAC partnerships, direct mail and online campaigns.

Calculation of Savings

Union conducted an impact evaluation for the ESK offering to verify installation and usage of measures. This impact evaluation determined the number of ESK measures that were installed and remained installed for 2013, the portion of showering that was attributable to the ESK showerhead, and the percentage of ESK recipients that used a natural gas water heater to heat their home's water. Through these efforts, the impact evaluation provides adjustment factors that are applied to the savings claims. See section 8.1.1 of this report for further details.

ESK Door-to-Door Distribution

Union first implemented a pilot door-to-door distribution for the ESK offering in Q4 2012 as a new channel to reach customers who had not yet received an ESK. The pilot proved door-to-door distribution to be a successful delivery method to make participating easier by eliminating the need to visit a pick-up location or retail event. As a result, Union employed this delivery approach in 2013 for the ESK offering.

Union partnered with Ecofitt to act as the delivery agent of this initiative.   Ecofitt deployed technicians in field to visit pre-identified customers with free ESKs in the following cities:

- Burlington
- Guelph
- London
- Milton

- Oakville
- Waterloo

A week prior to field visits, Union mailed a marketing promotional postcard to each customer notifying them that Union would be in their neighbourhood delivering a free ESK kit through our authorised partner Ecofitt during the next few days.

Energy Saving Kit

Door to Door Delivery Program

uniongas

A Spectra Energy Company

We Are Visiting Your Neighbourhood!

Expect a visit from our authorized partner ecofitt in the next few days to deliver your FREE energy saving products $60 value (See reverse for details)

SAVE up to $100* a year on your energy bills

Figure 4.0, Marketing Promotional Postcard for Door-to-Door Distribution

Ecofitt technicians wore an Ecofitt uniform and were equipped with an identification badge that also featured the Union Gas logo. Customers that received an ESK were asked to sign a customer acknowledgment form for tracking and reporting purposes and if a customer was not home, a door-hanger was left behind to encourage customers to call Ecofitt's toll free number or go to www.uniongas.com/esk to order an ESK. Approximately 19,000 ESKs were delivered through this channel.

FREE

$60 value

Energy Saving Kit

Install this kit and save up to $100* a year in energy costs!

This kit contains these energy saving items:

One Energy-Efficient Massage Showerhead

One Energy-Efficient Kitchen Swivel Aerator

One Energy-Efficient Bathroom Aerator

One Roll of Teflon Tape

Two Metres of Foam Pipe Insulation

uniongas A Spectra Energy Company

uniongas.com/esk

Installing the contents in this kit can save you up to $100 per year and approximately 20,000 litres of water. That's enough to fill a backyard pool.

One mature tree can remove up to 9kg of carbon dioxide a year. By installing the contents in this kit you can reduce the carbon dioxide equivalent to what 23 mature trees remove in a single year.

uniongas A Spectra Energy Company

enersmart HOME

uniongas.com/esk

Figure 4.1, Energy Savings Kit Bag Insert for Door-to-Door Distribution

Sorry we missed you!

Union Gas has a FREE Energy Saving Kit for you – valued at $60

You can save up to $100* a year in energy costs!

To get your kit, contact our partner ecofitt at 1 877 326-3488, Option 2 or order online at uniongas.com/esk

uniongas A Spectra Energy Company

enersmart HOME

Figure 4.2, Door Hanger for Door-to-Door Distribution

Pick-up Depots Partnership Initiative

Union continued to partner with strategically located retail stores that served as distribution centres for ESKs within Union's franchise. Examples of these stores are Home Depot and Sears as well as Heating, Ventilation and Air Conditioning dealers (HVACs) who own a showroom. Although no financial incentives are offered to these depots, the traffic created from the promotional bill inserts to Union's more than 1.2 million residential customers motivates participation. In 2013, customers accessed approximately 4,800 ESKs through pick-up depots.

Account Manager ESK Distribution

Since the ESK offering inception, Account Manager's have been working with their local communities to distribute ESKs through various events. Examples of local events include home shows, trade shows, business partner sales events, retail and community events. In 2013, approximately 3,800 ESKs were distributed through this channel.

HVAC Partnership Initiative

This channel is designed to influence energy conservation decisions at the point of purchase. Incentives are paid directly to HVAC partners for the distribution or installation of an ESK or programmable thermostat. For 2013, the following incentives were available to qualified HVAC partners:

- $20 for the distribution of an energy saving kit to a qualified Union Gas customer;
- $40 for the installation of an energy saving kit to a qualified Union Gas customer; and
- $25 for the sale and installation of a programmable thermostat.

The result of these HVAC partnership initiatives in 2013 amounted to 250 ESKs installed and approximately 5,400 ESKs distributed.

Please visit one of the participating pick-up locations, or visit uniongas.com/esk to order your FREE kit online.

Pick-up or order your FREE Energy Saving Kit

Save up to $100* per year in energy costs

$60 value

FREE Energy Saving Kit

Install this kit and save up to $100 per year in energy & water

The kit contains these elements:

To order your kit online, or for more information, visit uniongas.com/esk

Figure 4.3, ESK Pick-up Depot Promotional Material

Direct Mail and Online Campaigns

In 2013, Union continued with direct mail campaigns targeting customers who had not yet received an ESK. Bill inserts were sent to customers in May, July and November. The bill insert provided information on the components of the ESK and directed customers to Union's website to order an ESK online. Alternatively, the customer could complete the ESK request form on the bill insert and send it in by regular mail.

FREE Energy Saving Kit*

Can't Get Online?

Complete and mail this form to:
Union Gas ESK Request Campaign
50 Keil Dr. N., P.O. Box 2001
Chatham, ON N7M 5M1

Please **PRINT CLEARLY** the following information:

Customer Name on Union Gas Bill: ______
Street Address: ______
City: ______
Postal Code: ______
Home Phone: (____) ______
Email: ______
Union Gas Account Number ____-____-____-____

enersmart HOME

Go to **uniongas.com/esk** to order your kit today!

† Savings may vary by household.
Printed on recycled paper using environmentally friendly inks.
© Union Gas Limited 05/2013 UG2013.30100

$60 VALUE

FREE Energy Saving Kit*

Save $100† per year in energy & water

uniongas
A Spectra Energy Company

FREE Energy Saving Kit*

The FREE Energy Saving Kit contains:

Energy-Efficient Showerhead	Energy-Efficient Kitchen Aerator	Energy-Efficient Bathroom Aerator	One Roll of Teflon Tape	Two Metres Foam Pipe Insulation

Ordering online is easy!

Visit **uniongas.com/esk** to order your FREE Energy Saving Kit

You can also watch our video for easy installation instructions.

*This offer is only available to Union Gas residential customers with a natural gas water heater. While supplies last. One kit per address.
Please visit uniongas.com/esk for more information, complete rules and regulations.

Did you know...

- Water heating is the second largest user of energy in your home after space heating.
- Installing an energy-efficient showerhead will save approximately 10,570 L of water and 63 m³ of natural gas a year. This equates to reducing your CO_2 consumption by 119 kg a year.
- Installing a kitchen aerator will save approximately 7,797 L of water and 23 m³ of natural gas a year. This equates to a reduction in your CO_2 consumption by 43 kg a year.
- Installing a bathroom aerator will save approximately 2,000 L of water and 6 m³ of natural gas a year. This equates to a reduction in your CO_2 consumption by 11 kg a year.
- Installing foam pipe insulation will save 18 m³ of natural gas a year and help reduce CO_2 consumption by 34 kg a year.

Figure 4.4, ESK Bill Insert Promotional Material

As described above, Union uses a multi-channel approach to deliver ESKs to the residential market; pull, push and install approach. The results for each are shown in Table 4.5.

Table 4.5 - 2013 ESK Distribution Summary by Channel

Door-to-Door	Pick-up Depots	AM/Retail Events	HVACs	Install	Direct Mail & Online	Total
19,106	4,759	3,763	5,371	253	9,826	43,078

Programmable Thermostat

In 2013, Union promoted a $25 on-bill rebate for the purchase and installation of a programmable thermostat to its customers. This rebate, offered in the form of a coupon, was distributed through a number of channels:

- Bill inserts
- ESK insert
- Home Depot, Lowes
- HVAC dealers
- Union Gas website

SAVE $25 On any Programmable Thermostat you purchase
Certain conditions apply†

uniongas
A Spectra Energy Company

Save up to $100 per year,* every year, in energy costs.
Receive a $25 credit on your Union Gas bill.

Figure 4.5, Programmable Thermostat: Bill Insert

In order to receive the on-bill rebate, customers are required to submit their active Union Gas account on the completed coupon indicating whether they are replacing a non-programmable thermostat and submit it with a proof of purchase for the programmable thermostat.

Partnership with Green Impact Guelph (GIG)

In 2013, Union continued its partnership with City of Guelph, Guelph Hydro and Guelph Environmental Leadership (GEL) to launch the Green Impact Guelph (GIG). GIG is a delivery strategy that offers a free personalized in-home basic audit, completed by GEL. The audit aims at identifying water and energy saving opportunities and conducts retrofits on-site where appropriate and specifically the installation of ESK components.

Figure 4.6, Green Impact Guelph Program Overview

The GIG pilot program is promoted using flyers, posters, door hangers and through collaboration with local neighbourhood groups and community groups/institutions (i.e. schools, churches, etc.). All promotions focused solely on the targeted neighbourhood and did not include the broader community.

To be eligible, a participant must be:

- A resident of a detached, semi-detached or townhouse/row-house located in the city of Guelph constructed prior to 1996, with permission from the owners; and
- Be serviced by city of Guelph municipal water and wastewater system, Guelph Hydro Electric Systems Inc. and Union Gas.

4.1.2 Home Reno Rebate Offering *(formerly Home Retrofit Offering)*

Union rebranded the Home Reno Rebate (HRR) offering in Q2, 2013. The term ‘Retrofit’ was replaced with ‘Reno’, a more conventional term understood by residential customers.

The offering encourages homeowners to install two or more measures in their homes to:

- Achieve significant energy and money savings each year;
- Put a stop to costly home energy loss;
- Enjoy a home that’s warmer in the winter and cooler in the summer;
- Avoid unsightly mould and condensation that can be caused by poor insulation; and
- Improve health through better indoor air quality.

Deep Savings Homes

Deep Savings Homes must achieve a minimum gas savings of 11,000 lifetime m^3 (based on HOT2000 software used in EnerGuide mode) and implement a minimum of two major measures. In 2013, theHRR offering included 203 Deep Savings Homes.

Table 4.6 outlines the total number of measures installed in the Deep Savings Homes as well as the percentage of total m^3 savings each measure type represents. Table 4.7 shows total cumulative m^3 gas savings of Deep Savings Homes based on whether or not the homes installed a new furnace.

Table 4.6 – 2013 Deep Savings Homes Measure Summary

Measure	Number Installed	Percentage of Total Deep Homes Savings*
Attic Insulation	98	12%
Basement Insulation	89	24%
Draft Proofing	182	17%
Furnace	95	30%
Wall Insulation	51	13%
Water Heater	18	1%
Window	59	3%

*When two or more measures are installed in a home, interactive effects between measures may lead to reduced total savings in comparison to savings expected from the same measures installed in isolation. The reported percentages omit any interactive effects.

Table 4.7 - 2013 Deep Savings Homes by Furnace Gas Savings

	Number of Homes	Average Annual Gas Savings (m^3)	Total Cumulative Gas Savings (m^3)
With Furnace	95	1,870	3,019,336
Without Furnace	108	1,647	3,023,348

Note: Home Reno Rebate measures in 2013 have a 20-year effective useful life (EUL).

Non-Deep Savings Homes

Non-Deep Savings Homes are homes that did not achieve the minimum gas savings of 11,000 lifetime m^3 (based on HOT2000 software used in EnerGuide mode). In 2013, four homes were considered Non-Deep Savings Homes.

Table 4.8 outlines the total number of measures installed in the Non-Deep Savings Homes as well as the percentage of total m^3 savings each measure type represents. Table 4.9 shows total cumulative m^3 gas savings of Non-Deep Savings Homes based on whether or not the homes installed a new furnace.

Table 4.8 – 2013 Non-Deep Savings Homes Measure Summary

Measure	Number Installed	Percentage of Total Deep Homes Savings*
Attic Insulation	1	6%
Basement Insulation	1	1%
Draft Proofing	3	2%
Furnace	3	64%
Wall Insulation	1	22%
Window	2	5%

*When two or more measures are installed in a home, interactive effects between measures may lead to reduced total savings in comparison to savings expected from the same measures installed in isolation. The reported percentages omit any interactive effects.

Table 4.9 - 2013 Non-Deep Savings Homes by Furnace Gas Savings

	Number of Homes	Average Annual Gas Savings (m^3)	Total Cumulative Gas Savings (m^3)
With Furnace	3	430	21,947
Without Furnace	1	518	8,806

Note: Home Reno Rebate measures in 2013 have a 20-year effective useful life (EUL).

Target Market

The HRR offering targets Union's residential customers who own a detached home built in 1994 or earlier with a natural gas heating system.

In 2013, Union targeted the following cities:

- Elgin
- Guelph
- London
- Middlesex
- Oxford
- Perth
- Waterloo
- Wellington

Market Incentive

Table 4.10 outlines the various measures of the HRR offering with the corresponding criteria and incentive.

Table 4.10 – HRR Offering Rebates

Measure	Criteria	Incentives
Attic Insulation	Increase attic insulation to at least R50 from R12 or less	$ 600
	Increase attic insulation to at least R50 from R13 to R25	$ 300
	Increase cathedral/flat roof insulation to at least R28 from R12 or less	$ 600
Basement Insulation	Adding at least R23 to 40-100% of basement	$ 500 - 1,250
	Adding at least R12 to 40-100% of basement	$ 250 - 625
Crawl Space Insulation	Adding at least R23 to crawl space wall	$ 800
	Adding at least R10 to crawl space wall	$ 400
	Adding at least R24 to floor above crawl space	$ 450
Exterior Wall Insulation	Adding at least R9 to 40-100% of building	$ 500 - 1,250
Draft Proofing	Improve air-tightness of home by 10% above base target	$ 200
	Improve air-tightness of home by 5% above base target	$ 150
	Improve air-tightness of home to base target	$ 100
Furnace	Replace low or mid efficiency heating system with 95% AFUE or higher condensing natural gas furnace or 90% AFUE or higher ENERGY STAR® condensing gas boiler.	$ 500
Water Heater	Replace water heater with ENERGY STAR and ecoENERGY qualified instantaneous natural gas water heater with EF of 0.82 or higher	$ 200
Window/Door/Skylight	For each window, door or skylight replaced with ENERGY STAR-qualified models	$ 40

*Offering eligibility criteria required customers to complete both a pre and post audit. Customers were eligible for a $500 incentive to conduct both audits.

Market Delivery

In 2013, Union expanded partnership with Service Organizations to provide turn-key delivery service for customers to nine firms. Services included: managing a toll-free number, administering pre and post audits, and tracking and reporting results. The Service Organizations are:

- Amerispec of Canada
- Barrier Sciences Group
- Building Insight Technologies
- Direct Energy
- Energuy Canada
- F2 Energy
- Green Communities Canada (REEP and ELORA Environment)
- Hoover Home Inspections
- Ridge Energy Consultants

Customers have the option to choose the suppliers and installers for measure upgrades, or complete the installations themselves.

Direct Mail

To support Service Organizations and to create additional market traction Union developed and launched promotional efforts including a direct mail campaign targeting customers who live in detached homes in Guelph, London and Waterloo.

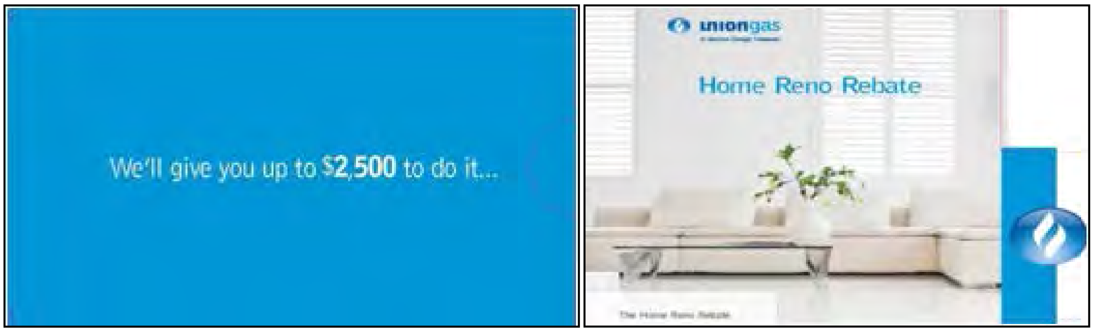


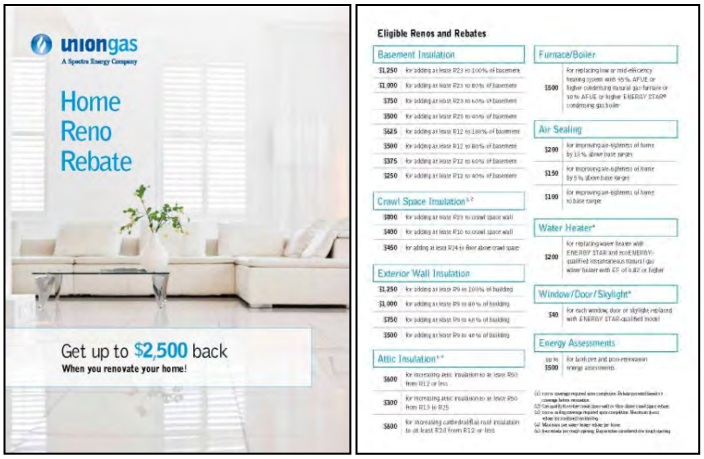
Figure 4.7, HRR Direct Mail

Local Newsprint

Union launched local newsprint campaigns targeting Guelph, London and Waterloo customers to generate awareness on the benefits and cost savings associated with home renovations. The newsprint ads directed customers to call one of the Service Organizations and/or to visit the Union's website for additional details.

Customer Brochure

A customer brochure was developed to be used by Service Organizations during their customer calls to explain the offering and as a leave behind for customer reference.



uniongas
A Spectra Energy Company

Home
Reno
Rebate

Get up to $2,500 back
When you renovate your home!

Eligible Renos and Rebates

Basement Insulation

$1,250	for adding at least R23 to 100% of basement
$1,000	for adding at least R23 to 80% of basement
$750	for adding at least R23 to 60% of basement
$500	for adding at least R23 to 40% of basement
$625	for adding at least R12 to 100% of basement
$500	for adding at least R12 to 80% of basement
$375	for adding at least R12 to 60% of basement
$250	for adding at least R12 to 40% of basement

Crawl Space Insulation[1,2]

$800	for adding at least R23 to crawl space wall
$400	for adding at least R10 to crawl space wall
$450	for adding at least R24 to floor above crawl space

Exterior Wall Insulation

$1,250	for adding at least R9 to 100% of building
$1,000	for adding at least R9 to 80% of building
$750	for adding at least R9 to 60% of building
$500	for adding at least R9 to 40% of building

Attic Insulation[1,3]

$600	for increasing attic insulation to at least R50 from R12 or less
$300	for increasing attic insulation to at least R50 from R13 to R25
$600	for increasing cathedral/flat roof insulation to at least R28 from R12 or less

Furnace/Boiler

$500	for replacing low or mid-efficiency heating system with 95% AFUE or higher condensing natural gas furnace or 90% AFUE or higher ENERGY STAR® condensing gas boiler

Air Sealing

$200	for improving air-tightness of home by 10% above base target
$150	for improving air-tightness of home by 5% above base target
$100	for improving air-tightness of home to base target

Water Heater[4]

$200	for replacing water heater with ENERGY STAR and ecoENERGY-qualified instantaneous natural gas water heater with EF of 0.82 or higher

Window/Door/Skylight[5]

$40	for each window, door or skylight replaced with ENERGY STAR-qualified model

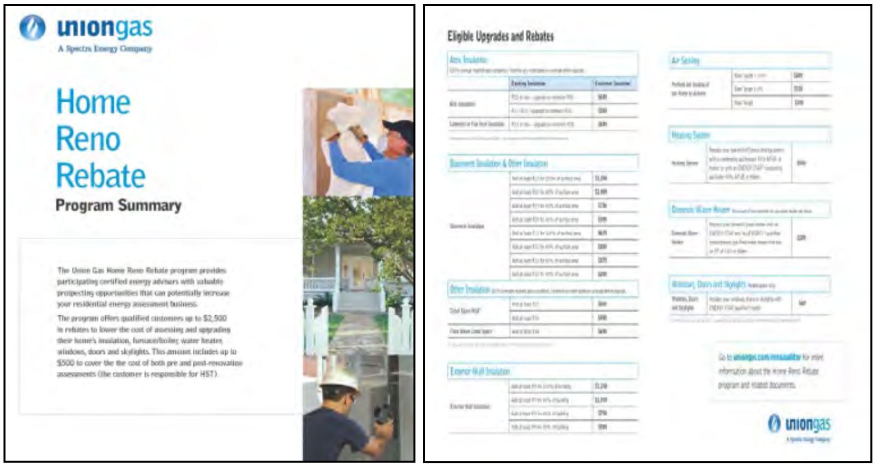
Energy Assessments

up to $500	for both pre and post-renovation energy assessments

Figure 4.8, HRR Customer Brochure

Sell Sheet

A sell sheet was developed to be used by Service Organizations and sales associates during their customer calls to explain and promote the offering and to act as a reference.



uniongas
A Spectra Energy Company

Home
Reno
Rebate
Program Summary

The Union Gas Home Reno Rebate program provides participating certified energy advisers with valuable prospecting opportunities that can potentially increase your residential energy assessment business.

The program offers qualified customers up to $2,500 in rebates to lower the cost of assessing and upgrading their home's insulation, furnace/boiler, water heater, windows, doors and skylights. This amount includes up to $500 to cover the the cost of both pre and post-renovation assessments (the customer is responsible for HST).

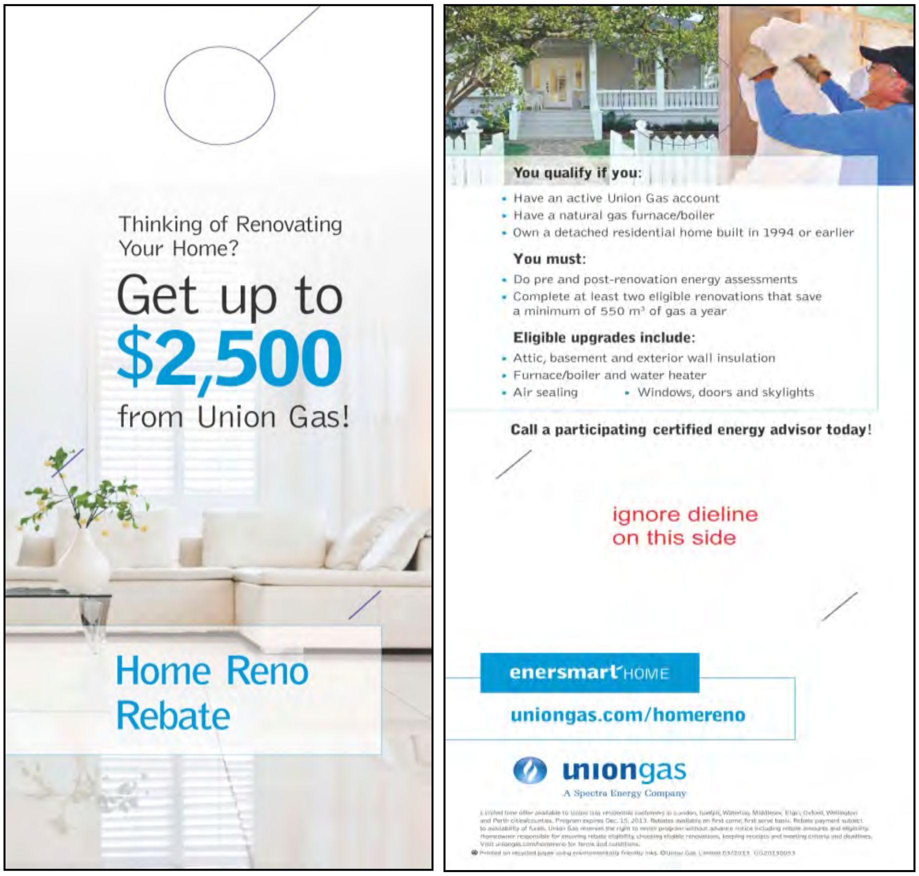
Eligible Upgrades and Rebates

uniongas

Figure 4.9, HRR Sell Sheet

Door Hangers

Door hangers were used by Service Organizations and sales teams to promote the offering during their visits. After a visit, the Service Organization representatives would distribute the door hangers to other homes on the same street.



Thinking of Renovating Your Home?

Get up to $2,500 from Union Gas!

Home Reno Rebate

You qualify if you:

- Have an active Union Gas account
- Have a natural gas furnace/boiler
- Own a detached residential home built in 1994 or earlier

You must:

- Do pre and post-renovation energy assessments
- Complete at least two eligible renovations that save a minimum of 550 m³ of gas a year

Eligible upgrades include:

- Attic, basement and exterior wall insulation
- Furnace/boiler and water heater
- Air sealing
- Windows, doors and skylights

Call a participating certified energy advisor today!

ignore dieline
on this side

enersmart HOME

uniongas.com/homereno

uniongas
A Spectra Energy Company

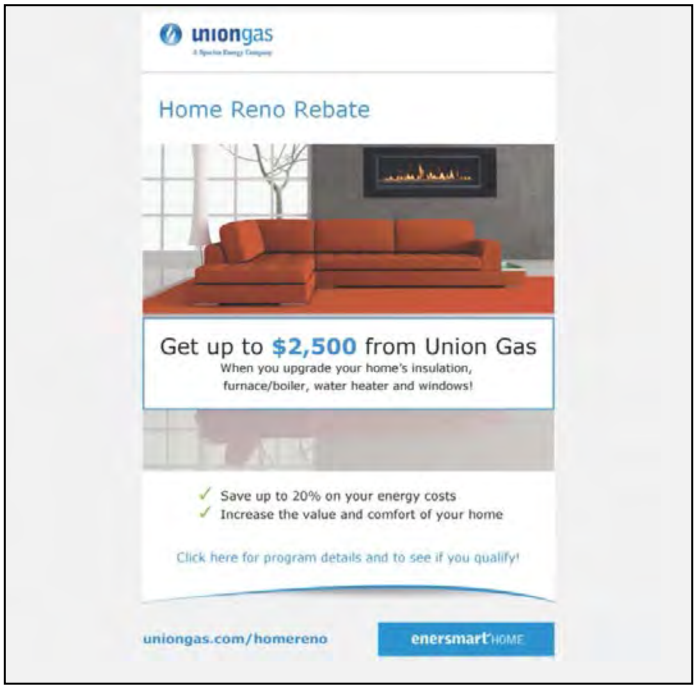
Limited time offer available to Union Gas residential customers in London, Guelph, Waterloo, Middlesex, Elgin, Oxford, Wellington and Perth cities/counties. Program expires Dec. 15, 2013. Rebates available on first come, first serve basis. Rebate payment subject to availability of funds. Union Gas reserves the right to revise program without advance notice including rebate amounts and eligibility. Homeowner responsible for ensuring rebate eligibility, choosing eligible renovations, keeping receipts and meeting criteria and deadlines. Visit uniongas.com/homereno for terms and conditions.

Printed on recycled paper using environmentally friendly inks. ©Union Gas Limited 03/2013 UG20130053

Figure 4.10, HRR Door Hangers

E-mail

An e-mail campaign was developed to target MyAccount customers (approximately 12,000 customers) who met the offering criteria. MyAccount is Union's online account management system for customers.


uniongas

Home Reno Rebate

Get up to **$2,500** from Union Gas

When you upgrade your home's insulation, furnace/boiler, water heater and windows!

- ✓ Save up to 20% on your energy costs
- ✓ Increase the value and comfort of your home

Click here for program details and to see if you qualify!

uniongas.com/homereno

enersmart HOME

Figure 4.11, HRR E-blast

Website

Union updated its web presence to reflect the re-branded offering: www.uniongas.com/homereno

4.1.3 Education and Awareness

Education and awareness efforts in the residential sector affecting consumer decisions are crucial to the success of Union's DSM programs. Union targets educational outreach to customers to empower them to manage their energy costs. In 2013, Union continued to disseminate educational materials through a variety of media:

- Interactive website;
- Wise Energy Guides (WEG);
- *InTouch* monthly bill inserts; and
- Residential HVAC Newsletter.

Residential Energy Efficiency Website

Energy efficiency, environmental stewardship and conservation are a central focus of the Union Gas website. Within the residential section of the site, there is a dedicated Energy Conservation menu heading (uniongas.com/energyefficiency) with the following sub-sections:

- ***Energy Saving Programs***: Information and links to Union's various conservation initiatives (e.g. ESK and the programmable thermostat rebate).

- ***Education***: Information and links on buying a new home, energy efficient labels, and a downloadable Wise Energy Guide.
- ***Industry Links and Government Programs***: Information on Union's major partners, stakeholders and affiliates as well as links to conservation-related programs, both gas and non-gas focused, in the Ontario marketplace.
- ***Manage My Bill***: A summary of 12 easy steps to help customers reduce their energy consumption and save money on their utility bill.

Features on the site include:

- Online videos (topics include: the ESK, air sealing, and programmable thermostats);
- A downloadable programmable thermostat rebate coupon;
- Downloadable educational materials;
- A listing of ESK depots across Union's franchise where customers can pick-up a free ESK;
- An online order form for customers to request an ESK and have it delivered to their home; and
- An overview of energy efficiency rebate programs offered in the province, as well as links to third party organizations involved in energy conservation.

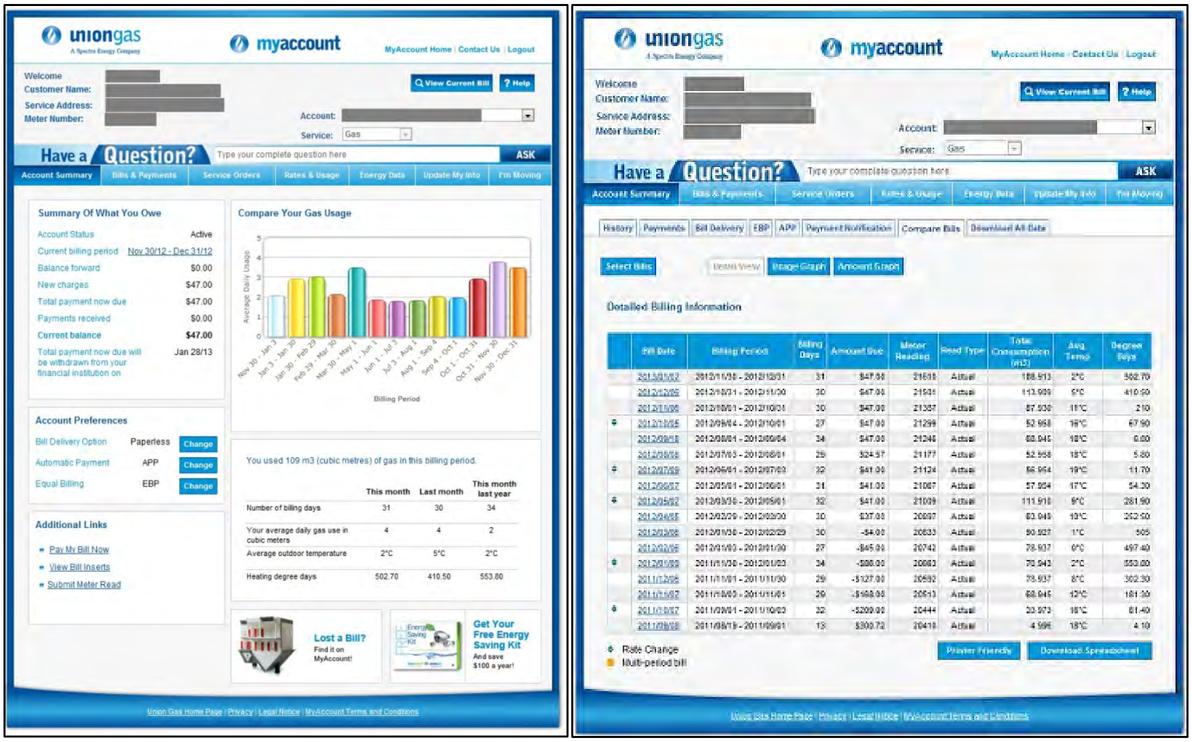
MyAccount

Launched in 2008, MyAccount is Union's online account management tool for residential and small business customers. After logging into MyAccount, customers can access personalized tools to help them better understand their energy use including:

- An archive containing 24 months of natural gas use and billing history;
- A "compare bills" feature to graph consumption or bill amounts from two or more months; and
- A download feature to export energy data into a spreadsheet or energy management software.

These tools provide customers with feedback that can:

- Break "bad habits" related to energy use and form new persistent habits;
- Build a greater understanding of how actions/behaviours relate to energy consumption; and
- Influence motivations related to the use of energy.



Welcome [redacted]
Customer Name: [redacted]
Service Address: [redacted]
Meter Number: [redacted]
Account: [redacted]
Service: Gas

Summary Of What You Owe

Account Status	Active
Current billing period	Nov 30/12 - Dec 31/12
Balance forward	$0.00
New charges	$47.00
Total payment now due	$47.00
Payments received	$0.00
Current balance	**$47.00**
Total payment now due will be withdrawn from your financial institution on	Jan 28/13

Account Preferences

Bill Delivery Option	Paperless	Change
Automatic Payment	APP	Change
Equal Billing	EBP	Change

Additional Links

- Pay My Bill Now
- View Bill Inserts
- Submit Meter Read

You used 109 m3 (cubic metres) of gas in this billing period.

	This month	Last month	This month last year
Number of billing days	31	30	34
Your average daily gas use in cubic meters	4	4	2
Average outdoor temperature	2°C	5°C	2°C
Heating degree days	502.70	410.50	553.80

Detailed Billing Information

Rate Change
Multi-period bill

Figure 4.12, MyAccount

Wise Energy Guide

In 2013, Union continued to distribute copies of the Wise Energy Guide to customers. The guide includes up-to-date tips and solutions to reduce heat loss, suggestions to solve moisture problems, natural gas equipment options, and an easy-to-use checklist to assist customers to achieve greater energy efficiency in the home. The primary distribution method is Union's website, where customers can view a digital copy or order a printed version.

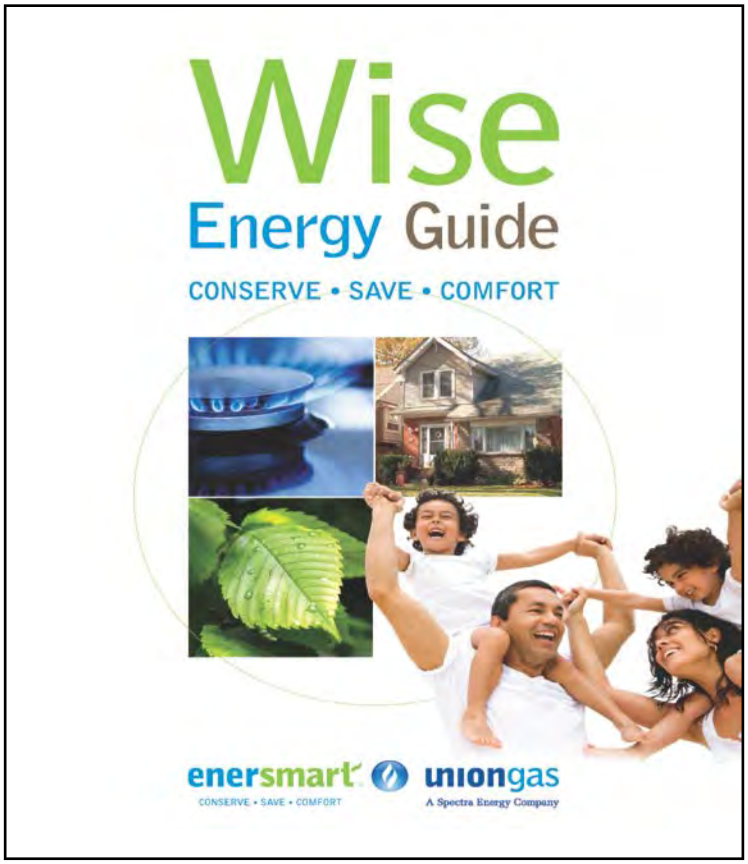


Figure 4.13, Wise Energy Guide

intouch Monthly Newsletter

Union continues to distribute the monthly *intouch* residential customer newsletter both in print and online. The newsletters include educational messages about energy efficiency, natural gas safety and the environmental and financial savings related to using natural gas.

Feature topics related to DSM in 2013 included:

- The importance of annual equipment inspections;
- The importance of caulking and weather stripping;
- How to avoid high winter heating bills.

Figure 4.14, *intouch* Newsletter

Residential HVAC Newsletter

In 2013, Union continued to target residential HVAC contractors through the GasFacts newsletter. This newsletter provides updates to the HVAC community related to Union's energy efficiency programs, codes and standards, recalls and manufacturers' notifications, as well as rebate offers from Union and third party organizations.

Dedicated HVAC Webpage

The HVAC partners section of the Union website has been designed to inform HVACs and the industry of relevant information, updates, codes and standards, in addition to driving further energy conservation messages and measures in the new construction and retrofit markets. The website hosts past GasFacts editions as well as FAQ's, rebate and incentive information, equipment and technical support, and other information.

4.1.4 Lessons Learned

ESK Offering

1. ***ESK door-to-door distribution***

   Based on the successful initial pilot of the ESK Door-to-Door distribution in 2012, this method of delivering ESKs was proven to be a cost effective way to reach the remaining eligible customers who had not yet received an ESK. This initiative was expanded in 2013 beyond the initial pilot to reach customers in different municipalities.

Home Reno Rebate Offering

2. ***Semi-detached homes***

   Union has exclusively targeted single detached homes for the HRR offering. However, feedback from Service Organizations indicated that semi-detached homes represented an untapped opportunity for energy conservation. Union will expand the target market to include semi-detached homes starting in 2014. Eligibility criteria must be met to participate.

3. ***Delivery partnerships***

   In 2012 Union partnered exclusively with Direct Energy for the delivery of the Home Reno Rebate offering. The Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) and its members expressed concerns with Union working exclusively with a single entity. HRAI felt that this offering should be open to all market players to create an even playing field in the market. Although it was never Union's intention to create an unfair advantage for any particular partner, Union heard and understood the concerns that HRAI raised and in 2013, augmented its delivery strategy by partnering with eight Service Organizations to provide energy assessments. In addition, customers also have the option to choose the HVACs/Contractors to perform the renovations and upgrades in their homes. This change in delivery strategy was welcomed by HRAI and its members as well as the insulation contractors.

4.2 Commercial/Industrial Program

A portfolio of energy efficient technology related incentives were available to commercial/industrial customers in 2013. Union uses the EnerSmart Business brand platform to promote the adoption of high efficiency natural gas technologies and/or processes, as well as promote energy audits, surveys, studies etc. Union's Commercial/Industrial program is divided into two offerings: prescriptive and custom.

Program savings results, budget spend, and program TRC are presented in Tables 4.11, 4.12 and 4.13 below.

Table 4.11 – 2013 Commercial/Industrial Program Results

Program	Offering	Units	Annual Gas Savings (m^3)	Cumulative Gas Savings (m^3)	Total Spend	Net TRC	TRC Ratio
Commercial/ Industrial	Prescriptive	6,558	14,207,995	272,204,417	$5,830,100	$22,058,811	2.37
	Custom	498	37,625,436	612,844,734	$6,756,908	$44,545,885	1.89
2013 Commercial/Industrial Total		**7,056**	**51,833,431**	**885,049,151**	**$12,587,008**	**$66,604,696**	**2.01**

Table 4.12 – 2013 Commercial/Industrial Program Spend

Item	Total
Incentives	$8,413,425
Administration	$2,554,405
Evaluation	$127,592
Promotion Costs	$1,491,586
2013 Total Commercial/Industrial Program Spend	**$12,587,008**

Table 4.13 – 2013 Commercial/Industrial Program Cost-Effectiveness

	TRC Benefits (a)	TRC Costs (b)	Net TRC (c)=(a-b)	TRC Ratio (d)=(a/b)
Measures	$132,574,618	$61,796,339	$70,778,279	2.15
Administration		$2,554,405		
Evaluation		$127,592		
Promotion		$1,491,586		
Commercial/Industrial Program Total	**$132,574,618**	**$65,969,922**	**$66,604,696**	**2.01**

4.2.1 Prescriptive and Quasi-Prescriptive Offering

Union continues to offer a full suite of DSM prescriptive and quasi-prescriptive measures to more than 100,000 commercial customers. These customers are made up of the following customer segments: office, retail, multi-family, foodservice, hotel and motel, manufacturing, agriculture, warehouse, entertainment and recreation, education and healthcare and all fall within the commercial rate classes: M1, M2, M4, M5, M7, R01, R10 and R20.

1. ***Prescriptive Measures:*** These measures have predictable energy savings based on the size and classification of the equipment.
2. ***Quasi-Prescriptive Measures:*** These measures are slightly different than the prescriptive technologies. The key difference is that the potential energy savings for these technologies are ‘quasi-prescriptive’ not prescriptive. This means that the majority of the saving inputs will be prescriptive; however, there will be one or possibly several inputs that need to be customized for each installation to determine the cumulative m^3 savings. Examples of inputs that would have to be customized for each installation/claim are: where a piece of equipment is installed (new or existing building), type of business (e.g. Foodservice or Healthcare) and size of equipment (e.g. CFM or BTU).

Target Market

Union Gas continues to approach segments of the commercial market uniquely based on the business/industry type. Segmenting based on business type means that Union approaches ‘like’ customers in a harmonized way and targets each segment with more customized, relevant and valuable communications. This approach allows Union to use existing resources more effectively to educate business customers about potential energy savings. In addition, segmenting based on business type has provided Union with market insights; allowing better understanding of Union's commercial, institutional and industrial customer base and barriers for DSM uptake. Details specific to each of the prescriptive and quasi-prescriptive measures are provided below.

Market Incentive

Union offered the prescriptive incentives as outlined in Table 4.14 below, as well as some bonus incentives for a few of the initiatives as detailed in this section. In addition, National Account customers were also eligible for a multi-unit installation incentive. National Account customers are those that have multiple property locations throughout Union's franchise with similar design and use, such as retail chains, property management firms and foodservice chains. National Account customers have the ability to install various different energy efficient technologies within numerous locations across Union's franchise. As a result of the high number of savings opportunities, Union designed a bonus structure to encourage multiple installations by National Account customers within a given year. The following bonus was offered in 2013:

- 25% incentive increase on 6-30 installations per national account
- 50% incentive increase on >30 installations per national account

The key reasons for this initiative was to encourage more meaningful conversations with National Account franchises and corporate offices to adopt energy efficiency technologies broadly versus only in areas where the return on investment was the greatest. It also encouraged the early retirement of inefficient equipment and the opportunity to install emerging technologies.

Table 4.14 –Commercial/Industrial Prescriptive Offering Incentives

Initiative	Measure	Customer Incentive	Service Provider	Distributor Incentive
Water Heating	Condensing Gas Water Heaters - 100, 500 & 1,000 gal/day/tank	$ 350	$ 100	$ 50
	Laundry Washing Equipment with Ozone - ≤ 120 lbs & 100,000 - 199,999 lbs/yr	$ 1,000	$ 100	
	Laundry Washing Equipment with Ozone - ≤ 120 lbs & ≥ 200,000 lbs/yr	$ 1,500	$ 100	
	Laundry Washing Equipment with Ozone - > 120 lbs & ≥ 260,000 lbs/yr	$ 6,000	$ 100	
Space Heating	Air Curtains - ≥ 48ft^2 and < 96ft^2 – Pedestrian	$ 250	$ 100	
	Air Curtains - ≥ 96ft^2 – Pedestrian	$ 500	$ 100	
	Air Curtains - ≥ 64ft^2 and < 96ft^2 - Shipping and Receiving	$ 1,000	$ 100	
	Air Curtains - ≥ 80ft^2 and < 100ft^2 - Shipping and Receiving	$ 1,000	$ 100	
	Air Curtains - ≥ 100ft^2 - Shipping and Receiving	$ 1,500	$ 100	
	Condensing Boiler - ≤ 299 MBtu/hr	$ 600	$ 100	$ 50
	Condensing Boiler - 300 to 999 MBtu/hr	$ 1,500	$ 100	$ 50
	Condensing Boiler - ≥ 1,000 MBtu/hr	$ 4,500	$ 100	$ 50
	Condensing Rooftop Units (MUA) Improved efficiency 1,000 – 4,999 CFM	$ 500	$ 100	
	Condensing Rooftop Units (MUA) Efficiency + 2 speed 1,000 – 4,999 CFM	$ 1,000	$ 100	
	Condensing Rooftop Units (MUA) Improved efficiency ≥ 5,000 CFM	$ 1,200	$ 100	
	Condensing Rooftop Units (MUA) Efficiency + VFDs 1,000 – 4,999 CFM	$ 1,400	$ 100	
	Condensing Rooftop Units (MUA) Efficiency + 2 speed ≥ 5,000 CFM	$ 1,800	$ 100	
	Condensing Rooftop Units (MUA) Efficiency + VFDs ≥ 5,000 CFM	$ 2,600	$ 100	
	Destratification Fan	$ 1,300	$ 100	
	ERV - ≤ 1,999 CFM	$ 600	$ 100	$ 50
	ERV - ≥ 2,000 CFM	$ 1,500	$ 100	$ 50
	HRV Multi Family, Health Care, Nursing	$ 400	$ 100	$ 50
	HRV 500 - 1,999 CFM - Hotel, Rest, Retail, Rec, School, Off, Warehouse, Man	$ 400	$ 100	$ 50
	HRV ≥ 2,000 CFM - Hotel, Rest, Retail, Rec, School, Off, Warehouse, Man	$ 700	$ 100	$ 50
	Infrared Heating**	$ 300	$ 100	$ 50
	Non Condensing Boiler - ≤ 299 MBtu/hr	$ 250	$ 100	$ 50
	Non Condensing Boiler - 300 to 999 MBtu/hr	$ 1,000	$ 100	$ 50
	Non Condensing Boiler - ≥ 1,000 MBtu/hr	$ 3,500	$ 100	$ 50
Commercial Kitchen	Energy Star Dishwasher - Stationary Rack & Under counter	$ 100	$ 50	
	Energy Star Dishwasher - Rack Conveyor - Single & Multi Tank	$ 400	$ 50	
	Cooking Equipment - Energy Star Fryer	$ 200	$ 50	
	DCKV Fast Food - ≤ 4,999 CFM	$ 1,200	$ 100	
	DCKV Full Menu - 5,000 – 9,999 CFM	$ 3,000	$ 100	
	DCKV Dinner House - 10,000 – 15,000 CFM	$ 4,000	$ 100	

*Additional incentives available. For more information, see details below.

**Service Provider Incentive to HVAC Contractors only.

Market Delivery

When targeting each segment, Union's highly skilled team of Account Managers and marketing support execute on one or more of the following approaches:

- ***Direct Sales Approach***: With this approach, Union's Account Managers work directly with the end-user to educate them on potential options to improve the energy efficiency of their facilities, offerings available to facilitate those options, and how the application process works. The direct sales approach requires working with multiple contacts within an organization as well as service providers, manufacturers and distributors who are instrumental in affecting a decision to install energy efficiency technologies.

- ***Mass Market Approach***: Union Gas uses a number of mass marketing techniques to target the end-use customer such as direct mails, email blasts, and advertising as well as event based marketing including tradeshows and other similar events to reach a large number of customers and channel partners.
- ***National Account Approach***: Union's National Account Managers communicate and influence end-use customers using a top-down, centralized approach. National Account customers are those that have multiple property locations throughout Union's franchise with similar design and use, such as retail chains, property management firms and foodservice chains.

Not only does Union reach and influence through the above direct sales, mass market and national account approaches, but support is also provided by a network of industry partners. These industry partners specify or install energy efficient equipment and/or directly educate or influence Union's customers to adopt natural gas energy efficient equipment. Maintaining and cultivating relationships with each of the following industry partners ensures that they are informed of Union's programs and that they can present the savings, benefits and incentives to customers.

- ***Service Providers:*** Architectural consultants, builders, HVACs, engineering consultants and energy service companies all carry significant influence with end use customers.
- ***Associations:*** Associations align with segment specific approach to market and provide industry insight necessary to designing programs that resonate with customers and drive action.
- ***Manufacturers:*** Manufacturers of the technologies that Union promotes provide insight into product key benefits, as well as an effective method to influence the market.
- ***Distributors:*** Distributors influence the market and their contractor customers. Contractors then influence the end-user customers installing the equipment.

By employing various market approaches and tailoring initiatives to specific business segments, Union is able to ensure communication with customers is relevant to their needs. For the purpose of this report, prescriptive and quasi-prescriptive measures are grouped in terms of 'initiatives' for Water Heating, Space Heating, and Kitchen as detailed below.

4.2.1.1 Water Heating Initiative

The Water Heating initiative is designed to reduce a customer's energy use and water consumption. In 2013, Union offered the following:

- Condensing Gas Water Heaters – High efficiency gas water heaters that operate at 95% thermal efficiency. This thermal efficiency is higher than the conventional tank type water heaters that operate at 80% efficiency, which results in faster hot water cycle times and, therefore, reduced building operating/energy costs.
- Ozone Laundry System - A piece of auxiliary equipment added onto a new or existing commercial washing machine which reduces the amount of chemicals, detergents and hot washing and drying times required to achieve the same standard of cleaning.

Target Market

Within the Water Heating initiative, there are specific target markets depending on the technology as detailed below:

- Condensing Gas Water Heaters were targeted to multi-family, foodservice, education, entertainment and recreation and healthcare customers.
- Ozone Laundry was marketed to customers with large volumes of laundry such as hotel/motels, laundry services and long-term care segments.

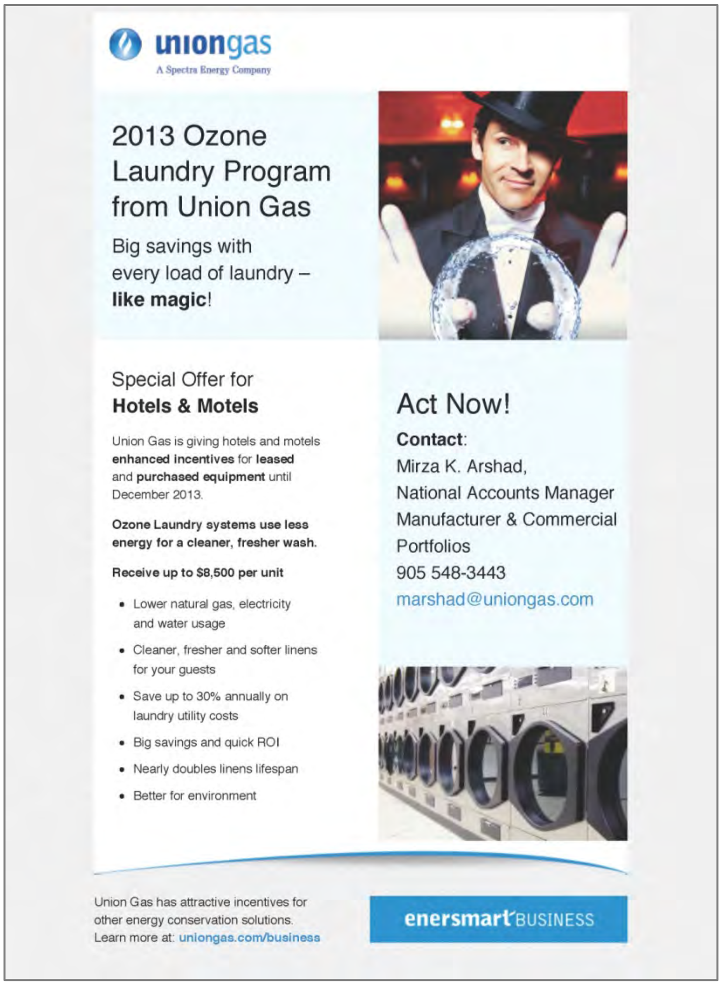
Market Incentive

- The incentive for condensing gas water heaters was $350 per unit.
- The incentive for the ozone laundry rental or leased equipment consisted of:
    - Washer Extractor(WE) ≤ 120 lbs capacity & 100,000 to 199,000 lbs/yr - $1,000 per unit
    - WE ≤ 120 lbs capacity & ≥ 200,000 lbs/yr - $1,500 per unit
    - WE > 120 lbs capacity & > 260,000 lbs/yr - $6,000 per unit

Union offered a special segment-specific bonus incentive of $200, $500 and $800 per unit corresponding to the bullet list above to hotel/motel and laundromat customers to encourage uptake of ozone laundry.

Market Delivery

- Condensing Gas Water Heater marketing efforts included promotion through a direct sales approach and mass market initiatives including direct mail, an advertising campaign targeting non-account managed small business retail customers, and tradeshows.
- Ozone laundry marketing efforts included promotion through a direct sales approach by collaborating with technology manufacturers to effectively reach and influence early technology adopters. In addition, Union implemented a mass market approach through an e-blast campaign directed to hotel/motel decision makers.



uniongas
A Spectra Energy Company

2013 Ozone Laundry Program from Union Gas

Big savings with every load of laundry – **like magic**!

Special Offer for
Hotels & Motels

Union Gas is giving hotels and motels **enhanced incentives** for **leased** and **purchased equipment** until December 2013.

Ozone Laundry systems use less energy for a cleaner, fresher wash.

Receive up to $8,500 per unit

- Lower natural gas, electricity and water usage
- Cleaner, fresher and softer linens for your guests
- Save up to 30% annually on laundry utility costs
- Big savings and quick ROI
- Nearly doubles linens lifespan
- Better for environment

Act Now!

Contact:
Mirza K. Arshad,
National Accounts Manager
Manufacturer & Commercial Portfolios
905 548-3443
marshad@uniongas.com

Union Gas has attractive incentives for other energy conservation solutions.
Learn more at: **uniongas.com/business**

enersmart BUSINESS

Figure 4.15, Ozone Laundry E-blast

4.2.1.2 Space Heating Initiative

The Space Heating Initiative is designed to stimulate customer action to retire older inefficient space heating equipment and install new energy efficient space heating equipment. In 2013, Union offered the following:

- Air Curtain Technology - Delivers a controlled stream of air that separates the indoor and outdoor environment. Air curtains reduce infiltration of cold or hot outside air through doorways, significantly reducing natural gas heating in winter and air conditioning in summer. Air curtains are often used where doors stay open for long periods of time. Typical examples include shipping docks and retail or office entrances.
- Condensing Boiler - Recovers energy that would normally be discharged into the atmosphere through a flue. This improves heating efficiency by approximately 15-20% compared to a conventional boiler, resulting in reduced gas bills. It also requires less space, offering more flexibility in small space environments.
- Condensing Make-up Air - These units are indirect gas fired and provide fresh air to common areas in commercial buildings. The majority of furnaces built into rooftop units are mid

efficiency units with efficiencies ranging from 78% - 82%. Condensing technology offers improved efficiencies of 90% and above and the high 'turn down' feature results in lower operating costs, better control, and increased comfort. There are three sub-categories for this technology:

  1. Improved efficiency
  2. Efficiency + 2 speed
  3. Efficiency + Variable Frequency Drives (VFDs)

- Destratification Fans - Large downdraught fans ranging from 8 to 24 feet in diameter. They offer an inexpensive and efficient way to bring heat down from the ceiling to mix with cooler floor temperature air, ensuring a consistent and comfortable temperature where it is most needed. Facilities with large stratified temperature differences have the greatest potential for energy savings; typically, the greater the ceiling height, the greater the potential for savings in the heating load.
- Energy Recovery Ventilators (ERVs)/ Heat Recovery Ventilators (HRVs) – ERVs capture heat and moisture, while HRVs capture heat. The recovered heat energy from the indoor air is used to heat air entering the building. ERVs and HRVs reduce the energy use associated with heating the space and related energy costs, and making the ventilation system operate more efficiently.
- High Efficiency Non-Condensing Boiler - The high efficiency non-condensing boiler technology is used for space heating, domestic water heating or a combination of both applications. Significant savings can be achieved through the installation of high efficiency non-condensing boilers with a combustion efficiency of over 85% in comparison to older boilers currently still being used in the market.
- Infrared Heaters - This measure helps customers conserve energy and money, as they deliver heat directly to where it's needed instead of heating the air within a space, like traditional forced air heating systems. Efficiency for this technology is especially evident in large volume buildings that do not require a steady state of heat or where there is a large amount of air exchange such as near a loading dock.

Target Market

Within the Space Heating initiative, there are specific target markets depending on the technology as detailed below:

- Air Curtains were targeted to warehouse, retail and manufacturing segments.
- All commercial/industrial customers were eligible for the Condensing Boiler measure; however Union mainly targets healthcare, multi-family and education customers.
- Condensing Make-up Air was targeted primarily to multi-family and healthcare segments as well as all other segments where the technology is appropriate.
- Destratification Fans were targeted to warehouse, manufacturing and retail facilities with high ceilings.
- All commercial/industrial customer segments are eligible for ERVs/HRVs, provided an engineer stipulates that it is not a code requirement. Union mainly targets healthcare and education customers.

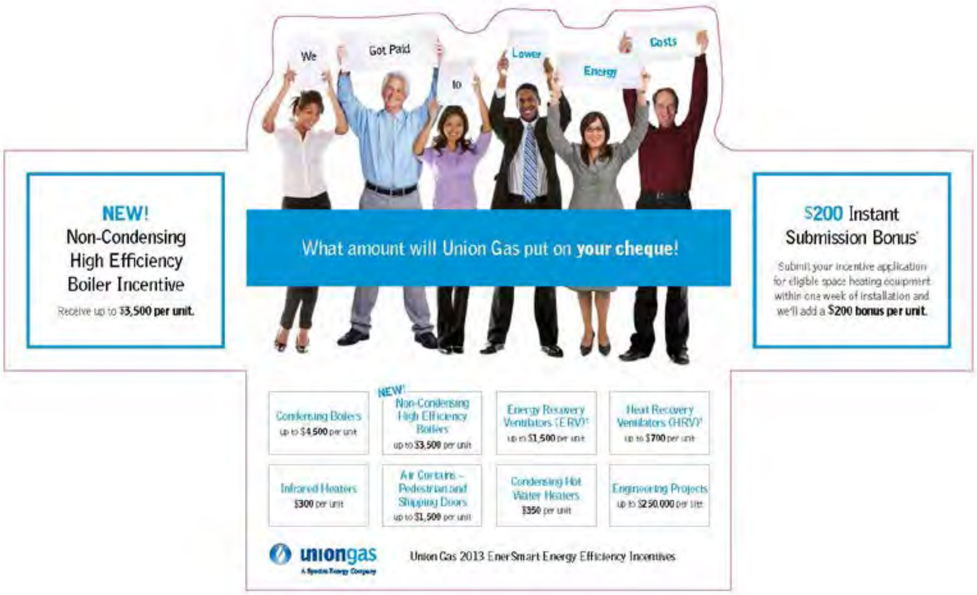
- High Efficiency Non-Condensing Boilers are available to all commercial/industrial customers, though Union mainly targets healthcare, multi-family and education customers.
- For the Infrared Heater technology, Union targeted segments such as warehouses, agriculture, retail and manufacturing.

Market Incentive

- Union offered end-use customers the following incentives for Air Curtains:
    - Shipping Doors: $1,000 - $1,500 per unit
    - Pedestrian Doors: $250 - $500 per unit
- For Condensing Boilers, Union offered end-use customers $600 - $4,500 per unit.
- The incentives for Condensing Make-Up Air were as follows:
    - Improved efficiency $500 - $1,200 per unit
    - Efficiency + 2 speed $1,000 - $1,800 per unit
    - Efficiency + Variable Frequency Drives (VFDs) $1,400 - $2,600 per unit
- Destratification Fans were eligible for $1,300 per unit.
- Union offered an end-use customer incentive of $600 - $1,500 per unit for ERVs and $400 - $700 for HRVs.
- High Efficiency Non-Condensing Boilers were eligible for incentives of $250 - $3,500 per unit.
- For Infrared Heaters, Union offered end-use customers $300 per unit.

Market Delivery

- Promotion of Air Curtains included a direct sales approach primarily with National Account customers with retail, manufacturing, and warehouse facilities. Union developed relationships with these customers' key service providers to educate them about Union's programs and help them promote the programs to their customers.
- Condensing Boilers, ERVs/HRVs, and High Efficiency Non-Condensing Boilers were promoted through:
    - Direct and national account sales approach;
    - Local advertising campaigns to create awareness of Union's energy efficiency programs targeting retail mass market**;**
    - Key healthcare and education association advertisements, press releases, newsletters, publications as well as through direct mails and email blasts to their membership who are also Union's customers;
    - Tradeshows and events with speaking opportunities highlighting condensing boilers and customer testimonial success stories, such as the Association of Municipalities of Ontario (AMO) Local Authority Services (LAS) Energy Workshops targeting municipalities;
    - Building and maintaining relationships with key service providers and manufacturers to ensure education and awareness of Union's programs, as well as promotion of the programs to their customers; and
    - Developed marketing collateral to be used as a leave behind with customers after a sales call.



NEW!
Non-Condensing
High Efficiency
Boiler Incentive
Receive up to $3,500 **per unit.**

What amount will Union Gas put on **your cheque!**

$200 Instant
Submission Bonus*
Submit your incentive application for eligible space heating equipment within one week of installation and we'll add a **$200 bonus per unit.**

Condensing Boilers
up to **$4,500** per unit

NEW!
Non-Condensing High Efficiency Boilers
up to **$3,500** per unit

Energy Recovery Ventilators (ERV)¹
up to **$1,500** per unit

Heat Recovery Ventilators (HRV)¹
up to **$700** per unit

Infrared Heaters
$300 per unit

Air Curtains – Pedestrian and Shipping Doors
up to **$1,500** per unit

Condensing Hot Water Heaters
$350 per unit

Engineering Projects
up to **$250,000** per site

uniongas
A Spectra Energy Company

Union Gas 2013 EnerSmart Energy Efficiency Incentives

Figure 4.16, Mass Market Direct Mail

- The marketing of Condensing Make-Up Air units included a direct sales approach, tradeshows, educational workshop opportunities to create knowledge and awareness, as well as targeted marketing materials, such as customized sales letters.
- Marketing efforts for Destratification Fans included working with manufacturers and targeting potential customers, such as warehousing, manufacturing and retail segments. Relationships with service providers and manufacturers continued to be a key focus in 2013 to ensure Union's offering was being consistently promoted to their customers.
- Union's promotion of Infrared Heaters was through a direct sales approach and mass marketing initiatives such as direct mails, email blasts, and Union's website. Furthermore, Union promoted the technology though building/maintaining relationships with key service providers, distributors, contractors and manufacturers to ensure they are educated about Union's programs and to ensure they are promoting it to their customers.

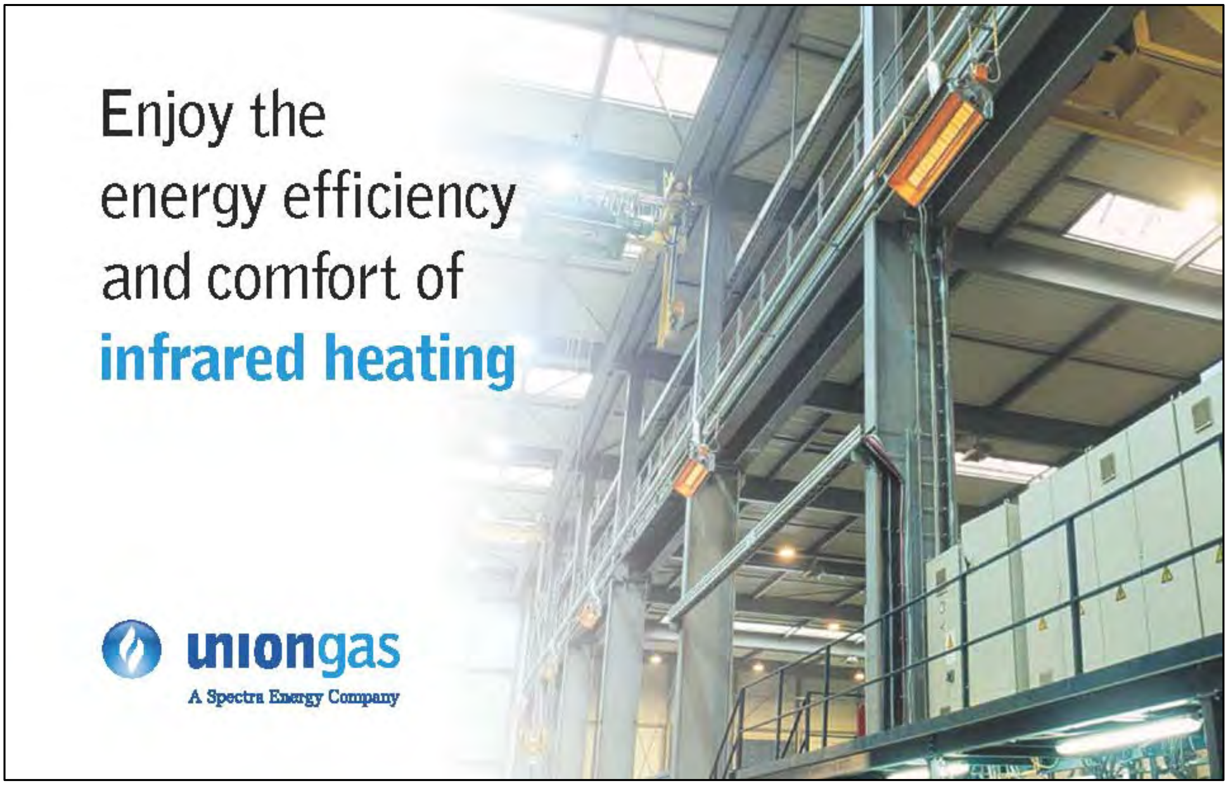


Figure 4.17, Infrared Heater Warehouse and Manufacturing Direct Mail

4.2.1.3 Commercial Kitchen Initiative

The Commercial Kitchen Initiative is designed to encourage food establishment owners and operators to install high efficiency technologies and Energy Star cooking equipment which are designed to reduce hot water consumption and/or natural gas use. In 2013, Union offered the following:

- Cooking Equipment - Energy Star fryers are 20-50% more efficient than traditional cooking equipment.
- Demand Control Kitchen Ventilation (DCKV) - Traditional ventilation systems operate at only one speed, whereas the speed of demand control kitchen ventilation systems automatically respond to changes in cooking volume and heat, resulting in much greater efficiency. The prescriptive savings for DCKV were based on three ranges of total range hood exhaust: 0 – 4,999 CFM, 5,000 – 9,999 CFM, and 10,000 – 15,000 CFM.
- Energy Star Dishwashers - Energy Star rated commercial dishwashers reduce energy and water consumption and improve performance. On average, they are 25% more energy efficient and 25% more water efficient than standard models. Models include under counter, stationary and conveyor.

Target Market

Cooking Equipment, DCKV, and Energy Star Dishwashers were targeted to the following commercial kitchen customer segments: foodservice, hotel/motel, education, and healthcare segments.

Market Incentive

- For Cooking Equipment (Energy Star fryers), Union offered $200 for each unit.
- The incentives for DCKV were based on unit sizes:
  - Up to 4,999 CFM – $1,200 per unit
  - 5,000 to 9,999 CFM – $3,000 per unit
  - 10,000 to 15,000 CFM – $4,000 per unit
- The Energy Star Dishwasher incentive was:
  - Under counter and stationary rack - $100 per unit
  - Rack conveyor - $400 per unit

Market Delivery

- Marketing efforts for cooking equipment included mass marketing to commercial kitchen customers through email blast, association newsletters and trade publications, as well as a direct marketing approach to the foodservice, hotel/motel, education and healthcare segments. Union also utilized a targeted National Accounts strategy to the foodservice segment to capitalize on program uptake from the key chains within Union's franchise. To further enhance these efforts, Union focused on continued relationship management with manufacturers to support awareness of Union's offerings and to ensure they were being promoted to their customers.
- Union works closely with manufacturers and end use customers to promote DCKV systems. Union marketed the benefits of DCKV through the following communication vehicles: industry trade magazine advertisements, mass marketing and personalized customer letters through direct mail, trade show participation, a National Accounts strategy and a multi-installation bonus with foodservice chains.
- A two pronged approach was utilized to promote Energy Star Dishwashers. Union partnered with dishwasher distributors to reach foodservice end users as well as a National Accounts strategy for key chains within Union's franchise.

Demand Control Kitchen Ventilation Systems

NOW SERVING…

Cash Incentives and Big Savings

Receive up to $4,000 in incentives per unit*

- Up to 4,999 cfm - $1,200 per unit
- 5,000 to 9,999 cfm - $3,000 per unit
- 10,000 to 15,000 cfm - $4,000 per unit

Save up to $10,000 in energy costs per hood, per year*

- Improves your kitchen environment
- Regulates exhaust and makeup airflow
- Reduces noise and need for shouting
- Improves indoor air quality
- Improves productivity
- Increases fire safety

Providing energy solutions to professional kitchens in southwestern, eastern and northern Ontario

uniongas
A Spectra Energy Company

enersmart BUSINESS

To get started, contact an Account Manager at uniongas.com/cams

Figure 4.18, DCKV Magazine Advertisement

2013 Prescriptive and Quasi-Prescriptive Offerings Highlights

- ***Bill Communications:*** A quarterly bill insert newsletter for business customers (Energylink) was introduced in 2013. This newsletter provided Union with a low cost communication channel to reach all business customers. Energylink included promotion of our DSM programs, our DSM website section “Save Money and Energy”, service provider partners and other online tools to help guide customers in managing their energy.
- ***Union’s Business Website:*** Union created and launched a new energy calculator for business customers on the website. The calculator allows business customers to complete an online survey and to identify natural gas saving opportunities in their business. The calculator was promoted in the quarterly bill inserts and on Union’s website, with the objective to leverage the tool to create awareness of the DSM prescriptive offerings.

4.2.2 Custom Offering

Union also focuses on advancing customer energy efficiency and productivity by providing a mix of custom incentives, education and awareness to commercial and industrial customers across all segments. The objective of the custom offering is to generate long-term and cost-effective energy savings for Union Gas customers.

Target Market

Custom offerings cover opportunities where energy savings are linked to unique building specifications or design concepts, processes or new technologies that are outside the scope of prescriptive and/or quasi-prescriptive measures. The offerings and incentives are targeted direct to the end-user, while trade allies involved in the design, engineering and consulting communities assist to expand the message of energy efficiency.

Market Incentive

Various incentives are available for custom participants specific to education and audit assessments, however the resource acquisition incentive value for projects is $0.10 per annual m^3 of natural gas saved.

Market Delivery

There are numerous approaches to delivering the custom offering, many of which involve customer education designed to increase awareness on energy efficiency opportunities and benefits. These include the following:

Customer Engagement - Communication and Education

Union Gas provided education, training and technical expertise and offered a wide variety of materials aimed at building an increased awareness of energy efficiency opportunities and benefits.

Engineering Feasibility and Process Improvement Studies

Union supported the completion of studies to identify and quantify potential energy savings measures. Furthermore, Union supported comprehensive process improvement studies to determine and assess financial costs and benefits of energy efficiency opportunities, supporting the customer’s internal decision making process.

Operation and Maintenance

Union Gas provided financial incentives to support the completion of operation and maintenance actions and practices which result in saving natural gas, and which may also increase energy efficiency and/or improve productivity of customers’ operations. These incentives were available for customers, with or without an engineering feasibility or process improvement study.

New Equipment and Processes

Union Gas provided financial incentives to support the installation of new equipment and processes which result in saving natural gas, and which may also increase energy efficiency and/or improve productivity of customer’s operations. These incentives were available for customers, with or without an engineering feasibility or process improvement study.

Energy Management

Union Gas provided financial incentives to support the installation of energy meters, monitoring and management systems, allowing customers to manage the energy intensity of their operations actively and continuously.

2013 Custom Offering Highlights

Union Gas continues to utilize a rigorous quality control process for all custom projects. Professional Engineers (P.Eng), licensed to practice in Ontario, assist customers with the quantification of energy savings prior to application submission. After application submission, all custom projects undergo a secondary professional engineering review to validate the reasonableness of the savings calculations, while ensuring appropriate supporting documentation is provided.

In the spirit of continuous improvement, all custom projects utilize the project application summary sheet (PAS), to summarize all key project inputs and specific details. The use of this summary sheet continues to strengthen Union's secondary professional engineering review, and assists in the annual verification of custom projects.

In 2013, Union Gas added one new standard calculator to the selection. The value of these standard calculators is to consistently estimate natural gas savings for common commercial custom projects. The standard calculators currently being used are as follows:

- Formula 1 laundry
- Destratification Fan
- Make-up air VFD retrofit
- Make-up air
- NEW in 2013 - High Extraction Washer (>300G)
- Hot water heating
- Roof insulation
- Boiler combustion control
- Window

4.2.3 Education and Awareness

Union offers a wide variety of materials and workshops aimed at building awareness for energy efficiency in the customer's facility. The focus is on educating the customer and their employees on how to identify energy conservation opportunities and supply them with the resources to research and evaluate possible solutions. Specific customer education and awareness efforts included:

Association of Municipalities of Ontario (AMO) Local Authority Services (LAS) Energy Workshop Sessions

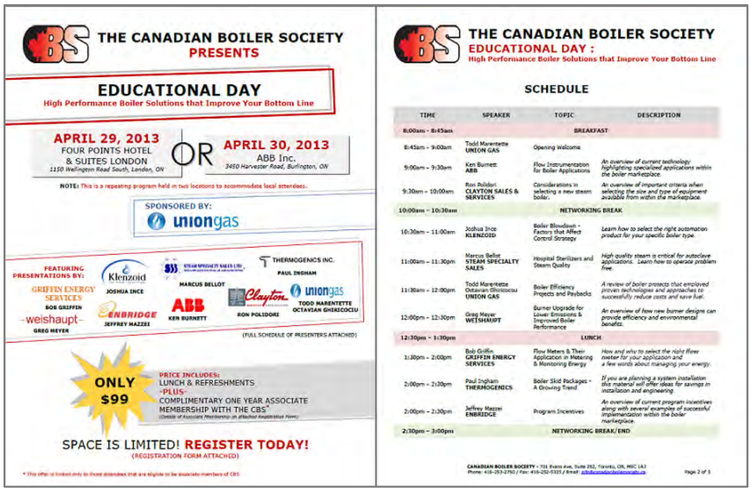
Union Gas and NRCan supported the AMO's LAS in their initiative to educate municipal staff, elected officials and others interested in municipal energy planning and opportunity identification. Union sponsored and participated in five workshops across the franchise area. There were approximately 20 participants at each workshop.

Hog and Poultry Producer Energy Strategy Workshop

Union Gas participated in an Energy Strategy Workshop for the hog and poultry industry facilitated by the Centre of Environmental Sustainability in Healthcare (CESH). There were 68 attendees. The session was designed to inform hog and poultry producers about energy efficient technologies in the market and available utility incentives. Union delivered a presentation on infrared heaters as the most applicable energy conservation measure for this agricultural segment.

Canadian Boiler Society (CBS) Educational Days: High Performance Boiler Solutions that Improve Your Bottom Line

Union Gas partnered with the Canadian Boiler Society to deliver educational forums in London, Burlington, and Toronto. The London and Burlington sessions had more than 80 attendees while the Toronto session had 22 attendees. Information shared with participants included common boiler solutions to increase energy efficiency and how to save natural gas, with a focus on boiler selection and sizing, operation and maintenance, burner upgrades for lower emissions and improved performance.



THE CANADIAN BOILER SOCIETY
PRESENTS

EDUCATIONAL DAY
High Performance Boiler Solutions that Improve Your Bottom Line

APRIL 29, 2013
FOUR POINTS HOTEL
& SUITES LONDON
1150 Wellington Road South, London, ON

OR

APRIL 30, 2013
ABB Inc.
3450 Harvester Road, Burlington, ON

NOTE: This is a repeating program held in two locations to accommodate local attendees.

SPONSORED BY: uniongas

FEATURING PRESENTATIONS BY:
GRIFFIN ENERGY SERVICES – BOB GRIFFIN
weishaupt – GREG MEYER
Klenzoid – JOSHUA INCE
ENBRIDGE – JEFFREY MAZZEI
MARCUS BELLOT
ABB – KEN BURNETT
THERMOGENICS INC. – PAUL INGHAM
Clayton – RON POLIDORI
uniongas – TODD MARENTETTE, OCTAVIAN GHIRICOCIU

(FULL SCHEDULE OF PRESENTERS ATTACHED)

ONLY $99

PRICE INCLUDES:
LUNCH & REFRESHMENTS
-PLUS-
COMPLIMENTARY ONE YEAR ASSOCIATE MEMBERSHIP WITH THE CBS*
(Details of Associate Membership on attached Registration Form)

SPACE IS LIMITED! REGISTER TODAY!
(REGISTRATION FORM ATTACHED)

* This offer is limited only to those attendees that are eligible to be associate members of CBS

THE CANADIAN BOILER SOCIETY
EDUCATIONAL DAY :
High Performance Boiler Solutions that Improve Your Bottom Line

SCHEDULE

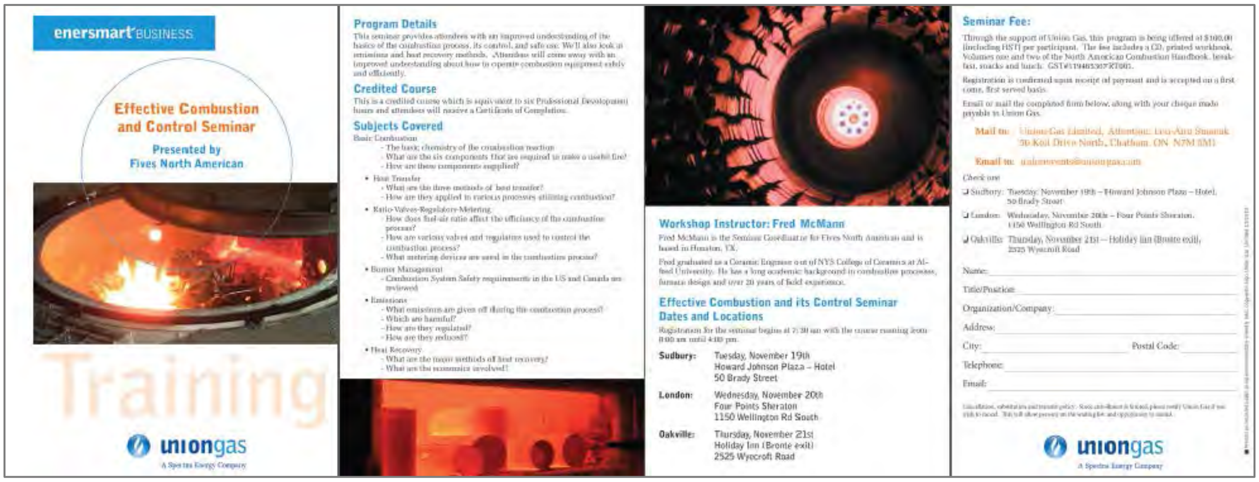
TIME	SPEAKER	TOPIC	DESCRIPTION
8:00am - 8:45am	BREAKFAST		
8:45am - 9:00am	Todd Marentette UNION GAS	Opening Welcome	
9:00am - 9:30am	Ken Burnett ABB	Flow Instrumentation for Boiler Applications	An overview of current technology highlighting specialized applications within the boiler marketplace.
9:30am - 10:00am	Ron Polidori CLAYTON SALES & SERVICES	Considerations in selecting a new steam boiler.	An overview of important criteria when selecting the size and type of equipment available from within the marketplace.
10:00am - 10:30am	NETWORKING BREAK		
10:30am - 11:00am	Joshua Ince KLENZOID	Boiler Blowdown - Factors that Affect Control Strategy	Learn how to select the right automation product for your specific boiler type.
11:00am - 11:30pm	Marcus Bellot STEAM SPECIALTY SALES	Hospital Sterilizers and Steam Quality	High quality steam is critical for autoclave applications. Learn how to operate problem free.
11:30am - 12:00pm	Todd Marentette Octavian Ghiricocu UNION GAS	Boiler Efficiency Projects and Paybacks	A review of boiler projects that employed proven technologies and approaches to successfully reduce costs and save fuel.
12:00pm - 12:30pm	Greg Meyer WEISHAUPT	Burner Upgrade for Lower Emissions & Improved Boiler Performance	An overview of how new burner designs can provide efficiency and environmental benefits.
12:30pm - 1:30pm	LUNCH		
1:30pm - 2:00pm	Bob Griffin GRIFFIN ENERGY SERVICES	Flow Meters & Their Application in Metering & Monitoring Energy	How and why to select the right flow meter for your application and a few words about managing your energy.
2:00pm - 2:30pm	Paul Ingham THERMOGENICS	Boiler Skid Packages - A Growing Trend	If you are planning a system installation this material will offer ideas for savings in installation and engineering.
2:00pm - 2:30pm	Jeffrey Mazzei ENBRIDGE	Program Incentives	An overview of current program incentives along with several examples of successful implementation within the boiler marketplace.
2:30pm - 3:00pm	NETWORKING BREAK/END		

CANADIAN BOILER SOCIETY - 701 Evans Ave, Suite 202, Toronto, ON, M9C 1A3
Phone: 416-253-2760 / Fax: 416-252-5335 / Email: info@canadianboilersociety.ca
Page 2 of 3

Figure 4.19, Educational Day Brochure

Effective Combustion and Control Seminar

In collaboration with Fives North America, a world-class leader in combustion engineering, Union Gas delivered seminars in Sudbury, London and Oakville. A total of 78 customers participated in these seminars. The objectives were to help combustion equipment users find ways to save energy, improve product quality, enhance safety, increase productivity and reduce pollution through a better understanding of combustion. Topics included; the combustion process, monitoring and control, safety requirements, associated emissions, and heat recovery.



enersmart BUSINESS

Effective Combustion and Control Seminar
Presented by Fives North American

Training

uniongas
A Spectra Energy Company

Program Details

Credited Course

Subjects Covered

Workshop Instructor: Fred McMann

Effective Combustion and its Control Seminar Dates and Locations

Sudbury: Tuesday, November 19th
Howard Johnson Plaza – Hotel
50 Brady Street

London: Wednesday, November 20th
Four Points Sheraton
1150 Wellington Rd South

Oakville: Thursday, November 21st
Holiday Inn (Bronte exit)
2525 Wyecroft Road

Seminar Fee:

Check one

☐ Sudbury: Tuesday, November 19th – Howard Johnson Plaza – Hotel, 50 Brady Street
☐ London: Wednesday, November 20th – Four Points Sheraton, 1150 Wellington Rd South
☐ Oakville: Thursday, November 21st – Holiday Inn (Bronte exit), 2525 Wyecroft Road

Name:
Title/Position:
Organization/Company:
Address:
City: Postal Code:
Telephone:
Email:

uniongas
A Spectra Energy Company

Figure 4.20, Effective Combustion and Control Brochure

Hospital and Education Steam System Walkthrough Blitz
Union Gas partnered with Swagelock Energy Advisors, a leading steam system equipment and solutions provider, to conduct steam system walk-thru blitzes of one hospital and two universities. The blitzes were intended to be short, intense activities providing a fresh perspective review of complex steam systems to identify short-term and long-term energy savings measures.

Process Integration Workshop for Industrial Customers
Union Gas conducted a three-day Process Integration Workshop in London in partnership with NRCan and the Canadian Industry Program for Energy Conservation (CIPEC). Attendees included 11 of Union Gas' customers. The workshop discussed how process integration can be used to identify projects that reduce energy consumption.

4.2.4 Lessons Learned

Prescriptive and Quasi-Prescriptive Offering

1. ***Energy Efficiency for small business owners***
   Small business customers are very difficult to reach and influence as they are often resource and capital constrained and lack understanding of the relevant energy efficient technologies. External partners, who include manufacturers, distributors, associations and contractors, have been identified as key influencers for small business owners to adopt energy efficient technologies. Union is currently exploring how to further enhance our relationships with external partners to better reach small business customers.

2. ***Increased focus on diversity***
   Prescriptive portfolio diversification is a necessary requirement for the continued success in delivering DSM to all business customers in all segments. Union will focus on adding new technologies to the current prescriptive offering in order to address a wider range of customers.

Custom Offering

3. ***Streamlined PAS sheet***
   All custom projects continue to utilize the PAS to consistently summarize all key project inputs, variables and detail. The use of the PAS continues to strengthen Union's secondary professional engineering review, and assists in the annual verification of custom projects.

4. ***New standard calculator***
   The new High Extraction Washer calculator was developed to complement Union's growing suite of standard calculators. These calculators allow for consistent calculation of natural gas savings across common commercial custom projects.

5. Low-Income Scorecard

Low-Income programs are similar in nature to resource acquisition programs, but are separated to recognize the specific needs of this customer group. They may result in lower TRC net savings than non-low-income programs although they provide various other benefits that are difficult to quantify[5]. These programs also more adequately address the challenges involved in identifying and providing DSM programs that meet the special needs of this consumer segment. Like resource acquisitions programs, low-income programs seek to achieve direct, measureable savings customer-by-customer and involve the installation of energy efficient equipment.

Table 5.0 presents the results of the low-income scorecard. Union achieved 150% of the overall scorecard target, resulting in an incentive of $2.729 million.

Table 5.0 – 2013 Low-Income Scorecard Results

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Cumulative Natural Gas Savings from Single Family (m^3)	19,500,000	26,000,000	32,500,000	60%	40,236,650	210%	126%
Cumulative Natural Gas Savings from Multi-Family (m^3)	13,200,000	17,600,000	22,000,000	40%	15,267,883	73%	29%
						Total Scorecard Target Achieved	***150%***[6]
						Scorecard Incentive Achieved	***$ 2,728,501***

The single family metric consists of cumulative m^3 saved from the Helping Homes Conserve (HHC) offering. The multi-family metric consists of cumulative m^3 saved from the Affordable Housing Conservation (AHC) offering.

5.1 Low-Income Program

The Low-Income program is designed to reduce the energy burden facing low-income single family and multi-family dwelling customers. In 2013, Union's Low-Income single family HHC offering consisted of building envelope measures. Details for this offering are located in section 5.1.1. Union's multi-family market AHC offering provides municipalities and social and assisted housing owners with enhanced incentives on all multi-family prescriptive and custom measures currently offered in the Commercial/Industrial Program. Details of this offering are located in section 5.1.2.

---

[5] These various benefits not captured by the traditional net TRC savings measure may include reduction in arrears management costs, increased home comfort, improved safety and health of residents, avoided homelessness and dislocation, and reductions in school dropouts from low-income families.

[6] Actual scorecard achievement result is 155%. Maximum achievement is capped at 150%.

Table 5.1 shows the results of the Low-Income program. The total spend for the Low-Income program is administered on a program level and is not available per offering. Table 5.2 breaks down the total spend into its components.

Table 5.1 – 2013 Low-Income Program Results

Program	Offering	Units	Annual Gas Savings (m^3)	Cumulative Gas Savings (m^3)	Total Spend	Net TRC	TRC Ratio
Low-Income	Affordable Housing Conservation	7,645	933,333	15,267,883	$8,042,873	-$2,305,267	0.77
	Helping Homes Conserve	4,658	1,618,601	40,236,650			
2013 Low-Income Total		**12,303**	**2,551,934**	**55,504,533**	**$8,042,873**	**-$2,305,267**	**0.77**

Table 5.2 – 2013 Low-Income Program Spend

Item	Total
Incentives	$6,200,913
Administration	$768,319
Evaluation	$219,938
Promotion	$853,703
2013 Total Low-Income Program Spend	**$8,042,873**

Table 5.3 shows the calculation of the Low-Income program's TRC ratio.

Table 5.3 – 2013 Low-Income Program Cost-Effectiveness

	TRC Benefits (a)	TRC Costs (b)	Net TRC (c)=(a-b)	TRC Ratio (d)=(a/b)
Measures	$7,764,747	$8,228,054	-$463,307	0.94
Administration		$768,319		
Evaluation		$219,938		
Promotion		$853,703		
Low-Income Program Total	**$7,764,747**	**$10,070,014**	**-$2,305,267**	**0.77**

5.1.1 Helping Homes Conserve Offering

The HHC offering provides low-income customers living in single-family homes with a free home energy audit and upgrades including: attic insulation, wall insulation, basement insulation and draft-proofing measures. Basic measures including showerheads, aerators, pipe insulation and programmable thermostats are provided to qualified customers at the time of the home energy audit if they have not previously received them.

Target Market

This offering targets customers who meet the following criteria:

- Income is at or below 135% LICO;
- Occupants of single detached and low-rise multi-family (3 stories or less);
- Private homeowner or tenant who pays their own gas bills or;
- Tenants residing in social and assisted housing, regardless of who pays the gas bills.

Income verification is required to participate in this offering.

In 2013, Union expanded the geographic reach of HHC to northern communities including North Bay, Sudbury, and Thunder Bay while continuing to focus on customers in communities across Southwestern Ontario such as Cambridge, Hamilton, Waterloo, and Windsor.

Market Incentive

Helping Homes Conserve is delivered at no cost to the customer. Customers participating can receive all recommended thermal envelope upgrades at no cost as determined through the free energy audit. On average, customers can expect to reduce gas consumption by 30% and benefit from a much more comfortable home.

Market Delivery

Union's main approach to delivering the HHC offering is to work with experienced and reliable delivery agents to perform energy audits and measure installation. Measures that are installed in the home are determined by a free home energy audit performed by a Certified Energy Auditor. All measures that screen at 0.7 TRC ratio or greater are installed in the home. After the measures are installed, a second home energy audit is conducted to verify the gas savings realized.

Figures 5.0, Helping Homes Conserve Brochure

Union was successful in delivering the HHC offering to 1,404 customers in the social housing market and 570 customers in the private market for a total of 1,974 customers. Approximately 50% of realized gas savings were derived from social housing and 50% from the private market.

Table 5.4 illustrates the distribution and gas savings of Helping Home Conserve customers both by region and housing market.

Table 5.4 – Helping Homes Conserve Distribution

Region	Homes Completed in Social Housing	Homes Completed in Private Market	Total m³ Social Housing	Total m³ Private	Total m³ Saved	% of Total m³
Bath	0	1	0	29,496	29,496	0.1%
Belleville	0	1	0	37,387	37,387	0.1%
Brantford	116	72	1,454,543	1,869,207	3,323,750	8.3%
Cambridge	0	6	0	148,488	148,488	0.4%
Chatham-Kent	0	55	0	2,026,200	2,026,200	5.0%
Delhi	22	0	376,516	0	376,516	0.9%
Guelph	0	4	0	66,047	66,047	0.2%
Hamilton	268	122	7,533,757	4,035,488	11,569,245	28.8%
London	348	53	3,538,752	2,165,101	5,703,853	14.2%
North Bay	57	15	1,032,063	571,877	1,603,940	4.0%
Perth County	22	2	237,049	27,038	264,087	0.7%
Region of Waterloo	224	0	2,687,376	0	2,687,376	6.7%
Sarnia	0	3	0	257,820	257,820	0.6%
Simcoe	0	2	0	73,028	73,028	0.2%
Sudbury	0	12	0	477,859	477,859	1.2%
Thunder Bay	68	35	886,083	1,322,893	2,208,976	5.5%
Windsor	279	187	2,917,773	6,464,809	9,382,582	23.3%
Total	**1,404**	**570**	**20,663,912**	**19,572,738**	**40,236,650**	**100.0%**

Social and Assisted Housing Strategies

Union continued to have success in targeting and addressing single and multi-family homes managed by social and assisted housing providers requiring building envelope upgrades by leveraging existing strong relationships with 27 municipal social and assisted housing providers in Union’s franchise area. A direct sales approach targeting key influencers and decision makers within each of these municipal housing providers was utilized to determine program participation potential. This approach significantly contributed to addressing the needs of over 1,400 homes in 2013.

Private Market Strategies

Union continues to leverage a turn-key private market approach to augment the existing lead generation process in the social and assisted housing market. Customer intelligence, LICO level and characteristics including age of home, size of home, and natural gas consumption were utilized to assess a customer's potential to qualify for low-income programs, and then develop targeted direct mailing lists.

Online Self-Serve Web Strategy

Union's Helping Homes Conserve website www.uniongas.com/helpinghomes supports the marketing efforts and allows private homeowners, renters and social housing providers to register for the program and begin the screening process. The website outlines the details of the offering, the benefits of participating, eligibility criteria and how to register. In 2013, Union enhanced the web content by including improved layout/navigation and the addition of a "frequently asked questions" (FAQ) section.

Helping Homes Conserve

Real savings. Real comfort. Really free.

Our program provides FREE, professionally installed products that could lower your gas bill by up to 30% and make your home more comfortable all year around.

What does the program offer?

How does the program work?

Why should I participate?

Frequently asked questions

Who is eligible?

Call to apply

Belinda meeting the energy auditor for the first time

Figure 5.1, Snapshot of HHC Website

Partnership Strategies

Union works with several organizations in its franchise area to deliver the HHC program to low-income customers.

Neighbourhood Home Improvement Program (NHIP)

The NHIP is a new program the Ministry of Training, the City of Hamilton, Threshold School of Building, and the Hamilton Community Foundation. The objective of the program is to provide free exterior home renovations for low-income families in Hamilton. To qualify, participating home owners must have total household income at or below the LICO. Customers meeting the income requirements for the NHIP also received the HHC application package. These pre-qualified customers were invited to apply directly to Ecofitt for the HHC offering without providing income documentation.

Winter Warmth Emergency Assistance Program

In 2013, Union launched a referral partnership with the social service agencies that offer the *Winter Warmth* emergency assistance program. Winter Warmth is coordinated and delivered to customers by the United Way through a network of community agencies within Union Gas' franchise area. The Winter

Warmth program provides low-income customers with one-time financial assistance if they are unable to pay their gas bill. To qualify, individuals must have a Union Gas bill in arrears, have recently received a disconnection notice, and/or are experiencing personal circumstances that make it difficult to pay a current natural gas bill. Union identified the opportunity for all Winter Warmth participants to be referred to the HHC offering. To establish a seamless lead referral process, Union developed a strong relationship with the Director of Community Impact at the United Way. This is a key relationship for Union, as this Director oversees all Winter Warmth administering agencies and with their buy-in and support, Union was able to bring all administering agencies on board at the same time, maximizing the opportunity for private lead referrals.

Make paying your natural gas bill easier!

Benefits to eligible Winter Warmth Program participants:

- ✓ **Emergency Assistance**
  - One time assistance grant for customers facing bill payment arrears
- ✓ **Equal Billing**
  - Easier budgeting
  - Stable and equal monthly bills throughout the year
- ✓ **Waived Security Deposit**
- ✓ **Waived Late Payment Fee**
  - When enrolled in a payment arrangement
- ✓ **21 days** to secure assistance before additional collection action is taken for non-payment

Contact your local Social Service Agency for enrolment today!

Helping Homes Conserve
Real savings. Real comfort. Really free.

All work will be performed by our authorized contractors, envirocentre & ecofitt

Home Comfortable Home!

How to participate:

- Inform agency staff of your interest in this program during your Winter Warmth enrolment
- **For more information visit** uniongas.com/helpinghomes

uniongas
A Spectra Energy Company

uniongas
A Spectra Energy Company

FREE
Home Energy Improvements
to Save You Money

Meeting with the energy auditor for the first time

Helping Homes Conserve
Real savings. Real comfort. Really free.

Figure 5.2, HHC Winter Warmth Referral Brochure

Health and Safety Initiative

Through the home audit process, it has been found that almost 8% of qualifying homes were ultimately deemed ineligible due to health and safety issues within the building envelope, such as inadequate ventilation, combustion safety, mould, moisture, asbestos, vermiculite, excessive clutter, and lead paint. These are often the result of poor structural design, age of the home, as well as the inability for the homeowner to address maintenance concerns due to lack of time, knowledge, and money. Union developed the Health and Safety Policy in 2012 to address these problems and to avoid disqualifying homes based on treatable environmental hazards such as excess clutter. Under this policy, if a treatable environmental hazard is identified during the audit, a service provider will address the concern prior to the commencement of any installation work.

5.1.2 Affordable Housing Conservation Offering

The Affordable Housing Conservation (AHC) offering targets the multi-family social and assisted housing market with custom and prescriptive measures. In recognition of the limited capital available for upgrades in social housing, Union offers enhanced incentives for these providers to implement any energy efficient measures available to commercial multi-family customers. These improved incentives aim to help this market segment achieve greater long term energy and cost savings in their properties.

Target Market

This offering targets social and assisted housing providers that manage multi-family housing stock. Social and assisted housing is defined as housing developed, acquired or operated under a federal, provincial or municipally funded program.

Examples of social and assisted housing are:

- Non-profit corporations as outlined in the *Social Housing Reform Act, 2000*;
- Public housing corporations owned by municipalities directly or through Local Housing Corporations;
- Non-profit housing co-operatives as defined in the *Co-operative Corporations Act, 1990*;
- Non-profit housing corporations that manage/own rural and native residential housing; and
- Non-profit housing corporations that manage/own residential buildings developed under the Affordable Housing Program.

Union has established strong relationships with 27 municipal social housing providers in its franchise area. Union's Account Managers assist them to proactively plan their energy efficiency upgrades. The majority of these 27 municipal housing providers have participated in the AHC offering over the past two years. In 2013, Union sharpened its focus on the 400+ smaller housing providers, including non-profit housing providers, low-income co-operative housing providers as well as faith and ethnic based providers. This targeted approach enabled broader access to low-income customers.

Market Incentive

Prescriptive Measures

The AHC offering includes all of the prescriptive measures offered to the multi-family segment within the standard Commercial portfolio. However, the incentive levels offered to the low-income sub-segment of the market are higher in recognition of the capital barriers that face this group. Participating social and assisted housing providers were responsible for sourcing service providers for installation of these measures and they received the appropriate incentives from Union upon project completion as outlined in Table 5.5 below. Service providers include architectural consultants, builders, HVACs, engineering consultants and energy service companies.

Table 5.5 – Affordable Housing Conservation Offering

Measure	End-user Incentive	Service Provider Incentive
Condensing Boiler – up to 299 MBtu/h	$0.10 per cumulative m^3	$ 100
Condensing Boiler – 300 to 999 MBtu/h	$0.10 per cumulative m^3	$ 100
Condensing Boiler – over 1,000 MBtu/h	$0.10 per cumulative m^3	$ 100
Non-Condensing Boiler – up to 299 MBtu/h	$0.10 per cumulative m^3	$ 100
Non-Condensing Boiler – 300 to 999 MBtu/h	$0.10 per cumulative m^3	$ 100
Non-Condensing Boiler – over 1,000 MBtu/h	$0.10 per cumulative m^3	$ 100
Condensing Gas Water Heater (1000 gal/day) purchase	$1,900 flat incentive	$ 100
Condensing Gas Water Heater (500 gal/day) purchase	$1,000 flat incentive	$ 100
Condensing Gas Water Heater (100 gal/day) purchase	$500 flat incentive	$ 100
ERV (New Build) Multi-family 0-2,000 CFM	$0.10 per cumulative m^3	$ 100
HRV (New Build) Multi-family	$0.10 per cumulative m^3	$ 100
MUA Unit (Existing Build) Improved Efficiency 1,000-4,999 CFM	$0.10 per cumulative m^3	$ 100

Custom Initiative

Custom measures were also made available to social and assisted housing providers where there was an opportunity for significant energy savings. Participating social and assisted housing providers were responsible for driving the installation process for these measures and they received the incentives for participation as outlined below:

- $0.10 per cumulative m^{3}of gas saved
- Incentive cap: 50% of the eligible costs of the project

Building Assessments

Building assessments identify prescriptive and custom upgrade opportunities in social and assisted housing multi-family buildings. Union offered social and assisted housing providers a free comprehensive building assessment service for their multi-family buildings. These assessments resulted in a report that identified prescriptive and custom measure upgrade recommendations. Parameters for the site assessment offering were:

- Multi-family site assessments funded up to a maximum of $5,000 per site and up to a maximum of $25,000 per entity per year; and

Account Managers follow existing commercial market protocols for assessing energy auditor reports and site assessment subsidization.

Free Showerhead Installation Initiative
This initiative contains energy efficient showerheads and aerators. Union provides free installation of showerheads to eligible multi-unit social and assisted housing properties.

Market Delivery

The AHC Offering was delivered by the Account Managers. Account Managers focused their sales efforts on housing managers and decision-makers within 27 municipal social housing providers in the Union Gas franchise area. While the prospect of significant subsidization of capital expenditures through Union's offerings may seem like an easy decision, there are many barriers to adoption. Social housing managers are extremely busy, under-resourced and face tight budget constraints. To maximize program adoption Union took two main approaches for outreach: direct sales and association marketing.

Figure 5.3, AHC Sell Sheet

Direct Sales

- Account Managers met directly with key social and assisted housing managers amongst 27 municipal housing providers in Union's franchise to present Union's suite of offerings and to elicit participation. An AHC sales package was developed to assist the Account Managers in their direct sales initiatives that clearly and concisely conveyed the offerings available to all multi-family and single-family stock managed by the social and assisted housing provider.
- Qualified prescriptive and custom measures were identified by the housing provider and a building assessment was considered if there was potential to discover projects.
- Social and assisted housing managers were responsible for sourcing contractors to implement prescriptive and custom measures which were followed by the applicable incentive payment from Union.

Association Marketing
Union has developed and fostered relationships with relevant associations and organizations while educating them on our suite of offerings in the social and assisted housing sector.

Partnership with the Ontario Non-Profit Housing Association (ONPHA)
Union partnered with the Ontario Non-Profit Housing Association (ONPHA) by sponsoring regional meetings in Hamilton, London and Windsor to further promote energy conservation, in addition to placing advertisements in their bi-monthly newsletter, *Quick Connections*. Moreover, Union sponsored

and exhibited at the 2013 ONHPA tradeshow, which provided the opportunity to promote the AHC offering. Union found that this partnership was an effective means of educating social and assisted housing providers on the cost benefits of Union's AHC offering for multi-unit properties in order to drive participation.

Figure 5.4, Affordable Housing Conservation Tradeshow Poster

Partnership with Housing Services Corporation (HSC)

HSC is a non-profit organization that delivers province wide programs that benefit Ontario's affordable housing sector. HSC has been a long standing key partner for Union in promoting the low-income DSM program. In 2013, Union was a key sponsor for *Measuring Matters Conference*, which focused on providing practical energy efficiency solutions for social housing providers. Real-life case studies were used to illustrate how to reduce natural gas consumption by understanding and integrating energy benchmarking data, overcoming technical and organizational challenges, and maximizing human and financial resources. The main speaker highlighted the AHC offering and discussed how their organization had participated and benefitted from significant natural gas savings in several multi-family buildings. The conference provided Union with the opportunity to connect with housing providers.

5.1.3 Market Research

Low-Income DSM Offerings to Market-Rate Multi-Family Buildings

This secondary research project was agreed to in the 2012-2014 Settlement Agreement. The objective of this study was to evaluate the viability of offering low-income programming to market-rate multi-family housing providers, in addition to the existing programming targeting social housing. The study was completed in the spring of 2013, and Union is currently discussing next steps with the Low-Income Consultative Group.

Social Housing Provider Research

In 2012, Union started the preliminary stages of a research project that would target decision makers and influencers of social and assisted housing providers. The primary goal of the research was to deepen the understanding of social and assisted housing providers to increase participation and improve the effectiveness and delivery of Union's AHC offering. A key study finding was that non-profit and co-operative housing providers are smaller and more spread out than municipal housing providers, but comprise over 89% of all social housing in Ontario. The vast majority of the non-profit and co-operative housing providers struggle financially and could greatly benefit from Union's DSM incentives to support the energy efficiency improvements. The study findings will be used to plan future program offerings for the non-profit and co-operative housing segment.

Service Manager Office Research

In 2013, Union continued research on Ontario's social housing landscape with a focus on the role of Service Manager Offices. Service Manager Offices manage the distribution of subsidies and technical services to all social housing providers in a given municipality, including both municipal and independent social housing providers, such as those supporting co-operative and non-profit housing. Within the offices, technical staff oversee the building condition assessments of the housing portfolios, so they have an understanding of the building condition as well as the financial viability. Union is leveraging existing Service Manager Office relationships to gain insights into the social housing market structure, funding models, building condition assessments and decision making processes associated with the different types of housing.

5.1.4 Education and Awareness

Education has been, and will continue to be, an important part of the Low-Income Program. Union recognizes that there is a need not only to provide conservation programs directed to low-income customers, but also to educate customers on the direct benefits of energy-efficient behaviour. To date, Union has focused education efforts on private market customers through targeted education brochures and education workshops hosted at the community level.

Education Workshops

Union Gas continued to strategically offer education workshops as part of the Low-Income program. In Q1 of 2013, Union held a workshop for independent non-profit and co-operative housing provider staff in London, Ontario. The workshop focused on educating participants on how to reduce energy costs and increase their comfort through the application of basic weatherization materials in the home. Each participant received a free weatherization kit that included a variety of basic weatherization materials to be used around the home. Participants were also provided with an assortment of education literature including an energy saving guide and information on Union's Low-Income offerings including eligibility criteria and application instructions.

Education Video

In the spirit of education and awareness, Union continued to leverage a short educational video on weatherization through the low-income program website to promote low-cost and no-cost energy saving tips and tricks for around the home. The video can be found on the Union Gas website: http://www.uniongas.com/residential/energy-conservation/manage-bill/air-sealing.

5.1.5 Lessons Learned

Helping Homes Conserve

1. ***Private single family market***
   Through the success of the HHC program over the past three years, Union has addressed over 2,500 homes managed by municipal housing providers. Union addressed the social housing properties most in need of building envelope upgrades in each municipal provider's portfolio, and then worked through other homes within the portfolio that meet offering requirements. In view of this success, the building envelope improvement opportunities within properties managed by municipal housing providers have largely been addressed, resulting in Union now placing a greater emphasis on the private single family market segment.

2. ***Health and Safety policy***
   Throughout 2012, EnviroCentre and Ecofitt monitored potential Health and Safety concerns that emerged within social housing homes. The most common issue experienced was customers not having the ability to prepare their basement walls for retrofit work by clearing 4 ft of space around the perimeter for installers to work. Union created two risk categories under the Health and Safety policy. Low risk concerns, such as clutter and ventilation issues, are addressed by the Service Provider or subcontracted if needed, with a typical spend not exceeding $500. Medium/High risk concerns, such as mould and moisture, asbestos or lead paint, require more costly remediation work and are dealt with on a case by case basis, dependent on maintaining an overall portfolio TRC of at least 0.7.

Affordable Housing Conservation

3. ***Service Manager Offices***
   Service Manager Offices manage the distribution of subsidies to all social housing providers within a given municipality, and are an important part of Ontario's social housing landscape. Union needs to further develop Service Manager relationships across the franchise area in order to reach more social housing providers, especially the smaller non-profit and co-operative housing providers that have yet to participate in the AHC offering. The vast majority of these non-profit and co-operative housing providers struggle financially and could greatly benefit from Union's incentive program when dealing with capital replacements or improvements. It will be crucial for the future success of low-income programs to establish relationships with these housing providers.

6. Large Volume Scorecard (Rate T1, T2/R100)

The Large Volume scorecard consists of cumulative m^3 saved from customers within Rate T1, Rate T2/R100. Table 6.0 presents the results of the Large Volume scorecard. Union achieved 129% of the overall scorecard target, resulting in an incentive of $1.362 million.

Table 6.0 – 2013 Large Volume Rate T1, Rate T2/R100 Scorecard Results

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Rate T1 Cumulative Natural Gas Savings (m^3)	150,477,098	200,636,131	250,795,164	60%	180,388,329	80%	48%
Rate T2 / Rate100 Cumulative Natural Gas Savings (m^3)	821,502,546	1,095,336,728	1,369,170,910	40%	1,664,166,592	204%	82%
				Total Scorecard Target Achieved			***129%***
				Scorecard Incentive Achieved			***$ 1,362,407***

6.1 Large Volume Program

Consistent with 2012, Union continued to encourage the adoption of energy-efficient equipment, technologies, and actions through direct customer interaction. As noted in section 2.1, Union's Large Industrial DSM programming filed in the 2012-2014 DSM Plan Settlement Agreement applied for 2012 only, and was replaced by the Large Volume DSM Program for 2013-2014.

The new program includes a shift in the customer incentive budget process for Rate T2/R100 customers to a new Direct Access budget mechanism. In lieu of an aggregate pool approach, at the beginning of the year these customers each have direct access to the full customer incentive budget they pay in rates. Customers must use these funds to identify and implement energy efficiency projects, or lose the funds which will consequently become available for use by other customers in the same rate class. This "use it or lose it" approach ensures each customer has first access to the amount of incentive budget funded by their rates. The Direct Access budget mechanism was introduced in direct response to feedback received from Union's largest customers. The incentive approach for Rate T1 customers remained unchanged.

Union's Large Volume program is aligned under one brand platform, EnerSmart. This ensures a seamless, recognizable brand throughout Union's franchise.

For Large Volume customers, the EnerSmart program was designed with a particular focus on achieving savings in a process-specific energy application. Account Managers market the program directly to customers and indirectly through trade allies, channel partners, Energy Service Companies (ESCO's), engineering firms, and equipment manufacturers. Account Managers work to cost-effectively promote energy efficiency within Union's Large Volume Rate T1, Rate T2/R100 customer base.

Large Volume custom projects are jointly delivered through Union's Account Managers and Technical Project Managers. Success is achieved by combining strong engineering expertise with the relationships established through the direct account-management approach. This approach is critical to influencing the market and achieving successful implementation of the program.

Table 6.1 shows the results of the Large Volume program and Table 6.2 breaks down the total spend into its components.

Table 6.1 – 2013 Large Volume Program Results

Program	Offering	Units	Annual Gas Savings (m^3)	Cumulative Gas Savings (m^3)	Total Spend	Net TRC	TRC Ratio
Large Volume	Rate T1	333	10,488,841	180,388,329			
	Rate T2	90	91,908,922	1,356,721,466	$4,738,953	$252,262,463	8.74
	Rate 100	61	20,020,746	307,445,127			
2013 Large Volume Total		**484**	**122,418,509**	**1,844,554,921**	**$4,738,953**	**$252,262,463**	**8.74**

Table 6.2 – 2013 Large Volume Program Spend

Item	Total
Incentives	$3,917,213
Administration	$750,796
Evaluation	$32,045
Promotion	$38,899
2013 Total Large Volume Rate T1, Rate T2 and Rate 100 Program Spend	**$4,738,953**

Table 6.3 shows the calculation of the Large Volume program's TRC ratio. With a TRC ratio of 8.74, the Large Volume program's net TRC benefits are nearly nine times greater than its net TRC costs. This TRC ratio is the largest of all of Union's 2013 DSM programs.

Table 6.3 – 2013 Large Volume Program Cost-Effectiveness

	TRC Benefits (a)	TRC Costs (b)	Net TRC (c)=(a-b)	TRC Ratio (d)=(a/b)
Measures	$284,858,279	$31,774,075	$253,084,203	8.97
Administration		$750,796		
Evaluation		$32,045		
Promotion		$38,899		
Large Volume Rate T1, Rate T2 and Rate 100 Program Total	**$284,858,279**	**$32,595,815**	**$252,262,463**	**8.74**

6.1.1 Program Offerings

Given the low level of new build activity in this sector, the Large Volume market is not differentiated into new build and existing buildings. The Large Volume market is highly heterogeneous, with most projects tied directly to unique processes or technology requirements.

The Large Volume custom program goal is to generate long-term and cost-effective energy savings for Union Gas customers. While there was a shift in incentive structure for this sector, the program offerings are consistent with 2012 and are outlined below.

Customer Engagement - Communication and Education

Union Gas provided education, training and technical expertise and offered a wide variety of materials aimed at building an increased awareness of energy efficiency opportunities and benefits.

New Equipment and Processes

Union's role in promoting and implementing energy efficient options continued to help companies control energy costs and remain competitive in today's global economy. The instability of the current economic climate is a threat to the industrial customer base in Union's franchise. With the continual focus on cost reduction, many industries lack the resources to analyze potential energy saving opportunities. Union helps fill this gap with its reliable, knowledgeable and reputable Technical Project Managers in conjunction with incentives designed to influence equipment choices.

Operations and Maintenance

Union assisted customers maintain equipment standards at optimal performance levels by providing financial incentives for implementing operations and maintenance practices that save natural gas through repairs, replacements or retrofits of existing equipment.

Process Improvement Studies

Union provided customer incentives for conducting detailed engineering analysis and designing specific process equipment or operational improvements identified with or without a general plant audit. The program works to support performance testing and analyses of industrial boilers, total steam plants, thermal fluid heaters, vaporizers, furnaces and special process equipment. Testing identifies and quantifies energy saving opportunities, cost saving opportunities, implementation costs and payback periods as well as NO_x and CO_2 impacts.

Engineering Feasibility Studies

Engineering Feasibility Studies that included an analysis of natural gas equipment as well as electricity, compressed air, water and wastewater were provided. These feasibility studies helped customers formulate a priority list of energy efficiency projects geared to site-specific energy plans and budgets. Union also assisted the customer's technical staff in generating business cases to enable the customer to secure corporate capital funding for energy efficient equipment and/or process changes.

Steam Trap Surveys

Steam trap surveys conducted by qualified service companies are designed to reduce losses from steam distribution systems. Each survey identifies leaking, over-sized or under-sized, blocked and/or flooded traps, as well as the need for improvements in condensate return systems.

Boiler Tune-ups

Union provided an incentive to large volume industrial customers for the optimization of their facilities boiler's air-to-fuel ratio, ensuring efficient combustion and natural gas savings.

Infrared Anti-Condensate Polyethylene Plastic

For the large greenhouse customers, Union provided an incentive for the installation of IRAC polyethylene plastic to assist greenhouses in saving natural gas.

Similar to the commercial/industrial custom offering, Union continued a rigorous quality control process for all Large Volume custom projects. Professional Engineers (P.Eng), licensed to practice in Ontario, assist customers with the quantification of energy savings prior to application submission. All custom projects are then subjected to a secondary professional engineering review to validate the reasonability of the claimed savings, while ensuring appropriate supporting documentation is contained in the project files.

In the spirit of continuous improvement, all custom projects utilize the PAS to summarize all key project inputs and details. The use of this summary sheet continues to strengthen Union's secondary professional engineering review, as well as support annual verification of large volume custom projects.

6.1.2 2013 Large Volume Program Incentives

Table 6.4 and Table 6.5 show the incentive guidelines for the 2013 Large Volume offerings respectively.

Table 6.4– 2013 Incentive Guidelines for Rate T1

Offer	Incentive
Engineering Feasibility Study	50% of the cost, up to $10,000
Process Improvement Study	66% of the cost, up to $20,000
Steam Trap Survey	50% of the cost, up to $6,000
New Equipment	$0.08 per cumulative m³, up to $40,000
Operations & Maintenance	$0.08 per cumulative m³, up to $20,000
Boiler Tune-Up	$250 per boiler
Meters – Gas/Steam/Hot-water	50% of the cost, up to $1,000
Infrared Polyethylene – IR Poly	$400 per growing acre
Demonstration of New Technologies	25% of the cost, up to $75,000

Table 6.5 – 2013 Incentive Guidelines for Rate T2/R100

Offer	Incentive
Engineering Feasibility Study	50% of the cost, up to $10,000
Process Improvement Study	66% of the cost, up to $20,000
Steam Trap Survey	50% of the cost, up to $6,000
Direct Access Budget (DAB) New Equipment	$0.08 per cumulative m^3, up to $40,000
Aggregate Pool Funded (LVAP) New Equipment	$0.05 per cumulative m^3, up to $20,000
Direct Access Budget (DAB) Operations & Maintenance	$0.08 per cumulative m^3, up to $20,000
Aggregate Pool Funded (LVAP) Operations & Maintenance	$0.05 per cumulative m^3, up to $10,000
Meters – Gas/Steam/Hot-water	50% of the cost, up to $1,000
Demonstration of New Technologies	25% of the cost, up to $75,000

6.1.3 Education and Awareness

Customers have repeatedly told Union they find significant value in the training and educational material provided.

Union continues to expand and broaden distribution of the following educational and promotional tools, which contain information specifically geared towards Rate T1, Rate T2/R100 customers:

- GasWorks newsletter;
- EnerSmart brochures;
- EnerCase reports;
- Workshops to promote the efficient use of natural gas and increase the awareness of energy savings opportunities;
- Sponsorship of specific educational forums;
- Promotion and attendance at independent professional development groups, trade organizations, and government workshops; and,
- Developed an online calculator for greenhouse customers that lets them compare the cost of burning natural gas and extracting CO_2 to the cost of burning natural gas and buying liquid CO_2.

GasWorks is a technology and energy conservation newsletter, designed to assist large users of natural gas to better manage their business. *GasWorks* provides industry trend, technology and energy efficiency information to help businesses improve process productivity, enhance reliability of equipment and control energy expenses. The newsletter provides links to Union's website and energy efficiency programming as well as various tools, calculators, an online resource library, and an "Ask an Expert" service to provide technical advice.

Below is a summary of the top five most accessed articles of 2013:

- Calculating the Cost of Steam
- Air-Fuel Ratios for Maximum Burner Efficiency
- Changes to the Ontario Building Code: Building Envelope Requirements
- Steam Accumulators Meet Peak Demand and Save Energy
- High Efficiency Gas Rooftop Units Pack a Punch

Union's webpage, dedicated to the EnerSmart program, contains an application form, technology information, conversion calculations, technical presentations from customer meetings, and a series of links for additional references; and an expanding library of ***EnerSmart*** and ***EnerCase*** brochures. These brochures include customer challenges and solutions Union provided.

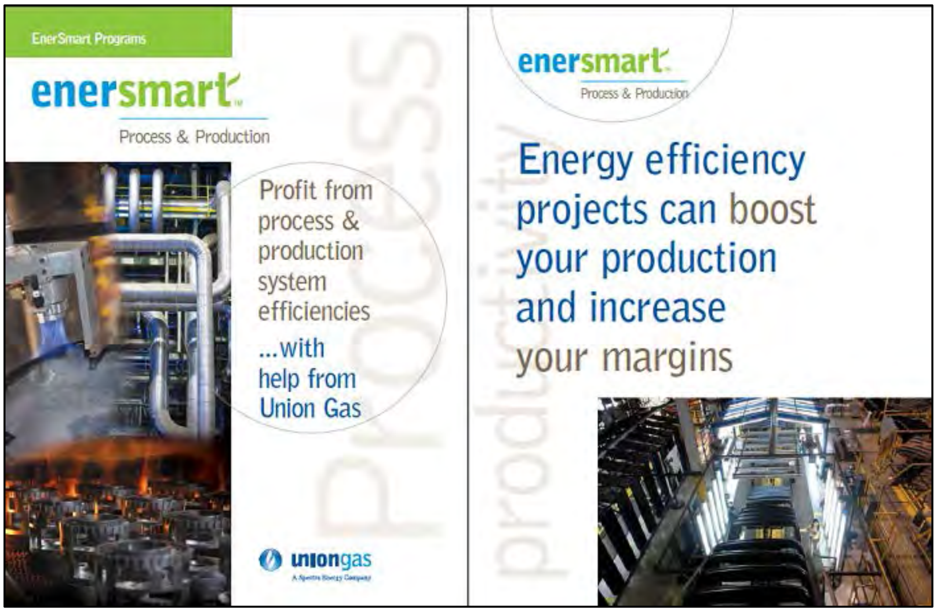


Figure 6.0, EnerSmart Process and Production Brochure

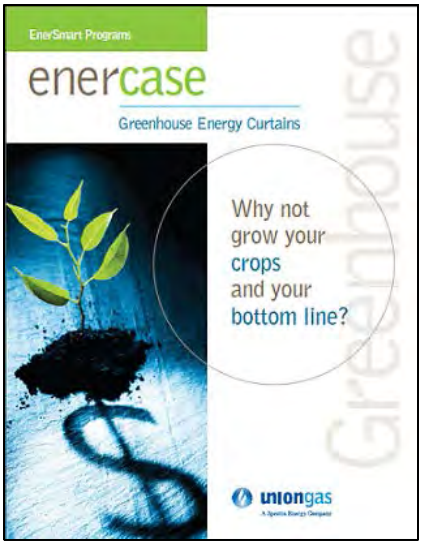
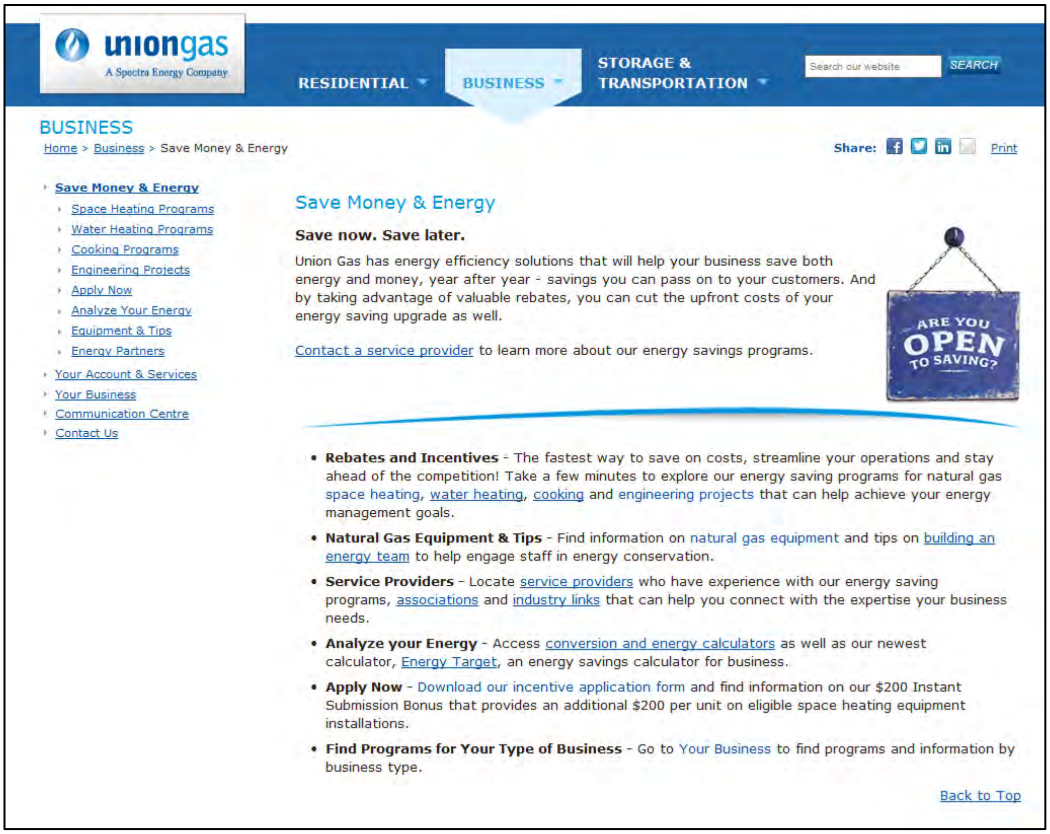


Figure 6.1, EnerCase Greenhouse Energy Curtains Brochure



Save Money & Energy

Save now. Save later.

Union Gas has energy efficiency solutions that will help your business save both energy and money, year after year - savings you can pass on to your customers. And by taking advantage of valuable rebates, you can cut the upfront costs of your energy saving upgrade as well.

Contact a service provider to learn more about our energy savings programs.

- **Rebates and Incentives** - The fastest way to save on costs, streamline your operations and stay ahead of the competition! Take a few minutes to explore our energy saving programs for natural gas space heating, water heating, cooking and engineering projects that can help achieve your energy management goals.
- **Natural Gas Equipment & Tips** - Find information on natural gas equipment and tips on building an energy team to help engage staff in energy conservation.
- **Service Providers** - Locate service providers who have experience with our energy saving programs, associations and industry links that can help you connect with the expertise your business needs.
- **Analyze your Energy** - Access conversion and energy calculators as well as our newest calculator, Energy Target, an energy savings calculator for business.
- **Apply Now** - Download our incentive application form and find information on our $200 Instant Submission Bonus that provides an additional $200 per unit on eligible space heating equipment installations.
- **Find Programs for Your Type of Business** - Go to Your Business to find programs and information by business type.

Figure 6.2, Website screenshot: http://www.uniongas.com/business/save-money-and-energy

Union hosted seminars throughout 2013 to promote energy conservation to Rate T1, Rate T2/R100 customers.

Table 6.6 provides a summary of seminars and number of participating large volume customers.

Table 6.6 – Union Hosted Large Volume Industrial Seminars

Name of Seminar	# of Large Volume Customers
Effective Combustion and Control Seminar	23
Large Volume Industrial Customer & Energy Marketer Seminar	20

In addition to hosting seminars, Union also showcased its program offerings and industry knowledge by attending industry tradeshows. Table 6.7 lists the tradeshows specific to Large Volume customers that Union attended in 2013.

Table 6.7 – Industry Tradeshow Participation

Industry Tradeshow Attendance	Date
Canadian Boiler Society Education & Training Forum	June 2013
Canadian Healthcare Engineering Society Conference	September 2013
Greenhouse Growers Luncheon	September 2013
Canadian Manufacturers and Exporters Conference	November 2013
Ontario Hot Mix Producers Association Conference	December 2013

Education does not stop with customer training and seminars. Union prides itself on providing highly valued energy expertise, technical support, and resources for Large Volume Rate T1, Rate T2/R100 customers. As a leader in energy efficiency committed to working closely with government, efficiency, environmental and professional organizations, Union fully understands the latest trends and technologies. This is not limited to potential solutions for individual customers, but also includes the co-benefit of shared learning. Some examples of industry partnerships include:

Consortium for Energy Efficiency (CEE)
Through this partnership, Union networked with efficiency program administrators from across the United States and Canada with a focus on developing common approaches to advancing energy efficiency.

Energy Solutions Centre (ESC)
Through the ESC, Union collaborated with energy utilities, municipal energy authorities, equipment manufacturers, and vendors to accelerate the acceptance and deployment of new energy-efficient, gas-fuelled technologies.

Natural Resources Canada (NRCan)
Union's involvement with NRCan includes participation in research activities, funding of industry-specific benchmark studies, and offering Union customers assistance in obtaining government funding for energy efficiency projects. Specific NRCan programs include:

- Office of Energy Efficiency (OEE)
- Canadian Industry Program for Energy Conservation (CIPEC)
- CANMET Energy Technology Centre

Canadian Boiler Society (CBS)
Union partnered with the Canadian Boiler Society to provide technical training to Union customers that will help them operate their equipment at optimum efficiency.

6.1.4 Lessons Learned

1. ***Direct Access Budget***

   The Direct Access budget mechanism for Rate T2/R100 was designed in consultation with Large Volume customers. In its first year, the program was successful and operated as outlined in the plan. The following outlines some key observations of the program in 2013:

   - Approximately 95% of T2/R100 customers in the rate classes participated by submitting energy efficiency plans
   - 82% of T2/R100 customers submitted energy efficiency plans and at least one project
   - 59% of T2/R100 customers utilized all their budget
   - 49% of T2/R100 customers received additional funding from the Aggregate Pool
   - Approximately 39% of the total T2/R100 program savings were funded by the Aggregate Pool

   The direct access budget mechanism will continue to be an important component of Union's Large Volume program in 2014.

7. Market Transformation Scorecard

In 2013, Union focused its market transformation efforts on the Optimum Home Program.

Table 7.0 presents the results of the market transformation scorecard. Union achieved over 150% of the overall scorecard target, resulting in an incentive of $0.550 million.

Table 7.0 – 2013 Market Transformation Scorecard Results

Metrics	**Metric Target Levels**			**Weight**	**Achievement**	**% of Metric Achieved**	**Weighted % of Scorecard Achieved**
	Lower Band	**Target**	**Upper Band**				
New Participating Builders	6	8	15	60%	8	100%	*60%*
Prototype Homes Built	20% of participating builders	30% of participating builders	40% of participating builders	40%	63%	266%	*106%*
				Total Scorecard Target Achieved			***150%***[7]
				Scorecard Incentive Achieved			***$550,259***

The New Participating Builders metric refers to the number of "top builders" who signed up for the Optimum Home Program by signing a Participation Contract in 2013. A builder is considered a "top builder" based on its number of housing starts in Union's franchise in the prior calendar year. Top builders are discussed further in Section 7.1.

The Prototype Homes Built metric is associated to the number of top builders who have signed up for the program in either 2012 or 2013 and have built at least one prototype home. This number of builders is reported as a percentage of all top builders that have signed up for the Optimum Home program in either 2012 or 2013. Prototype homes are discussed as Discovery Homes in Section 7.1.

Table 7.1 shows Union's total spend on market transformation program.

Table 7.1 – 2013 Market Transformation Results

Scorecard	**Program**	**Item**	**Result**	**Total Spend**
Market Transformation	Optimum Home	Top Builders Signed in 2013	8	$944,661
		Prototype Homes Built in 2013	12	
2013 Market Transformation Total				**$944,661**

---

[7] Scorecard is capped at 150%. Actual scorecard achievement is 166%.

Table 7.2 breaks down the total spend for the Optimum Home Program into its components.

Table 7.2 – 2013 Market Transformation Spend

Item		Total
Optimum Home Incentives	$	368,200
Optimum Home Administration	$	365,383
Optimum Home Evaluation	$	0
Optimum Home Promotion	$	211,078
Total Market Transformation Spend	**$**	**944,661**

7.1 Optimum Home Program

The Optimum Home Program is based on a whole-home consultant based approach. The objective of the Optimum Home Program is designed to accelerate residential home builders' energy efficiency practices. The goal is to prepare builders prior to an increase in minimum building efficiency standard expected in the next release of the Ontario Building Code (OBC) in 2017. This objective is achieved by supporting the builders towards building to 20% above the current OBC 2012. The program is not based on a single technology and is not tied to a specific label.

The Optimum Home Program is targeted to the top fifty most active builders in Union Gas' service territory based on the number of housing starts in Union's franchise in the prior calendar year. Builders that sign up for the Optimum Home Program enter into a three-year consulting process. This process partners participating builders with a leading building science consultant who can provide cutting edge advice on how to build residential homes to 20% above current OBC 2012. These consultants are the leading group of consultants in Ontario's residential building industry which reinforces the value proposition for builders. They include Gord Cook, Al Schmidt, Michael Leo, Tex McLeod, and Andy Oding.

The outcome of advanced building is achieved through a process which identifies and addresses barriers to energy efficient construction. The consulting process deals with every aspect of the builder's business including marketing, sales, contracts, construction, services and trades.

The Optimum Home Program recognizes that every builder is different and consultants tailor the advice offered to suit each builder's individual needs. The consultant works with the builder to develop capacity within its organization to effectively build to a higher efficiency, and to understand opportunities to mitigate any incremental costs through business process improvements. The Optimum Home Program consists of three phases:[8]

- **Phase One – Discover:** Union Gas pairs participating top builders with a leading building science consultant to develop a baseline by benchmarking current product and business practices and by conducting an on-site audit. The consultant will lead discussion on new technologies, building practices and options, resulting in a customized handbook of building

---

[8] Up to 30 Consultant days are available to each builder over the three phases of the program.

specifications called the Builder Options Package to assist the builder to build 20% above OBC 2012. The builder will then build at least one prototype home ("Discovery Home") to meet this requirement. On behalf of the builder, a Certified Energy Evaluator (CEE) must demonstrate that the Discovery Home is indeed 20% above OBC 2012 by conducting a blower door test and modeling the home using HOT2000.[9] Cost of this evaluation work is covered by the builder.

- **Phase Two – Implement:** The builder will work with the consultant to test the new Builder Options Package, examine lessons learned, establish training requirements and conduct training, engage sales and marketing in the discussion and conduct performance testing in the Discovery Home.
- **Phase Three – Sustain:** The consultant will work with the builder towards full implementation of the new specifications as identified throughout the Optimum Home process. The consultant sets out a sustainability plan to maintain momentum of building to the new level of efficiency. A minimum of 10% of the builder's total housing starts must be built 20% above OBC 2012 Code.

During 2013, Union Gas successfully recruited eight new builders into the program, bringing the total participating builder group to 19. Twelve of these builders moved through phase one and two of the program which resulted in 12 discovery homes being built and tested to be 20% above OBC 2012.

In the third quarter of 2013, Union Gas expanded Optimum Home beyond the 19 participating builders to all interested builders across the service territory through the Optimum Home Education Workshops. The technical sales and marketing workshops were held in Burlington, Kingston and Sudbury to help all builders design, build, and sell high performance homes that are 20% above the OBC 2012.

OPTIMUM HOME PROGRAM
Building High Performance Homes

"Advanced, robust building practices and a creative marketing strategy can help builders set themselves apart in a competitive marketplace, while still keeping focused on the bottom line."

Dave Simpson, vice president, in-franchise sales, marketing and customer care, Union Gas

Profit by building high performance homes

EDUCATION WORKSHOPS

Register now for the Technical and Sales & Marketing Workshops available in your area.

Offer your customers high performance homes that have:
- Greatly improved durability and comfort
- Healthier indoor air quality
- Lower energy costs
- A substantial return on investment

To register for the education workshops visit: uniongas.com/optimumhome

Design smart.
Market better.
Profit more.

uniongas
A Spectra Energy Company

Gain a **competitive edge** in high performance home building

OPTIMUM HOME PROGRAM
Building High Performance Homes

The Optimum Home Education Workshops offer you the opportunity to gain knowledge on the technical aspects and building efficiencies of constructing high performance homes, and how to profit from offering your customers a better built home.

Technical Workshop – full day

This course will provide you with the information, tools and support you need to transform your business and building efficiencies. Using real world experiences and lessons learned from builders like yourself, this course will ensure that your company is ahead of the next Ontario Building Code (OBC) change.

What you will learn
- What's in the new ENERGY STAR® for New Homes standard
- How to build to 20% above OBC 2012 in a cost effective manner using the ENERGY STAR® standard. What are the opportunities, challenges and solutions
- How to improve product quality, reduce costs and after sales service
- Why building high performance homes is good for business

Sales & Marketing Workshop – full day

Technical competence in building homes as per new standards is only half the battle. The bottom line is selling the homes.

What you will learn
- Home owners' perceptions and buying behaviour
- How to market and sell the features and benefits of high performance homes
- Value of high performance homes and ROI. Why consumers will want to buy one now
- How to close the sale through effective communication and demonstration

Who should attend

These courses are designed for residential home builders and industry stakeholders engaged in the home construction and sale process.
- CEOs, Presidents, Owners, Designers, Project Managers, Site Managers
- Architects, Developers, Consultants, Contractors, Interior Designers, Product Manufacturers
- Sales & Marketing Staff, Real Estate Representatives

We highly recommend attending both the Technical and Sales & Marketing Workshops.

Gord Cooke
Tex McLeod
Andy Oding

Union Gas is partnering with EnerQuality and renowned building science experts to offer these courses. These industry experts are the leading group of consultants in Ontario's residential building industry and bring to the table:
- Experience as professional engineers, builders, developers and trainers
- Intimate knowledge of advanced building science, mechanical systems, cost saving engineering, energy efficient building programs and code and labelling requirements

Central – Burlington
Technical: Monday, Oct. 21, 2013, delivered by Gord Cooke
Sales & Marketing: Tuesday Nov. 12, 2013, delivered by Gord Cooke

East – Kingston
Technical: Wednesday, Oct. 23, 2013, delivered by Tex McLeod
Sales & Marketing: Monday, Nov. 11, 2013, delivered by Gord Cooke

Northeast – Sudbury
Technical: Friday, Nov. 8, 2013, delivered by Tex McLeod
Sales & Marketing: Wednesday, Nov. 13, 2013, delivered by Andy Oding

Southwest – London
Technical: Tuesday, Feb. 4, 2014, delivered by Tex McLeod
Sales & Marketing: Tuesday, Feb. 18, 2014, delivered by Gord Cooke

Central – Hamilton
Technical: Thursday, Feb. 13, 2014, delivered by Andy Oding
Sales & Marketing: Tuesday, Feb. 25, 2014, delivered by Gord Cooke

Union Gas will fund 50%
of your course fees.
$199 per person, per course. Your cost is only $99.

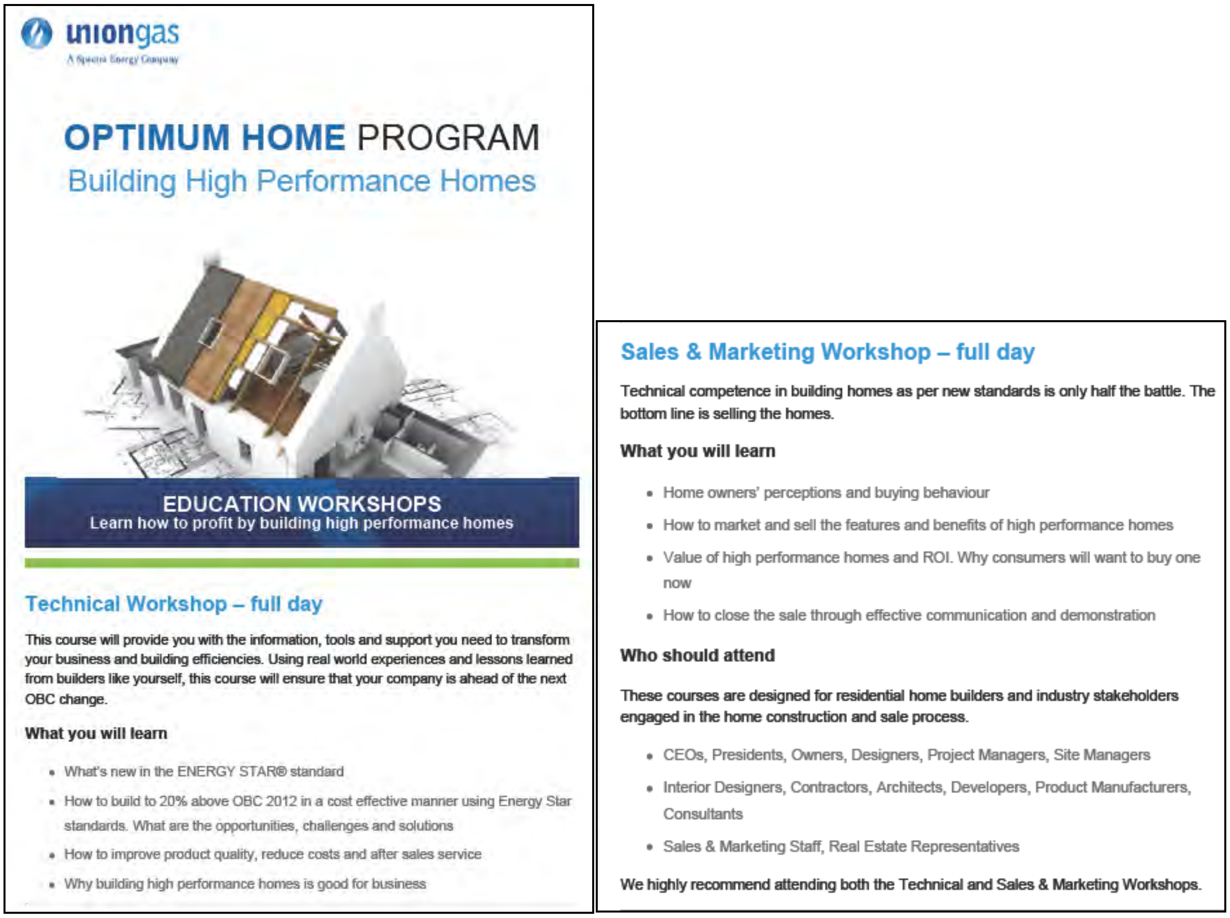
For builders and their partners who currently have building activity in the Union Gas franchise area.

Only
$99
Per person, per course

Figure 7.0, Optimum Home Brochure for Education Workshops Targeting all Builders

---

[9] HOT2000 is a building energy simulation tool offered by Natural Resources Canada. It is an industry standard in simulating building energy usage.



OPTIMUM HOME PROGRAM
Building High Performance Homes

EDUCATION WORKSHOPS
Learn how to profit by building high performance homes

Technical Workshop – full day

This course will provide you with the information, tools and support you need to transform your business and building efficiencies. Using real world experiences and lessons learned from builders like yourself, this course will ensure that your company is ahead of the next OBC change.

What you will learn

- What's new in the ENERGY STAR® standard
- How to build to 20% above OBC 2012 in a cost effective manner using Energy Star standards. What are the opportunities, challenges and solutions
- How to improve product quality, reduce costs and after sales service
- Why building high performance homes is good for business

Sales & Marketing Workshop – full day

Technical competence in building homes as per new standards is only half the battle. The bottom line is selling the homes.

What you will learn

- Home owners' perceptions and buying behaviour
- How to market and sell the features and benefits of high performance homes
- Value of high performance homes and ROI. Why consumers will want to buy one now
- How to close the sale through effective communication and demonstration

Who should attend

These courses are designed for residential home builders and industry stakeholders engaged in the home construction and sale process.

- CEOs, Presidents, Owners, Designers, Project Managers, Site Managers
- Interior Designers, Contractors, Architects, Developers, Product Manufacturers, Consultants
- Sales & Marketing Staff, Real Estate Representatives

We highly recommend attending both the Technical and Sales & Marketing Workshops.

Figure 7.1, Optimum Home Builder Workshop Webpage


Union Gas will fund 50% of your course fees.
$199 per person, per course. Your cost is only $99. Breakfast and lunch are included.

Register Now
A new window will open when you click on the Register button.

Windsor

Technical: Thursday, Jan. 23 2014 delivered by Andy Oding Register
Sales & Marketing: Tuesday, Jan. 28, 2014 delivered by Andy Oding Register
Both Windsor Technical and Sales & Marketing Workshops Register

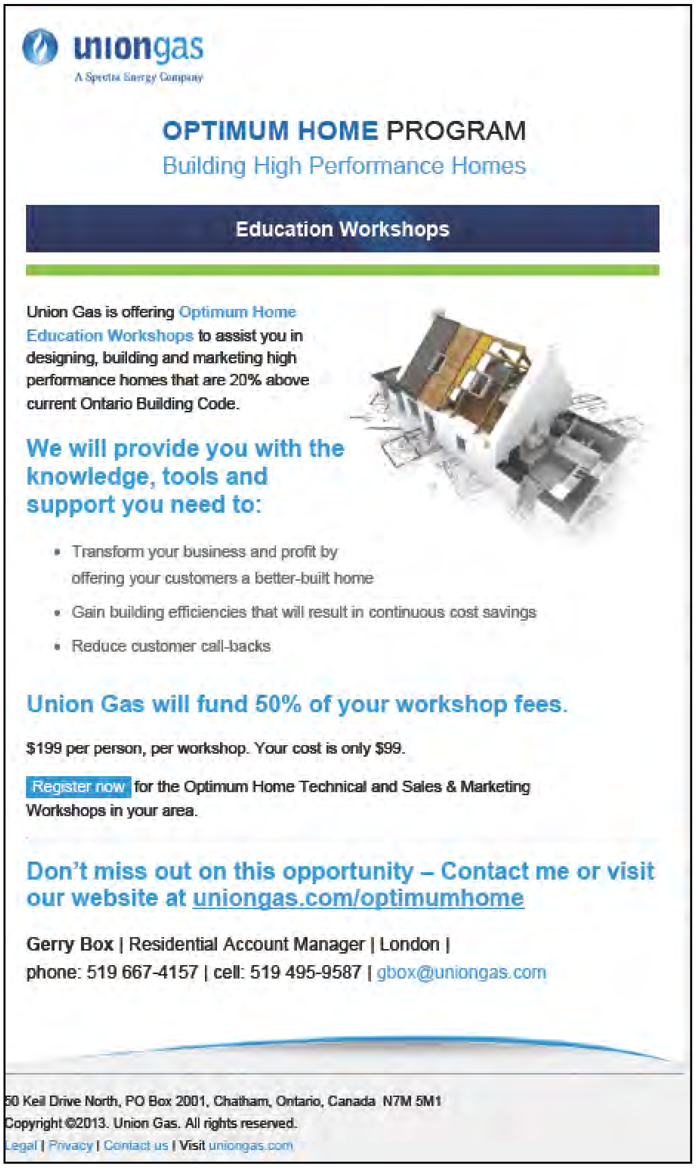
London

Technical: Tuesday, Feb. 4, 2014 delivered by Tex McLeod Register
Sales & Marketing: Tuesday, Feb. 18, 2014 delivered by Gord Cooke Register
Both London Technical and Sales & Marketing Workshops Register

Hamilton

Technical: Thursday, Feb. 13, 2014 delivered by Andy Oding Register
Sales & Marketing: Thursday, March 20, 2014 delivered by Andy Oding Register
Both Hamilton Technical and Sales & Marketing Workshops Register

Figure 7.2, Builder Workshop Registration Webpage



uniongas
A Spectra Energy Company

OPTIMUM HOME PROGRAM
Building High Performance Homes

Education Workshops

Union Gas is offering Optimum Home Education Workshops to assist you in designing, building and marketing high performance homes that are 20% above current Ontario Building Code.

We will provide you with the knowledge, tools and support you need to:

- Transform your business and profit by offering your customers a better-built home
- Gain building efficiencies that will result in continuous cost savings
- Reduce customer call-backs

Union Gas will fund 50% of your workshop fees.

$199 per person, per workshop. Your cost is only $99.

Register now for the Optimum Home Technical and Sales & Marketing Workshops in your area.

Don't miss out on this opportunity – Contact me or visit our website at uniongas.com/optimumhome

Gerry Box | Residential Account Manager | London |
phone: 519 667-4157 | cell: 519 495-9587 | gbox@uniongas.com

50 Keil Drive North, PO Box 2001, Chatham, Ontario, Canada N7M 5M1
Copyright ©2013. Union Gas. All rights reserved.
Legal | Privacy | Contact us | Visit uniongas.com

Figure 7.3, Optimum Home Workshop Email Communication to Builders

Target Market

The Optimum Home Program targets the top fifty builders in Union's franchise based on the previous year's housing starts.

The following groups play a secondary role in influencing a builder's decision to participate in the Optimum Home Program. Influencing these parties will help drive demand for high performance homes, and in turn, will raise builder interest in Optimum Home.

- **New home buyers** – who will ultimately purchase the higher efficiency homes.
- **Builder sales centres** – work on behalf of builders to promote and sell new homes directly to new home buyers. They greatly influence customers' choices and selection of upgraded features. Under the builder's direction, they will promote the programs and features that they believe will generate the most customer interest. There are many competing companies

attempting to influence design/sales centres (such as manufacturers of faucets, cabinets, and countertops), which can make it difficult for energy efficiency products to gain footing.

Market Incentive

Optimum Home is delivered at no cost to the builder. Participating builders receive the following:

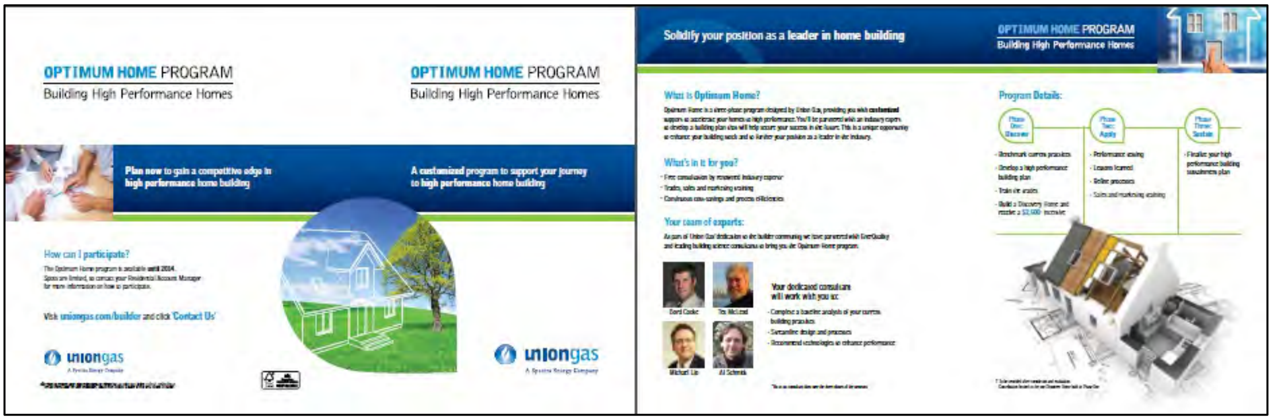
- Up to 30 free days of consultation by renowned industry experts;
- Trades, sales and marketing training;
- Continuous cost savings and process efficiencies; and
- $2,500 incentive towards the construction of a Discovery Home.[10]

Builders attending the Optimum Home Education Workshops receive information and training on meeting the Optimum Home building standard of 20% above OBC 2012. Union Gas funds 50% of the workshop fee of $199.

Market Delivery

Similar to 2012, a profile of the top fifty builders in Union's franchise was completed in order to determine which builders would be targeted for builder recruitment in 2013. Union's delivery agent, EnerQuality, was leveraged to add additional market intelligence to the top fifty builder list such as key contact information and labelling practices. Union led the builder recruitment process and collaborated with EnerQuality and the consultants to conduct builder outreach where Union did not have established builder relationships.

Union continued to utilize the Builder Partnership Package, developed in 2012, to formally sign builders up for Optimum Home. The package includes a Builder Partnership Agreement between the participating builder and Union Gas and a non-disclosure agreement. The Optimum Home builder portfolio was also updated with the revised brochure outlining the Optimum Home Program and its key benefits, a consultant biography piece to highlight the experience and credentials of the leading building science consultants, a testimonial piece and a PowerPoint presentation that further described the Optimum Home Program.



OPTIMUM HOME PROGRAM
Building High Performance Homes

Plan now to gain a competitive edge in high performance home building

How can I participate?

Visit uniongas.com/builder and click 'Contact Us'

uniongas

OPTIMUM HOME PROGRAM
Building High Performance Homes

A customized program to support your journey to high performance home building

uniongas
A Spectra Energy Company

Solidify your position as a leader in home building

OPTIMUM HOME PROGRAM
Building High Performance Homes

What is Optimum Home?

What's in it for you?

Your team of experts:

Program Details:

Figure 7.4, Optimum Home Brochure

---

[10] To be provided upon completion and evaluation. Limited to the one Discovery Home built in Phase One.

Marketing Support

Union Gas provided each participating builder with a press release/editorial and key message document that could be released to media at the opening and display of the builder's Discovery Home. Banners were also provided for each Discovery Home site to attract customers and encourage them to ask for more information regarding high performance homes.

Each builder was encouraged to create its own "high performance home" brand and market it to their customers.

DID YOU KNOW...

In consultation with:

Based on a sample calculation,

2,300 sqft two storey home built in 1982 (Energuide 50) uses 4,250 m^3 of natural gas per year (heating and hot water)

2,300 sqft two storey home built to the current building code uses 2,600 m^3 of natural gas per year

2,300 sqft two storey home built to Energuide 83 uses 1,700 m^3 of natural gas per year

60% Savings over a house built in the 1980's (gas alone) = 35% Savings over a newly built home

The CaraCo Performance Home 2020 is aiming to exceed Energuide 83. When you include improved comfort, and electrical savings, that is something to brag about!

THE CARACO PERFORMANCE HOME 2020

If built to base building code, is estimated to use 2,433 m^3 of natural gas per year

As built and site verified, is calculated to use 1,956 m^3 of natural gas per year

35% Energy reduction for heating and hot water = 837 m^3 per year = $249 Savings per year*

Further, a house with an energuide rating of 83 is eligible for an Ontario Power Authority of $500.

* Assuming today's natural gas rates (current rate of July 1, 2013 is 0.298$/$m^3$, which is historically low and expected to rise in the future.)

CARACO DEVELOPMENT CORP.

P.O. Box 70, Glenburnie, Ontario • Tel: (613)542-8400 • Fax: (613)544-9931 • www.caraco.net/performance

Built to Exceed 2020 Building Code Standards

SEE INSIDE OUR NEWEST MODEL

With CaraCo's Premium Quality,
Prime Kingston Locations,
Award Winning After Sales Service
and Our Comprehensive Warranty,

Find Out Why More Families Are Coming Home To CaraCo

AN INSIDE LOOK

ASPHALT SHINGLES
- Architectural textured – Lifetime Limited Warranty

DUCTWORK
- Professionally designed, installed and sized for future A/C, fully sealed

INDOOR AIR QUALITY
- Low VOC paint/primer and carpeting that is CRI Green Label Plus approved
- High efficient fresh air Heat Recovery Ventilator (HRV) ensures that the highest levels of indoor air quality are maintained

HRV CONTROLLER
- Smart central control
- Remotes throughout house, central system with presets to suit your lifestyle

FOAM EXTERIOR SHEATHING
- R26.2 with rigid foam to exterior of wall studs to eliminate thermal bridging

BELL/COGECO SERVICE
- Fiber optic ready central wiring enclosure for ease of technology installation

CONTINUOUS EXTERIOR AIR BARRIER
- High performance detailing for air tightness, third party air tightness tested
- Advanced DuPont™ Tyvek® Weatherization Systems

WATERPROOFING
- 100% rubber waterproofed foundation
- Lifetime Limited Warranty

BASEMENT WALL INSULATION
- Full height insulation R19 nominal including added continuous Roxul insulation in between foundation and framing to eliminate thermal bridging and for improved moisture transfer control
- 2" x 4" @ 24" o.c. ready for future finishing

LIGHTING
- Colour matched fixtures, compact fluorescent bulbs through most areas
- High efficiency LED (Light-Emitting Diode) potlights

ATTIC INSULATION
- R50
- Spray foam in the room over garage

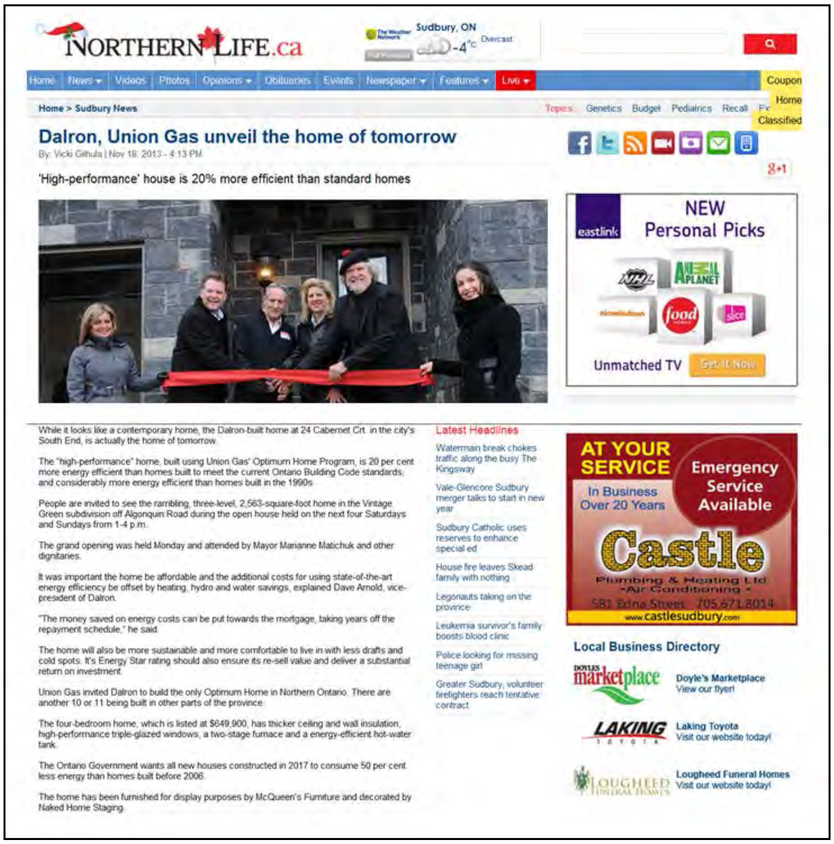
WINDOWS
- ENERGY STAR, maintenance free vinyl double glazed windows with Low E and argon gas

THERMOSTAT
- Smart thermostat
- Programmable for energy efficiency and comfort

HRV (HEAT RECOVERY VENTILATOR)
- Ensures fresh air supply
- Professionally designed, installed and tested
- 83% efficiency with ECM (electronically commutated motor)

FURNACE
- Professionally sized and installed, high efficiency 96% forced air gas furnace
- Two stage burner with ECM (electronically commutated motor)

Figure 7.5, Optimum Home Builder Brochure (CaraCo)



Dalron, Union Gas unveil the home of tomorrow

By: Vicki Gilhula | Nov 18, 2013 - 4:13 PM

'High-performance' house is 20% more efficient than standard homes

While it looks like a contemporary home, the Dalron-built home at 24 Cabernet Crt. in the city's South End, is actually the home of tomorrow.

The "high-performance" home, built using Union Gas' Optimum Home Program, is 20 per cent more energy efficient than homes built to meet the current Ontario Building Code standards, and considerably more energy efficient than homes built in the 1990s.

People are invited to see the rambling, three-level, 2,563-square-foot home in the Vintage Green subdivision off Algonquin Road during the open house held on the next four Saturdays and Sundays from 1-4 p.m.

The grand opening was held Monday and attended by Mayor Marianne Matichuk and other dignitaries.

It was important the home be affordable and the additional costs for using state-of-the-art energy efficiency be offset by heating, hydro and water savings, explained Dave Arnold, vice-president of Dalron.

"The money saved on energy costs can be put towards the mortgage, taking years off the repayment schedule," he said.

The home will also be more sustainable and more comfortable to live in with less drafts and cold spots. It's Energy Star rating should also ensure its re-sell value and deliver a substantial return on investment.

Union Gas invited Dalron to build the only Optimum Home in Northern Ontario. There are another 10 or 11 being built in other parts of the province.

The four-bedroom home, which is listed at $649,900, has thicker ceiling and wall insulation, high-performance triple-glazed windows, a two-stage furnace and a energy-efficient hot-water tank.

The Ontario Government wants all new houses constructed in 2017 to consume 50 per cent less energy than homes built before 2006.

The home has been furnished for display purposes by McQueen's Furniture and decorated by Naked Home Staging.

Latest Headlines

- Watermain break chokes traffic along the busy The Kingsway
- Vale-Glencore Sudbury merger talks to start in new year
- Sudbury Catholic uses reserves to enhance special ed
- House fire leaves Skead family with nothing
- Legonauts taking on the province
- Leukemia survivor's family boosts blood clinic
- Police looking for missing teenage girl
- Greater Sudbury, volunteer firefighters reach tentative contract

Figure 7.6, Optimum Home Builder Press Release (Dalron)

HELP THE ENVIRONMENT & HELP YOUR WALLET

20% ENERGY SAVINGS AND CMHC REBATES

THE DALRON HIGH PERFORMANCE HOME IS A HEALTHIER, MORE COMFORTABLE AND MORE EFFICIENT HOME FOR YOU AND YOUR FAMILY, FOR YOUR BUDGET AND FOR THE ENVIRONMENT.

QUALITY FROM THE INSIDE OUT: From the foundation to the roof and everywhere in between, the new Dalron High Performance Homes are built with efficiency and comfort in mind. Once built, your family can enjoy an environmentally responsible home with savings in energy and heating costs. The Dalron High Performance Homes deliver superior quality and reliability *without* sacrificing beauty, functionality or affordability.

The Dalron High Performance Home is part of the *Optimum Home Program*, sponsored by Union Gas. These homes are built to the new *Energy Star for New Homes* standard, which is 20 per cent above the current Ontario Building Code. Dalron is proud to build the first Optimum Home in Northern Ontario.

DALRON HIGH PERFORMANCE HOME	CURRENT ONTARIO BUILDING CODE SB12 PKG J
TRIPLE GLAZED WINDOWS U VALUE 1.4	U VALUE 1.6 MAX
IMPROVED AIR TIGHTNESS TESTED AND CONFIRMED BY LICENSED 3RD PARTY, CAN SPEC	VISUAL INSPECTION ONLY
INSULATION	
R7.5 FOAM BELOW BASEMENT FLOOR	NONE EXCEPT AT SLAB EDGE (R10) OR WHEN BASEMENT IS HEATED OR NOT 4' BELOW GRADE THEN R10 IS REQUIRED
R60 ATTIC	R 50 ATTIC
R27.5 FRAMED ABOVE GRADE WALLS...2X6@16"OC/R20/2" EXPANDED 4X8 SHEETS EFFECTIVE R VALUE 23.1	R24 EFFECTIVE R VALUE 17.5
R24 AGAINST BLOCK IN BASEMENT WITH 2X4 STANDOFF WALL AND 2 LAYERS OF R12 CRISS CROSSED EFFECTIVE R VALUE 16.9	R12 EFFECTIVE R VALUE 8 (FRAME WALL WITH R12)
HEADERS IN BASEMENT BATTED OUT AND SEALED TO INSIDE OF STANDOFF WALLS EFFECTIVE R VALUE 23.1	AS PER BASEMENT WALL, R12 EFFECTVE R VALUE 8 (FRAME WALL WITH R12)
R 32 AND 2" FOAM R39.5 BELOW BEDROOM FLOORS IN GARAGE CEILING EFFECTIVE R VALUE 33	R31 EFFECTIVE R VALUE AROUND 23
DIRECTIONAL POLY IN BASEMENT TO AVOID CONDENSATION BEHIND THE VAPOUR BARRIER	REGULAR POLY
6' OR EQUIVALENT FROST COVER	CODE WOULD BE 5'
INCREASED AND QUALITY GRAVEL FOR BACKFILLING INCREASED SLOPE TO SHED WATER	GOOD BUT CODE ADDRESSES BOTH, DALRON EXCEEDS CODE
MECHANICALS/ELECTRICALS	
42" DRAIN WATER RECOVERY UNIT T3342B DRAINING BOTH TOP FLOOR BATHS	NOT REQUIRED IN PKG J
LOW FLOW SHOWER HEADS AND FAUCETS 3 LITER TOILETS	CODE 6 LITERS
CFL BULBS	NOT CODE
SPARK IGNITION FIREPLACE	EXCEEDS CODE
95% 2 STAGE FURNACE WITH ECM MOTOR	ONE STAGE, NO ECM, 94%
CONSTRUCTD 1.0 68% HRV	CODE
95% RINNAI INSTANTANEOUS WATER HEATER	67% CODE
EXTRA SEALING OF JOINTS IN DUCTWORK	NOT REQUIRED BY CODE
ENERGUIDE FRIDGE,STOVE AND DISHWASHER	NOT REQUIRED BY CODE

The Bottom Line

A Dalron High Performance Home is:

- a healthier, quieter, more comfortable home
- deemed efficient by CMHC and eligible for 10% rebate on mortgage insurance
- independently verified to require 20% less energy for heating and hot water
- a labeled 2012 Energy Star home
- 3rd party inspected and tested by CanSpec, licensed by NRCan
- supported by Union Gas and Natural Resources Canada, Office of Energy Efficiency

130 Elm Street
Greater Sudbury, ON P3C 1T6
705 580 9770

DALRON.COM

Figure 7.7, Dalron Sell Sheet

Dalron

Welcome to our High Performance Home

This home is designed to be 20% above the current Ontario Building Code so you will enjoy...

- greatly improved durability and comfort
- healthier indoor air quality
- lower energy costs
- a substantial return on your investment

Ask your builder for more information

This high performance home is built with the support of the Optimum Home program from Union Gas

uniongas
A Spectra Energy Company

CaraCo PERFORMANCEHOME 2020

You are in a High Performance Home

These homes are designed to be 20% above the current Ontario Building Code so you will enjoy...

- greatly improved durability and comfort
- healthier indoor air quality
- lower energy costs
- a substantial return on your investment

Ask your builder for more information

This High Performance Home is built with the support of the Optimum Home Program from Union Gas

uniongas
A Spectra Energy Company

Figure 7.8, Discovery Home Signage (Dalron and CaraCo)

Ontario Home Builders' Association (OHBA) Partnership

As part of Union's ongoing commitment to the builder community, Union partnered with the Ontario Home Builders' Association. Support of the OHBA has provided Union with the ability to boost its brand profile amongst multiple stakeholders, receive strategic input in the direction of DSM programs and regulatory issues, and enhance market intelligence relating to energy efficiency, sustainability and "better building" in the new housing market. Union participated in the 2013 OHBA conference held in October and attended various events throughout the year with the OHBA's local chapters.

7.2 Lessons Learned

1. ***Greater building community***
   Union recognizes that in order for market transformation to be effective across Union's franchise, program knowledge and experiences must be shared across the greater building community, beyond the top builders participating in the program. This was accomplished through the Optimum Home Education Workshop Series, launched in 2013.

2. ***Marketing support required for customers***
   In 2013, the Optimum Home Program continued to assist in the creation of a supply of high performance homes with participating builders committed to building 10% of their stock to 20% above OBC 2012. Union will now focus efforts on creating demand in the market to support these builders in selling the high performance homes. This will be done by creating consumer awareness of the benefits and value of owning a high performance home.

3. ***Improvement in technology and building practices***
   In building their discovery homes, participating builders are finding that the tighter building envelope of a high performance home necessitates other changes in home design. For example, basement walls need breathable vapour barriers to allow moisture to escape without compromising insulation value. A smaller, smarter furnace is required since less heat is being lost through the building envelope than in a traditional home. These high performance home solutions will be shared with other builders through the Optimum Home Education Workshop Series.

8. Evaluation, Measurement and Verification

For the purpose of validating the accuracy of claimed savings, Union undertakes several impact evaluations each year. These impact evaluations are designed to ensure that the claimed participation and installation rates for technologies delivered through Union's programs are accurate. Union commissioned impact evaluations for the Residential ESK offering, Low-Income HHC offering and Commercial Hot Water Conservation (HWC) initiative as detailed in this section of the report. A verification of claimed savings obtained through custom projects was also completed. For 2013, custom project savings verification included the Low-Income Custom initiative, Commercial/Industrial Custom offering and Large Volume program with a total of 55 project verifications.

8.1 Residential Impact Evaluation

Union conducted an impact evaluation of the Residential ESK program offering to validate the program offering's energy savings. Beslin Communications Group Inc. was contracted to provide a statistically representative sample at the 90:10 confidence level and conduct the impact evaluation via a telephone survey. The details of the impact evaluation and its findings are outlined below.

8.1.1 Energy Savings Kit Offering Impact Evaluation

Union conducted an impact evaluation across three channels for the ESK offering to ensure the savings were accurate, as outlined in Table 8.0. This impact evaluation determined the number of ESK measures that were installed and remained installed for 2013. Additionally, since the savings associated with ESK showerheads relate to showering for an entire home, the impact evaluation also established the portion of showering that was attributable to the ESK showerhead. Furthermore, the impact evaluation determined the percentage of ESK recipients that used a natural gas water heater to heat their home's water. Through these efforts, the studies provide adjustment factors that are applied to the savings claims. Union also uses the collected information to assess areas of success and areas for potential improvement relating to the offering.

Table 8.0 - Summary of Residential ESK Impact Evaluation

ESK Channel	Participants	Source	Primary Objectives
Push	Customers who received an ESK through Union-run events, and HVAC partners visiting their home	Beslin Communications Group Inc.	- Verify measure installation - Verify continued use of the measure - Verify percentage of showering under the efficient showerhead - Verify water heater type
Pull	Customers who received an ESK by responding to Direct Mail campaigns, retail events, and web requests	Beslin Communications Group Inc.	- Verify measure installation - Verify continued use of the measure - Verify percentage of showering under the efficient showerhead - Verify water heater type
Door-to-Door (Push)	Customers who received an ESK through the door-to-door initiative	Beslin Communications Group Inc.	- Verify measure installation - Verify continued use of the measure - Verify percentage of showering under the efficient showerhead - Verify water heater type

Some participants also received an ESK kit through a fourth ESK delivery channel, known as the ESK Install channel. This delivery channel provided ESK kits to customers who elected to have the showerhead installed during a home visit from an HVAC partner. Since only 253 kits were delivered via this channel, it was not included in the 2013 ESK impact evaluation. Rather, adjustment factors determined during the 2012 ESK impact evaluation were applied to the 2013 savings claimed from the 2013 ESK Install kits.

The final adjustment factors for the four delivery channels are presented in Tables 8.1, 8.2, 8.3, and 8.4.

Table 8.1 - Adjustment Factors: ESK Push

Measure	Measure Verified Installed	Measure Remained Installed	% Showering Under Low-Flow Showerhead	% With Natural Gas Hot Water Heaters	Adjustment Factor
Kitchen Faucet Aerator	62%	59%		100%	59%
Bathroom Faucet Aerator	70%	68%		100%	68%
Pipe Wrap	85%	85%		100%	85%
Energy-efficient Showerhead	72%	71%	61%	100%	43%

Table 8.2 - Adjustment Factors: ESK Pull

Measure	Measure Verified Installed	Measure Remained Installed	% Showering Under Low-Flow Showerhead	% With Natural Gas Hot Water Heaters	Adjustment Factor
Kitchen Faucet Aerator	79%	72%		100%	72%
Bathroom Faucet Aerator	83%	82%		100%	82%
Pipe Wrap	90%	90%		100%	90%
Energy-efficient Showerhead	89%	89%	69%	100%	61%

Table 8.3 - Adjustment Factors: ESK Door-to-door

Measure	Measure Verified Installed	Measure Remained Installed	% Showering Under Low-Flow Showerhead	% With Natural Gas Hot Water Heaters	Adjustment Factor
Kitchen Faucet Aerator	81%	79%		100%	79%
Bathroom Faucet Aerator	86%	86%		100%	86%
Pipe Wrap	97%	97%		100%	97%
Energy-efficient Showerhead	84%	81%	91%	100%	74%

Table 8.4 - Adjustment Factors: ESK Install from 2012 ESK Impact Evaluation

Measure	Measure Verified Installed	Measure Remained Installed	% Showering Under Low-Flow Showerhead	% With Natural Gas Hot Water Heaters	Adjustment Factor
Kitchen Faucet Aerator	87%	82%		100%	82%
Bathroom Faucet Aerator	92%	92%		100%	92%
Pipe Wrap	100%	100%		100%	100%
Energy-efficient Showerhead	95%	92%	78%	100%	72%

8.2 Low-Income Impact Evaluations

Union conducted two impact evaluations specific to the Low-Income program in order to validate the savings results. SeeLine Group Ltd. undertook the Low-Income Free Showerhead Installation Initiative impact evaluation, while Michaels Energy conducted the Low-Income custom project savings verification.

Union did not contract for the completion of an impact evaluation of basic measures (low-flow bathroom and kitchen aerators, pipe insulation and low-flow showerheads) since fewer than 175 of each measure was delivered to customer.[11] Rather, the results of the 2012 HHC impact evaluation are applied to the savings claimed from the 2013 HHC offering. The impact evaluations used in 2013 and their results are outlined in the sections below.

8.2.1 Helping Homes Conserve Offering Impact Evaluation

In 2012, Beslin Communication Group Inc. on behalf of Union conducted an impact evaluation of basic measures offered as part of the 2012 HHC offering, as outlined in Table 8.5. Similar to the Residential ESK offering impact evaluation, the installation and persistence rates of showerheads, kitchen aerators, bathroom aerators and pipe wrap were determined. The percentage of showering in the home that used the HHC showerhead and the percentage of recipients that have a natural gas water heater in their home were also determined. Beslin Communications Group Inc. conducted the impact evaluation on a statistically representative sample of 2012 HHC offering participants at the 90:10 confidence level.

Table 8.5 – Helping Homes Conserve Impact Evaluation Parameters

Participants	Source	Primary Objectives
Customers who received a showerhead, bathroom aerator and kitchen aerator through the 2012 HHC offering	Beslin Communications Group Inc.	- Verify measure installation - Verify continued use of the measure - Verify percentage of showering under the efficient showerhead - Verify water heater type

---

[11] As noted in Section 5.*, basic measures were only provided to HHC participants installing weatherization measures if they had not previously received them.

The resulting adjustment factors in Table 8.6 have been applied to the 2013 claimed savings and will be used to help Union assess areas of success and areas for potential improvement.

Table 8.6 - Adjustment Factors: HHC Low-Income from 2012 HHC Impact Evaluation

Measure	Measure Verified Installed	Measure Remained Installed	% Showering Under Low-Flow Showerhead	% With Natural Gas Hot Water Heaters	Adjustment Factor
Kitchen Faucet Aerator	85%	81%		100%	81%
Bathroom Faucet Aerator	86%	86%		100%	86%
Pipe Wrap	94%	94%		100%	94%
Energy-efficient Showerhead	93%	92%	87%	100%	80%

8.2.2 Free Showerhead Installation Initiative Impact Evaluation

Union conducted an on-site verification study for the Free Showerhead Installation initiative. This initiative specifically targets social and assisted housing low-rise and high-rise apartment buildings with a free installation of up to two energy efficient showerheads in each unit, and a kitchen and bathroom aerator for tenants to install.

Seeline Group Ltd. was contracted to perform the impact evaluation. The purpose is to provide an adjustment factor to be applied to the results of the initiative to ensure the associated savings appropriately reflect installation rates and persistence for all of the measures, as well as showering usage rates associated with the showerhead.[12] Union also uses the collected information to assess areas of success and potential improvements.

SeeLine Group worked with municipal housing contacts to arrange site visits for inspections. On-site visits involved an inspection and digital photos of the installed showerheads and aerators in a randomly selected number of units in the building.

Navigant Inc. was contracted to provide a statistically representative random sample at the 90:10 confidence level for the initiative. The final verified results are presented in Table 8.7 below.

Table 8.7 - Adjustment Factors: Free Showerhead Installation Initiative

Measure	Adjustment Factor
Kitchen Faucet Aerator	24.62%
Bathroom Faucet Aerator	24.62%
Energy-efficient Showerhead	53.85%

---

[12] A survey was administered to participants who indicated that they had a second shower for which a low flow showerhead was not installed through Union's Free Showerhead Installation Initiative. SeeLine administered a survey to these participants to gather data on the percent usage of these second showerheads. This data was used to adjust the gas and water savings claimed from these participants.

8.2.3 Low-Income Custom Project Savings Verification

Table 8.8 – Low-Income Custom Project Savings Verification Sample

Description	n (Stratum)	Cumulative Natural Gas (m^3)
Large	8	2,237,487
Small	3	148,181
Very Small	0	0
Total Projects Sampled	**11**	**2,385,668**
Low-Income Custom Total Project Population	25	3,775,242
% of Population Sampled		**63%**

As shown in Table 8.8, Navigant pulled a sample of 11 projects for the 2013 Low-Income Custom Project Savings Verification based on cumulative gas savings strata to achieve a 90:10 confidence interval. All of these projects were verified by Michaels Energy. Of the 11 projects, 10 were verified on-site and one was verified by a telephone interview. For the one project where the consultant determined that no increase in accuracy/confidence would reasonably be expected from a site visit; the consultant documented the rationale and completed the assessment without a site visit.

The sample projects represent 63% of the total population in terms of cumulative natural gas (m^3). In completing the verifications, the focus was to validate whether or not the claimed savings reported through the custom projects were accurate and recommend any adjustment factors to the savings if required. At a high level, the objective of the custom project savings verification is to:

- Determination of whether the natural gas savings calculations in the application were reasonable based on information available at the time of verification;
- Review of the assumptions used in calculations;
- Discussion of variations between the project and savings;
- Recommend adjustment factors based on the variance between the projected and evaluated savings; and
- Verify that the equipment installation was completed at the site.

Low-Income Custom Project Savings Verification Results

Adjustment factors determined through the Low-Income Custom Project Savings Verification are presented in Table 8.9 below. These adjustment factors have been applied to the Low-Income Custom Program savings claims for the purpose of this report.

Table 8.9 - 2012 Low-Income Custom Project Savings Verification Results*

Resource	Claimed Savings	Verification Savings	Realization Rate
Cumulative Natural Gas Savings	**2,385,668**	**2,377,352**	**98%****
Water Savings	0	584,000	100%***
Electricity Savings	0	73,540	100%***
Incremental Cost	$1,609,138	$1,747,420	109%

** The claimed and verified results are represented by the total population.*
***The realization rate for cumulative natural gas savings has been calculated as per the TEC approved Sampling Methodology for Custom C/I Programs prepared by Navigant. Realization rates are calculated for each sample stratum and applied to each respective population for calculating total savings.*
****Adjustments to water and electricity are based on sample realization rates, which were designed to be statistically significant for natural gas only. Union Gas applied the sample realization rates for water and electricity to the population to calculate population savings.*

8.3 Commercial/Industrial Impact Evaluations

Union conducted impact evaluations for the Commercial/Industrial Hot Water Conservation (HWC) initiative as well as the Commercial/Industrial Custom offering to provide confidence that the savings claimed were accurate. All of the sampling for these verification efforts was conducted by Navigant to achieve a 90:10 Confidence Level.

8.3.1 Hot Water Conservation Initiative Impact Evaluation

Union contracted SeeLine Group Ltd. to perform an impact evaluation of the HWC initiative. Union officially exited the HWC initiative at the end of 2012 and did not offer this to customers in 2013. As part of the program exit strategy, Union had a grace period in which it honoured customer submissions to the end of Q1, 2013 for installations completed during Q4, 2012. The impact evaluation completed in 2013 was to verify savings from participants who submitted a claim form during this grace period.

The objective was to provide adjustment factors that can be applied to the claimed savings for units in multi-family buildings. The adjustment factors ensure that the associated savings appropriately reflect installation rates and persistence for all measures, as well as usage rates associated with the installed showerhead.[13]

The HWC initiative offers eligible customers up to two free energy efficient 1.25 GPM showerheads, a 1.5 GPM kitchen aerator and a 1.0 GPM bathroom aerator for applicable units.

SeeLine Group worked with the property managers to arrange site visits for the inspections. On-site visits involved an inspection and digital photo of the installed showerheads and aerators in a randomly selected number of units in the building.

---

[13] A survey was administered to participants who indicated that they had a second shower for which a low flow showerhead was not installed through Union's HWC initiative. SeeLine administered a survey to these participants to gather data on the percent usage of these second showerheads. This data was used to adjust the gas and water savings claimed from these participants.

Navigant Inc. was contracted to provide a statistically representative sample for the HWC initiative. The final verified results for the HWC impact evaluation are presented in Table 8.10.

Table 8.10 - Adjustment Factors: HWC Initiative

Measure	Adjustment Factor
Kitchen Faucet Aerator	54%
Bathroom Faucet Aerator	34%
Energy-efficient Showerhead	88%

8.3.2 Commercial Custom Project Savings Verification

Table 8.11 – Commercial Industrial Custom Project Savings Verification Sample

Description	n (Stratum)	Cumulative Natural Gas (m^3)
Large	7	143,837,435
Medium	7	27,550,998
Small	7	3,605,869
Very Small	0	0
Total Projects Sampled	**21**	**174,994,302**
C/I Custom Total Project Population	472	738,367,150
% of Population Sampled		**24%**

As shown in Table 8.11, Navigant pulled a sample of 21 projects for the 2013 Commercial/Industrial Custom Project Savings Verification based on cumulative gas savings strata to achieve a 90:10 confidence interval. All of these projects were verified by Byron Landry & Associates. All 21 projects were verified on-site. This was stated in the joint Union/Enbridge Custom Project Savings Verification Terms of Reference developed in collaboration with the Technical Evaluation Committee.

The sample projects represent 24% of the total population in terms of cumulative natural gas (m^3). In completing the verifications, the focus was to validate whether or not the claimed savings reported through the custom projects were accurate and recommend any adjustment factors to the savings if required. The objectives of the custom project savings verification are to:

- Determination of whether the natural gas savings calculations in the application were reasonable based on information available at the time of verification;
- Review of the assumptions used in calculations;
- Discussion of variations between the project and savings;
- Recommend adjustment factors based on the variance between the projected and evaluated savings; and
- Verify that the equipment installation was completed at the site.

Commercial/Industrial Custom Project Savings Verification Results

Adjustment factors determined through the Commercial/Industrial Custom Project Savings Verification are presented in Table 8.12 below. These adjustment factors have been applied to the Commercial/Industrial Custom Program savings claims for the purpose of this report.

Table 8.12 - 2013 Commercial/Industrial Custom Project Savings Verification Results*

Resource	Claimed Savings	Verification Savings	Realization Rate
Cumulative Natural Gas Savings	**174,994,302**	**178,844,840**	**97%****
Water Savings	2,221,864	2,369,560	107%***
Electricity Savings	73,358	81,336	111%***
Incremental Cost	$23,636,334	$23,636,334	100%

**The claimed and verified results are represented by the total population.*

***The realization rate for cumulative natural gas savings has been calculated as per the TEC approved Sampling Methodology for Custom C/I Programs prepared by Navigant. Realization rates are calculated for each sample stratum and applied to each respective population for calculating total savings.*

****Adjustments to water and electricity are based on sample realization rates, which were designed to be statistically significant for natural gas only. Union Gas applied the sample realization rates for water and electricity to the population to calculate population savings.*

8.4 Large Volume Custom Project Savings Verification

A sample of 23 custom projects from the Large Volume Rate T1, Rate T2/R100 program was selected for the verification study by Navigant. The new Large Volume scorecard includes two separate metrics, T1 and T2/R100, with a 60% and 40% respective weighting. The TEC approved sampling methodology for the Large Volume program is stratified based on size of projects in terms of cumulative gas savings to achieve a 90:15 confidence interval for each metric and a 90:10 confidence interval overall. Table 8.13 and Table 8.14 summarize the Large Volume Rate T1, Rate T2/R100 sample.

Table 8.13 - Large Volume Custom Project Savings Verification – Rate T1 Sample

Description	n (Stratum)	Cumulative Natural Gas (m^3)
Large	4	98,154,963
Medium	4	11,514,508
Very Small	0	0
Total Projects Sampled	**8**	**109,669,472**
Rate T1 Custom Total Project Population	75	220,504,516
% of Population Sampled		**50%**

Table 8.14 - Large Volume Custom Project Savings Verification – Rate T2/R100 Sample

Description	n (Stratum)	Cumulative Natural Gas (m^3)
Large	6	620,671,951
Medium	7	158,184,082
Small	2	5,000,403
Very Small	0	0
Total Projects Sampled	**15**	**783,856,436**
Rate T2/R100 Custom Total Project Population	145	1,751,754,308
% of Population Sampled		**45%**

The 23 sampled projects represent 50% of the total unadjusted cumulative gas savings of Rate T1 custom projects and 45% of Rate T2/R100 custom projects based on the original claimed savings. On-site verification studies were conducted by Diamond Engineering. In completing this work, the focus was to validate whether or not the claimed savings reported through the custom projects were accurate and recommend any adjustment factors to the savings if required. The objectives of the Custom Project Savings Verification included:

- Determination of whether savings calculations in the application were reasonable based on information available at the time of verification;
- Review of the assumptions used in calculations;
- Discussion of variations between project and savings;
- Recommend adjustment factors based on the variance between the projected and evaluated savings; and,
- Verify that the equipment installation was completed at the site.

Large Volume Custom Project Verification Results

The results of the Large Volume custom project verification are presented in Table 8.15 and Table 8.16 below.

Table 8.15 - 2013 Large Volume Custom Project Verification Study Results* – Rate T1 Sample

Resource	Claimed Savings	Verification Savings	Realization Rate
Cumulative Natural Gas Savings	**109,669,472**	**135,898,076**	**109%****
Water Savings	1,043,159,725	852,130,000	82%***
Electricity Savings	132,533	137,400	104%***
Incremental Cost	5,683,143	5,683,143	100%

** The claimed and verified results are represented by the total population.*
***The realization rate for cumulative natural gas savings has been calculated as per the TEC approved Sampling Methodology for Custom C/I Programs prepared by Navigant. Realization rates are calculated for each sample stratum and applied to each respective population for calculating total savings.*
****Adjustments to water and electricity are based on sample realization rates, which were designed to be statistically significant for natural gas only. Union Gas applied the sample realization rates for water and electricity to the population to calculate population savings.*

Table 8.16 - 2013 Large Volume Custom Project Verification Study Results* – Rate T2/R100 Sample

Resource	Claimed Savings	Verification Savings	Realization Rate
Cumulative Natural Gas Savings	**783,856,436**	**932,314,660**	**106%****
Water Savings	254,399,064	233,710,869	92%***
Electricity Savings	0	0	100%***
Incremental Cost	9,794,624	8,780,325	90%

** The claimed and verified results are represented by the total population.*
***The realization rate for cumulative natural gas savings has been calculated as per the TEC approved Sampling Methodology for Custom C/I Programs prepared by Navigant. Realization rates are calculated for each sample stratum and applied to each respective population for calculating total savings.*
****Adjustments to water and electricity are based on sample realization rates, which were designed to be statistically significant for natural gas only. Union Gas applied the sample realization rates for water and electricity to the population to calculate population savings.*

9. 2013 TEC Evaluation Activities

In the first quarter of 2013, the TEC provided recommendations on evaluation priorities for 2013. Based on these discussions and in light of time available in the calendar year, the committee established a list of top evaluation priorities for 2013. The resulting evaluation activities focused on in 2013 were:

- Custom Free Ridership and Participant Spillover Jurisdictional Review
- Technical Reference Manual
- Custom Net-to-Gross Study
- Custom Project Savings Verification Terms of Reference
- Sampling Methodology for Union's Large Volume Scorecard Verification
- Updates to Current Measure Inputs and Assumptions List

The TEC has authored quarterly reports for public dissemination. The Q1, Q2, Q3, and Q4 Reports can be found in Appendix A for reference.

Custom Free Ridership and Participant Spillover Jurisdictional Review

The TEC received and endorsed the Custom Free-ridership and Participant Spillover Jurisdictional Review completed by Navigant Consulting, Inc. The report aimed to provide insight into the free-ridership and participant spillover variables in comparable jurisdictions across Canada and the United States. A sensitivity analysis was included to ascertain the potential financial impact of changes to net-to-gross (NTG) values for each utility's shareholder incentive.

The jurisdictional review determined that studies done at other utilities are not easily transferrable to Union and Enbridge's custom programs. Factors that determine NTG values differed by utility size and location, types of customers, types of programs, and other factors; and there were not enough studies of situations similar to Union's and Enbridge's to find comparable results. In addition, the study did show that the incentive amounts earned by Union and Enbridge would be affected significantly by the NTG value used. Given that the last NTG study was performed in 2008, the TEC decided that a new NTG study be undertaken beginning in 2013.

Technical Reference Manual

Following a multi-stage selection process, the TEC selected Energy & Resource Solutions (ERS) to develop the Technical Reference Manual (TRM). Common to both utilities, the TRM will document efficiency measure savings assumptions (and/or formulae) and all other assumptions (other than avoided costs) necessary for cost-effectiveness screening and program metrics. The development of the TRM will include a review of all existing prescriptive measure assumptions, as well as an online, searchable repository of approved substantiation document underpinning each approved measure.

The TEC and ERS conducted the TRM kick-off meeting in the second quarter of 2013. Prior to starting a review of any specific measures, ERS developed a measure template for the TEC to review. The measure template will be used for all measures in an effort to standardize the structure of each measure document. Throughout the duration of the project, it was determined that ERS may bring forward new technologies that are not included in the existing list.

The measures that are being reviewed include:

- New Measures (Demand Control Ventilation and High Efficiency Water Heaters)
- Commercial Water Heating
- Multi-Family Water Heating
- Commercial Cooking
- Commercial Space Heating
- Multi-Family Space Heating
- Residential Water Heating
- Residential Space Heating
- Commercial / Multi-Family Other
- Residential Other

The TRM is scheduled for completion in 2014.

Custom Net-to-Gross Study

Following the TEC's decision to pursue a full custom net-to-gross (NTG) study, the TEC highlighted priority questions for proponents and key areas of interest as they relate to the framing, objectives and methodology of the study. The study is expected to recommend NTG values for the utilities' commercial and industrial custom DSM offerings.

TEC members reviewed the 2008 NTG study in an effort to revisit lessons learned and improve the quality of the upcoming study. The TEC decided that the study methodology should be left to the bidder to propose. The TEC finalized the NTG Request for Proposal (RFP) in the fourth quarter of 2013. The RFP instructed the bidders to provide a solution for taking into consideration the differences between Enbridge and Union's custom programs/customers/geographic reach as well as the timing issues related to Union's Large Volume Program.

The TEC received five proposals in the fourth quarter of 2013. The TEC selected DNV GL as the consultant in February 2014 and the study was initiated in March 2014.

Custom Project Savings Verification Terms of Reference

Following input from the utilities' respective auditors and Audit Committees, the TEC revised and updated the joint Terms of Reference for Custom Projects Savings Verifications (CPSV). The Terms of Reference was finalized in the fourth quarter of 2013 and was included in each utility's 2013 CPSV Request for Proposal.

Sampling Methodology for Union's Large Volume Scorecard Verification

Union's 2013 Large Volume scorecard is comprised of two cumulative gas savings metrics, using a 60/40 weighting. Since this was the first time the utility had encountered a scorecard with two different cumulative gas savings metrics for a custom program, Union requested TEC endorsement of a sampling methodology that would incorporate the 60/40 weighting. Union engaged Navigant Consulting for recommended approaches for the sampling methodology, and the TEC ultimately agreed that the appropriate methodology would be one that ensured a 90:10 confidence level at the scorecard level and 90:15 confidence levels at each of the metrics. The TEC agreed that this approach struck the appropriate balance of reliable results and reasonable costs.

Updates to Current Measure Inputs and Assumptions List

The TEC has initiated a comprehensive TRM development project; however for the short-term, the TEC agreed that the Utilities would file an update to the current inputs and assumptions to capture changes based on the 2012 Audit outcomes, new measures, as well as updates to gain consistency on a select number of measures. The Utilities filed a joint submission, as per the current DSM Guidelines, on April 30, 2014 (EB-2013-0430).

10. Status Updates for 2012 Audit and 2012 AC Recommendations

Resource Acquisition Scorecard – Residential Program Recommendations

Recommendation #1

Regarding the current use of natural gas hot water heaters, change all "Don't Know" responses collected through surveys supporting the Energy Savings Kits (ESKs) verification study to "No" responses, and change the adjustment factors for the ESK Residential Push/Pull measures accordingly. The 2012 Auditor recommends using this approach until the Technical Evaluation Committee (TEC) is able to address this issue.

Status Update:

Resolved - This recommendation was brought forward to the TEC for discussion in Q1 of 2014. The two specific questions from the 2011 and 2012 ESK Verification Studies of Union's ESK verification questionnaire from which the "Don't Know" responses resulted was shared with a subcommittee of the TEC. In the opinion of the subcommittee standard best market research practice was followed in these two instances when the "Don't Know" responses were removed from the sample. Several members of the TEC thought that the Auditor was incorrect however no consensus on the issue was achieved at the TEC. The TEC agreed that the treatment of "Don't Know" responses should be recommended by the market research firm up front and ahead of survey deployment. If the Auditor disagrees with the determined treatment, the utilities will work through the matter with their respective Audit Committees.

Recommendation #2

Future residential ESK verification reports should be properly labeled to reflect work conducted. Reports should be labeled as "Verification Study of Union Gas ESKs," not as an audit of ESKs.

Status Update:

Resolved – The AC accepted the Auditor's recommendation in principle, but will title these studies as as "Impact Evaluations" instead of "Verification Studies" on an ongoing basis. Accordingly Union has labelled 2013 ESK studies as impact evaluations.

Recommendation #3

In the Home Retrofit program, Union attributed a 20 year measure life for calculating lifetime savings. An issue was raised about whether an average measure life of 20 years was appropriate given that roughly one-third of the savings were associated with furnace replacements for which savings were calculated relative to the efficiency of the old unit being replaced. For the portion of those furnace replacements that were early retirements, the lifetime of the full estimated savings was probably more like 5 years (with smaller additional savings relative to new 90% AFUE furnace being applicable for the remaining 15 year furnace life that would bump up the savings weighted measure life by several years). For the portion of the furnace replacements that were not early retirements, the savings would have been much smaller (measured relative to a 90% AFUE for a new standard furnace – again, making the savings weighted life considerably less than 20 years for this group). Put simply, the estimated furnace savings are overstated at 20 years. Indeed, the 2012 Auditor estimated that it was reasonable to assume that the effective lifetime of program's estimate of furnace savings in 2012 was 7 years when the proper baseline is taken into account. On the other hand, the life of some other measures installed through the program was longer than 20 years (e.g. insulation measures should have a life of 30 years). The auditor concluded that the combined effects of these measure life assumptions for 2012 was a weighted average of 20 years – i.e. the same as assumed by Union. On this basis the 2012 Auditor recommends accepting Union's claim for 2012 but suggests collecting more furnace data in the future to assess whether the 20 year life remains appropriate.

The 2012 AC recommended a 20 year lifetime for 2012 and 2013 savings. For 2014, the 2012 AC recommended a 15 year measure life for homes undergoing furnace replacements and a 25 year measure life for homes not replacing a furnace as part of the Home Retrofit program.

Status Update:
Resolved - This recommendation does not affect the 2013 Home Retrofit offering results reported in the 2013 DSM Annual Report.

Resource Acquisition Scorecard – Commercial Prescriptive Program Recommendations

Recommendation #4
Union should provide greater detail in how the use of showers in secondary bathrooms is accounted for in the calculation of adjustment factors for the Hot Water Conservation Multi-family sector initiative.

Status Update:
Resolved - The AC accepted the Auditor's recommendation and Union updated the Final 2012 DSM Annual Report accordingly.

Recommendation #5
The incremental cost for space heating and domestic hot water non-condensing boilers between 200 and 300 MBH should be lowered to maintain a consistent trend of increasing incremental cost with increasing boiler size:

- Existing Construction incremental cost should be lowered from $2,114 to $1,883
- New Construction incremental cost should be lowered from $1,544 to $1,313

The incremental cost for domestic hot water non-condensing boilers between 1,000 and 1,500 MBH should be lowered for the same reason:

- Efficiency 83-84% incremental cost should be lowered from $7,400 to $5,850
- Efficiency 85-88% incremental cost should be lowered from $10,300 to $6,700

Status Update:
Pending – Union is in the process of resolving TEC-related recommendations collaboratively with the TEC on a prioritized basis. This recommendation is currently awaiting discussion at the TEC.

Recommendation #6
Within 2 to 5 years non-condensing boiler technology should be revisited as it will no longer make sense to provide incentives. However, since the baseline efficiency of 81% for non-condensing boilers is within the range of efficiencies for most non-condensing makes and models (78-82%), it is appropriate to keep incentives at this time.

Status Update:
Pending - Union is in the process of resolving TEC-related recommendations collaboratively with the TEC on a prioritized basis. This recommendation is currently awaiting discussion at the TEC.

Resource Acquisition Scorecard – Commercial/Industrial Custom Program Recommendations

Recommendation #7
The 2012 Auditor recommended reducing the rating of the steam leak for the largest C/I project to reflect the appropriate severity of the leak. The 2012 Auditor recommends that the effective rating of the two large leaks in question be reduced from a rating of 6 to 3 (out of 10). A leak with a rating of 3 is more likely to sustain for a long period of time in absence of the program. It is quite conceivable that the leaks had been small prior to the "events" that occurred and that they may have continued to be ignored had the gaskets not further failed.

Status Update:
Resolved - The 2012 AC disagreed in principle with basing savings on an assumption that is known to be factually incorrect, and agrees that going forward auditors will be instructed to base all recommendations on verifiable facts.

Recommendation #8
The 2012 Auditor recommended decreasing the EUL for Industrial Control Programming measures from 20 years to 15 years to match the value used for Commercial Controls Systems. This measure involves reprogramming and relocating thermostats. Even though the thermostats have been moved out of reach to avoid tampering, the measure is essentially a "comfort heating" one, so the EUL should not exceed the EUL of commercial building controls, which, according to Union's Custom Offering EUL and Base Case Assumptions document, is 15 years.

Status Update:
Pending – Union is in the process of resolving TEC-related recommendations collaboratively with the TEC on a prioritized basis. This recommendation is currently awaiting discussion at the TEC.

Recommendation #9
The 2012 Auditor recommended correcting the change in temperature for one control measure used to reflect the weighted/blended value for the ex-post savings. The delta T for the post case should use the weighted/blended value for the set temperature to account for both weekday and weekend settings (71° F) instead of 72° F, which is the weekday setting.

Status Update:
Resolved - The 2012 AC accepted the Auditor's recommendation. This recommendation increased project level cumulative natural gas savings for one audited project by a total of 1,311,688 m3 from the verified savings value. New realization rates were calculated based on a stratification of this finding and were applied to the entire custom project C/I portfolio.

Recommendation #10
The 2012 Auditor recommended changing the baseline efficiency for a repaired boiler to 75% to reflect the age of the boiler. The efficiency used for the baseline boiler was too high for a boiler of that type (80%). A baseline boiler efficiency of 75% is more appropriate given the type of the boiler. The 2012 AC did not agree with the 2012 Auditor's recommendation. The 2012 AC agreed with the 2012 CPSV contractor that the most reasonable baseline is replacement of the red-tagged boiler with a standard efficiency boiler.

Status Update:
Resolved – The 2012 AC did not agree with the Auditor's resolution. The AC agreed with the CPSV contractor that the most reasonable baseline is replacement of the red-tagged boiler with a standard boiler efficiency boiler. Therefore, the verified savings were reduced by the amount of the Auditor's increase (2,691,268 m3). New realization rates were calculated based on a stratification of this finding and were applied to the entire custom project C/I portfolio.

Recommendation #11
The 2012 Auditor recommended decreasing the EUL for one specific Industrial Control Programming measure from 15 to 10 years. The EUL for an Industrial Control Programming measure should not exceed the EUL of commercial building controls, which, according to Union's Custom Offering EUL and Base Case Assumptions document, is 15 years. Since the building automation system this project was already five years old, the 2012 Auditor discounted the EUL by 5 years to yield a 10 year EUL.

Status Update:
Resolved – The 2012 AC accepted the Auditor's recommendation for the purpose of the 2012 audit. This recommendation decreased project-level cumulative natural gas savings for one audited project by a total of 1,197,757 m3 from the verified savings value. New realization rates were calculated based on a stratification of this finding and were applied to the entire 2012 custom project C/I portfolio.

Recommendation #12
The 2012 Auditor recommended increasing the EUL for two specific Industrial Control Programming measures from 12 years to 15 years to match the value used for Commercial Controls Systems. The EUL for an Industrial Control Programming measure should be consistent with the EUL of commercial building controls, which, according to Union's Custom Offering EUL and Base Case Assumptions document, is 15 years.

Status Update:
Resolved – The 2012 AC accepted the Auditor's recommendation for the purpose of the 2012 audit. This recommendation increased project-level cumulative natural gas savings for two audited projects by

a total of 2,944,297 m3 from the verified savings value. New realization rates were calculated based on a stratification of this finding and were applied to the entire 2012 custom project C/I portfolio.

Recommendation #13
Union's sampling consultant should either not retroactively reclassify sample points to other strata or if so explain the rationale for this reclassification.

Status Update:
Resolved – For the 2012-2014 DSM Framework, Auditors are to accept the TEC approved sampling methodology as presented to them but that qualitative discussion on the issue can be included in the Audit report.

Recommendation #14
In future audits, the sampling consultant should provide more details about their definition of the 90% one-sided confidence interval and more details about calculations, such as showing the absolute errors.

Status Update:
Resolved – For the 2012-2014 DSM Framework, Auditors are to accept the TEC approved sampling methodology as presented to them but that qualitative discussion on the issue can be included in the Audit report.

Recommendation #15
Union should confirm with the sampling consultant that the sample within each stratum is truly randomly selected with equal probability of selection and without bias. The 2012 Auditor was concerned that smaller sites within strata may have been omitted from the sample selection process. While the sampling consultant did this with the "Very Small" stratum, and reported that they did this, it would be inappropriate to sample within each stratum non-randomly. However, there is no evidence that the sampling consultant biased the selection in this way apart from the "Very Small" stratum.

Status Update:
Resolved – For the 2012-2014 DSM Framework, Auditors are to accept the TEC approved sampling methodology as presented to them but that qualitative discussion on the issue can be included in the Audit report.

Recommendation #16
Union should include a note in the annual report that adjustments to water and electricity are based on sample realization rates, which were designed to be statistically significant for natural gas. Union Gas applied the sample realization rates for water and electricity to the population to calculate population savings. Although this is not the appropriate approach to assessing population savings based on a sample, since these results are not used in financial calculations, there is no impact on LRAM or performance incentives.

Status Update:
Resolved –. For the 2012-2014 DSM Framework, Auditors are to accept the TEC approved sampling methodology as presented to them but that qualitative discussion on the issue can be included in the Audit report.

Low-Income Scorecard – Custom Program Recommendations

Recommendation #17
Union should consider further study of appropriate EUL for energy efficient windows. The 2012 Auditor studied sources for approved EUL values, including reviewing the EULs recently approved for energy efficient windows by the Regional Technical Forum (RTF). The 2012 Auditor found the RTF has approved an EUL of 25 years for energy efficient windows applied to manufactured homes and 45 years for single family homes. The 2012 Auditor found the range of 20-25 years as being not unreasonable.

Status Update:
Resolved - The 2012 AC accepted the 2012 Auditor's recommendation.

Large Industrial Rate T1 and Rate 100 Scorecard – Custom Program Recommendations

Recommendation #18
Moving forward, Union should use the point value calculated by the Verification Consultant to determine population-level impacts instead of the sample mid-point. The Verification Consultant provided a high and low estimate for annual gas savings for 6 of 17 verified Large Industrial projects. The average of the range was used to calculate gas savings. As some ranges are asymmetrical, some estimates of cumulative gas were not based on the estimate that the Verification Consultant reported. These numbers were provided to the Sampling Consultant to calculate population savings. Upon review, the impact of using the point estimate on the sample realization rate and cumulative natural gas savings resulted in a decrease of less than 0.01% and 0.4% respectively. This will likely not have any material impact on the population realization rate. The 2012 Auditor accepts the findings but in the future Union should use the point value calculated by the Verification Consultant to determine population-level impacts.

Status Update:
Resolved – The 2012 AC accepted the 2012 Auditor's recommendation for the purposes of 2012. With respect to future CPSV RFPs (2013 and onwards) Union will request that the verifier provide a point estimate to be used for the purposes of the audit.

Recommendation #19
Union should reduce the savings for heat exchangers in custom Large Industrial Rate T1/Rate 100 projects by 50% to account for the uncertainty around baselines and the degradation of savings over time.

Status Update:
Resolved - The 2012 AC accepted the 2012 Auditor's recommendation for the purpose of the 2012 audit. New realization rates were calculated based on a stratification of these audit findings and were

applied to the entire Large Industrial Rate T1/Rate 100 portfolio. This resulted in a decrease of 63,315,091 cumulative m3 to the Large Industrial scorecard. However, the corresponding affect on DSM incentive is above the $1.807M cap and, as such did not alter the DSM incentive earned for this scorecard in 2012.

All 2012 AC members agreed that savings cannot be calculated without the collection of adequate baseline information. In custom projects, savings will not be recognized in the future without collecting baseline information that can support savings estimates.

For projects that involve savings degradation, Union will instruct all relevant staff and evaluators that degradation must be taken into account in savings calculations.

Where the conservation measure is of a behavioural or maintenance nature, the information about the customer's current practises (prior to participation in the program) must be collected. For example for steam leak repairs the rules being used by the customer or their schedule for repairing steam leaks, and at what pace steam leaks are being repaired before Union's involvement must be established.

Market Transformation (Optimum Home) Scorecard Recommendations

Recommendation #20
Union should shift one Optimum Home builder from the Top 10 Builder metric to the Top 50 Builder metric within the 2012 Market Transformation scorecard. This decreases the number of builders in the Top 10 to 3 and increases the number of builders in the Top 50 to 8.

Status Update:
Resolved - This recommendation impacted 2012 DSM program results only. Union shifted one builder as recommended when reporting its final 2012 DSM program results.

Recommendations Brought Forward by the 2012 Auditor and the 2012 AC That Reflect Audit Process Issues

Recommendation #21
In future studies, Union should request that Verification Consultants use zero decimal places when reporting verified gas savings in order to match number of decimal places used in original claim. One Verification Consultant used 3 significant decimal points whereas the reported savings values were rounded to zero decimal points. This approach resulted in different cumulative gas savings when reported and verified annual savings appeared identical. The impact of using this approach was a 0.5% increase in cumulative savings. The 2012 Auditor accepts the verified savings for these projects but recommends using zero decimal places in annual gas savings to match original values in future studies.

Status Update:
Resolved - This recommendation was brought forward to the TEC for discussion and resolution in Q1 of 2014. The TEC agreed that the verification consultant should not use decimal places when reporting verified gas savings. The TEC also agreed that the verification consultant should use best engineering

practice and round to the number of significant figures that carries meaning in contributing to the precision of the verified gas savings.

Recommendation #22
More detailed project documentation should be required for claiming savings to avoid having to make assumptions about unverifiable parameters that have substantial effects on the savings estimates (e.g. gasket type, thickness and extent and duration of rupture for steam leaks, etc.). Photographs and physical evidence would be extremely valuable.

Status Update:
Resolved – The 2012 AC accepted the 2012 Auditor's recommendation and Union notes that documentation improvements have already been implemented. Union will continue to refine the custom project data collections process.

Recommendation #23
Require Union to collect specific information for custom projects of the same type. Since many custom projects are similar, including insulation repair, steam leak repair, and steam trap repair, Union should require specific information be collected before repairs are started. This could be easily incorporated into any scope of work associated with these projects and make estimating energy savings simpler and more accurate.

Status Update:
Resolved –Union accepts the Auditors recommendation and notes that documentation improvements have already been implemented. Union will continue to refine the custom project data collections process.

Recommendation #24
Union should require the customer to provide more detailed information on the base case for custom projects of a certain absolute savings size (e.g. 1 million m3) to better quantify conditions before and after the measure's implementation. Union could involve an evaluator at pre-implementation stage for these projects to review savings calculations and assumptions, determine baseline, and set up an M&V plan for data collection.

Status Update:
Resolved - Union accepts the Auditors recommendation and notes that project documentation quality control improvements is an ongoing process and will work on collecting detailed data whenever possible.

Recommendation #25
Union should develop better EULs for control settings. Union should continue to investigate how best to handle EULs for controls settings in commercial and industrial settings and provide clear and consistent guidelines.

Status Update:

Pending - Union is in the process of resolving TEC-related recommendations collaboratively with the TEC on a prioritized basis. This recommendation is currently awaiting discussion at the TEC.

Recommendation #26

Union should clarify CPSV roles for Verification Consultants and Auditors. The role of the Auditor includes reviewing draft findings with Verification Consultants before CSPV reports are finalized and shared with the AC Team. There is confusion about roles of CPSV Verification Consultants and the Auditor and some Verification Consultants refer to their work as audits. The 2012 Auditor sees the most practical CPSV role as balancing:

- Simpler verification for projects conducted in the program year. Verify installation and operating conditions and update assumptions with better data and limited measurement.
- More comprehensive evaluation for projects carried over from the previous program year to allow more time to evaluate. Include a greater degree of billing analysis and independent estimation approaches.
- Require more details on baselines for projects of a certain savings level (e.g. 1 million m3). Union could involve an evaluator at pre-implementation stage for these projects to review savings calculations and assumptions, determine baseline, and set up an M&V plan for data collection.

Status Update:

Resolved - The 2012 AC did not necessarily agree with all solutions provided by the 2012 Auditor but Union worked with the TEC to review these recommendations to refine and standardize the process. As a result new Terms of Reference for the 2013 Custom Project Savings Verification process were developed and implemented by the utilities.

Recommendation #27

Include all formulas in the Audit Tool if they cannot be directly verified in the verification report. For ESK adjustment factors, the factors found within the audit tool were not linked back to its source data; confirming appropriate calculation of adjustment factors required review of data not provided within the audit tool.

Status Update:

Resolved –Union's audit tool maintains a clear link between all source data (survey results, impact evaluation results, program results, etc.) and calculated values.

Recommendation #28

Develop guidelines about how to differentiate issues related to baselines, EUL, and free riders.

Status Update:

Resolved - This recommendation was brought forward to the TEC for discussion and resolution in Q1 of 2014. The TEC agreed that issues related to baselines, EUL and free riders will be dealt with in the next generation framework as the current Natural Gas DSM Guidelines provide provision on how to deal with these issues.

Recommendation #29
Union should not use vendor's energy savings calculations for rebates unless independently verified. Vendor calculators include spreadsheets or other packaged calculators that take a few inputs and output expected savings. The source code and calculation methods are often not transparent; their purpose is to sell a particular product, not to accurately determine energy savings and thus they are often wildly optimistic.

Union Gas developed eight custom calculators for use in assessing savings. The 2012 Auditor briefly reviewed the calculators by following the code and found that the calculators are acceptable tools.

Status Update:
Resolved - Union continues to use its custom savings calculators and limits vendor tools. In instances where Union's calculators are not able to provide savings calculations, Union relies upon best available information to calculate savings provided that this information is independently corroborated.

Recommendation #30
The 2012 Auditor recommends conducting additional marketing and outreach directed at homeowners as part of the Optimum Home program. Increasing homeowners' awareness of the program could be an additional metric to track. This would involve a baseline survey followed by annual surveys measuring any increase in homeowner awareness. While the 2012 Auditor agrees that builders should be the top priority, the goal of the program is to transform the entire market.

Status Update:
Resolved - The 2012 AC collectively disagreed with the 2012 Auditor on this recommendation. The existing program elements are detailed in the settlement agreement and the focus on builders was intentional. The 2012 AC considers this recommendation to be a program design issue not an Audit issue.

Recommendation #31
The 2012 Auditor noted as follows: "Some custom projects were completed before 2012, but these projects had not been previously claimed and Union wanted to wait until they had more data on post-installation in order to increase the accuracy of the savings results". The intervenor members of the 2012 AC expressed a concern that this may not be consistent with the assumptions underlying the DSM Framework.

Status Update:
Resolved - The 2012 AC agreed that this practice can continue in the current manner for 2013 and 2014, but that an express protocol with respect to timing of recognition of projects should be included in the next DSM Framework.

11. Lost Revenue Adjustment Mechanism

The Board approved Lost Revenue Adjustment Mechanism (LRAM) allows Union to recover the lost distribution revenues associated with DSM activity. These lost revenues are calculated for each rate class impacted by DSM energy efficiency programs using the following formula:

$$\Sigma(\text{Rate Class Volume Reduction x 2013 Delivery Rate}) = \text{LRAM Claimed}$$

Under the Guidelines, LRAM is calculated on a monthly basis using the volumetric impact of the measures implemented in that month. This approach ensures that LRAM amounts closely reflect the actual timing of the implementation of the DSM measures.

For 2013, the LRAM amount of $1.138 million is based on 2013 delivery rates and annual natural gas savings of 126.5 million m^3. The 2013 LRAM statement is detailed in Table 11.0 on the following page.

Table 11.0 - 2013 LRAM Statement

Rate class	DSM Volumes (10^3 m^3)												Total Volumes (10^3 m^3)	2013 Delivery Rates ($/$10^3$ m^3)	Revenue Impact ($)
	January	February	March	April	May	June	July	August	September	October	November	December	(a)	(b)	(a) x (b)
South															
M1 Residential	828	97	153	152	116	128	184	190	210	156	33	21	2,267	$38.14	$86,465
M1 Commercial	895	96	116	58	96	144	69	96	77	95	90	8	1,839	$38.14	$70,144
M1 Industrial	36	10	4	7	0	0	2	0	13	4	4	1	81	$38.14	$3,094
M2 Commercial	2,928	407	203	423	145	204	186	449	292	142	188	14	5,579	$45.85	$255,814
M2 Industrial	374	51	27	20	120	292	0	58	17	29	81	7	1,076	$45.85	$49,340
M4 Industrial	2,966	524	331	61	505	544	136	184	105	51	79	219	5,704	$9.56	$54,541
M5 Industrial	9,685	419	49	107	141	335	626	138	262	148	66	24	12,000	$22.00	$263,985
M7 Industrial	0	0	0	6	0	4	0	978	800	0	0	0	1,788	$3.15	$5,625
T1 Industrial	2,933	845	0	174	1,271	437	9	403	466	73	130	24	6,765	$0.71	$4,817
T2 Industrial	49,970	3,857	2,747	1,635	4,244	527	1,991	2,620	1,234	1,464	860	0	71,148	$0.08	$5,550
South Total	**70,614**	**6,306**	**3,630**	**2,643**	**6,637**	**2,616**	**3,202**	**5,115**	**3,476**	**2,161**	**1,531**	**317**	**108,249**		**$799,374**
North															
01 Residential	138	9	23	35	12	17	15	13	20	9	8	3	302	$119.99	$36,254
01 Commercial	179	10	205	35	18	4	24	22	21	21	17	4	560	$113.74	$63,710
10 Commercial	985	243	219	193	46	25	110	32	150	14	4	2	2,025	$77.84	$157,644
10 Industrial	142	0	99	0	7	259	0	0	0	0	0	9	516	$72.68	$37,530
20 Industrial	2,920	73	124	38	0	141	272	17	24	24	33	0	3,667	$5.36	$19,640
100 Industrial	3,163	441	490	545	1,492	298	3,069	52	657	1,006	9	0	11,223	$2.14	$23,983
North Total	**7,527**	**777**	**1,161**	**847**	**1,575**	**746**	**3,490**	**136**	**871**	**1,074**	**72**	**19**	**18,293**		**$338,761**
Total	**78,142**	**7,083**	**4,790**	**3,490**	**8,212**	**3,362**	**6,692**	**5,251**	**4,348**	**3,234**	**1,603**	**336**	**126,542**		**$1,138,136**

The 2013 LRAM statement is prepared by using the best available input assumptions at the time of the audit. These inputs include measure-level gas saving assumptions, participant numbers and measure install month. Install date and participation numbers are captured by Union's internal databases. Savings assumptions are found in Appendix B.

12. DSM Incentives

For 2013, Union is eligible to earn a shareholder incentive based on its performance against DSM targets presented within four separate scorecards: Resource Acquisition; Low-Income; Large Volume Rate T1, Rate T2/R100; and Market Transformation. The target incentive for each scorecard is detailed in Table 12.0.

Table 12.0 – Target 2013 DSM Incentives per Scorecard

Scorecard	Target DSM Incentive	
Resource Acquisition	$	2,237,786
Large Industrial Rate T1, Rate T2/R100	$	723,506
Low-Income	$	1,091,400
Market Transformation	$	220,104
Total	**$**	**4,272,796**

The DSM incentive payments earned by Union for each scorecard is calculated using the methodology approved by the Board in EB-2011-0327:

- No incentive will be provided for achieving a scorecard weighted score of less than 50%;
- Union will earn 40% of the DSM incentive for achieving a scorecard weighted score of 100%, with the remaining 60% available for performance up to the 150% target level;
- Scorecard results will be linearly interpolated between the scorecard metric target levels; The incentive amount will be capped at the scorecard weighted score of 150%.

Union's 2013 results for each scorecard are presented in Tables 12.1, 12.2, 12.3, and 12.4 below.

Table 12.1 – 2013 Results - Resource Acquisition Scorecard

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Cumulative Natural Gas Savings (m^3)	639,840,620	853,120,826	1,066,401,033	90%	920,774,950	116%	104%
Deep Savings – Residential	120	160	200	5%	203	154%	7.7%
Deep Savings - C/I	9.36%	10.36%	11.36%	5%	8.97%	31%	2%
						Total Scorecard Target Achieved	113%
						Scorecard Incentive Achieved	$3,143,206

Table 12.2 – 2013 Results - Low-Income Scorecard

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Cumulative Natural Gas Savings from Single Family (m^3)	19,500,000	26,000,000	32,500,000	60%	40,236,650	210%	126%
Cumulative Natural Gas Savings from Multi-Family (m^3)	13,200,000	17,600,000	22,000,000	40%	15,267,883	73%	29%
						Total Scorecard Target Achieved	***150%***[14]
						Scorecard Incentive Achieved	***$2,728,501***

Table 12.3 – 2013 Results - Large Volume Rate T1, Rate T2/R100 Scorecard

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
Rate T1 Cumulative Natural Gas Savings (m3)	150,477,098	200,636,131	250,795,164	60%	180,388,329	80%	48%
Rate T2 / Rate100 Cumulative Natural Gas Savings (m3)	821,502,546	1,095,336,728	1,369,170,910	40%	1,664,166,592	204%	82%
						Total Scorecard Target Achieved	***129%***
						Scorecard Incentive Achieved	***$ 1,362,407***

Table 12.4 – 2013 Results - Market Transformation Scorecard

Metrics	Metric Target Levels			Weight	Achievement	% of Metric Achieved	Weighted % of Scorecard Achieved
	Lower Band	Target	Upper Band				
New Participating Builders	6	8	15	60%	8	100%	*60%*
Prototype Homes Built	20%	30%	40%	40%	63%	266%	*106%*
						Total Scorecard Target Achieved	*150%*[15]
						Scorecard Incentive Achieved	*$550,259*

Union achieved a total of $7.784 million in DSM incentives as a result of its program performance results in 2013 as shown on the following page in Table 12.5.

---

[14] Actual scorecard achievement result is 155%. Maximum achievement is capped at 150%.

[15] Actual scorecard achievement result is 166%. Maximum achievement is capped at 150%.

Table 12.5 – Summary of 2013 DSM Incentives Achieved

Scorecard	DSM Incentive Achieved
Resource Acquisition	$ 3,143,206
Large Industrial Rate T1, Rate T2/R100	$ 1,362,407
Low-Income	$ 2,728,501
Market Transformation	$ 550,259
Total	**$ 7,784,373**

The Market Transformation scorecard and the Low-Income scorecard each achieved its respective maximum incentive. The DSM incentive breakdown by rate class is shown in Table 12.6 below.

Table 12.6 – Breakdown of DSM Incentive by Rate Class

Line No.	Rate Class	2013 Amount
	South	
1	M1	$ 3,323,745
2	M2	$ 1,045,315
3	M4	$ 459,787
4	M5	$ 462,424
5	M7	$ 78,035
6	T1	$ 439,804
7	T2	$ 588,821
8		**$ 6,397,931**
	North	
9	Rate 01	$ 567,478
10	Rate 10	$ 275,787
11	Rate 20	$ 209,395
12	Rate 100	$ 333,782
13		**$ 1,386,442**
14	**Total**	**$ 7,784,373**

13. Budget

Union's 2013 DSM Budget as approved by the Board was $31.6 million. The total spend for 2013 was $32.8 million.

13.1 Budget Overspend

As per the Guidelines, Union can spend above the approved annual DSM budget to allow it to aggressively pursue DSM programs that are successful. The total amount of the overspend must not exceed 15% of the total DSM budget, and can only be used on scorecards once they have achieved their weighted scorecard target (i.e. 100%) on a pre-audit basis.

As part of the EB-2011-0327 Settlement Agreement ("the Settlement"), Union filed a 2013 DSM budget allocation for the 2013 Residential, Commercial/Industrial, Low-Income and Market Transformation programs.[16] As part of EB-2012-0337, Union filed a DSM budget allocation for the Large Volume program. In all filings, 2013 budgets were reported based on 2012 budgets and an assumed inflation factor. Actual 2013 budgets reflect an updated inflation factor, as described in Section 2.3 of the Settlement.

Parties within the Settlement agreed that actual spending would be limited to an increase of 100% of the budgeted amount in any rate class (not including Rate T1, Rate T2/R100). As outlined in EB-2012-0337, a maximum of $0.500 million of the program budget allocated to Rate T1, Rate T2 or Rate 100 can be transferred to Rate T1, Rate T2 or Rate 100 respectively. Union adhered to this guideline and the overall under spend following this transfer allocation for the Large Volume program is credited in the DSMVA. In addition, Union did not transfer budget dollars from any other part of the overall DSM budget into Rate T1, Rate T2 or Rate 100 rate classes. The Guidelines require Union to inform the Board and stakeholders if cumulative fund transfers between DSM programs exceed 30% of the approved annual DSM budget for an individual natural gas DSM program. In 2013, Union surpassed the weighted scorecard target on a pre-audit basis on all four scorecards. The overspend was used for the Resource Acquisition and Low-Income scorecards. The overspend adhered to all overspend rules for the two scorecards, and Union did not transfer more than 30% of the approved annual DSM budget between programs.

13.2 Integrated Energy Management Systems Spend

The $0.631 million budget associated with Integrated Energy Management Systems (IEMS) was allocated according to the provisions in section 6.1 of the Settlement. If any of this budget was not spent, it could be transferred to another program on the basis that Resource Acquisition target would be

---

[16] For continuity, the Settlement also included budgets for a 2013 Large Industrial Rate T1 and Rate 100 program but stated that "Participating Parties [of the Settlement] have agreed that the DSM Plan for 2013 and 2014 relating to Large Industrial Rate T1 Rate 100 will not be included in this Agreement, and Union hereby withdraws its request for approvals of that part of its Plan as set forth in the Application. Union agrees to file a new application and evidence with the Board supporting a Large Industrial Rate T1 / Rate 100 DSM plan for 2013..." Union filed EB-2012-0337, which sought approval of the Large Volume Rate T1, Rate T2 and Rate 100 program for the years 2013 and 2014.

increased by 150 m^3 for every dollar transferred in excess of 50% of the IEMS budget. Otherwise, the unspent amount would be returned to ratepayers.

In 2013, Union spent $0.185 million on the IEMS initiative, or less than 50% of the 2013 IEMS budget. The remaining $0.446 million was not transferred to another program, and was returned to ratepayers.

13.3 Evaluation Spend

As part of the Settlement, Parties agreed to a budget of $1.129 million plus inflation for evaluation spend, including portfolio evaluation and specific program evaluation. If any of this budget was not spent, it could not be transferred elsewhere and would be returned to ratepayers.

In 2013, the evaluation budget was $1.187 million. Union spent $0.465 million on portfolio evaluation and $0.440 million on specific program evaluation, for a total evaluation spend of $0.905. The remaining $0.283 million will be returned to ratepayers.

13.4 Spend and Budget Summary

Table 13.0 tracks the variance between 2013 spend and budget. Total DSMVA amount is $1,197,648.

Table 13.0 – Summary of 2013 Spend and Budget

	2013 Spend	2013 Budget	Variance	Budget Transfers	Total DSMVA
	A	B	C=A-B	D	E=C-D
Program Budget					
Resource Acquisition Scorecard					
Residential Program Incentives/Promotion/Admin	$3,311,807	$3,304,558	$7,249		$7,249
Residential Evaluation	$60,350	$21,031	$39,319	$39,319	$0
Commercial/Industrial Incentives/Promotion/Admin	$12,274,671	$10,725,092	$1,549,579	$300,000	$1,249,579
Commercial/Industrial Evaluation	$127,592	$63,092	$64,500	$64,500	$0
IEMS	$184,745	$630,922	-$446,177	-$300,000	-$146,177
Large Volume Scorecard (Rate T1, T2/R100)					
Large Volume T1 Incentives/Promotion	$1,303,430	$1,266,514	$36,916	$36,916	-$0
Large Volume T2/R100 Incentives/Promotion	$2,652,682	$2,505,350	$147,332	$147,332	$0
Large Volume T1/T2/R100 Administration	$750,796	$953,230	-$202,434	-$184,248	-$18,186
Large Volume T1/T2/R100 Evaluation	$32,045	$42,061	-$10,016	-$10,016	$0
Low-Income Scorecard					
Low-Income Program Incentives/Promotion/Admin	$7,822,935	$7,149,140	$673,795		$673,795
Low-Income Evaluation	$219,938	$42,060	$177,878	$177,878	$0
Market Transformation Scorecard					
Optimum Home Incentives/Promotion/Admin	$944,661	$1,450,255	-$505,594	-$219,546	-$286,048
Programs Sub-total	**$29,685,652**	**$28,153,305**	**$1,532,347**	**$52,135**	**$1,480,212**
Portfolio Budget					
Research	$835,349	$805,692	$29,657	$29,657	$0
Evaluation	$464,788	$1,019,032	-$554,244	-$271,681	-$282,563
Administration	$1,853,137	$1,663,249	$189,888	$189,889	-$1
Portfolio Sub-total	**$3,153,274**	**$3,487,973**	**-$334,699**	**-$52,135**	**-$282,564**
Total 2013 DSM Budget	**$32,838,926**	**$31,641,278**	**$1,197,648**	**$0**	**$1,197,648**

14. 2014 Scorecards

The 2014 scorecard metrics for the Low-Income, Market Transformation, Large Volume Rate T1, Rate T2/R100, and Resource Acquisition scorecards are provided below. The Low-Income and Market Transformation scorecards, shown in Tables 14.0 and 14.1, are as outlined in the Settlement.

Table 14.0 – 2014 Low-Income Scorecard

Metric	Metric Target Levels			Weight
	Lower Band	Target	Upper Band	
Cumulative Natural Gas Savings from Single Family (m^3)	19,500,000	26,000,000	32,500,000	60%
Cumulative Natural Gas Savings from Multi-Family (m^3)	13,200,000	17,600,000	22,000,000	40%

Table 14.1 – 2014 Market Transformation Scorecard

Metric	Metric Target Levels			Weight
	Lower Band	Target	Upper Band	
New Participating Builders	2	4	10	40%
Prototype Homes Built	50% of participating builders	60% of participating builders	70% of participating builders	40%
Homes Built (>20% above OBC 2012) by Participating Builders	3%	6%	9%	20%

Derivation of the 2014 Large Volume scorecard per the EB-2012-0337 Decision is provided in Table 14.2.

Table 14.2 – 2014 Large Volume Rate T1, Rate T2/R100 Scorecard

Metric	Metric Target Levels			Weight
	Lower Band	Target	Upper Band	
Rate T2/R100 Cumulative Natural Gas Savings (m^3)	75% of target	Three-year rolling average (2011-2013) post-audit Rate T2/R100 customer incentive cost effectiveness (m^3 per customer incentive dollar spent) × (2014 customer incentive budget for Rate T2/R100)	125% of target	40%
Rate T1 Cumulative Natural Gas Savings (m^3)	75% of target	Three-year rolling average (2011-2013) post-audit Rate T1 customer incentive cost effectiveness (m^3 per customer incentive dollar spent) × (2014 customer incentive budget for Rate T1)	125% of target	60%

The rolling three year cost effectiveness and 2014 customer incentive budgets are provided in Table 14.3.

Table 14.3 – Cost Effectiveness and Customer Incentive Budgets Used for the 2014 Large Volume Scorecard Target Setting

Rate Class	2011 Cost Effectiveness	2012 Cost Effectiveness	2013 Cost Effectiveness	Three-year Average Cost Effectiveness	2014 Customer Incentive Budget
Rate T2/R100	346.88	360.35	627.35	444.86	$ 2,383,000
Rate T1	129.58	286.07	151.49	189.05	$ 1,104,000

The 2014 Large Volume scorecard is thus as shown in Table 14.4.

Table 14.4 – 2014 Large Volume Scorecard

Metric	Metric Target Levels			Weight
	Lower Band	Target	Upper Band	
Rate T2/R100 Cumulative Natural Gas Savings (m^3)	795,074,195	1,060,098,927	1,325,123,659	40%
Rate T1 Cumulative Natural Gas Savings (m^3)	156,530,251	208,707,001	260,883,751	60%

The 2014 Resource Acquisition Scorecard metrics are based upon Union's performance results of 2013 as shown in Table 14.5.

Table 14.5 – Metric-Setting Methodology - 2014 Resource Acquisition Scorecard

Metrics	Metric Target Levels			Weight
	Lower Band	Target	Upper Band	
Cumulative Natural Gas Savings (m^3)	75% of target	2013 Post-audit scorecard cost effectiveness (m^3 per promotion and incentive dollar spent) times $10.684M times 1.02	125% of target	90%
Deep Savings - Residential (Homes)[17]	2014 target minus 50 homes	2013 actual times 1.25	2014 target plus 50 homes	5%
Deep Savings - C/I (% of Baseline Consumption)	The higher of i) 2013 actual ii) 4.5%	The higher of i) 2013 actual + 1% ii) 5.5%	The higher of i) 2013 actual + 2% ii) 6.5%	5%

---

[17] In the event the calculated 2014 target (2013 Actual times 1.25) is lower than the 2012 target (160 homes), the 2014 metric target levels will become the 2012 targets (lower band: 120, target: 160, upper band: 200).

The 2014 Resource Acquisition cost-effectiveness factor is 72.32 as shown in Table 14.6.

Table 14.6 – 2013 Resource Acquisition Cost Effectiveness Factor

Program	Promotion & Incentive Budget Spend (a)	Cumulative Natural Gas Savings (m^3) (b)	Cost Effectiveness (m^3/$) (c) = (b)/(a)
Commercial Prescriptive	$ 4,641,749	272,204,417	58.64
Commercial Custom	$ 1,350,994	102,567,855	75.92
Small Industrial Custom	$ 3,912,268	510,276,879	130.43
Commercial/Industrial Program Total	$ 9,905,011	885,049,151	89.35
Residential Program	$ 2,827,593	35,725,799	12.63
Resource Acquisition Total	$12,732,604	920,774,950	72.32

The 2014 Resource Acquisition scorecard is thus as shown in Table 14.7.

Table 14.7 – 2014 Resource Acquisition Scorecard

Metrics	Metric Target Levels			Weight
	Lower Band	Target	Upper Band	
Cumulative Natural Gas Savings (m^3)	591,060,012	788,080,016	985,100,020	90%
Deep Savings - Residential (Homes)	204	254	304	5%
Deep Savings - C/I (% of Baseline Consumption)	8.97%	9.97%	10.97%	5%

14.1 2014 Avoided Costs

The Avoided Costs for 2014 are found in Table 14.8.

Table 14.8 – 2014 Avoided Costs

Gas Avoided Costs						
	Residential and Commercial				Industrial	
	Baseload (\$/m^3)		Weather Sensitive (\$/m^3)		Baseload (\$/m^3)	
	Rate	NPV	Rate	NPV	Rate	NPV
1	\$0.1753	\$0.1753	\$0.1908	\$0.1908	\$0.1723	\$0.1723
2	\$0.1802	\$0.3424	\$0.1969	\$0.3733	\$0.1723	\$0.3321
3	\$0.1693	\$0.4878	\$0.1828	\$0.5303	\$0.1730	\$0.4806
4	\$0.1694	\$0.6226	\$0.1830	\$0.6760	\$0.1628	\$0.6102
5	\$0.1715	\$0.7492	\$0.1854	\$0.8127	\$0.1649	\$0.7319
6	\$0.1738	\$0.8680	\$0.1878	\$0.9411	\$0.1670	\$0.8461
7	\$0.1760	\$0.9795	\$0.1902	\$1.0616	\$0.1692	\$0.9533
8	\$0.1783	\$1.0842	\$0.1926	\$1.1747	\$0.1714	\$1.0540
9	\$0.1806	\$1.1825	\$0.1951	\$1.2809	\$0.1736	\$1.1485
10	\$0.1829	\$1.2748	\$0.1976	\$1.3806	\$0.1758	\$1.2371
11	\$0.1853	\$1.3614	\$0.2002	\$1.4742	\$0.1781	\$1.3204
12	\$0.1876	\$1.4427	\$0.2028	\$1.5621	\$0.1804	\$1.3986
13	\$0.1901	\$1.5190	\$0.2054	\$1.6445	\$0.1827	\$1.4719
14	\$0.1925	\$1.5906	\$0.2080	\$1.7220	\$0.1851	\$1.5408
15	\$0.1950	\$1.6579	\$0.2107	\$1.7946	\$0.1875	\$1.6055
16	\$0.1975	\$1.7210	\$0.2134	\$1.8629	\$0.1899	\$1.6662
17	\$0.2001	\$1.7803	\$0.2162	\$1.9269	\$0.1923	\$1.7231
18	\$0.2026	\$1.8360	\$0.2190	\$1.9870	\$0.1948	\$1.7766
19	\$0.2053	\$1.8882	\$0.2218	\$2.0435	\$0.1973	\$1.8268
20	\$0.2079	\$1.9372	\$0.2247	\$2.0965	\$0.1999	\$1.8740
21	\$0.2106	\$1.9832	\$0.2276	\$2.1462	\$0.2025	\$1.9182
22	\$0.2133	\$2.0264	\$0.2305	\$2.1929	\$0.2051	\$1.9598
23	\$0.2161	\$2.0670	\$0.2335	\$2.2367	\$0.2077	\$1.9988
24	\$0.2188	\$2.1051	\$0.2365	\$2.2779	\$0.2104	\$2.0354
25	\$0.2217	\$2.1408	\$0.2395	\$2.3165	\$0.2131	\$2.0697
26	\$0.2245	\$2.1744	\$0.2426	\$2.3527	\$0.2159	\$2.1020
27	\$0.2274	\$2.2059	\$0.2458	\$2.3868	\$0.2186	\$2.1323
28	\$0.2304	\$2.2354	\$0.2489	\$2.4187	\$0.2215	\$2.1607
29	\$0.2333	\$2.2632	\$0.2521	\$2.4487	\$0.2243	\$2.1874
30	\$0.2363	\$2.2893	\$0.2554	\$2.4769	\$0.2272	\$2.2124

Water and Electricity Avoided Costs				
	Residential/Commercial/Industrial			
	Water (\$/m^3)		Electricity (\$/kWh)	
	Rate	NPV	Rate	NPV
1	\$2.26	\$2.26	\$0.1111	\$0.1111
2	\$2.29	\$4.39	\$0.1125	\$0.2153
3	\$2.32	\$6.39	\$0.1139	\$0.3132
4	\$2.35	\$8.26	\$0.1154	\$0.4051
5	\$2.38	\$10.02	\$0.1169	\$0.4913
6	\$2.41	\$11.67	\$0.1184	\$0.5723
7	\$2.45	\$13.22	\$0.1199	\$0.6483
8	\$2.48	\$14.67	\$0.1215	\$0.7196
9	\$2.51	\$16.04	\$0.1231	\$0.7866
10	\$2.54	\$17.32	\$0.1246	\$0.8495
11	\$2.57	\$18.52	\$0.1263	\$0.9085
12	\$2.61	\$19.65	\$0.1279	\$0.9639
13	\$2.64	\$20.71	\$0.1295	\$1.0159
14	\$2.67	\$21.71	\$0.1312	\$1.0648
15	\$2.71	\$22.64	\$0.1329	\$1.1106
16	\$2.74	\$23.52	\$0.1346	\$1.1536
17	\$2.78	\$24.34	\$0.1363	\$1.1940
18	\$2.82	\$25.12	\$0.1381	\$1.2319
19	\$2.85	\$25.84	\$0.1399	\$1.2675
20	\$2.89	\$26.52	\$0.1417	\$1.3010
21	\$2.93	\$27.16	\$0.1435	\$1.3323
22	\$2.96	\$27.76	\$0.1454	\$1.3618
23	\$3.00	\$28.33	\$0.1472	\$1.3894
24	\$3.04	\$28.85	\$0.1491	\$1.4154
25	\$3.08	\$29.35	\$0.1511	\$1.4397
26	\$3.12	\$29.82	\$0.1530	\$1.4626
27	\$3.16	\$30.25	\$0.1550	\$1.4841
28	\$3.20	\$30.67	\$0.1570	\$1.5042
29	\$3.24	\$31.05	\$0.1590	\$1.5231
30	\$3.28	\$31.41	\$0.1611	\$1.5409

The inflation rate used in Table 14.8 was 1.29%. The discount factor used was 7.9%.

Appendix A: TEC 2013 Quarterly Reports

Ontario Natural Gas Technical Evaluation Committee
1st Quarter Report
March 2013

The Technical Evaluation Committee (TEC) publicly reports its discussions and activities on a quarterly basis. This report reflects work conducted for the period of January 1st to March 31st, 2013. Previous quarterly reports are now available on the Ontario Energy Board (OEB) website online.

1. 2013 TEC Evaluation Priorities and Budget:

As per its mandate, the TEC provided recommendations on evaluation priorities for 2013. Recommended areas include:

- Recommended evaluation activities identified in 2012;
- Actions arising from the Custom Free ridership and Participant Spillover Jurisdictional Review;
- Actions arising from the Technical Reference Manual project; and
- Recommendations made by utilities' respective auditors.

The TEC reviewed the 2013 evaluation budgets for Enbridge and Union Gas. A main focus in 2013 will be the development of a Technical Reference Manual and the Net to Gross study.

2. Custom Free Ridership and Participant Spillover Jurisdictional Review:

The TEC received and endorsed the Custom Free-ridership and Participant Spillover Jurisdictional Review completed by Navigant Consulting, Inc. The report aimed to provide insight into the free-ridership and participant spillover variables in comparable jurisdictions across Canada and the United States. A sensitivity analysis was included to ascertain the potential financial impact of changes to net to gross values for each utility's shareholder incentive. The study determined that studies done at other utilities are not easily transferrable to Union and Enbridge's custom programs. Factors that determine NTG values differed by utility size and location, types of customers, types of programs, and other factors; and there were not enough studies of situations similar to Union's and Enbridge's to find comparable results. In addition, the study did show that the incentive amounts earned by Union and Enbridge would be affected significantly by the NTG value used. Given that the last NTG was performed in 2008, the TEC has decided that a new NTG study be undertaken in 2013.

The report outlined the costs and benefits of five potential next steps in the study. The TEC resolved that a more fulsome study was warranted, based partly on the following observations:

- The magnitude of change in shareholder incentive based on potential changes to net to gross values;
- The benefits of having a higher level of precision for net to gross estimates;
- The likelihood that a study would result in an accurate net to gross estimate; and
- The benefits of employing different methodologies for estimating net to gross values.

Union Gas will continue to serve as administrative lead on this study. The TEC agreed to collect examples of requests for proposals from other jurisdictions for review in Q2. The TEC also resolved to release a request for proposals for the next stage of the study.

3. Technical Reference Manual:

Following a multi-stage selection process, the TEC proceeded to select a consultant to develop a Technical Reference Manual (TRM). Following a discussion on conflict of interest and a preliminary culling of proposals, two finalists were invited for a telephone interview. In the end, the TEC endorsed ERS Inc. as the successful proponent for the project. Common to both utilities, the Manual will document efficiency measure savings assumptions (and/or formulae) and all other assumptions (other than avoided costs) necessary for cost-effectiveness screening and program metrics. The development of the TRM will include a review of all existing prescriptive measure assumptions, as well as an online, searchable repository of approved substantiation document underpinning each approved measure.

As the project initiates in Q2, an initial meeting will be held to establish administrative and communication parameters with the consultant, as well as a process by which the TEC will review and provide ongoing feedback and guidance to ERS. A tri-party consulting agreement was drafted and circulated to the TEC for review and comment. Enbridge will serve as administrative lead on the project, which is scheduled for completion in early 2014.

4. Custom Projects Savings Verification: Relationship with the Audit Committee:

The TEC initiated a discussion on the role of the Audit Committee in relation to draft reports produced under the Custom Project Savings Verification program. The TEC resolved to reassess the relationship between auditors, the CPSV evaluators and the Audit Committee in the third quarter of 2013.

5. Sharing of Reports Endorsed by the TEC:

Upon request from a recent consultant to the TEC, the Committee agreed to publicly share a report on the Sampling Methodology for Custom Commercial and Industrial Programs, produced in 2012. The Committee resolved to develop a formal process for approving requests to publicly release reports. For added transparency, the TEC initiated discussions with the Ontario Energy Board with an aim to have TEC- endorsed reports posted on the OEB website.

Upcoming Meeting Dates:

April 18th; May 15th; June 13th

Ontario Natural Gas Technical Evaluation Committee 2nd Quarter Report
July 2013

The Technical Evaluation Committee (TEC) publicly reports its discussions and activities on a quarterly basis. This report reflects work conducted for the period of April 1st to June 30th, 2013. Previous quarterly reports are available on the Ontario Energy Board (OEB) website online.

1. Custom Net-to-Gross Study

Following the Committee's decision to pursue a full custom net-to-gross study, the Committee highlighted priority questions for proponents and key areas of interest as they relate to the framing, objectives and methodology of the study. Committee members reviewed the 2008 net-to-gross study in an effort to revisit lessons learned and improve the quality of the upcoming study.

The Committee decided that the study methodology should be left to the bidder to propose. The RFP should instruct the bidder to provide a solution for taking into considerations the differences between Enbridge and Union's custom programs/customers/geographic reach as well as the timing issues related to Union's Large Industrial Program.

The Committee is in the process of drafting the RFP and it is expected to be finalized in the fall.

2. Technical Reference Manual

On May 15, 2013 the TEC and ERS conducted the TRM kick-off meeting. Prior to starting a review of any specific measures, ERS developed a measure template for the Committee to review. The measure template will be used for all measures in an effort to standardize the structure of each measure document. Throughout the duration of the project, it was determined that ERS may bring forward new technologies that are not included in the existing list.

The Committee pushed the project completion data from January 1, 2014 to March 1, 2014. The Committee agreed that having the TRM completed properly is a bigger priority than having it completed on time.

A tri-party agreement (Union, Enbridge, third-party contractor) is being developed to be used for all future TEC-initiated projects that require a contract, including the TRM project.

3. Free-ridership Values for New Prescriptive Measures

The Committee identified the need for guidelines to determine free ridership values for new prescriptive measures. The Committee will address this task in a future meeting.

Upcoming Meeting Dates: July 15, August 28, September 25

Ontario Natural Gas Technical Evaluation Committee
3rd Quarter Report

The Technical Evaluation Committee (The Committee) publicly reports its discussions and activities on a quarterly basis. This report reflects work conducted between July 1 and September 30, 2013. All quarterly reports are available on the Ontario Energy Board (OEB) website online.

1. Confirmation of 2014 Committee Intervenor and Independent Members

As per the Terms of Reference for Stakeholder Engagement (EB-2011-0327), three intervenor members (J. Shepherd, C. Neme and J. Girvan) were elected in September, 2013, by the Consultative. T. Kesik and R. Wirtshafter were invited to remain on the Committee as independent members for the 2014 calendar year. The elected members will serve for one year, starting October 1, 2013, while the independent members' term will begin January 1, 2014.

2. Custom Projects Savings Verification (CPSV)

With input from auditors and the utilities' respective Audit Committees, the Committee revised and updated a joint Terms of Reference for Custom Projects Savings Verifications (CPSV) to be included in requests for proposals. Finalization of the Terms of Reference is anticipated in early Q4 2013.

3. Technical Reference Manual (TRM)

The Committee and the consultant (ERS) continued their review of prescriptive measures as part of the TRM project. The consultant shared its initial analysis of four groups of measures (ten groups in total):

Initiated:

- New Measures (Demand Control Ventilation and High Efficiency Water Heaters)
- Commercial Water Heating
- Multi-Family Water Heating
- Commercial Cooking

To be analyzed:

- Commercial Space Heating
- Multi-Family Space Heating
- Residential Water Heating
- Residential Space Heating
- Commercial / Multi-Family Other
- Residential Other

The Committee worked with the consultant to finalize the project work plan and develop the template used to display and organize key information for each measure. The Committee provided guidance to the consultant on proposing, where reasonable, a single value for measure assumptions, as the measures in the TRM are to be applied prescriptively.

The Committee also provided feedback on the consultant's analysis of the following measures:

- Demand Control Ventilation
- High Efficiency Water Heaters
- Condensing Gas Water Heaters (New Construction)
- Condensing Gas Water Heaters (Retrofit)
- High Efficiency Condensing Boilers <300MBH (New Construction)
- High Efficiency Condensing Boilers <300MBH (Retrofit)

Next steps in the TRM project include finalization of these prescriptive measures and review of the remaining measures. This project is scheduled for completion in 2014.

4. Net to Gross Study: Request for Proposals (RFP)

The Committee is finalizing a Request for Proposals to select a firm that will conduct a study to determine Net to Gross values for the utility's respective commercial and industrial custom DSM offerings. The Committee further refined the project scope and provided additional clarity on the study methodology. A final draft is expected for release in Q4 2013. Selection and engagement of the successful proponent is expected in January 2014.

5. Guidelines for establishing a Free Ridership value for new prescriptive measures

Based on discussions in Q2, a background document was circulated by the utilities in July 2013. At a future meeting, the utilities (led by Union Gas) will propose a framework for determining free ridership for new prescriptive measures, and when the free ridership value should be revisited.

Ontario Natural Gas Technical Evaluation Committee
2013 4th Quarter Report
January 2014

The Technical Evaluation Committee (TEC; "the Committee") publicly reports its discussions and activities on a quarterly basis. This report reflects work conducted for the period of October 1st to December 31st, 2013. Previous quarterly reports are available on the Ontario Energy Board (OEB) website online.

1. Custom Net-to-Gross Study

The TEC finalized the Net-to-Gross (NTG) Request for Proposal (RFP). The study is expected to recommend NTG values for the utilities' commercial and industrial custom DSM offerings. The RFP was posted on industry websites AESP and IEPEC in November, and was sent to a bidder's list as determined by the TEC. Five firms submitted proposals in time for the December 23 deadline. The Committee will begin the selection process in January 2014 with the goal of selecting a firm by the last week of January.

2. 2013 Custom Project Savings Verification Terms of Reference

Following input from the utilities' respective auditors and Audit Committees, the Committee finalized the joint Terms of Reference for Custom Projects Savings Verifications (CPSV). The Terms of Reference will be included in each utility's 2013 CPSV Request for Proposal.

3. Technical Reference Manual (TRM)

The Committee, along with the consultant (ERS Inc.), continued the process of reviewing measure substantiation documents. The measures that are currently in the process of being reviewed are:

- New Measures (Demand Control Ventilation and High Efficiency Water Heaters)
- Commercial Water Heating
- Multi-Family Water Heating
- Commercial Cooking

The Committee expressed concern over the progress of the project; specifically the pace and quality of the work. The Committee acknowledged that the responsibility hinges on both the contractor and the Committee's own review process. To address this, the Committee created a subcommittee to streamline its feedback to ERS. Furthermore, the Committee asked ERS to create a tracking log to display each measure's review status. The Committee also asked ERS to resolve and finalize measures that have already been initiated before initiating new measures.

A tri-party agreement (Union, Enbridge, consulting firm) has not yet been finalized by the utilities. The document is expected to be used for TEC-initiated projects, including the current TRM project.

4. Annual Input Assumption Filing

The Committee endorsed a letter filed by the utilities informing the Board that no changes have been made to the 2012 measure assumption filing. As the Technical Reference Manual project continues, it is expected that input assumption updates will be available in the first quarter of 2014, and that an update will be submitted at that time.

5. Sampling Methodology for Union’s Large Industrial Scorecard Verification

Union’s 2013 Large Industrial scorecard is composed of two cumulative gas savings metrics, using a 60/40 weighting. Since this is the first time the utility has encountered a scorecard with two different cumulative gas savings metrics for a custom program, Union requested TEC endorsement of a sampling methodology that would incorporate the 60/40 weighting. Union engaged Navigant Consulting for recommended approaches for the sampling methodology, and the TEC ultimately agreed that the appropriate methodology would be one that ensured a 90/10 confidence level at the scorecard level and 90/15 confidence levels at each of the metrics. The TEC agreed that this approach struck the appropriate balance of reliable results and reasonable costs.

6. TEC-related Audit Recommendations

The Committee reviewed 14 recommendations (13 for Union Gas; 1 for EGD) raised during the utilities’ respective 2012 audits. The recommendations were prioritized by the Committee so that recommendations that may affect the 2013 audit could be dealt with sooner. The recommendations will be addressed in early 2014.

Future meetings: January 23, February 13, March 2

Appendix B: Sampling Methodology for Custom C&I Programs

Due to the size of the report - A Sampling Methodology for Custom Commercial and Industrial Programs by Navigant Consulting, Inc., the document is available on the OEB website at the following address: http://www.ontarioenergyboard.ca/documents/TEC/Evaluation%20Studies%20and%20Other%20Reports/TEC%20SC%20-%20Sampling%20Method%20-%20Final%20Report%2020121112.pdf

Appendix C: Custom Project Verication

1375 Walnut Street
Suite 200
Boulder CO 80302
303.728.2500 phone
303.728.2501 fax

Memorandum

To: **Tina Nicholson, Eric Buan – Union Gas Ltd.**

From: **Brad Rogers, Dan Violette – Navigant Consulting**

Date: **October 22, 2014**

Re: **Sample Design and Evaluation Results for Audited Union Gas 2013 Custom Projects**

This memorandum presents the sample design and results for the evaluation of Union Gas custom projects completed during the 2013 program year including custom projects in the Large Volume Rate T1, Rate T2/R100 program, the Commercial/Industrial (C/I) program, and the Low Income (LI) program. This memorandum is organized according to the following section headings:

1. Summary of the Custom Program Population
2. Description of the Sample Frame
3. Determination of Evaluation Sample Sizes
4. Approach to Selecting the Sample
5. Summary of the Selected Sample
6. Sampled Project Evaluation Results
7. Evaluation Study Results

The approach taken to design and analyze the sample for 2013 Custom Programs reflects the prescribed methodology. [1,2] The audited cumulative savings results of the evaluation study are:

- **T2/R100 audited cumulative savings of 1,671,545,303 m^3 with a realization rate (RR) of 0.95**
- **T1 audited cumulative savings of 179,162,770 m^3 with a realization rate (RR) of 0.81**
- **C/I audited cumulative savings of 614,153,881 m^3 with a realization rate (RR) of 0.83**
- **LI audited cumulative savings of 3,107,807 m^3 with a realization rate (RR) of 0.82**

The results for the Large Volume, and LI custom programs achieved the 90/10 one-sided precision targets. The C/I custom program achieved 90/10.8 precision, falling just short of the targeted precision due to a slightly higher variance in sampled realization rates.[3]

---

[1] "A Sampling Methodology for Custom C&I Programs." Prepared for the Technical Evaluation Committee, Union Gas, and Enbridge by Navigant Consulting Inc. (Violette, D. M., and B. Rogers), November 12, 2012.

[2] For the rationale underlying the approaches used, see the Sampling Methodology Report cited in footnote 1, available from Union Gas.

1. Summary of the Custom Program Population

Figure 1 below shows that 717 custom projects were implemented during the 2013 project year. All custom projects in the population reported cumulative gas savings, which served as the basis for grouping projects into size-based strata.[4]

Figure 1. Reported Cumulative Savings (m^3) for Union 2013 Custom Projects

Stratum	Projects (N)	Reported Cumulative Gas Savings (m3)	% of Total Gas Savings by Program
T2/R100	145	1,751,754,308	65%
T1	75	220,504,516	8%
C/I	472	738,367,150	27%
LI	25	3,775,242	0.1%
Total	**717**	**2,714,401,216**	**100%**

The Large Volume custom program T2/R100 rate class accounts for about one-fifth of the total number of custom projects, but represents about two-thirds of the reported custom cumulative gas savings. The C/I custom program accounts for about two-thirds of the projects, but represents less than one-third of reported savings. The Large Volume custom program T1 rate class accounts for about ten percent of the projects and eight percent of reported savings. The LI custom program represents three percent of the projects, but only a tenth of a percent of reported savings.

2. Description of the Sample Frame

Separate samples were designed for each of the three custom programs (C/I, LI and Large Volume). The Large Volume required separate samples for T2/R100 and T1 rate classes. Within each program, strata were defined based on the amount of reported cumulative gas savings. Stratifying by project size reduced the overall sample size (i.e., number of sites drawn) by taking advantage of the concentrations of savings when relatively few projects contribute to a large fraction of total impacts.[5] The very small sites representing 3% or less of each program's cumulative gas savings were excluded from the sample selection in order to ensure cost-effective use of evaluation budget.

Figure 2 through Figure 5 below illustrate how the large projects represent a larger fraction of program savings, while the very small projects contribute much less.

---

[3] For additional discussion on achieved precision see Section 0 of this memorandum.

[4] This is consistent with the 2012 Custom project analysis, but differs from the 2011 Custom project analysis where the basis was on Total Resource Cost benefits.

[5] "A Sampling Methodology for Custom C&I Programs." Prepared for the Technical Evaluation Committee, Union Gas, and Enbridge by Navigant Consulting Inc. (Violette, D. M., and B. Rogers), November 12, 2012. (See Section 5.1 Stratification)

Figure 2. Distribution of Cumulative Savings from Union's Large Volume Custom Program – Rate T2/R100

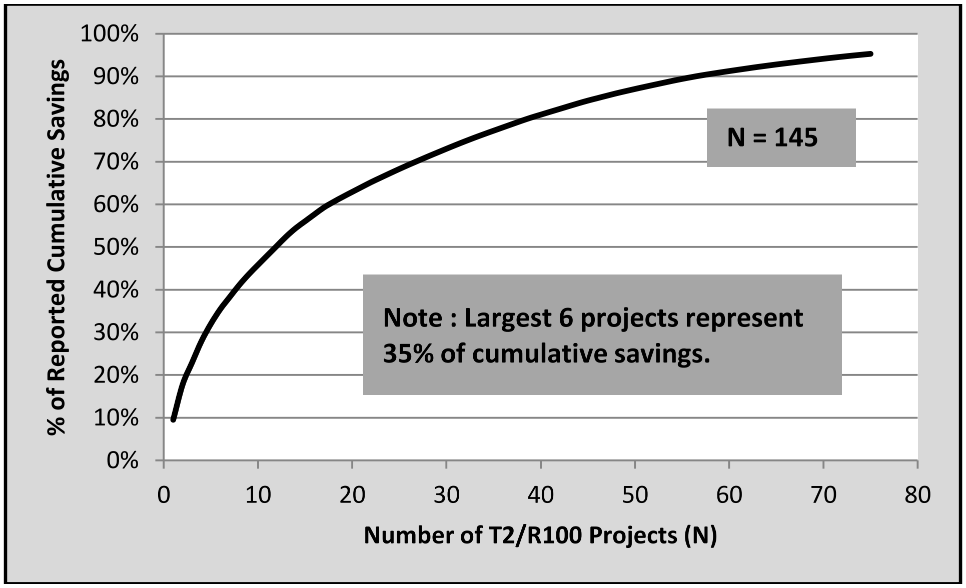


Figure 3. Distribution of Cumulative Savings from Union's Large Volume Custom Program – Rate T1

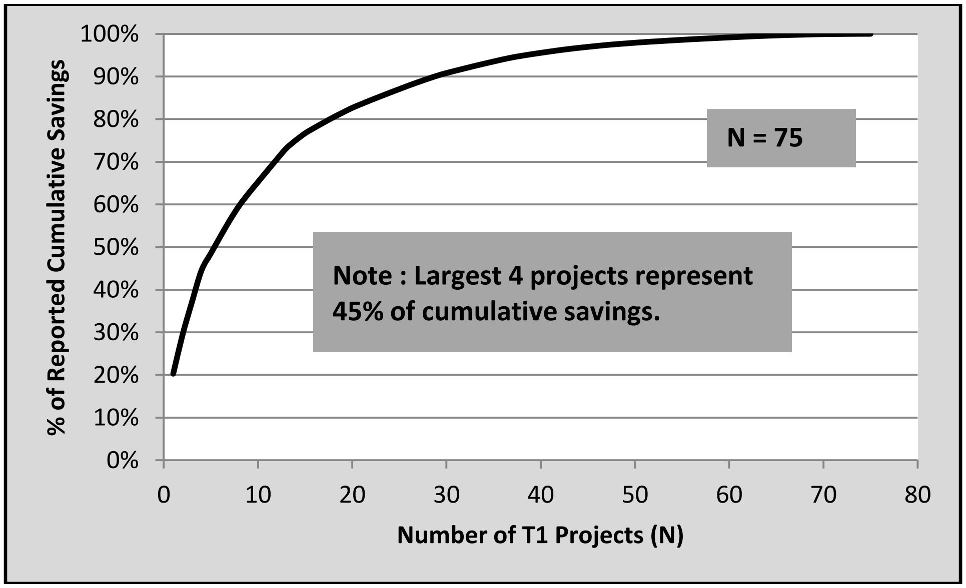


Figure 4. Distribution of Cumulative Savings in Union's C/I Custom Program

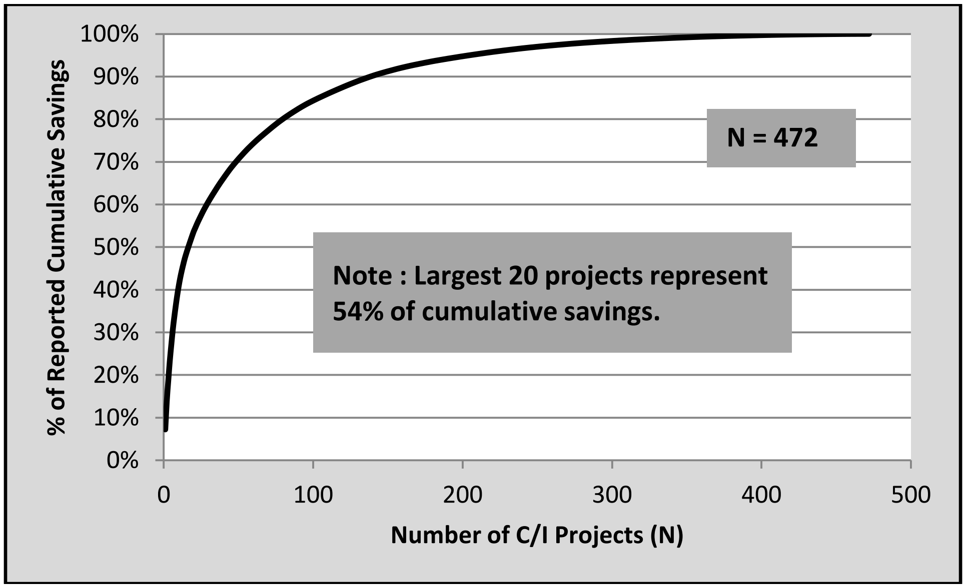


Figure 5. Distribution of Cumulative Savings in Union's LI Custom Program

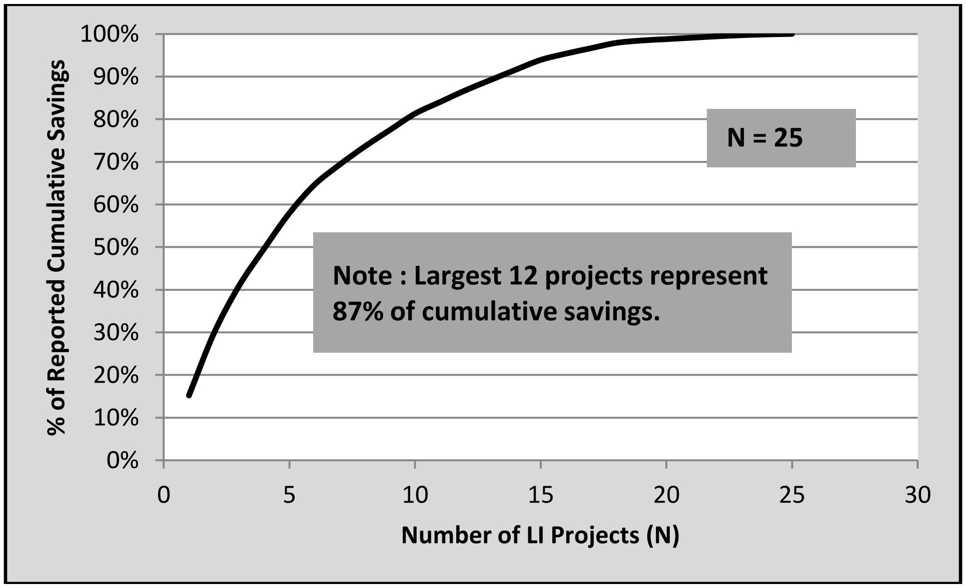


Figure 6 below indicates the cumulative gas savings thresholds applied to each stratum.

Figure 6. Program Segmentation Thresholds (Based on Reported Cumulative Gas Savings)

Stratum	T2/R100	T1	C/I	LI
Large	> 50,000,000 m^3	> 10,000,000 m^3	> 6,000,000 m^3	> 100,000 m^3
Medium	> 5,000,000 m^3	> 500,000 m^3	> 2,000,000 m^3	-
Small	> 500,000 m^3	-	> 100,000 m^3	> 10,000 m^3
Very Small	<500,000 m^3	< 500,000 m^3	< 100,000 m^3	< 10,000 m^3

Figure 7 below indicates the number of projects, the cumulative gas savings, and the percent contribution to total program cumulative gas savings represented in each stratum.

Figure 7. Program Reported Cumulative Savings Characteristics

Program	Stratum	Population	Reported Cumulative Gas Savings (m^3)	% of Program Gas Savings
T2/R100	Large	6	620,671,951	35%
	Medium	59	1,004,520,296	57%
	Small	55	121,102,823	7%
	Very Small	25	5,459,237	0.3%
	Total	**145**	**1,751,754,308**	**100%**
T1	Large	4	98,154,963	45%
	Medium	41	115,600,604	52%
	Very Small	30	6,748,949	3%
	Total	**75**	**220,504,516**	**100%**
C/I	Large	20	396,070,076	54%
	Medium	56	187,891,874	25%
	Small	275	148,581,708	20%
	Very Small	121	5,823,492	1%
	Total	**472**	**738,367,150**	**100%**
LI	Large	12	3,275,343	87%
	Small	11	488,804	13%
	Very Small	2	11,096	0.3%
	Total	**25**	**3,775,242**	**100%**

3. Determination of Evaluation Sample Sizes

The samples were designed to target 90% confidence that the actual population gas savings would exceed 90% of the sample estimate (i.e., 90/10 one-sided confidence interval) for each program individually. Coefficients of variation (CV) of 0.35 were applied for the custom programs based on historically observed results from Union custom programs.[6] The finite population correction factor was applied in order to take advantage of the concentrations of benefits in the large project strata. Strata were weighted based on their contribution to total program cumulative gas savings. T-values were applied to standard errors in order to estimate the relative precision for 90% one-sided confidence coverage.

These assumptions were applied to estimate the minimum sample sizes required to hit the 90/10 one-sided confidence interval target by appropriately allocating sample projects to each stratum based on reported cumulative gas savings.

Figure 8 below indicates the designed sample sizes for each stratum that are expected to achieve the desired precision targets.

Figure 8. Sample Sizes by Custom Program Segment

Stratum	T2/R100	T1	C/I	LI
Large	6	4	7	8
Medium	7	4	7	-
Small	2	-	7	3
Very Small	0	0	0	0
Total	**15**	**8**	**21**	**11**

A sample size of 15 is estimated for the T2/R100 program, 8 for the T1 program, 21 for the C/I program, and 11 for the LI program.[7]

4. Approach to Selecting the Sample

The sample was designed based on reported cumulative gas savings. Projects were randomly selected from each stratum to meet the target sample size for each stratum. Each stratum sample was developed as per the prescribed sampling methodology. A preliminary sample was selected following Q3 of 2013 in order to begin evaluating projects early enough to ultimately meet the reporting deadline. The sample design was finalized at the end of 2013 to account for the known final population, and a final sample was selected.

---

[6] The observed 2013 results of the CI program sample indicated a slightly higher CV of 0.42, while the other custom programs achieved CV lower than 0.35. Future sample design efforts may apply a greater CV for the CI program in order to increase the likelihood of meet the targeted sample precision.

[7] "A Sampling Methodology for Custom C&I Programs." Prepared for Union Gas and Enbridge by Navigant Consulting Inc. (Violette, D. M., and B. Rogers), November 12, 2012.

5. Summary of the Selected Sample

Figure 9 through Figure 12 below show the percent of the population projects and population savings represented by the sample for each stratum in each program.

Figure 9. T2/R100 Sample Summary

Stratum	Sample Size (n)	Population (N)	% of Stratum Population Covered by Sample	Sample Reported Cumulative Gas Savings (m3)	Population Reported Cumulative Gas Savings (m3)	% of Stratum Reported Savings Covered by Sample
Large	6	6	100%	620,671,951	620,671,951	100%
Medium	7	59	12%	158,184,082	1,004,520,296	16%
Small	2	55	4%	5,000,403	121,102,823	4%
Very Small	0	25	0%	-	5,459,237	-
Total	**15**	**145**	**10%**	**783,856,436**	**1,751,754,308**	**45%**

Figure 10. T1 Sample Summary

Stratum	Sample size (n)	Population (N)	% of Stratum Population Covered by Sample	Sample Reported Cumulative Gas Savings (m3)	Population Reported Cumulative Gas Savings (m3)	% of Stratum Reported Savings Covered by Sample
Large	4	4	100%	98,154,963	98,154,963	100%
Medium	4	41	10%	11,514,508	115,600,604	10%
Very Small	0	30	0%	-	6,748,949	-
Total	**8**	**75**	**11%**	**109,669,472**	**220,504,516**	**50%**

Figure 11. C/I Sample Summary

Stratum	Sample size (n)	Population (N)	% of Stratum Population Covered by Sample	Sample Reported Cumulative Gas Savings (m3)	Population Reported Cumulative Gas Savings (m3)	% of Stratum Reported Savings Covered by Sample
Large	7	20	35%	143,837,435	396,070,076	36%
Medium	7	56	13%	27,550,998	187,891,874	15%
Small	7	275	3%	3,605,869	148,581,708	2%
Very Small	0	121	0%	-	5,823,492	-
Total	**21**	**472**	**4%**	**174,994,302**	**738,367,150**	**24%**

Figure 12. LI Sample Summary

Stratum	Sample size (n)	Population (N)	% of Stratum Population Covered by Sample	Sample Reported Cumulative Gas Savings (m3)	Population Reported Cumulative Gas Savings (m3)	% of Stratum Reported Savings Covered by Sample
Large	8	12	67%	2,237,487	3,275,343	68%
Small	3	11	27%	148,181	488,804	30%
Very Small	0	2	0%	-	11,096	-
Total	**11**	**25**	**44%**	**2,385,668**	**3,775,242**	**63%**

6. Sampled Project Evaluation Results

Figure 13 through

Figure 16 below summarize the reported and audited savings for sampled projects from the Large Volume – T1, T2/R100, C/I, and LI programs respectively.

Figure 13. T2/R100 Sample Results

Identification No.	Population Stratum	Reported Annual Gas Savings (m^3)	Reported Measure Life (yrs)	Free Rider Rate	Reported Cumulative Gas Savings (m^3)	Audited Annual Gas Savings (m^3)	Audited Measure Life (yrs)	Audited Cumulative Gas Savings (m^3)	Site Realization Rate
2013-IND-0124	Large	18,099,008	20.00	0.54	166,510,874	32,310,000	20.00	297,252,000	1.79
2013-IND-0348	Large	10,480,821	30.00	0.54	144,635,330	5,820,000	30.00	80,316,000	0.56
2013-IND-0450	Large	9,790,690	20.00	0.54	90,074,348	7,343,000	20.00	67,555,600	0.75
2013-IND-0179	Large	9,572,937	20.00	0.54	88,071,020	7,180,000	20.00	66,056,000	0.75
2013-IND-0469	Large	7,753,349	20.00	0.54	71,330,811	6,940,000	20.00	63,848,000	0.90
2013-IND-0451	Large	6,527,127	20.00	0.54	60,049,568	4,895,000	20.00	45,034,000	0.75
2013-IND-0120	Medium	4,299,973	20.00	0.54	39,559,752	4,097,000	20.00	37,692,400	0.95
2013-IND-0157	Medium	4,218,598	20.00	0.54	38,811,102	2,998,000	20.00	27,581,600	0.71
2013-IND-0205	Medium	2,287,034	20.00	0.54	21,040,713	2,324,000	20.00	21,380,800	1.02
2013-IND-0121	Medium	1,760,727	20.00	0.54	16,198,688	1,678,000	20.00	15,437,600	0.95
2013-IND-0273	Medium	1,740,129	20.00	0.54	16,009,187	1,239,000	20.00	11,398,800	0.71
2013-IND-0240	Medium	1,610,769	20.00	0.54	14,819,075	1,934,000	20.00	17,792,800	1.20
2013-IND-0416	Medium	1,276,692	20.00	0.54	11,745,566	1,247,000	20.00	11,472,400	0.98
2013-IND-0123	Small	888,303	7.00	0.54	2,860,336	1,116,000	7.00	3,593,520	1.26
2013-IND-0230	Small	232,616	20.00	0.54	2,140,067	236,500	20.00	2,175,800	1.02

Figure 14. T1 Sample Results

Identification No.	Population Stratum	Reported Annual Gas Savings (m^3)	Reported Measure Life (yrs)	Free Rider Rate	Reported Cumulative Gas Savings (m^3)	Audited Annual Gas Savings (m^3)	Audited Measure Life (yrs)	Audited Cumulative Gas Savings (m^3)	Site Realization Rate
2013-IND-0101	Large	4,861,000	20.00	0.54	44,721,200	3,405,000	20.00	31,326,000	0.70
2013-IND-0074	Large	2,208,231	20.00	0.54	20,315,725	2,206,000	20.00	20,295,200	1.00
2013-IND-0229	Large	1,477,273	25.00	0.54	16,988,640	1,707,000	25.00	19,630,500	1.16

2013-IND-0117	Large	2,504,565	14.00	0.54	16,129,399	2,085,000	14.00	13,427,400	0.83
2013-IND-0072	Medium	636,068	20.00	0.54	5,851,826	477,000	20.00	4,388,400	0.75
2013-IND-0159	Medium	208,366	20.00	0.54	1,916,967	233,000	20.00	2,143,600	1.12
2013-IND-0204	Medium	206,166	20.00	0.54	1,896,727	155,000	20.00	1,426,000	0.75
2013-IND-0542	Medium	200,977	20.00	0.54	1,848,988	98,580	20.00	906,936	0.49

Figure 15. C/I Sample Results

Identification No.	Population Stratum	Reported Annual Gas Savings (m^3)	Reported Measure Life (yrs)	Free Rider Rate	Reported Cumulative Gas Savings (m^3)	Audited Annual Gas Savings (m^3)	Audited Measure Life (yrs)	Audited Cumulative Gas Savings (m^3)	Site Realization Rate
2013-IND-0455	Large	5,927,716	18.00	0.54	49,081,488	5,927,716	18.00	49,081,488	1.00
2013-IND-0013	Large	2,864,979	20.00	0.54	26,357,807	2,864,979	20.00	26,357,807	1.00
2013-IND-0267	Large	3,085,122	14.00	0.54	19,868,186	3,085,122	14.00	19,868,186	1.00
2013-IND-0185	Large	1,741,055	20.00	0.54	16,017,706	1,741,055	10.00	8,008,853	0.50
2013-IND-0083	Large	1,531,967	20.00	0.54	14,094,096	1,531,967	20.00	14,094,096	1.00
2013-IND-0186	Large	1,112,600	20.00	0.54	10,235,920	1,112,600	20.00	10,235,920	1.00
2013-IND-0037	Large	889,373	20.00	0.54	8,182,232	667,000	20.00	6,136,400	0.75
2013-IND-0045	Medium	651,488	20.00	0.54	5,993,690	0	0.00	0	0.00
2013-IND-0457	Medium	544,277	20.00	0.54	5,007,348	544,277	20.00	5,007,348	1.00
2013-IND-0046	Medium	472,215	20.00	0.54	4,344,378	402,543	20.00	3,703,396	0.85
2013-IND-0177	Medium	567,304	15.00	0.54	3,914,398	567,304	15.00	3,914,398	1.00
2013-IND-0055	Medium	381,402	20.00	0.54	3,508,898	286,100	20.00	2,632,120	0.75
2013-COM-0162	Medium	349,726	15.00	0.54	2,413,109	342,886	15.00	2,365,913	0.98
2013-IND-0256	Medium	321,899	16.00	0.54	2,369,177	321,899	15.00	2,221,103	0.94
2013-IND-0042	Small	178,289	20.00	0.54	1,640,259	158,733	20.00	1,460,344	0.89
2013-COM-0026	Small	79,769	20.00	0.54	733,875	11,633	20.00	107,024	0.15
2013-IND-0064	Small	172,935	7.00	0.54	556,851	172,935	7.00	556,851	1.00
2013-IND-0196	Small	24,260	20.00	0.54	223,192	0	0.00	0	0.00
2013-COM-0149	Small	25,660	15.00	0.54	177,054	25,660	15.00	177,054	1.00
2013-COM-0069	Small	14,480	22.00	0.54	146,538	14,480	20.00	133,216	0.91
2013-COM-0101	Small	13,924	20.00	0.54	128,101	13,924	20.00	128,101	1.00

Figure 16. LI Sample Results

Identification No.	Population Stratum	Reported Annual Gas Savings (m^3)	Reported Measure Life (yrs)	Free Rider Rate	Reported Cumulative Gas Savings (m^3)	Audited Annual Gas Savings (m^3)	Audited Measure Life (yrs)	Audited Cumulative Gas Savings (m^3)	Site Realization Rate
2013-COM-0014	Large	30,199	20.00	0.05	573,781	20,757	18.00	354,945	0.62
2013-COM-0013	Large	34,267	17.00	0.05	553,412	28,720	17.00	463,828	0.84

2013-COM-0271	Large	23,117	15.00	0.05	329,417	20,428	15.00	291,099	0.88
2013-COM-0218	Large	17,748	20.00	0.05	250,829	17,935	15.00	255,574	1.02
2013-COM-0239	Large	9,375	20.00	0.05	178,125	5,995	20.00	113,905	0.64
2013-COM-0172	Large	7,690	20.00	0.05	146,110	5,998	20.00	113,962	0.78
2013-COM-0130	Large	7,239	15.00	0.05	103,156	9,665	15.00	137,726	1.34
2013-COM-0240	Large	5,403	20.00	0.05	102,657	9,554	20.00	181,526	1.77
2013-COM-0128	Small	4,604	20.00	0.05	87,476	4,614	13.00	56,983	0.65
2013-COM-0016	Small	2,541	20.00	0.05	48,279	1,098	20.00	20,862	0.43
2013-COM-0263	Small	654	20.00	0.05	12,426	673	20.00	12,787	1.03

7. Evaluation Study Results

The primary goal of the evaluation study was to estimate the audited cumulative gas savings. Figure 17 through Figure 20 below present the audited cumulative gas savings for each program by stratum and in total.

Figure 17. T2/R100 Evaluation Results

Stratum	Population Size (N)	Reported Cumulative Gas Savings (m3)	Audited Realization Rate	Audited Cumulative Gas Savings (m3)	Achieved Precision (rel)
Large	6	620,671,951	1.00	620,061,600	0.0%
Medium	59	1,004,520,296	0.90	906,549,502	13.3%
Small	55	121,102,823	1.15	139,724,930	34.9%
Very Small	25	5,459,237	0.95	5,209,271	
Total	**145**	**1,751,754,308**	**0.95**	**1,671,545,303**	**6.9%**

Figure 18. T1 Evaluation Results

Stratum	Population Size (N)	Reported Cumulative Gas Savings (m3)	Audited Realization Rate	Audited Cumulative Gas Savings (m3)	Achieved Precision (rel)
Large	4	98,154,963	0.86	84,679,100	0.0%
Medium	41	115,600,604	0.77	89,000,062	17.6%
Very Small	30	6,748,949	0.81	5,483,608	
Total	**75**	**220,504,516**	**0.81**	**179,162,770**	**7.8%**

Figure 19. C/I Evaluation Results

Stratum	Population Size (N)	Reported Cumulative Gas Savings (m3)	Audited Realization Rate	Audited Cumulative Gas Savings (m3)	Achieved Precision (rel)
Large	20	396,070,076	0.93	368,383,544	8.0%
Medium	56	187,891,874	0.72	135,333,703	41.1%
Small	275	148,581,708	0.71	105,592,810	32.0%
Very Small	121	5,823,492	0.83	4,843,823	
Total	**472**	**738,367,150**	**0.83**	**614,153,881**	**10.8%**

Figure 20. LI Evaluation Results

Stratum	Population Size (N)	Reported Cumulative Gas Savings (m3)	Audited Realization Rate	Audited Cumulative Gas Savings (m3)	Achieved Precision (rel)
Large	12	3,275,343	0.85	2,799,706	8.5%
Small	11	488,804	0.61	298,967	25.8%
Very Small	2	11,096	0.82	9,134	
Total	**25**	**3,775,242**	**0.82**	**3,107,807**	**7.7%**

The results for the Large Volume – T1 and T2/R100, and LI programs achieved the 90/10 one-sided precision targets. The C/I program achieved 90/10.8 precision, falling just short of the targeted precision due to a slightly higher variance in sampled realization rates. Applying a coefficient of variation of 0.42 would have generated sufficiently high sample sizes to meet the targeted precision for the 2013 C/I sample.

The audited cumulative savings results of the evaluation study are:

- T2/R100 audited cumulative savings of 1,671,545,303 m3 with a realization rate (RR) of 0.95
- T1 audited cumulative savings of 179,162,770 m3 with a realization rate (RR) of 0.81
- C/I audited cumulative savings of 614,153,881 m3 with a realization rate (RR) of 0.83
- LI audited cumulative savings of 3,107,807 m3 with a realization rate (RR) of 0.82

The realization rates and achieved precision were calculated in accordance with the prescribed methodology.[8]

---

[8] "A Sampling Methodology for Custom C&I Programs." Prepared for the Technical Evaluation Committee, Union Gas, and Enbridge by Navigant Consulting Inc. (Violette, D. M., and B. Rogers), November 12, 2012.

Appendix D: Measure Inputs

	Measure Name	Equip Life	Energy Load	Free Rider	Adj. Factor	Natural Gas Savings m^3/Unit	Water Savings L/Unit	Elec Savings kWh/Unit	Inc Costs $/Unit
ESK	Install - Faucet Aerator - Bath - 1.0 gpm	10	Baseload	33%	92%	10	3,435	0	$0.59
	Install - Faucet Aerator - Kitchen - 1.5 gpm	10	Baseload	33%	82%	23	7,797	0	$1.29
	Install - Pipe Insulation - 2m	10	Baseload	4%	100%	18	0	0	$0.98
	Install - Showerhead - 1.25gpm	10	Baseload	10%	72%	44	13,885	0	$3.79
	Pull - Faucet Aerator - Bath - 1.0pgm	10	Baseload	33%	61%	10	3,435	0	$0.59
	Pull - Faucet Aerator - Kitchen - 1.5gpm	10	Baseload	33%	72%	23	7,797	0	$1.29
	Pull - Pipe Insulation - 2m	10	Baseload	4%	82%	18	0	0	$0.98
	Pull - Showerhead - 1.25gpm	10	Baseload	10%	90%	44	13,885	0	$3.79
	Push - Faucet Aerator - Bath - 1.0gpm	10	Baseload	33%	43%	10	3,435	0	$0.59
	Push - Faucet Aerator - Kitchen - 1.5gpm	10	Baseload	33%	59%	23	7,797	0	$1.29
	Push - Pipe Insulation - 2m	10	Baseload	4%	68%	18	0	0	$0.98
	Push - Showerhead - 1.25gpm	10	Baseload	10%	85%	44	13,885	0	$3.79
	D2D - Faucet Aerator - Bath - 1.0gpm	10	Baseload	33%	74%	10	3,435	0	$0.59
	D2D - Faucet Aerator - Kitchen - 1.5gpm	10	Baseload	33%	79%	23	7,797	0	$1.29
	D2D - Pipe Insulation - 2m	10	Baseload	4%	86%	18	0	0	$0.98
	D2D - Showerhead - 1.25gpm	10	Baseload	10%	97%	44	13,885	0	$3.79
HHC	Basic-Faucet Aerator-Bath	10	Baseload	1%	86%	10	3,435	0	$0.59
	Basic-Faucet Aerator-Kitchen	10	Baseload	1%	81%	23	7,797	0	$1.29
	Basic-Pipe Insulation - 2 m	10	Baseload	1%	94%	18	0	0	$0.98
	Basic-Showerhead-1.25 gpm existing 2.0-2.5	10	Baseload	1%	80%	46	14,294	0	$3.79
	Basic-Showerhead-1.25 gpm existing 2.6+	10	Baseload	1%	80%	88	22,580	0	$3.79
HWC	Faucet Aerator-Bath MURB Rebate	10	Baseload	10%	34%	7	2,371	0	$0.59
	Faucet Aerator-Kitchen MURB Rebate	10	Baseload	10%	54%	16	5,377	0	$1.29
	Showerhead-MURB Rebate	10	Baseload	10%	88%	32	9,585	0	$3.79
LIMF	MF-Faucet Aerator-Bath 1.0gpm	10	Baseload	1%	25%	7	2,371	0	$0.56
	MF-Faucet Aerator-Kitchen 1.5gpm	10	Baseload	1%	25%	16	5,377	0	$1.14
	MF-Showerhead-1.25 gpm existing 2.0-2.5	10	Baseload	1%	54%	33	9,892	0	$3.79
	MF-Showerhead-1.25 gpm existing 2.6+	10	Baseload	1%	54%	64	15,549	0	$3.79
NC/ BR[26]	Air Curtains-Shipping >=64 sq ft & < 80 sq ft	15	Weather Sensitive	5%	100%	7,565	0	-5,380	$8,242.00
	Air Curtains-Shipping >=80 sq ft & < 100 sq ft	15	Weather Sensitive	5%	100%	9,457	0	-5,220	$8,242.00
	Air Curtains-Shipping >=100 sq ft	15	Weather Sensitive	5%	100%	20,605	0	-936	$10,170.00
	Condensing Boiler SH - 300 to 999 MBtu/hr	25	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	Condensing Boiler SH - 300 to 999 MBtu/hr LIMF	25	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	Condensing Boiler SH - => 1,000 MBtu/hr	25	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	Condensing Boiler SH - => 1,000 MBtu/hr LIMF	25	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	Condensing Boiler WH - 300 to 999 MBtu/hr	25	Baseload	5%	100%	Quasi	0	0	Quasi
	Condensing Boiler WH - 300 to 999 MBtu/hr LIMF	25	Baseload	5%	100%	Quasi	0	0	Quasi
	Condensing Boiler WH - => 1,000 MBtu/hr	25	Baseload	5%	100%	Quasi	0	0	Quasi
	Condensing Gas Water Heater 1- 100gal/day	13	Baseload	5%	100%	332	0	0	$2,230.00
	Condensing Gas Water Heater 2- 500gal/day	13	Baseload	5%	100%	873	0	0	$2,230.00
	Condensing Gas Water Heater 2- 500gal/day LIMF	13	Baseload	5%	100%	873	0	0	$2,230.00
	Condensing Gas Water Heater 3- 1000gal/day	13	Baseload	5%	100%	1,551	0	0	$2,230.00
	Condensing Gas Water Heater 3- 1000gal/day LIMF	13	Baseload	5%	100%	1,551	0	0	$2,230.00
	DCKV < 5000 cfm	15	Weather Sensitive	5%	100%	4,801	0	13,521	$10,000.00
	DCKV 5000 - 9999 cfm	15	Weather Sensitive	5%	100%	11,486	0	30,901	$15,000.00

---

[26] New Construction / Building Retrofit (or Replacement)

Measure Name	Equip Life	Energy Load	Free Rider	Adj. Factor	Natural Gas Savings m^3/Unit	Water Savings L/Unit	Elec Savings kWh/Unit	Inc Costs $/Unit
DCKV 10000-15000 cfm	15	Weather Sensitive	5%	100%	18,924	0	49,102	$20,000.00
Destratification Fan	15	Weather Sensitive	10%	100%	Quasi	0	Quasi	$7,021.00
Dishwasher - Rack Conveyor Single HT	20	Baseload	27%	100%	2,203	310,271	9,811	$2,375.00
Dishwasher - Stationary Rack Door Type HT	15	Baseload	20%	100%	619	87,119	3,553	$-350.00
Dishwasher - Stationary Rack Door Type LT	15	Baseload	20%	100%	841	118,369	855	$-350.00
Dishwasher - Stationary Rack Single Rack HT	15	Baseload	20%	100%	619	87,119	3,553	$-350.00
Dishwasher - Stationary Rack Single Rack LT	15	Baseload	20%	100%	841	118,369	855	$-350.00
Dishwasher - Undercounter HT	10	Baseload	40%	100%	801	112,795	3,754	$-13.00
Dishwasher - Undercounter LT	10	Baseload	40%	100%	326	45,891	559	$-13.00
Energy Star Convection Oven	12	Baseload	20%	100%	847	0	1	$875.00
Energy Star Fryer	12	Baseload	20%	100%	1,083	0	17	$1,028.00
Energy Star Steam Cooker	10	Baseload	20%	100%	3,224	42,812	162	$2,000.00
Infrared Heating 1- 20-99 MBtu/hr 1-Stage	20	Weather Sensitive	33%	100%	Quasi	0	Quasi	Quasi
Infrared Heating 2- 100-300 MBtu/hr 1-Stage	20	Weather Sensitive	33%	100%	Quasi	0	Quasi	Quasi
Infrared Heating 3- 20-99 MBtu/hr 2-Stage	20	Weather Sensitive	33%	100%	Quasi	0	Quasi	Quasi
Infrared Heating 4- 100-300 MBtu/hr 2-Stage	20	Weather Sensitive	33%	100%	Quasi	0	Quasi	Quasi
MUA 01- MURB&LTC Imp Effic 1000-4999cfm	15	Weather Sensitive	5%	100%	Quasi	0	0	$2,190.00
MUA 02- MURB&LTC Imp Effic =>5000 cfm	15	Weather Sensitive	5%	100%	Quasi	0	0	$3,148.00
MUA 03- MURB&LTC Effic + 2 speed 1000-4999cfm	15	Weather Sensitive	5%	100%	Quasi	0	Quasi	$8,788.00
MUA 05- MURB&LTC Effic + VFD 1000-4999 cfm	15	Weather Sensitive	5%	100%	Quasi	0	Quasi	$2,910.00
MUA 06- MURB&LTC Effic + VFD => 5000 cfm	15	Weather Sensitive	5%	100%	Quasi	0	Quasi	$2,910.00
MUA 08- Other Comm Imp Effic => 5000 cfm	15	Weather Sensitive	5%	100%	Quasi	0	0	$4,758.50
MUA 09- Other Comm Effic + 2 speed 1000-4999cfm	15	Weather Sensitive	5%	100%	Quasi	0	Quasi	$8,788.00
MUA 10- Other Comm Effic + 2 speed =>5000cfm	15	Weather Sensitive	5%	100%	Quasi	0	Quasi	$8,788.00
MUA 11- Other Comm Effic + VFD 1000-4999 cfm	15	Weather Sensitive	5%	100%	Quasi	0	Quasi	$2,910.00
MUA 12- Other Comm Effic + VFD =>5000 cfm	15	Weather Sensitive	5%	100%	Quasi	0	Quasi	$11,274.00
Non-Condensing Boiler SH - 300 to 999 MBtu/hr MF	25	Weather Sensitive	20%	100%	Quasi	0	0	Quasi
Non-Condensing Boiler SH - 300 to 999 MBtu/hr NMF	25	Weather Sensitive	12%	100%	Quasi	0	0	Quasi
Non-Condensing Boiler SH - =>1,000 MBtu/hr MF	25	Weather Sensitive	20%	100%	Quasi	0	0	Quasi
Non-Condensing Boiler SH - =>1,000 MBtu/hr NMF	25	Weather Sensitive	12%	100%	Quasi	0	0	Quasi
Non-Condensing Boiler SH - =>1,000 MBtu/hr LIMF	25	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
Non-Condensing Boiler WH - 300 to 999 MBtu/hr MF	25	Baseload	20%	100%	Quasi	0	0	Quasi
Non-Condensing Boiler WH - 300 to 999 MBtu/hr NMF	25	Baseload	12%	100%	Quasi	0	0	Quasi

	Measure Name	Equip Life	Energy Load	Free Rider	Adj. Factor	Natural Gas Savings m^3/Unit	Water Savings L/Unit	Elec Savings kWh/Unit	Inc Costs $/Unit
	Non-Condensing Boiler WH - 300 to 999 MBtu/hr LIMF	25	Baseload	5%	100%	Quasi	0	0	Quasi
	Non-Condensing Boiler WH - =>1,000 MBtu/hr MF	25	Baseload	20%	100%	Quasi	0	0	Quasi
	Non-Condensing Boiler WH - =>1,000 MBtu/hr NMF	25	Baseload	12%	100%	Quasi	0	0	Quasi
	Ozone WE =< 120 lbs cap & 100,000 to 199,999lbs/yr	15	Baseload	8%	100%	Quasi	Quasi	Quasi	Quasi
	Ozone WE =< 120 lbs cap & => 200,000 lbs/yr	15	Baseload	8%	100%	Quasi	Quasi	Quasi	Quasi
	Ozone WE > 120 lbs cap & => 260,000 lbs/yr	15	Baseload	8%	100%	Quasi	Quasi	Quasi	Quasi
	Building Optimization Weather	Actual	Weather Sensitive	54%	100%	Actual	Actual	Actual	Actual
	Custom Equip Baseload	Actual	Baseload	54%	100%	Actual	Actual	Actual	Actual
	Custom Equip Weather	Actual	Weather Sensitive	5%	100%	Actual	Actual	Actual	Actual
	Custom Infrared Poly Baseload	Actual	Baseload	54%	100%	Actual	Actual	Actual	Actual
NC only	Condensing Boiler SH - up to 299 MBtu/hr	25	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	Condensing Boiler SH - up to 299 MBtu/hr LIMF	25	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	Condensing Boiler WH - up to 299 MBtu/hr	25	Baseload	5%	100%	Quasi	0	0	Quasi
	ERV 1- up to 1999 cfm MURB,Healthcare,Nursing	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	ERV 2- => 2000 cfm MURB,Healthcare,Nursing	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	ERV 3- up to 1999 cfm Hotel,Restaurant,Retail	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	ERV 4- => 2000 cfm Hotel,Restaurant,Retail	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	ERV 5- up to 1999 cfm Off,Whse,Ed & All Other Comm	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	ERV 6- => 2000 cfm Off,Whse,Ed & All Other Comm	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	HRV 1- 500 to 1999cfm-Hotel,Restaurant,Retail,Rec	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	HRV 3- 500 to 1999cfm-Off,Whse,Man,Ed,Other Comm	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	HRV 4- =>2,000cfm-Off,Whse,Man,Ed,Other Comm	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	HRV 5- MURB,Healthcare,Nursing	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
BR only	Air Curtains-Pedestrian >=48 sq ft & < 96 sq ft	15	Weather Sensitive	5%	100%	667	0	172	$1,650.00
	Air Curtains-Pedestrian >=96 sq ft	15	Weather Sensitive	5%	100%	1,529	0	1,023	$2,500.00
	Condensing Boiler SH - up to 299 MBtu/hr	25	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	Condensing Boiler SH - up to 299 MBtu/hr LIMF	25	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	Condensing Boiler WH - up to 299 MBtu/hr	25	Baseload	5%	100%	Quasi	0	0	Quasi
	Condensing Boiler WH - up to 299 MBtu/hr LIMF	25	Baseload	5%	100%	Quasi	0	0	Quasi
	ERV 1- up to 1999 cfm MURB,Healthcare,Nursing	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	ERV 2- => 2000 cfm MURB,Healthcare,Nursing	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
	ERV 3- up to 1999 cfm Hotel,Restaurant,Retail	14	Weather	5%	100%	Quasi	0	0	Quasi

Measure Name	Equip Life	Energy Load	Free Rider	Adj. Factor	Natural Gas Savings m^3/Unit	Water Savings L/Unit	Elec Savings kWh/Unit	Inc Costs $/Unit
		Sensitive						
ERV 4- => 2000 cfm Hotel,Restaurant,Retail	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
ERV 5- up to 1999 cfm Off,Whse,Ed & All Other Comm	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
ERV 6- => 2000 cfm Off,Whse,Ed & All Other Comm	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
HRV 1- 500 to 1999cfm-Hotel,Restaurant,Retail,Rec	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
HRV 2- =>2,000cfm-Hotel,Restaurant,Retail,Rec	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
HRV 3- 500 to 1999cfm-Off,Whse,Man,Ed,Other Comm	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
HRV 4- =>2,000cfm-Off,Whse,Man,Ed,Other Comm	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
HRV 5- MURB,Healthcare,Nursing	14	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
Non-Condensing Boiler SH - up to 299 MBtu/hr MF	25	Weather Sensitive	20%	100%	Quasi	0	0	Quasi
Non-Condensing Boiler SH - up to 299 MBtu/hr NMF	25	Weather Sensitive	12%	100%	Quasi	0	0	Quasi
Pstat- D2C $25	15	Weather Sensitive	43%	100%	53	0	54	$25.00
Pstat- HVAC $25	15	Weather Sensitive	43%	100%	53	0	54	$25.00
Pstat- HVAC No Incent$	15	Weather Sensitive	43%	100%	53	0	54	$25.00
Attic Insulation	25	Weather Sensitive	0%	100%	Actual	Actual	Actual	Actual
Basement Insulation	25	Weather Sensitive	0%	100%	Actual	Actual	Actual	Actual
Custom O&M Baseload	Actual	Baseload	54%	100%	Actual	Actual	Actual	Actual
Custom O&M Weather	Actual	Weather Sensitive	54%	100%	Actual	Actual	Actual	Actual
Deep Measure	20	Weather Sensitive	15%	100%	Actual	Actual	Actual	Actual
Draft Sealing	25	Weather Sensitive	0%	100%	Actual	Actual	Actual	Actual
Non-Deep Measure	20	Weather Sensitive	15%	100%	Actual	Actual	Actual	Actual
Wall Insulation	25	Weather Sensitive	0%	100%	Actual	Actual	Actual	Actual
Air Curtains-Pedestrian >=48 sq ft & < 96 sq ft	15	Weather Sensitive	5%	100%	667	0	172	$1,650.00
Air Curtains-Pedestrian >=96 sq ft	15	Weather Sensitive	5%	100%	1,529	0	1,023	$2,500.00
Condensing Boiler SH - up to 299 MBtu/hr	25	Weather Sensitive	5%	100%	Quasi	0	0	Quasi
Condensing Boiler SH - up to 299 MBtu/hr LIMF	25	Weather Sensitive	5%	100%	Quasi	0	0	Quasi

Appendix E: 2013 Gas Savings by Scorecard and Measure

Table E.1 – Gas Savings by Measure for the Low-Income Scorecard

Segment	Measure	Average Net Cumulative Gas Savings (m^3/Unit)	Units	Net Cumulative Gas Savings (m^3)
Low-Income Single Family	Attic Insulation	4,672	657	3,069,200
	Basement Insulation	14,467	1,563	22,611,825
	Basic-Faucet Aerator-Bath	85	173	14,729
	Basic-Faucet Aerator-Kitchen	184	172	31,723
	Basic-Pipe Insulation - 2 m	168	175	29,314
	Basic-Showerhead-1.25 gpm existing 2.0-2.5	364	5	1,822
	Basic-Showerhead-1.25 gpm existing 2.6+	697	94	65,514
	Basic-Showerhead-Replacement	261	35	9,148
	Draft Sealing	5,183	1,400	7,256,375
	Wall Insulation	18,612	384	7,147,000
Low-Income Single Family Total			**4,658**	**40,236,650**
Low-Income Multi-Family Custom	Custom Equip Baseload	344,178	1	344,178
	Custom Equip Weather	110,061	25	2,751,521
Low-Income Multi-Family Custom Total			**26**	**3,095,698**
Low-Income Multi-Family Prescriptive	Condensing Boiler SH - up to 299 MBtu/hr LIMF	45,305	10	453,047
	Condensing Boiler SH - 300 to 999 MBtu/hr LIMF	94,574	9	851,162
	Condensing Boiler SH - => 1,000 MBtu/hr LIMF	263,467	6	1,580,800
	Condensing Boiler WH - up to 299 MBtu/hr LIMF	43,347	5	216,734
	Condensing Boiler WH - 300 to 999 MBtu/hr LIMF	87,281	1	87,281
	Condensing Gas Water Heater 2- 500gal/day LIMF	10,782	8	86,252
	Condensing Gas Water Heater 3- 1000gal/day LIMF	19,155	10	191,549
	HRV 5- MURB,Healthcare,Nursing	672,187	4	2,688,748
	MF-Faucet Aerator-Bath 1.0gpm	17	2,536	43,268
	MF-Faucet Aerator-Kitchen 1.5gpm	39	2,536	98,899
	MF-Showerhead-1.25 gpm existing 2.0-2.5	176	1,421	249,994
	MF-Showerhead-1.25 gpm existing 2.6+	341	146	49,814
	MF-Showerhead-Replacement 2.0gpm	128	906	115,921
	MUA 11- Other Comm Effic + VFD 1000-4999 cfm	105,585	8	844,683
	MUA 12- Other Comm Effic + VFD =>5000 cfm	391,981	11	4,311,795
	Non-Condensing Boiler WH - 300 to 999 MBtu/hr LIMF	80,413	1	80,413
	Non-Condensing Boiler SH - =>1,000 MBtu/hr LIMF	221,825	1	221,825
Low-Income Multi-Family Prescriptive Total			**7,619**	**12,172,185**
Low-Income Scorecard Total			**12,303**	**55,504,533**

Table E.2 – Gas Savings by Measure for the Resource Acquisition Scorecard

Segment	Measure	Average Net Cumulative Gas Savings (m^3/Unit)	Units	Net Cumulative Gas Savings (m^3)
Commercial/ Industrial	Air Curtains-Pedestrian >=48 sq ft & < 96 sq ft	9,505	16	152,076
	Air Curtains-Pedestrian >=96 sq ft	21,788	6	130,730
	Air Curtains-Shipping >=100 sq ft	293,621	19	5,578,804
	Air Curtains-Shipping >=64 sq ft & < 80 sq ft	107,801	2	215,603
	Air Curtains-Shipping >=80 sq ft & < 100 sq ft	134,762	2	269,525
	Building Optimization Weather	70,052	6	420,310
	Condensing Boiler SH - up to 299 MBtu/hr	51,233	132	6,762,797
	Condensing Boiler SH - 300 to 999 MBtu/hr	119,689	249	29,802,526
	Condensing Boiler SH - => 1,000 MBtu/hr	424,796	124	52,674,726
	Condensing Boiler WH - up to 299 MBtu/hr	59,863	16	957,808
	Condensing Boiler WH - 300 to 999 MBtu/hr	87,316	24	2,095,592
	Condensing Boiler WH - => 1,000 MBtu/hr	154,043	7	1,078,298
	Condensing Gas Water Heater 1- 100gal/day	4,100	17	69,703
	Condensing Gas Water Heater 2- 500gal/day	10,782	85	916,432
	Condensing Gas Water Heater 3- 1000gal/day	19,155	177	3,390,408
	Custom Equip Baseload	2,321,783	210	487,574,421
	Custom Equip Weather	279,182	53	14,796,656
	Custom Infrared Poly Baseload	177,199	29	5,138,758
	Custom O&M Baseload	694,964	129	89,650,356
	Custom O&M Weather	221,221	69	15,264,232
	DCKV < 5000 cfm	68,414	12	820,971
	DCKV 5000 - 9999 cfm	163,676	5	818,378
	DCKV 10000-15000 cfm	269,667	2	539,334
	Destratification Fan	282,963	40	11,318,515
	Dishwasher - Rack Conveyor Single HT	32,164	12	385,966
	Dishwasher - Stationary Rack Door Type HT	7,428	32	237,696
	Dishwasher - Stationary Rack Door Type LT	10,092	136	1,372,512
	Dishwasher - Stationary Rack Single Rack HT	7,428	1	7,428
	Dishwasher - Stationary Rack Single Rack LT	10,092	1	10,092
	Dishwasher - Undercounter HT	4,806	18	86,508
	Dishwasher - Undercounter LT	1,956	1	1,956
	Energy Star Convection Oven	8,131	2	16,262
	Energy Star Fryer	10,397	83	862,934
	Energy Star Steam Cooker	25,792	1	25,792
	ERV 1- up to 1999 cfm MURB,Healthcare,Nursing	23,476	226	5,305,506
	ERV 2- => 2000 cfm MURB,Healthcare,Nursing	432,355	41	17,726,549
	ERV 3- up to 1999 cfm Hotel,Restaurant,Retail	34,962	11	384,584
	ERV 4- => 2000 cfm Hotel,Restaurant,Retail	167,276	55	9,200,202
	ERV 5- up to 1999 cfm Off,Whse,Ed & All Other Comm	18,485	135	2,495,523
	ERV 6- => 2000 cfm Off,Whse,Ed & All Other Comm	196,915	56	11,027,253
	HRV 1- 500 to 1999cfm-Hotel,Restaurant,Retail,Rec	33,233	11	365,564
	HRV 2- =>2,000cfm-Hotel,Restaurant,Retail,Rec	72,897	3	218,692
	HRV 3- 500 to 1999cfm-Off,Whse,Man,Ed,Other Comm	18,454	28	516,714
	HRV 4- =>2,000cfm-Off,Whse,Man,Ed,Other Comm	238,119	31	7,381,674
	HRV 5- MURB,Healthcare,Nursing	17,722	100	1,772,217
	HWC - Faucet Aerator-Bath MURB Rebate	21	235	5,034
	HWC - Faucet Aerator-Kitchen MURB Rebate	78	947	73,639
	HWC - Showerhead-MURB Rebate	253	463	117,343

Segment	Measure	Average Net Cumulative Gas Savings (m^3/Unit)	Units	Net Cumulative Gas Savings (m^3)
	HWC - Showerhead-Replacement MURB Rebate	190	661	125,643
	Infrared Heating 1- 20-99 MBtu/hr 1-Stage	9,146	1,204	11,011,455
	Infrared Heating 2- 100-300 MBtu/hr 1-Stage	26,211	585	15,333,373
	Infrared Heating 3- 20-99 MBtu/hr 2-Stage	21,078	50	1,053,910
	Infrared Heating 4- 100-300 MBtu/hr 2-Stage	51,704	215	11,116,318
	MUA 01- MURB&LTC Imp Effic 1000-4999cfm	41,164	9	370,472
	MUA 02- MURB&LTC Imp Effic =>5000 cfm	203,490	1	203,490
	MUA 03- MURB&LTC Effic + 2 speed 1000-4999cfm	109,659	3	328,976
	MUA 05- MURB&LTC Effic + VFD 1000-4999 cfm	159,505	12	1,914,060
	MUA 06- MURB&LTC Effic + VFD => 5000 cfm	358,886	8	2,871,090
	MUA 08- Other Comm Imp Effic => 5000 cfm	73,226	3	219,678
	MUA 09- Other Comm Effic + 2 speed 1000-4999cfm	35,625	1	35,625
	MUA 10- Other Comm Effic + 2 speed =>5000cfm	106,839	1	106,839
	MUA 11- Other Comm Effic + VFD 1000-4999 cfm	49,556	5	247,779
	MUA 12- Other Comm Effic + VFD =>5000 cfm	367,771	7	2,574,394
	Non-Condensing Boiler SH - up to 299 MBtu/hr MF	15,900	1	15,900
	Non-Condensing Boiler SH - up to 299 MBtu/hr NMF	10,844	6	65,063
	Non-Condensing Boiler SH - 300 to 999 MBtu/hr MF	108,279	25	2,706,980
	Non-Condensing Boiler SH - 300 to 999 MBtu/hr NMF	155,574	17	2,644,763
	Non-Condensing Boiler SH - =>1,000 MBtu/hr MF	322,768	51	16,461,192
	Non-Condensing Boiler SH - =>1,000 MBtu/hr NMF	377,117	38	14,330,449
	Non-Condensing Boiler WH - 300 to 999 MBtu/hr MF	68,840	10	688,396
	Non-Condensing Boiler WH - 300 to 999 MBtu/hr NMF	70,057	6	420,343
	Non-Condensing Boiler WH - =>1,000 MBtu/hr MF	119,607	20	2,392,140
	Non-Condensing Boiler WH - =>1,000 MBtu/hr NMF	262,436	12	3,149,235
	Ozone WE =< 120 lbs cap & 100,000 to 199,999lbs/yr	68,900	11	757,905
	Ozone WE =< 120 lbs cap & => 200,000 lbs/yr	118,947	31	3,687,350
	Ozone WE > 120 lbs cap & => 260,000 lbs/yr	181,735	1	181,735
Commercial/Industrial Total			**7,054**	**885,049,151**
Residential	Deep Measure	29,767	203	6,042,684
	ESK Install- HVAC	646	253	163,418
	ESK Pull	631	17,400	10,983,034
	ESK Push- Door to Door	640	19,106	12,228,127
	ESK Push	489	6,319	3,091,232
	Non-Deep Measure	7,688	4	30,753
	Pstat	453	7,032	3,186,551
Residential Total			**50,317**	**35,725,799**
Resource Acquisition Scorecard Total			**57,371**	**920,774,950**

Table E.3 – Gas Savings by Measure for the Large Volume Rate T1 and Rate T2/R100 Scorecard

Segment	Measure	Average Net Cumulative Gas Savings (m^3/Unit)	Units	Net Cumulative Gas Savings (m^3)
Large Volume T1	Custom Equip Baseload	432,028	223	96,342,259
	Custom Infrared Poly Baseload	190,119	2	380,238
	Custom O&M Baseload	844,187	97	81,886,160
	Destratification Fan	675,000	2	1,350,000
	Infrared Heating 4- 100-300 MBtu/hr 2-Stage	47,741	9	429,671
Large Volume T1 Total			**333**	**180,388,329**
Large Volume T2	Custom Equip Baseload	35,003,0078	10	350,030,781
	Custom O&M Baseload	12,583,634	80	1,006,690,685
Large Volume T2 Total			**90**	**1,356,721,466**
Large Volume R100	Custom Equip Baseload	17,160,833	10	171,608,331
	Custom O&M Baseload	2,663,467	51	135,836,796
Large Volume R100 Total			**61**	**307,445,127**
Large Volume Scorecard Total			**484**	**1,844,554,921**

Appendix F: DSM Tracking & Reporting Processes

Tracking Systems Overview

Union Gas uses two 2003 Windows web-based proprietary applications, DSMt and AIMS. Both applications interact with Banner and utilize Crystal Reports to pull data from the applications. The following are descriptions of these four components, their respective functions and how they are connected.

Banner

Banner is Union's (CIS) customer information and billing system that is used to store current customer information including rate class and historical consumption.

DSMt

DSMt is a custom 2003 Windows web-based database that is run using Oracle 11G. DSMt stores all information required to track customer-specific applications and produce DSM reporting requirements specific to the current DSM Framework. DSMt also receives automated uploads from Banner to ensure that customer information remains up-to-date. Uploads are constant and every time an account is accessed, the most current Banner rate class info is provided. DSMt content includes:

- Customer information including name, address, rate class, sector, measures installed, installation date
- Measure details or input assumptions for each DSM measure including number of units, measure life, resource savings, incremental cost, project description, basecase, and net-to-gross adjustment factors
- Customer incentive details

AIMs

Account Information Management System (AIMS) is a custom 2003 Windows web-based application that is run using Oracle 11G. AIMS houses Customer and Service provider information including mailing addresses and customer contact information for customer and service providers that participate in custom DSM programs. Custom project details, including all attachments associated with the custom project submission, are housed in AIMS.

Crystal Reports

Crystal Reports is used to extract data and generate reports from the information contained in DSMt. There are several pre-defined monthly reports produced in DSMt that contain information such as cumulative m^3 savings, LRAM amounts, TRC values and incentive dollars paid by rate class. A General Extraction Report of most data fields tracked in DSMt is also generated monthly and used for additional reporting. The general extraction of data is referred to as the End User Measure (EUM) report. This report is generated automatically from DSMt and is exported directly into Excel. The EUM report is found as the EUM tab in the 2013 Audit Tool.

Data Collection and Data Entry

Customer applications, participant forms and rebate forms come from multiple sources depending on the offering. The following table summarises how data is collected for each of Union's DSM offerings.

Table F1 – Data Collection Method for Various Program Offerings

Offering	Data Collection Method
C/I Prescriptive and Quasi-Prescriptive Offering	Account managers are responsible for completing C/I prescriptive applications on behalf of the participant. Completed applications are received by DSM Tracking & Reporting (DSM T&R) directly from account managers via email. Applications are verified for completeness and eligibility as per Union's QA protocol by DSM T&R and entered accordingly by the DSM T&R
C/I Hot Water Conservation Offering	Hot Water Conservation participants are tracked by Service providers administering the program. The applications are reviewed by Commercial Marketing and sent to DSM T&R via email. The Applications are verified for completeness and eligibility as per Union's QA protocol by DSM T&R and entered accordingly.
C/I Custom and Large Industrial Custom Offerings	Custom applications are first entered into the AIMS application by account managers and project managers. The files are then reviewed by another team of engineers in the Commercial Industrial Energy Efficiency Program group (CIEEP) prior to submission into DSMt, where the customer information and incentive levels are validated by DSM T&R. The custom project files, including all the supporting documents are retained in the AIMS application.
Residential and Low-Income ESKs and Programmable Thermostat Offerings	Customers complete an application for an ESK kit and/or a free programmable thermostat on the Union Gas website.[27] Customers can also receive an ESK kit at a service provider depot or event giveaway and complete a tracking form onsite. A third delivery option is via direct mail campaigns or bill inserts where the customer completes a coupon for an ESK and/or a programmable thermostat and submits this coupon directly to DSM T&R. The Applications are verified for completeness and eligibility as per Union's QA protocol by DSM T&R and entered accordingly
Low Income Helping Homes Conserve Offering	Delivery Agents submit a workplan to the Low Income marketing team. The marketing team reviews all of the documents for accuracy and completion and submits a final tracking sheet to DSM T&R for entry into DSMt. The Applications are verified for completeness and eligibility as per Union's QA protocol by DSM T&R and entered accordingly
Low Income Affordable Housing Conservation Offering	The data collection method for this offering is the same as for C/I Prescriptive and Quasi-Prescriptive Offering & C/I Custom Offerings
Residential Home Retrofit Offering	Delivery Agents submit a workplan to the Residential marketing team. The marketing team reviews all of the documents for accuracy and completion and submits a final tracking sheet to DSM T&R for entry into DSMt. The Applications are verified for completeness and eligibility as per Union's QA protocol by DSM T&R and entered accordingly.

---

[27] The energy conservation website can be accessed at http://www.uniongas.com/residential/energy-conservation/energy-savings

Quality Assurance Protocol

Union Gas has QA protocol that ensures that data entered into DSMt meets the rigour required to accurately track program participation and eligibility requirements, as well as calculate resource savings, LRAM amounts, TRC values, customer incentives and company DSM incentives. All applications are screened for completeness and accuracy by the DSM Tracking & Reporting team. Each incentive payment is also reviewed and approved by the DSM T&R Manager to ensure it falls within the guidelines of each program. The following is a list of items verified as part of Union's tracking system QA process:

- Is the customer a valid Union Gas customer?
- Is the customer's application or project claim a duplicate of an existing entry?
- Are the correct program and program offering selected?
- Is customer information (name, address, phone number, account number, account status) to Banner complete?
- Does customer meet program and incentive eligibility criteria?
- Does the measure or project type meet program and incentive eligibility requirements?
- Is the number of installed measures correctly captured?
- Are measure details sufficient to calculate TRC, LRAM, customer incentives and DSM incentives?
- Are the project description and basecase adequately captured in the database?
- Is the measure eligible upon the basis of commission or application date?
- Are all required data fields populated?
- Are the checklists complete and all appropriate documentation for custom projects attached to the AIMS project?

Customers and measures that are identified as not being eligible for any reason continue to be tracked in DSMt with a Does Not Qualify (DNQ) demarcation. An email is sent to the Account Managers notifying them that their application has been disqualified for follow-up with a customer.

Appendix G: Final Report Following an Impact Evaluation of the Union Gas ESK Residential Program: Door-to-Door Drop-off Initiative 2013

Final Report Following
An Impact Evaluation of the Union Gas
ESK Residential Program:
Door-to-Door Drop-off Initiative 2013

Introduction

This Report follows our administration of a telephone survey involving householders who received an Energy Savings Kit (ESK) in conjunction with Union Gas' ESK—Door-to-Door Drop-off Initiative. The Initiative offers financial support/incentives to help promote the use of high-efficiency natural gas products and accessories amongst residential customers.

Our firm conducted this Impact Evaluation in January 2014, employing the methodology outlined on Page 3 of this Report. The primary purpose of this research project was to validate the accuracy of information on Tracking Sheets sent to Union Gas by technicians who delivered the kits. Comprising a separate Union Gas database, the tracking sheet files contain customer information (name, address & phone number), program identifier and product/installation information. Installation sites included only residential locations.

Additional objectives for this research project were to understand end-users' knowledge of energy efficiency and their motivations for installing the items, as well as determine their usage habits and satisfaction level regarding the items in the kit.

This research project has been conducted according to generally accepted guidelines designed to ensure objectivity and personal confidentiality. Research-gathering procedures have yielded statistically valid results. We are confident our analysis of findings represents and interprets accurately the views and perspectives of respondents, who were co-operative and forthright in sharing information with us.

In submitting this report, we wish to express our appreciation to the staff of Union Gas for their active participation and support during the project. We particularly appreciate the assistance provided internally by Eric Buan, Analyst, DSM Research & Evaluation, who served as Project Coordinator.

Respectfully submitted by:

Ralph Beslin

Ralph Beslin, ABC
President

Objectives of this ESK Program Impact Evaluation Residential—Door-to-Door Drop-off Initiative

The **primary objectives** for this research project were as follows:

1. To validate consumers' awareness of the products received from participating channel partners and determine the products that were actually installed and remain installed.

2. To determine customers' satisfaction with the products in the kit they received and their usage habits with respect to the measures installed

The **secondary objectives** for this research project were as follows:

3. To gauge residential end-users' understanding regarding the benefits of energy- efficient products

4. To determine the factors affecting residential end-users' decision to install the products and who actually installed the products

Methodology for the ESK Program Impact Evaluation: Door-to-Door Drop-off Initiative

Telephone Surveying of End-Users

Random selection techniques were used to create a survey sample from files within Union Gas databases containing approximately 20,500 Tracking Sheet records submitted by Union Gas representatives (technicians). Controls were applied and monitored to ensure appropriate representation of segments within the customer base. Segmentation criteria included: city (area code) and age group of the kit recipients.

We employed a slightly modified version of the survey instrument used in the previous year's impact evaluation—approximately 7 minutes in length. This was administered to randomly selected end-users—all of whom were qualified as kit recipients—within a survey population comprised of customers who received Energy Savings Kits during a front-door visit by a Union Gas representative (technician) in 2013. Size and segmentation of the survey sample are identified in the chart below.

A total of 100 survey completions was achieved, which was the target number set for this impact evaluation. The number of completions results in a high level of confidence in the findings: 95% ± 10%.

Readers are encouraged to consult the survey instrument for exact wording of questions and response options. *(See questionnaire in the Appendix.)*

End-User Response Groups Profile: ESK-Residential-Door-to-Door Drop-off Impact Evaluation re 2013 Initiative

Total Completions = 100

Distribution Channel	Total completions
Visit by UG rep (technician) to front door	100 (100%)
Area Code	*Age Group*
416 = 4 (4%)	*18 - 34 = 10 (10%)*
519 = 80 (80%)	*35 - 44 = 23 (23%)*
613 = 2 (2%)	*45 - 54 = 31 (31%)*
705 = 2 (2%)	*55 - 64 = 30 (30%)*
905 = 12 (12%)	*65+ = 6 (6%)*

Executive Summary

Primary Objective: Awareness & Installation of Products Received

- Information in the Union Gas database regarding receipt of the kit was confirmed [100%]. All respondents received the kit at home from a Union Gas representative (technician); and all (100%) verified the site/address of the front-door visit. In addition, 100% of total respondents verified that they have a natural gas water heater in their home.
- Information related to individual products received was verified as extremely accurate for all products: Showerhead (100%), kitchen faucet aerator (95%), bathroom faucet aerator (95%) and pipe wrap (100%).
- Regarding installation of individual products, at least eight in ten respondents indicated they had installed each of the four products: Showerhead (84%), kitchen faucet aerator (81%), bathroom faucet aerator (86%) and pipe wrap (97%). Verification rates from 96% - 100% strongly indicate that once installed, products remain installed in the home.

Objective #2: Customers' Usage Habits with respect to the Measures Installed

- Almost three-quarters (77%) of respondents who indicated the showerhead item is still installed also indicated all of the showering done in their home is now done under the new showerhead. Additionally, 12% indicated most (more than three quarters) is done under the new showerhead; and approximately 10% indicated half is done under the new showerhead.

Objective #3: Understanding re Benefits of Energy-Efficient Products

- Almost all (89%) of total respondents indicated they believe high-efficiency heating equipment can play a significant role in saving money on home energy costs, including more than one-quarter (28%) who said it could be very significant.

- Some 81% of total respondents agreed the products in the kit will help them save money on home energy costs, including 21% who strongly agreed.

Objective #4: Factors Affecting End-Users' Decision to Install Kit Products

- The main reasons end-users decided to install products are to conserve energy, to save money on the heating bill and the items were free.
- It appears likely that the recipient will install the products themselves. More than half of respondents indicated this for items installed in their home.

ESK-Res-Door-to-Door Drop-off Research Findings—Section 1: Findings re Awareness & Installation of Products Received

Findings related to Project Objectives #1 & 2:

To validate consumers' awareness of the products received from participating channel partners and to determine the products that were actually installed / remain installed, as well as usage habits regarding products that are still installed and general satisfaction with the kit

Verification of Consumers' Awareness, Installation of Products Received, Usage Habits re Products that are Installed and Satisfaction Level (Qs #1-4, 7, 8 & 11)

D2D-1.1 All (100%) respondents indicated they received the kit during a front-door visit by a Union Gas representative/technician. (Qs#1&2)

- In response to our request for verification regarding the site address, 100% of respondents indicated the Tracking Sheet information was correct.

D2D-1.2 Information re receipt of the kit was verified by 100% of total respondents. (Q#1) Regarding individual products in the kit, verification was as noted in the following table (Q#4).

- Ownership of a natural gas water heater was verified by 100% of total respondents. (Q#3)

ESK-Residential Impact Evaluation: Door-to-Door Drop-off Products Received in 2013	Column A Respondents: # Verified—Received	Column B Respondents: Total # survey completions	Column C Respondents: % Verified—Received
Energy-efficient Showerhead	100	100	100%
Kitchen Faucet Aerator	95	100	95%
Bathroom Faucet Aerator	95	100	95%
Pipe Wrap Insulation	100	100	100%
$25 Programmable Thermostat Coupon	90	100	90%
Booklet (How-to-install)	84	100	84%
	Yes	**No**	**Don't know**
Does your home have a natural gas water heater?	100 (100%)	0 (0%)	0 (0%)

D2D-1.3 More than 80% of total respondents indicated they had installed the products they received. Once installed, the products remain installed. (Qs7&8)

ESK-Residential- Door-to-Door Drop-off **Products installed in 2013** **Total = 100 completions**	**A. Respondents: # Verified—Installed**	**B. Respondents: % Verified—Installed** *(Base=100)*	**C. Respondents: # Verified—Still Installed**	**D. Respondents: % Verified—Still Installed** *(Base=# in A)*
Energy-efficient Showerhead	84	84%	81	96%
Kitchen Faucet Aerator	81	81%	79	98%
Bathroom Faucet Aerator	86	86%	86	100%
Pipe Wrap Insulation	97	97%	97	100%

D2D-1.4 Regarding level of satisfaction with the kit, all (100%) respondents indicated they are satisfied with the kit and the products they received, including 55% who are very satisfied. (Q#11)

D2D-1.5 Regarding level of satisfaction with the performance of the Union Gas representative (technician) who delivered the kit, all (100%) respondents indicated they are satisfied, including 56% who are very satisfied. (Q#11)

ESK-Res-Door-to-Door Drop-off Research Findings—Section 2: Findings re End-User Understanding of the Benefits of Energy-Efficient Products and Energy Efficiency

Findings related to Project Objective #3:

To gauge end-users' understanding regarding the benefits of energy-efficient products

Measurement of ESK—Residential-Door-to-Door Drop-off End-Users' Knowledge Level re Energy-Efficient Products (Qs #5, 6, 13 14)

D2D-2.1 Almost all respondents indicated they have a Programmable Thermostat in their home. (Qs# 6&13)

- Some 92% of total respondents verified they have a Programmable Thermostat in their home.
- Also, 49% of total respondents indicated they used the $25 programmable thermostat coupon include in the ESK package.

D2D-2.2 Respondents displayed indecisiveness as to whether higher-efficiency heating products can play a significant role in saving money on home energy costs (Qs#5, 12).

- Some 89% of total respondents believe high-efficiency heating products can play a significant role in saving money on home energy costs, yet only 28% said it could be very significant.
- Some 81% of total respondents agreed that the products they received in the kit will help to save money on home energy costs; yet only 21% strongly agreed.

D2D-2.3 With respect to other types of incentives to encourage energy efficiency in homes, respondents indicated the following would be useful to them: (Q#14—aided)

- Insulation products = 9 (9%)
- Appliances such as furnaces, water heaters = 53 (53%)
- Windows = 31 (31%)
- None of the above / No response = 7 (7%)

ESK-Res-Door-to-Door Drop-off Research Findings—Section 3: Findings re Factors Affecting End-Users' Decision to Install & Usage Habits re Installed Products

Findings related to Project Objectives #2 & 4:

To determine the factors affecting residential end-users' decision to install the products, who actually installed them and end-users' usage habits regarding products that are still installed

Identification of Factors Affecting End-Users' Installation Decision and Usage Habits re Products that are Still Installed (Qs# 7-10)

D2D-3.1 More than 80% of total respondents indicated they had installed the products they received. Once installed, products remain installed. (Q#7)

ESK-Residential-Door-to-Door Drop-off Products installed in 2013 (Total = 100 completions)	A. Respondents: # Verified—Installed	B. Respondents: % Verified—Installed *(Base=100)*	C. Respondents: # Verified—Still Installed	D. Respondents: % Verified—Still Installed *(Base=# in A)*
Energy-efficient Showerhead	84	84%	81	96%
Kitchen Faucet Aerator	81	81%	79	98%
Bathroom Faucet Aerator	86	86%	86	100%
Pipe Wrap Insulation	97	97%	97	100%

D2D-3.2 Regarding installation of products, more than half of respondents who installed a product indicated they installed it themselves. (Q#8)
(NB: Union Gas technicians did not enter the house and therefore did not install products.)

ESK-Residential: Door-to-Door Drop-off Products Installed in 2013	Column A Products: Total # Verified—Installed	Column B Products: #(%) Installed by respondent *(Base=# in A)*	Column C Products: #(%) Installed by someone else in household *(Base=# in A)*	Column D Other / Don't Recall #(%) *(Base=# in A)*
Energy-efficient Showerhead	84	58 (69%)	23 (27%)	3 (4%)
Kitchen Faucet Aerator	81	53 (65%)	24 (30%)	4 (4%)
Bathroom Faucet Aerator	86	52 (60%)	30 (35%)	4 (5%)
Pipe Wrap Insulation	97	57 (59%)	36 (37%)	4 (4%)

NB: Two reasons were cited by respondents who did not install products they received: The products were not compatible (i.e. did not fit) or they have no time now but do plan to install the products.

D2D-3.3 The following table contains the complete list of factors presented to respondents, as well as the percentages of total respondents who, on an aided basis, identified a factor as their main reason for installing some or all of the items in the kit (Q#10):

ESK-Residential: Door-to-Door Drop-off Initiative 2013: Main Reason for Installing Product(s)—Aided	**Main Reason** (% of total respondents who installed items—Cite one only)
To conserve energy/Use energy wisely	30
To save money on my heating bill	17
To reduce my environmental footprint	11
Items were free	28
To conserve energy/use energy wisely AND to save money on my heating bill*	14
** Unaided—cited both combined as main reason*	

D2D-3.4 Specifically regarding the Energy-efficient Showerhead, two questions were asked to respondents who received this item. (Q#9) The following findings are noted:

- More than three-quarters (77%) of total respondents who received showerhead(s) indicated all of the showering in their home now is done under a new showerhead. Slightly less than one-quarter of total respondents indicated that most (12%) or about half (10%) of the showering in their home now is done under a new showerhead.

Table 2: **ESK-Door-to-Door Drop-off Initiative** **Products installed in 2013 (Total = 100 completions)**	**A. Respondents: # Verified—Installed**	**B. Respondents: % Verified—Installed** *(Base=100)*	**C. Respondents: # Verified—Still Installed**	
Energy-efficient Showerhead	84	84%	81	*(Base = 81)*
Of all the showering done in your home, how much is done under a New Showerhead? (# & % of total still installed: Col C)			*All (100%) = 62 Most (75%+) = 10 Half (50%) = 8 1/3 (30%) or less = 1 None =0*	*All (100%) = 77% Most (75%+) = 12% Half (50%) = 10% 1/3 (30%) or less= 1% None = 0%*

Appendix H: Final Report Following an Impact Evaluation of the Union Gas ESK Residential Program: Pull Initiative 2013

Final Report Following An Impact Evaluation of the Union Gas ESK—Residential Program: Pull Initiative 2013

Introduction

This Report follows our administration of a telephone survey involving customers who received an Energy Savings Kit (ESK) via the Union Gas website, at an event at selected retail outlets or at another type of location, in conjunction with Union Gas' ESK Residential-Pull Initiative. The Initiative offers financial support/incentives to Partners to help promote the purchase of high-efficiency natural gas products and accessories amongst their (residential) customers.

Our firm conducted this Residential-Pull Impact Evaluation in Nov/Dec 2013, employing the methodology outlined on Page 3 of this Report.

The primary purpose of this research project is to validate the accuracy of information on Tracking Sheets sent to Union Gas by Partners claiming incentives. Comprising a separate Union Gas database, the tracking sheet files contain customer information (name, address & phone number), program identifier and product/installation/delivery information.

Additional objectives for this research project are to understand end-users' knowledge of energy efficiency and motivations regarding installation of products, as well as usage of and satisfaction with the products they installed.

This research project has been conducted according to generally accepted guidelines designed to ensure objectivity and personal confidentiality. Research-gathering procedures have yielded statistically valid results. We are confident our analysis of findings represents and interprets accurately the views and perspectives of respondents, who were co-operative and forthright in sharing information with us.

In submitting this report, we wish to express our appreciation to the staff of Union Gas for their active participation and support during the project. We particularly appreciate the assistance provided internally by Eric Buan, Analyst, DSM Research & Evaluation, who served as Project Coordinator.

Respectfully submitted by:

Ralph Beslin

Ralph Beslin, ABC
President

Objectives of this ESK Program Impact Evaluation: Residential-Pull Initiative

The **primary objectives** for this research project were as follows:

1. To validate customers' awareness of the products received in the kit and determine the products that were actually installed and remain installed.

2. To determine customers' usage habits with respect to the measures installed, as well as satisfaction with the kit and the products they installed

The **secondary objectives** for this research project were as follows:

3. To gauge customers' understanding regarding the benefits of energy-efficient products

4. To determine the factors that affect residential end-users' decision to install the products, reasons for installing or not installing products and who actually installed them.

Methodology for the ESK Program Impact Evaluation: Residential-Pull Initiative

Telephone Surveying of End-Users

Random selection techniques were used to create a survey sample from a population encompassing approximately 15,600 Union Gas Tracking Sheet records. Controls were applied and monitored to ensure appropriate representation of segments within the customer base. Segmentation criteria included area code and distribution channel (ordered directly from Union Gas website, at an event at a retailer location or at another location).

We used a slightly revised version of the survey instrument—approximately 7 minutes in length—used in the previous year's Evaluation. This instrument was administered to end-users—all of whom were qualified as kit recipients—within a survey population comprised of customers who received Energy Savings Kits from the UG website or at events at a retailer or other location in 2013.

A total of 165 survey completions was achieved, representing the target number (165) set for this impact evaluation. The number of completions results in a high level of confidence in the findings: 99% ± 10%.

Readers are encouraged to consult the survey instrument for exact wording of questions and responses. The questionnaire can be found in the Appendix.

End-User Response Groups Profile:
ESK-Residential-Pull
Impact Evaluation re 2013 Initiative
Total completions = 165

Distribution Channel	
Ordered from Union Gas Website	*58 (35%)*
From a retailer such as Home Depot, Rona, Lowe's	*99 (60%)*
Picked it up from a local pick-up depot	*8 (5%)*
Another way / Another retail location	*0 (0%)*
Area Code	Age
416 = 5 (3%)	*18-34 = 27 (16%)*
519 = 90 (55%)	*35-44 = 47 (29%)*
613 = 10 (6%)	*45-54 = 46 (28%)*
705 = 15 (9%)	*55-64 = 25 (15%)*
807 = 15 (9%)	*65+ = 20 (12%)*
905 = 30 (18%)	*No response = 0 (0%)*

Executive Summary

Primary Objective: Awareness & Installation of Products Received

- Information in the Union Gas database regarding receipt of the kit (100%) and address of the recipients (100%) was confirmed. In addition, all respondents (100%) verified that they have a natural gas water heater in their home.
- Information related to individual products received was verified as extremely accurate for the showerhead (100%), kitchen faucet aerator (99%); bathroom faucet aerator (96%) and pipe wrap (98%).
- Regarding installation of individual products, more than three-quarters of respondents indicated they had installed each of the four products they received: Showerhead (89%), kitchen faucet aerator (79%), bathroom faucet aerator (87%) and pipe wrap (92%). Verification rates from 91% - 100% strongly indicate that once installed, products remain installed in the home.
- Almost all (96%) respondents indicated they are satisfied with the kit they received, including 38% who indicated they are very to extremely satisfied.

Objective #2: Customers' Usage Habits with respect to the Measures Installed

- Some 27% of respondents who installed the showerhead item indicated all of the showering done in their home is now done under the new showerhead. Additionally, 28% indicated most (more than three quarters) is done under the new showerhead; and approximately 39% indicated about half is done under the new showerhead.

- Some 33% of respondents whose showerhead item is still installed indicated that had they received a second showerhead, they would have installed it.

Objective #3: Understanding re Benefits of Energy-Efficient Products

- Some 89% indicated they believe high-efficiency heating equipment can play a significant role in saving money on home heating costs; including 25% who said it could be very significant.

- Almost all (99%) respondents indicated they have a programmable thermostat in their home

Objective #4: Factors Affecting End-Users' Decision to Install Kit Products

- The main reasons end-users decided to install products are to conserve energy and save money on the heating bill.
- The reasons cited by respondents as the main reasons why they did **not** install an item in the kit is that they had no time/not gotten around to it or the item did not fit.
- It is extremely likely that the recipient or someone else in the household will install the items. Contractors appear to be responsible for installing the items for only about 4% of kit recipients.

ESK—Residential-Pull Research Findings—Section 1: Findings re Awareness & Installation of Products Received

Findings related to Project Objectives #1 & 2:

To validate customers' awareness of the products received in the kit and to determine the products that were actually installed / remain installed, as well as customers' usage habits and level of satisfaction with respect to the products they installed

Verification of Customers' Awareness, Installation of Products Received and Usage Habits re Installed Products
(Qs#1-4, 9, 10, 11, 13)

PLL-1.1 Information re receipt of the kit was verified by 100% of total respondents. (Q#1)

- Ownership of a natural gas water heater, a requirement for receipt of the kit, was verified by 100% of respondents. (Q#9)
- Additionally, almost all (99%) of total respondents indicated they have a Programmable Thermostat in their home. (Q#9)
- Regarding individual products in the kit, verification was as noted in the following chart (Q#4):

ESK-Residential-Pull: **Products Verified Received in 2013**	**Column A Respondents: # Verified—Received**	**Column B Respondents: Total # survey completions**	**Column C Respondents: % Verified—Received**
Energy-efficient Showerhead	165	165	100%
Kitchen Faucet Aerator	164	165	99%
Bathroom Faucet Aerator	158	165	96%
Pipe Wrap Insulation	162	165	98%
$25 Programmable Thermostat Rebate Coupon	137	165	83%
	Yes	**No**	**No response**
Do you have a natural gas water heater?	165 (100%)	0 (0%)	0

PLL-1.2 Information related to home address of the recipient of the kit was verified as extremely accurate (Q#2a).

- In response to our request for verification of the customer's address identified on the Tracking Sheet, all (100%) respondents indicated the information was correct.

PLL-1.3 Information related to how respondents received the kit was verified as accurate. (Q#2b)

- Of the 165 respondents, 131(79%) identified that they received the kit via the channel identified in the Union Gas database.

PLL-1.4 The 99 respondents who indicated they received the kit at a retailer location such as Home Depot were asked—on an aided basis—to identify the purpose for their visit to the retailer store on the day they received the kit. A majority (55%) of these respondents indicated they went ESPECIALLY to get a kit [25%] or for other reasons *AND* to pick up a kit [30%] (Q#3).

- Retail-location respondents who indicated they had heard about the availability of the kit before entering the store identified four main ways: In a bill insert [47%]; via a coupon in the mail (19%); on the Union Gas website (13%) or in flyers [10%].

- More than 40% of retail location respondents did not remember the purpose of their visit to the location when they picked up a kit.

PLL-1.5 Of the four products in the kit that require installation, all of the products were installed by more than three-quarters of respondents who received the item, as noted in the following table. In Column D, note that verification rates ranging from 91% to 100% strongly indicate that once installed, the products remain installed in the home. (Qs#10, 11)

ESK-Residential-Pull: Products Verified Installed in 2013	**Column A** **Respondents: # Verified—Installed**	**Column B** **Respondents: % Verified—Installed** ***(Base=# verified received)***	**Column C** **Respondents: # Verified—Still Installed**	**Column D** **Respondents: % Verified—Still Installed** ***(Base=# in Col A)***
Energy-efficient Showerhead	147	89%	147	100%
Kitchen Faucet Aerator	130	79%	118	91%
Bathroom Faucet Aerator	137	87%	136	99%
Pipe Wrap Insulation	149	92%	148	99%

PLL-1.6 With respect to all four items in the kit requiring installation, the items were most likely to be installed by the respondents themselves (55 %+). Alternatively, approximately one-quarter of the items were installed by someone else in their household. (Q#11)

PLL-1.7 Almost all (96%) respondents indicated they are satisfied with the kit they received, including 38% who indicated they are very to extremely satisfied. (Q#13)

ESK—Residential-Pull Research Findings—Section 2: Findings re End-User Understanding of the Benefits of Energy-Efficient Products and Energy Efficiency

Findings related to Project Objective #3:

To gauge customers' understanding regarding the benefits of energy-efficient products

Measurement of ESK—Residential-Pull End-Users' Knowledge Level re Energy-Efficient Products (Qs#6, 9, 14-15)

PLL-2.1 Respondents generally believe higher-efficiency products can play a significant role in saving money on home energy costs (Q#6) and making their home more comfortable.

- Some 89% of total respondents indicated they believe high-efficiency products can play a significant role in saving money on home energy costs, including 25% who said it could be very significant.

- About 70% of total respondents agreed with the following statement: "The products I installed from the Energy Savings Kit will help save money on my home energy costs"; including 7% who strongly agreed with this statement.

- Slightly more than three-quarters (77%) of total respondents agreed with the following statement: "The products I installed from the Energy Savings Kit will help make my home more comfortable"; including 8% who strongly agreed.

PLL-2.2 Almost all (99%) respondents indicated they have a Programmable Thermostat. (Q#9b)

- Slightly more than one-third (38%) of total respondents indicated they had used the Programmable Thermostat Rebate Coupon that was included with the package. (Q#15a)

PLL-2.3 With respect to other types of incentives to encourage energy efficiency in homes, a significant percentage of respondents who installed items in this kit indicated the following would be useful to them: (Q#15)

- Insulation products = 11%
- Weather stripping products = 10%
- Rebates after purchasing any high-efficiency natural gas product = 38%
- Solar pool covers = 3%
- *None of the above = 38%*

ESK—Residential-Pull Research Findings—Section 3:

Findings re Factors Affecting End-Users' Decision to Install

Findings related to Project Objectives #2 & 4:

To determine the factors that affect residential end-users' decision to install the products, who actually installed the products and end-users' usage habits regarding products that are still installed

Identification of Factors Affecting Residential-Pull End-Users' Installation Decision and Usage Habits re Products that are Still Installed (Qs#10-12)

PLL-3.1 Of the four products in the kit that require installation, all products were installed by more than three-quarters of respondents who received the item, as noted in the following table. (Q#11)

ESK-Residential-Pull: Products Verified Installed in 2013	Column A	Column B	Column C	Column D
	Respondents: # Verified—Installed	Respondents: % Verified—Installed *(Base=# verified received)*	Respondents: # Verified—Still Installed	Respondents: % Verified—Still Installed *(Base=# in Col A)*
Energy-efficient Showerhead	147	89%	147	100%
Kitchen Faucet Aerator	130	79%	118	91%
Bathroom Faucet Aerator	137	87%	136	99%
Pipe Wrap Insulation	149	92%	148	99%

PLL-3.2 Respondents who indicated they did not install items in the kit cited a variety of reasons for not doing so, as noted in the following table: (Q#10)

ESK-Residential-Pull: Reason Did NOT Install Product (in 2013)	Showerhead: *% of did not installs*	K-Faucet Aerator: *% of did not installs*	B-Faucet Aerator: *% of did not installs*	Pipe Wrap: *% of did not installs*
a. Did not need/Already had one	6	6	10	0
b. Did not know how to install it	0	0	0	0
c. Did not like it/Needed a different one	0	0	0	0
d. Kit item did not fit	33	56	14	0
e. Have not gotten around to it/No time	39	32	52	92
f. Don't know/No response/Not sure received/Other reason	22	6	24	8

PLL-3.3 Regarding installation of the products, for all items it was most likely that the individual respondent or, alternatively, someone else in the household installed the item. Only 6 (approx 4%) of respondents indicated the items had been installed by an outside contractor. (Q#11)

PLL-3.4 The following chart contains the complete list of factors presented to respondents, as well as the percentages of total respondents who, on an aided basis, identified a factor as their main reason for installing some or all of the items in the kit (Q#12):

ESK-Residential-Pull: Main Reason for Installing Product(s) in 2013	**Main Reason (% of total respondents that installed products… Cite one only)**
To conserve energy/Use energy wisely	38
To save money on my heating bill	27
The items were free	15
To conserve energy AND to save money on my heating bill (cited both reasons on an unaided basis)	20
No main reason	*0*

PLL-3.5 Specifically with respect to the Showerhead, several questions were asked to those respondents who decided to install this item in their home. (Q#11a9-11) The following findings are noted:

- Some 27% of respondents who installed the showerhead item indicated all of the showering done in their home is now done under the new showerhead. Additionally, 28% indicated most (more than three quarters) is done under the new showerhead; and approximately 39% indicated about half is done under the new showerhead.
- Some 33% of respondents whose showerhead item is still installed indicated that had they received a second showerhead, they would have installed it. A further 22% indicated *Maybe*.
- Amongst the respondents who indicated they would or may have installed a second showerhead had they received one, more than three-quarters (78%) estimated that all of the showering in their home would be done under the two showerheads combined, and a further 18% estimated that most would be done under the two showerheads combined.

ESK—Residential-Pull **Showerhead Product installed in 2013**	A. Respondents: # Verified—Installed	**B. Respondents: # Verified—Still Installed**	**C. Respondents: % Verified—Still Installed**
Energy-efficient Showerhead	147	147	100%
Of all the showering done in your home, how much is done under the New Showerhead? (# & % of total still installed—Col B)		All (100%) = 39 Most (75%+) = 41 Half (50%) =58 1/3(30%) or less = 9 Don't know = 0	All (100%) = 27% Most (75%+) = 28% Half (50%) = 39% 1/3(30%) or less=6% Don't know = 0%

Appendix I: Final Report Following an Impact Evaluation of the Union Gas ESK Residential Program: Push Initiative 2013

Final Report Following
An Impact Evaluation of the Union Gas
ESK Residential Program
Push Initiative 2013

Introduction

This Report follows our administration of a telephone survey involving homeowners who received an Energy Savings Kit (ESK) in conjunction with Union Gas' ESK Residential-Push Initiative. The Initiative offers financial support/incentives to registered Channel Partners to help promote the purchase of high-efficiency natural gas products and accessories amongst their residential customers.

Our firm conducted this ESK Impact Evaluation in Nov/Dec.2013, employing the methodology outlined on Page 3 of this Report. The primary purpose of this research project was to validate the accuracy of information on Tracking Sheets sent to Union Gas by Partners claiming incentives. Comprising a separate Union Gas database, the tracking sheet files contain customer information (name, address & phone number), program identifier and product/installation information. Installation sites included only residential locations.

Additional objectives for this research project were to understand end-users' knowledge of energy efficiency and motivations regarding installation of products, as well as usage of and satisfaction with the products they installed.

This research project has been conducted according to generally accepted guidelines designed to ensure objectivity and personal confidentiality. Research-gathering procedures have yielded statistically valid results. We are confident our analysis of findings represents and interprets accurately the views and perspectives of respondents, who were co-operative and forthright in sharing information with us.

In submitting this report, we wish to express our appreciation to the staff of Union Gas for their active participation and support during the project. We particularly appreciate the assistance provided internally by Eric Buan, Analyst, DSM Research & Evaluation, who served as Project Coordinator.

Respectfully submitted by:

Ralph Beslin

Ralph Beslin, ABC
President

Objectives of this ESK Program Impact Evaluation Residential-Push Initiative

The **primary objectives** for this research project were as follows:

1. To validate consumers' awareness of the products received from participating channel partners and determine the products that were actually installed and remain installed.

2. To determine customers' usage habits with respect to the measures installed and level of satisfaction with the kit and products they installed

The **secondary objectives** for this research project were as follows:

3. To gauge residential end-users' understanding regarding the benefits of energy- efficient products

4. To determine the factors that affect residential end-users' decision to install the products and who installed them.

Methodology for the ESK Program Impact Evaluation
Residential-Push Initiative

Telephone Surveying of End-Users

Random selection techniques were used to create a survey sample from files within Union Gas databases containing approximately 5,500 Tracking Sheet records submitted by registered Channel Partners and Union Gas representatives. Controls were applied and monitored to ensure appropriate representation of segments within the customer base. Segmentation criteria included: region (area code) of the province where the kit was delivered and whether the kit was delivered by a channel partner directly at a residence or at a special giveaway event.

We employed a slightly revised version of the same survey instrument—approximately 7 minutes in length—used in the previous year's Evaluation. This was administered to end-users—all of whom were qualified as kit recipients—within a survey population comprised of customers who received Energy Savings Kits during a home visit by a contractor, during a door-to-door delivery or at a special giveaway event in 2013. Size and segmentation of the survey population are identified in the chart below.

A total of 165 survey completions was achieved, representing the target number (165) set for this Impact Evaluation. The number of completions results in a high level of confidence in the findings: 99% ± 10%, the target level set for this survey.

Readers are encouraged to consult the survey instrument for exact wording of questions and response options. The questionnaire can be found in the Appendix.

ESK-Residential-Push
2013
End-User Response Groups
By Region / Reason for Site Visit / Age

Region	**Area Code 416**	**Area Code 519**	**Area Code 613**	**Area Code 705**	**Area Code 807**	**Area Code 905**
Total Completions = 165 *Kit delivered by:* *Channel Partner at a home visit =140* *Channel Partner at giveaway event = 25*	**2** **(1%)**	**95** **(58%)**	**12** **(7%)**	**33** **(20%)**	**3** **(2%)**	**20** **(12%)**
Age*		**18-34**	**35-44**	**45-54**	**55-64**	**65+**
		18 **(11%)**	**51** **(31%)**	**58** **(35%)**	**23** **(14%)**	**15** **(9%)**

Executive Summary

Primary Objective: Awareness & Installation of Products Received

- Information in the Union Gas database regarding receipt of the kit was confirmed [100%]. With respect to respondents who indicated they received the kit at home from a contractor, the site of the visit (100%) was verified as extremely accurate. In addition, all (100%) respondents verified that they have a natural gas water heater in their home.
- Information related to individual products received was verified as extremely accurate for the showerhead (100%), kitchen faucet aerator (99%), bathroom faucet aerator (96%)) and pipe wrap (100%).
- Regarding installation of individual products, a majority of respondents indicated they had installed each of the four products they received: Showerhead (72%), kitchen faucet aerator (63%), bathroom faucet aerator (73%) and pipe wrap (85%). Verification rates from 96% - 100% strongly indicate that once installed, products remain installed in the home.

Objective #2: Customers' Usage Habits with respect to the Measures Installed

- Some 43% of respondents who installed the showerhead item indicated all (8%) or most (35%) of the showering done in their home is now done under the new showerhead. Additionally, 49% indicated about half is done under the new showerhead.

- Some 42% of respondents whose showerhead item is still installed indicated that had they received a second showerhead, they would have installed it. An additional 28% indicated maybe.

Objective #3: Understanding re Benefits of Energy-Efficient Products

- Some 83% indicated they believe high-efficiency heating equipment can play a significant role in saving money on home energy costs; including 33% who said it could be very significant.

- All (100%) respondents indicated they have a programmable thermostat in their home.

Objective #4: Factors Affecting End-Users' Decision to Install Kit Products

- The main reasons end-users decided to install products are to conserve energy, save money on the heating bill and the items were free.
- The reasons cited by respondents as the main reasons why they did **not** install an item in the kit is that they had no time/not gotten around to it or the item was not compatible/did not fit. In the case of the bathroom faucet aerator, a significant percentage of respondents cited that they did not need/already had one.
- It is most likely that the recipient or someone else in the household will install the items. However, more than one-third of the showerheads, almost half of the pipe wrap insulation and approximately one-quarter of the aerator items were installed by contractors.

ESK—Residential-Push Research Findings—Section 1: Findings re Awareness & Installation of Products Received

Findings related to Project Objectives #1 & 2:

To validate consumers' awareness of the products received and determine the products that were actually installed / remain installed, as well as consumers' usage habits.

Verification of Consumers' Awareness, Installation of Products Received and Usage Habits re Products that are Still Installed

(Qs#2-4, 10, 11, 13)

PSH-1.1 Information re receipt of the kit was verified by 100% of total respondents. (Q#1) Regarding individual products in the kit, verification was as noted in the following table (Q#4).

- Ownership of a natural gas water heater, a requirement for receiving a kit during a residential site visit, was verified by 100% of respondents. (Q#2)

ESK-Residential-Push: Products Received in 2013	Column A Respondents: # Verified—Received	Column B Respondents: Total # survey completions	Column C Respondents: % Verified—Received
Energy-efficient Showerhead	165	165	100%
Kitchen Faucet Aerator	163	165	99%
Bathroom Faucet Aerator	158	165	96%
Pipe Wrap Insulation	165	165	100%
$25 Programmable Thermostat Rebate Coupon	143	165	87%
	Yes	**No**	
Does your home have a natural gas water heater?	165 (100%)	0 (0%)	

PSH-1.2 Amongst the 140 respondents who received the kit at home, the site of the contractor's visit was verified as extremely accurate (Q#2).

- In response to our request for verification regarding the site, 100% of respondents indicated the Tracking Sheet information was correct.

PSH-1.3 Information related to the contractor who conducted the site visit was verified as very accurate (Q#3).

- One hundred forty respondents (85% of total respondents) verified they had received the kit during a visit by a contractor to their home, as indicated in the Union Gas database records.
- Approximately one-third (34%) of these respondents indicated that the reason for the contractor's visit was to install/convert/replace equipment, while 66% indicated that the reason was to conduct a regular maintenance appointment. No respondent indicated that the kit was received from a channel partner representative delivering kits door-to-door. (Q#3)

PSH-1.4 Of the four products in the kit that require installation, a majority of respondents indicated they had installed each of the four items they received: Showerhead (72%), kitchen faucet aerator (63%), bathroom faucet aerator (73%) and pipe wrap (85%). Verification rates from 96% - 100% strongly indicate that once installed , products remain installed in the home. (Q#11).

ESK-Residential-Push: Products Installed in 2013	Column A Respondents: # Verified—Installed	Column B Respondents: % Verified—Installed *(Base- # verified received)*	Column C Respondents: # Verified—Still Installed	Column D Respondents: % Verified—Still Installed *(Base=# in Col A)*
Energy-efficient Showerhead	118	72%	117	99%
Kitchen Faucet Aerator	102	63%	98	96%
Bathroom Faucet Aerator	115	73%	113	98%
Pipe Wrap Insulation	140	85%	140	100%

PSH-1.5 A strong majority (77%) of total respondents indicated they are satisfied with the kit they received, including 16% who indicated they are very to extremely satisfied. (Q#13)

ESK—Residential-Push Research Findings—Section 2: Findings re End-User Understanding of the Benefits of Energy-Efficient Products and Energy Efficiency

Findings related to Project Objective #3:

To gauge end-users' understanding regarding the benefits of energy-efficient products

Measurement of ESK—Residential-Push End-Users' Knowledge Level re Energy-Efficient Products (Qs#6, 8, 14-15)

PSH-2.1 With respect to saving money on their home energy costs, respondents believe higher efficiency products help save money. (Q#6)

- Some 83% of total survey respondents believe higher efficiency products can play a very (33%) or somewhat (50%) significant role in saving money on home energy costs.

- In addition, some 60% agreed that the products they installed will save money on home heating costs, including 10% who strongly agreed.

PSH-2.2 All (100%) respondents indicated they have a programmable thermostat in their home. (Q#8b)

PSH-2.3 About 32% of total respondents indicated they used the $25 Programmable Thermostat Rebate Coupon that was included with the package. (Q#15)

PSH-2.4 With respect to other types of incentives to encourage energy efficiency in homes, respondents indicated the following would be useful to them: (Q#15—aided, cite one only)

- Insulation products = 8%
- Weather stripping products = 17%
- Rebates after purchasing any high-efficiency natural gas product = 24%
- Solar pool covers = 8%
- Reflector panels for radiant heaters = 1%
- None of the above = 42%

ESK—Residential-Push Research Findings—Section 3: Findings re Factors Affecting End-Users' Decision to Install

Findings related to Project Objectives #2 & 4:

To determine the factors that affect residential end-users' decision to install the products, who actually did the installation and usage habits regarding products that are still installed

Identification of Factors Affecting End-Users' Installation Decision and Usage Habits re Products that are Still Installed (Qs# 10-12)

PSH-3.1 Of the four products in the kit that require installation, a majority of respondents indicated that they had installed each of these products, as noted in the following table. (Q#11)

ESK-Residential-Push: Products Installed in 2013	**Column A** **Respondents: # Verified—Installed**	**Column B** **Respondents: % Verified—Installed** ***(Base=# verified received)***	**Column C** **Respondents: # Verified—Still Installed**	**Column D** **Respondents: % Verified—Still Installed** ***(Base=# in Col A)***
Energy-efficient Showerhead	118	72%	117	99%
Kitchen Faucet Aerator	102	63%	98	96%
Bathroom Faucet Aerator	115	73%	113	98%
Pipe Wrap Insulation	140	85%	140	100%

PSH-3.2 Respondents who indicated they did not install kit items cited a variety of reasons for NOT doing so, as noted in the following table: (Q#10)

ESK-Residential-Push: Reason Did NOT Install Product(s) received in 2013	**Showerhead:** *% of did not installs*	**K-Faucet Aerator:** *% of did not installs*	**B-Faucet Aerator:** *% of did not installs*	**Pipe Wrap:** *% of did not installs*
a. Did not need/Already had one	4	8	14	4
b. Did not know how to install it	0	0	0	0
c. Did not like it/Needed a different one	0	0	0	0
d. Kit item did not fit	28	41	12	0
e. Have not gotten around to it/No time	51	39	56	88
f. Don't know/Other	17	12	19	8

PSH-3.3 Regarding installation of the products, for all items it was most likely that the individual respondent or, alternatively, someone else in the household installed the item. However, more than one-third of the showerheads, almost half of the pipe wrap insulation and approximately one-quarter of the aerator items were installed by contractors. (Q#11)

PSH-3.4 The following chart contains the complete list of factors presented to respondents, as well as the percentages of total respondents who, on an aided basis, identified a factor as their main reason for installing some or all of the items in the kit (Q#12):

ESK-Residential-Push: Main Reason for Installing Product (in 2013)	**2013 Main Reason (% of total who installed product: Cite 1 reason only)**	***Main Reason (Compare 2012)***
a. To conserve energy/Use energy wisely	17	*45*
b. To save money on my heating bill	26	*35*
c. The items were free	22	*14*
d. Contractor offered to do it	15	*0*
e. To conserve energy AND to save money on my heating bill (Cited a & b--unaided)	*20*	*Other = 6*

PSH-3.5 Specifically with respect to the Energy-efficient Showerhead, several questions were asked to respondents who decided to install this item in their home. (Q#11)

The following findings are noted:

- Some 8% of respondents who installed the showerhead item indicated all of the showering done in their home now is done under the new showerhead. Approximately 35% indicated most (more than three quarters) is done under the new showerhead; and 49% indicated about half is done under the new showerhead.

- Some 42% of respondents whose showerhead item is still installed indicated that had they received a second showerhead, they would have installed it. A further 28% indicated maybe.

- Of the respondents who indicated they would or may install a second showerhead had they received one, some 96% estimated that all [78%] or most [18%] of the showering in their home would be done under the two showerheads combined.

ESK—Residential Push **Showerhead Product installed in 2013**	A. Respondents: # Verified—Installed	**B. Respondents: # Verified—Still Installed**	**C. Respondents: % Verified—Still Installed**
Energy-efficient Showerhead	118	117	99%
Of all the showering done in your home, how much is done under the New Showerhead? (# & % of total still installed—Col B)		All (100%) = 9 Most (75%+) = 41 Half (50%) =58 1/3 (30% or less = 9 Don't know = 0	All (100%) =8% Most (75%+) = 35% Half (50%) = 49% 1/3(30% or less= 8% Don't know = 0%

Appendix J: Final Report Following An Audit of the Union Gas ESK Residential Program: Install Initiative 2012

Final Report Following An Audit of the Union Gas ESK—Residential Program Install Initiative (2012)

Introduction

This Report follows our administration of a survey involving householders who received an Energy Savings Kit (ESK) in conjunction with Union Gas' ESK—Install Initiative. The Initiative offers financial support/incentives to registered Channel Partners to help promote the use of high-efficiency natural gas products and accessories amongst residential customers.

Our firm conducted this Audit in February 2013, employing the methodology outlined on Page 3 of this Report. The primary purpose of this research project was to validate the accuracy of information on Tracking Sheets sent to Union Gas by Partners claiming incentives. Comprising a separate Union Gas database, the tracking sheet files contain customer information (name, address & phone number), program identifier and product/installation information. Installation sites included only residential locations.

Additional objectives for this research project were to understand end-users' knowledge of energy efficiency and their motivations for installing the items, as well as determine their usage habits and satisfaction level regarding the items in the kit.

This research project has been conducted according to generally accepted guidelines designed to ensure objectivity and personal confidentiality. Research-gathering procedures have yielded statistically valid results. We are confident our analysis of findings represents and interprets accurately the views and perspectives of respondents, who were co-operative and forthright in sharing information with us.

In submitting this report, we wish to express our appreciation to the staff of Union Gas for their active participation and support during the project. We particularly appreciate the assistance provided internally by [redacted], Analyst, DSM Research & Evaluation, who served as Project Coordinator.

Respectfully submitted by:

Ralph Beslin

Ralph Beslin, ABC
President

Objectives of this ESK—Residential—Install Initiative Audit

The **primary objectives** for this Audit research project were as follows:

1. To validate consumers' awareness of the products received from participating channel partners and determine the products that were actually installed and remain installed.

2. To determine customers' satisfaction with the products in the kit they received and their usage habits with respect to the measures installed

The **secondary objectives** for this Audit research project were as follows:

3. To gauge residential end-users' understanding regarding the benefits of energy- efficient products

4. To determine the factors affecting residential end-users' decision to install the products and who actually installed the products

Methodology for the ESK—Residential—Install Initiative Audit

Telephone Surveying of End-Users

Random selection techniques were used to create a survey sample from files within Union Gas databases containing approximately 150 Tracking Sheet records submitted by registered Channel Partners and Union Gas representatives. Controls were applied and monitored to ensure appropriate representation of segments within the customer base. Segmentation criteria included: region (area code) of the province where the kit was delivered; and a qualifying question was used to ensure the kit was delivered directly by a channel partner (contractor) during a visit to a residence.

We employed a modified version of the survey instrument used in other ESK audits—approximately 7 minutes in length. This was administered to randomly selected end-users—all of whom were qualified as kit recipients—within a survey population comprised of customers who received Energy Savings Kits during a home visit by a contractor. Size and segmentation of the survey population are identified in the chart below. Readers are encouraged to consult the survey instrument for exact wording of questions and response options. *(See questionnaire in the Appendix.)*

A total of 38 survey completions was achieved, representing a satisfactory level of confidence for this audit—approximately one-quarter of the survey population. NB: There were a large number of declines, attributed primarily to lack of time; however, a strong majority of declining respondents confirmed they had received the kit and were very satisfied with items they received.

End-User Response Groups Profile:
ESK-Residential-Install
Audit re 2012 Initiative
Total Completions = 38

Distribution Channel	Total completions
Contractor visit to home	100 (100%)

Area Code	*Age Group*
519 =30 (80%)	*18 - 34 = 2 (5%)*
705 = 2 (5%)	*35 - 44 = 7 (18%)*
905 = 6 (15%)	*45 - 54 = 8 (21%)*
	55 - 64 = 16 (42%)
	65+ = 5 (13%)

Executive Summary

Primary Objective: Awareness & Installation of Products Received

- Information in the Union Gas database regarding receipt of the kit was confirmed [100%]. With respect to respondents who indicated they received the kit at home from a contractor, the site of the visit (100%) was verified as extremely accurate. In addition, 100% of total respondents verified that they have a natural gas water heater in their home.
- Information related to individual products received was verified as extremely accurate for all products: Showerhead (100%), kitchen faucet aerator (97%), bathroom faucet aerator (100%) and pipe wrap (100%).
- Regarding installation of individual products, almost nine in ten respondents indicated they had installed each of the four products: Showerhead (95%), kitchen faucet aerator (89%), bathroom faucet aerator (92%) and pipe wrap (100%). Verification rates from 94% - 100% strongly indicate that once installed, products remain installed in the home.

Objective #2: Customers' Usage Habits with respect to the Measures Installed

- Slightly more than half (54%) of respondents who installed the showerhead item indicated all of the showering done in their home is now done under the new showerhead. Additionally, 3% indicated most (more than three quarters) is done under the new showerhead; and approximately 43% indicated half is done under the new showerhead.

Objective #3: Understanding re Benefits of Energy-Efficient Products

- Almost all (95%) of total respondents indicated they are knowledgeable about energy efficiency in the home, including more than one-third (37%) who indicated very knowledgeable.

- Some 89% indicated they believe high-efficiency heating equipment can play a significant role in saving money on home heating costs; including 29% who said it could be very significant.

- Some 82% of total respondents agreed the products in the kit will help them save money on home energy costs, including 26% who strongly agreed.

Objective #4: Factors Affecting End-Users' Decision to Install Kit Products

- The main reasons end-users decided to install products are to conserve energy, to save money on the heating bill and because of the contractor's advice.
- It appears more likely that the recipient will install the aerators and pipe wrap, while in almost all cases the contractor will install the showerhead.

ESK—Res—Install Research Findings—Section 1: Findings re Awareness & Installation of Products Received

Findings related to Project Objectives #1 & 2:

To validate consumers' awareness of the products received from participating channel partners and to determine the products that were actually installed / remain installed, as well as usage habits regarding products that are still installed and general satisfaction level with the kit

Verification of Consumers' Awareness, Installation of Products Received and Usage Habits re Products that are Installed (Qs #1, 2 6, 7, 11)

INS-1.1 All (100%) respondents indicated they received the kit at home during a routine visit by a contractor. (Qs#1&2)

- In response to our request for verification regarding the site, 100% of respondents indicated the Tracking Sheet information was correct.

INS-1.2 Information re receipt of the kit was verified by 100% of total respondents. (Q#1) Regarding individual products in the kit, verification was as noted in the following table (Q#3).

- Ownership of a natural gas water heater was verified by 100% of total respondents. Ownership of a natural gas furnace also was verified by 100% of total respondents. (Q#2)

ESK-Residential-Install Audit: Products Received in 2012	Column A Respondents: # Verified—Received	Column B Respondents: Total # survey completions	Column C Respondents: % Verified—Received
Energy-efficient Showerhead	38	38	100%
Kitchen Faucet Aerator	37	38	97%
Bathroom Faucet Aerator	38	38	100%
Pipe Wrap	38	38	100%
	Yes	No	Don't know
Does your home have a natural gas water heater?	100 (100%)	0 (0%)	0 (0%)

INS-1.3 Almost all total respondents indicated they had installed the products they received. Once installed, the products remain installed. (Qs#6&7)

ESK-Residential-Install **Products installed in 2012 (Total = 38 completions)**	**A. Respondents: # Verified—Installed**	**B. Respondents: % Verified—Installed** *(Base=38)*	**C. Respondents: # Verified—Still Installed**	**D. Respondents: % Verified—Still Installed** *(Base=# in A)*
Energy-efficient Showerhead	36	95%	35	97%
Kitchen Faucet Aerator	33	89%	31	94%
Bathroom Faucet Aerator	35	92%	35	100%
Pipe Wrap	38	100%	38	100%

INS-1.4 Regarding level of satisfaction with the kit, all (100%) respondents indicated they are satisfied with the kit and the products they received, including 79% who are very or extremely satisfied. (Q#11)

ESK—Residential-Install Initiative Research Findings—Section 2: Findings re End-User Understanding of the Benefits of Energy-Efficient Products and Energy Efficiency

Findings related to Project Objective #3:

To gauge end-users' understanding regarding the benefits of energy-efficient products

Measurement of ESK—Residential-Install End-Users' Knowledge Level re Energy-Efficient Products (Qs #4, 5, 12, 13)

INS-2.1 Almost all respondents indicated the furnace in their home is a high-efficiency model. (Q#5)

- Some 92% of total respondents verified their furnace is a high-efficiency model.

INS-2.2 Respondents appear to be knowledgeable about energy efficiency in the home. (Qs#4, 12)

- Almost 95% of total respondents indicated they are knowledgeable about energy efficiency in the home, including 37% who indicated they are very knowledgeable.

INS-2.3 Respondents displayed indecisiveness as to whether higher-efficiency heating products can play a significant role in saving money on home heating costs (Q#4).

- Some 89% of total respondents believe high-efficiency heating products can play a significant role in saving money on home heating costs, yet only 29% said it could be very significant.
- Some 82% of total respondents agreed that the products they received in the kit will help to save money on home energy costs; yet only 26% strongly agreed.

INS-2.4 With respect to other types of incentives to encourage energy efficiency in homes, respondents who installed items in this kit indicated the following would be useful to them: (Q#13—aided)

- Insulation products = 20 (53%)
- Weather-stripping products = 12 (32%)
- Rebates after purchasing high-efficiency products = 3 (8%)
- None of the above / No response = 3 (8%)

ESK—Residential-Install Research Findings—Section 3: Findings re Factors Affecting End-Users' Decision to Install & Usage Habits re Installed Products

Findings related to Project Objectives #2 & 4:

To determine the factors affecting residential end-users' decision to install the products, who actually installed them and end-users' usage habits regarding products that are still installed

Identification of Factors Affecting End-Users' Installation Decision and Usage Habits re Products that are Still Installed (Qs# 6-10)

INS-3.1 Almost all respondents indicated they had installed the products they received. Once installed, the products remain installed. (Qs#6&7)

ESK-Residential- Install Products installed in 2012 (Total = 38 completions)	**A. Respondents: # Verified—Installed**	**B. Respondents: % Verified—Installed** *(Base=38)*	**C. Respondents: # Verified—Still Installed**	**D. Respondents: % Verified—Still Installed** *(Base=# in A)*
Energy-efficient Showerhead	36	95%	35	97%
Kitchen Faucet Aerator	33	89%	31	94%
Bathroom Faucet Aerator	35	92%	35	100%
Pipe Wrap	38	100%	38	100%

INS-3.2 Regarding installation of products, it was more likely that the respondent or someone else in the household installed the aerators and pipe wrap, while in almost all cases the contractor installed the showerhead. (Q#7)

ESK-Residential-Install Products Installed in 2012	**Column A Products: Total # Verified—Installed**	**Column B Products: #(%) Installed by respondent** *(Base=# in A)*	**Column C Products: #(%) Installed by other in household** *(Base=# in A)*	**Column D Products: #(%) Installed by Contractor** *(Base=# in A)*
Energy-efficient Showerhead	36	2 (6%)	4 (11%)	30 (83%)
Kitchen Faucet Aerator	33	24 (73%)	4 (12%)	5 (15%)
Bathroom Faucet Aerator	35	26 (74%)	4 (11%)	5 (14%)
Pipe Wrap	38	29 (76%)	4 (11%)	5 (13%)

NB: Three reasons were cited by respondents who did not install products they received: The products were not compatible (i.e. did not fit) or they have no time now but do plan to install the products or they are currently renovating their home and plan to install the products eventually.

INS-3.3 The following table contains the complete list of factors presented to respondents, as well as the percentages of total respondents who, on an aided basis, identified a factor as their main reason for installing some or all of the items in the kit (Q#10):

ESK-Residential-Install 2012 Audit: Main Reason for Installing Product(s)—Aided	**Main Reason** (% of total respondents who installed items—Cite one only)
To conserve energy/Use energy wisely	16%
To save money on my heating bill	18%
Recommended by relatives/friends	0%
Because of the contractor's advice	34%
To conserve energy/use energy wisely AND to save money on my heating bill*	32%
** Unaided—cited both combined as main reason*	

INS-3.4 Specifically regarding the Energy-efficient Showerhead, two questions were asked to respondents who received this item. (Qs#8-9) The following findings are noted:

- Most respondents (61%) who received the showerhead(s) indicated they have two showers in their home; the remainder indicated they have one shower (34%) or three showers (5%).
- Approximately half (54%) of total respondents who received showerhead(s) indicated all of the showering in their home now is done under a new showerhead. Slightly less than half of total respondents indicated that most (3%) or about half (43%) of the showering in their home now is done under a new showerhead.

Table 2: **ESK-Install** **Products installed in 2012 (Total = 38 completions)**	**A. Respondents: # Verified—Installed**	**B. Respondents: % Verified—Installed** *(Base=38)*	**C. Respondents: # Verified—Still Installed**	**D. Respondents: % Verified—Still Installed** *(Base=# in Col A)*
Energy-efficient Showerhead	36	95%	35	97%
Of all the showering done in your home, how much is done under a New Showerhead? (# & % of total still installed—Col C)			*All (100%) = 19* *Most (75%+) = 1* *Half (50%) =15* *1/3 (30%) or less = 0* *None =0*	*NB: Base = 35 (Col C)* *All (100%) = 54%* *Most (75%+) = 3%* *Half (50%) = 43%* *1/3 (30%) or less= 0%* *None = 0%*

Appendix K: Final Report Following An Audit of the Union Gas ESK Helping Homes Conserve (HHC) Program: Low Income Initiative 2012

Final Report Following An Audit of the Union Gas ESK—Helping Homes Conserve—HHC—Program Low-income Initiative 2012

Introduction

This Report follows our administration of a survey involving low-income householders who received an Energy Savings Kit (ESK) in conjunction with Union Gas' ESK Helping Homes Conserve Program—Low-income Initiative. The Initiative offers financial support/incentives to registered Channel Partners to help promote the use of high-efficiency natural gas products and accessories amongst residential customers.

Our firm conducted this Audit in two waves in Nov/Dec.12, employing the methodology outlined on Page 3 of this Report. The primary purpose of this research project was to validate the accuracy of information on Tracking Sheets sent to Union Gas by Partners claiming incentives. Comprising a separate Union Gas database, the tracking sheet files contain low-income customer information (name, address & phone number), program identifier and product/installation information. Installation sites included only residential locations.

Additional objectives for this research project were to understand end-users' knowledge of energy efficiency and their motivations for installing the items.

This research project has been conducted according to generally accepted guidelines designed to ensure objectivity and personal confidentiality. Research-gathering procedures have yielded statistically valid results. We are confident our analysis of findings represents and interprets accurately the views and perspectives of respondents, who were co-operative and forthright in sharing information with us.

In submitting this report, we wish to express our appreciation to the staff of Union Gas for their active participation and support during the project. We particularly appreciate the assistance provided internally by [redacted], Analyst, DSM Research & Evaluation, who served as Project Coordinator.

Respectfully submitted by:

Ralph Beslin

Ralph Beslin, ABC
President

Objectives of this
ESK—Residential—HHC Program: Low-income Initiative Audit

The **primary objectives** for this Audit research project were as follows:

1. To validate consumers' awareness of the products received from participating channel partners and determine the products that were actually installed and remain installed.

2. To determine customers' usage habits with respect to the measures installed

The **secondary objectives** for this Audit research project were as follows:

3. To gauge residential end-users' understanding regarding the benefits of energy- efficient products

4. To determine the factors affecting residential end-users' decision to install the products and who actually installed the products

Methodology for the ESK—Residential—HHC: Low-income Initiative Audit

Telephone Surveying of End-Users

Random selection techniques were used to create a survey sample from files within Union Gas databases containing approximately 7,500 Tracking Sheet records submitted by registered Channel Partners and Union Gas representatives. Controls were applied and monitored to ensure appropriate representation of segments within the customer base. Segmentation criteria included: region (area code) of the province where the kit was delivered and whether the kit was delivered directly by a channel partner during a visit to a residence or as a result of an installation booking after seeing a brochure.

We employed a modified version of the survey instrument used in the previous year's audit—approximately 7 minutes in length. This was administered to randomly selected end-users—all of whom were qualified as kit recipients—within a survey population comprised of customers who received Energy Savings Kits during a home visit by a contractor, during a door-to-door delivery, or as a result of a booking after seeing a brochure. Size and segmentation of the survey population are identified in the chart below.

A total of 165 survey completions was achieved, the target number set for this audit. The number of completions results in a high level of confidence in the findings: 99% ± 10%, the target level set for this survey.

Readers are encouraged to consult the survey instrument for exact wording of questions and response options. *(See questionnaire in the Appendix.)*

End-User Response Groups Profile:
ESK-Residential-HHC Low-income Audit re
2012 Initiative
Total Completions = 165

Distribution Channel	Total completions	
Contractor visit to home	153 (93%)	
Booking after seeing brochure	12 (7%)	
Area Code	***Type of Dwelling***	***Age of Dwelling***
289 = 12 (7%)	*Detached house = 92 (56%)*	*Less than 10 years = 2 (1%)*
416 = 1 (1%)	*Semi-detached = 40 (24%)*	*10-20 years = 10 (6%)*
519 = 45 (27%)	*Townhouse = 16 (10%)*	*20-30 years = 23 (14%)*
613 = 20 (12%)	*Apt/Condo = 12 (7%)*	*30 -40 years = 33 (20%)*
705 = 10 (6%)	*Duplex = 5 (3%)*	*40-50 years = 71 (43%)*
905 = 77 (47%)	*Own=140 (85%)/ Rent=25 (15%)*	*50+ years = 26 (16%)*

Executive Summary

Primary Objective: Awareness & Installation of Products Received

- Information in the Union Gas database regarding receipt of the kit was confirmed [100%]. With respect to respondents who indicated they received the kit at home from a contractor, the site of the visit (100%) was verified as extremely accurate. In addition, all (100%) of total respondents verified that they have a natural gas water heater in their home.
- Information related to individual products received was verified as extremely accurate for all products: Showerhead (99%), kitchen faucet aerator (95%), bathroom faucet aerator (90%) and pipe wrap (96%).
- Regarding installation of individual products, more than four in five of total respondents indicated they had installed each of the four products: Showerhead (93%), kitchen faucet aerator (85%), bathroom faucet aerator (86%) and pipe wrap (94%). Verification rates from 96% - 100% strongly indicate that once installed, products remain installed in the home.

Objective #2: Customers' Usage Habits with respect to the Measures Installed

- Some 74% of respondents who installed the showerhead item indicated all of the showering done in their home is now done under the new showerhead. Additionally, 2% indicated most (more than three quarters) is done under the new showerhead; and approximately 23% indicated half is done under the new showerhead.

Objective #3: Understanding re Benefits of Energy-Efficient Products

- Some 86% indicated they believe high-efficiency heating equipment can play a significant role in saving money on home heating costs; including 41% who said it could be very significant.

- Respondents appear to be knowledgeable about energy-efficiency in the home, as almost 98% of total respondents indicated they are knowledgeable, including 69% who indicated they are very knowledgeable.

- More than two-thirds (70%) of total respondents indicated the furnace in their home is a high-efficiency model.

- Approximately 90% of total respondents indicated they use weather stripping in their home.

Objective #4: Factors Affecting End-Users' Decision to Install Kit Products

- The main reasons end-users decided to install products are to conserve energy and save money on the heating bill.
- It appears most likely that the recipient will install all items (although in this audit, almost 40% of respondents indicated the contractor installed the showerhead).

ESK—Res—HHC: L-I Initiative Research Findings—Section 1: Findings re Awareness & Installation of Products Received

Findings related to Project Objectives #1 & 2:

To validate consumers' awareness of the products received from participating channel partners and to determine the products that were actually installed / remain installed, as well as usage habits regarding products that are still installed

Verification of Consumers' Awareness, Installation of Products Received and Usage Habits re Products that are Installed (Qs#2, 3, 7)

HHC-1.1 Amongst respondents who received the kit at home, the site of the contractor's visit was verified as extremely accurate (Q#2).

- In response to our request for verification regarding the site, 100% of respondents indicated the Tracking Sheet information was correct.

HHC-1.2 Information re receipt of the kit was verified by 100% of total respondents. (Q#1) Regarding individual products in the kit, verification was as noted in the following table (Q#3).

- Ownership of a natural gas water heater was verified by 100% of total respondents. Ownership of a natural gas furnace was verified by 95% of total respondents. (Q#2)

ESK-Residential-HHC: Low-income Audit: Products Received in 2012	Column A Respondents: # Verified—Received	Column B Respondents: Total # survey completions	Column C Respondents: % Verified—Received
Energy-efficient Showerhead	164	165	99%
Kitchen Faucet Aerator	156	165	95%
Bathroom Faucet Aerator	148	165	90%
Pipe Wrap	158	165	96%
	Yes	No	Don't know
Do you have a natural gas water heater?	165 (100%)	0 (0%)	0 (0%)

HHC-1.3 Almost all respondents indicated they had installed the products they received. Once installed, the products remain installed. (Q#7)

ESK-Residential HHC: Low-income **Products Installed in 2012** **Total survey completions = 165**	**Column A** **Respondents: # Verified—Installed**	**Column B** **Respondents: % Verified—Installed** *(Base=165)*	**Column C** **Respondents: # Verified—Still Installed**	**Column D** **Respondents: % Verified—Still Installed** ***(Base=# in Col A)***
Energy-efficient Showerhead	153	93%	151	99%
Kitchen Faucet Aerator	140	85%	134	96%
Bathroom Faucet Aerator	142	86%	142	100%
Pipe Wrap	155	94%	155	100%
NB: Amongst respondents who did not install one or more items, the most often cited reasons for non-installation were: item not compatible and plan to install after renovation.				

ESK—Res-HHC: L-I Initiative Research Findings—Section 2: Findings re End-User Understanding of the Benefits of Energy-Efficient Products and Energy Efficiency

Findings related to Project Objective #3:

To gauge end-users' understanding regarding the benefits of energy-efficient products

Measurement of ESK—HHC-LI End-Users' Knowledge Level re Energy-Efficient Products (Qs#4-5, 14-17, 20)

HHC-2.1 Most respondents indicated the furnace in their home is a high-efficiency model. (Q#5)

- Some 70% of total respondents verified their furnace is a high-efficiency model.
- Approximately 90% of total respondents indicated they use weather stripping in their home.
- Only 20% of total respondents indicated they use window film in their home.

HHC-2.2 Respondents appear to be knowledgeable about energy efficiency in the home. (Q#4)

- Almost 98% of total respondents indicated they are knowledgeable about energy efficiency in the home, including 69% who indicated they are very knowledgeable.

HHC-2.3 Respondents appear to be somewhat indecisive as to whether higher-efficiency heating products can play a significant role in saving money on home heating costs (Q#4).

- While some 86% of total respondents believe high-efficiency heating products can play a significant role in saving money on home heating costs, less than a majority (41%) said it could be very significant.

HHC-2.4 Respondents were asked—on an aided basis—to describe the current level of natural gas usage, as well as the level of insulation and replacement of windows, in their home. (Qs#14-17)

Tabulated responses appear in the following table:

ESK-Residential-HHC: Low-income 2012 Initiative **Current Natural Gas Usage / Insulation Levels / Replacement of Windows**	**High**	**Med**	**Low**	**None/ Nothing**	**Don't know**	**Don't have**
% of Total Respondents (165)						
Natural Gas Usage	5%	84%	11%			
Insulation Levels						
Attic	13%	63%	7%	-	-	17%
Main Walls	41%	59%	-	-	-	-
Basement	21%	62%	9%	-	-	8%
	Yes	**No**	**Don't know**			
Have your windows been replaced in the last 20 years?	38%	53%	9%			

HHC-2.5 Respondents were asked whether they had previously participated in any other conservation program in the past—either through the government or a utility. Tabulated responses were as follows: (Q#20)

- Yes = 93 (56%)
- No = 42 (26%)
- Don't know = 30 (18%)

ESK—Res-HHC: LI Initiative Research Findings—Section 3: Findings re Factors Affecting End-Users' Decision to Install

Findings related to Project Objectives #2 & 4:

To determine the factors affecting residential end-users' decision to install the products, who actually installed them and end-users' usage habits regarding products that are still installed

Identification of Factors Affecting End-Users' Installation Decision and Usage Habits re Products that are Still Installed (Qs# 7-12)

HHC-3.1 Almost all respondents indicated they had installed the products they received. Once installed, the products remain installed. (Q#7)

ESK-Residential HHC: Low-income Initiative Products Installed in 2012 Total survey completions = 165	Column A Respondents: # Verified—Installed	Column B Respondents: % Verified—Installed *(Base=(165)*	Column C Respondents: # Verified—Still Installed	Column D Respondents: % Verified—Still Installed *(Base=# in Col A)*
Energy-efficient Showerhead	153	93%	151	99%
Kitchen Faucet Aerator	140	85%	134	96%
Bathroom Faucet Aerator	142	86%	142	100%
Pipe Wrap	155	94%	155	100%

HHC-3.2 Regarding installation of products, it was more likely that the respondent or someone else in the household installed the aerators and pipe wrap. However a significant percentage (39%) of respondents indicated that the contractor installed the showerhead. (Q#8)

ESK-Residential-HHC: Low-income Initiative Products Installed in 2012	Column A Products: Total # Verified—Installed	Column B Products: #(%) Installed by respondent *(Base=# in A)*	Column C Products: #(%) Installed by other in household *(Base=# in A)*	Column D Products: #(%) Installed by Contractor *(Base=# in A)*
Energy-efficient Showerhead	153	75 (49%)	19 (12%)	59 (39%)
Kitchen Faucet Aerator	140	98 (70%)	34 (24%)	8 (6%)
Bathroom Faucet Aerator	142	97 (68%)	37 (26%)	8 (5%)
Pipe Wrap	155	110 (71%)	40 (26%)	5 (3%)

NB: Two reasons were cited by respondents who did not install products they received: The products were not compatible (i.e. did not fit) or they are currently renovating their home and planned to install the products eventually.

HHC-3.3 The following chart contains the complete list of factors presented to respondents, as well as the percentages of total respondents who, on an aided basis, identified a factor as their main reason for installing some or all of the items in the kit (Qs#9&12):

ESK-Residential-HHC: Low-income Initiative 2012 **Main Reason for Installing Product(s)—Aided**	**2012 Main Reason** (% of total respondents—Cite one only)	***Compare 2011 Main Reason*** (% of total respondents—Cite one only)
To conserve energy/Use energy wisely	14	*16*
To save money on my heating bill	20	*22*
To conserve energy/use energy wisely AND to save money on my heating bill*	65	*62*
Because of the contractor's advice	1	*0*
** Unaided—cited both combined as main reason*		

HHC-3.4 Specifically regarding the Energy-efficient Showerhead, several questions were asked to respondents who received this item. (Qs#9-10) The following findings are noted:

- Most respondents (56%) who received the showerhead(s) indicated they have one shower in their home; the remainder indicated they have two showers (42%) or three showers (2%).
- Approximately three-quarters (74%) of total respondents who received showerhead(s) indicated all of the showering in their home now is done under a new showerhead. More than one-quarter of total respondents indicated that most (2%) or about half (23%) of the showering in their home now is done under a new showerhead.

HHC—Low-income Initiative **Showerhead product installed in 2012** **(Total = 165 completions)**	A. Respondents: # Verified—Installed	B. Respondents: % Verified—Installed *(Base=165)*	**C. Respondents: # Verified—Still Installed**	**D. Respondents: % Verified—Still Installed** *(Base=# in A)*
Energy-efficient Showerhead	153	93%	151	99%
Of all the showering done in your home, how much is done under a New Showerhead? (# & % of total still installed—Col C)			All (100%) = 112 Most (75%+) = 3 Half (50%) =34 1/3 (30%) or less = 2 Don't know = 0	All (100%) = 74% Most (75%+) = 2% Half (50%) = 23% 1/3(30%) or less= 1% Don't know = 0%

Appendix L: Low Income Free Showerhead Installation Initiative (Multi-Family)

VERIFICATION RESULTS:

2013 Low Income Free Showerhead Installation Initiative (Multi-Family)

SUBMITTED TO:

Eric Buan

Program Evaluator, DSM Research & Evaluation

Union Gas Ltd., 777 Bay Street, Suite 2901, PO Box 153,
Toronto, Ontario, M5G 2C8

By

SeeLine Group Ltd.

416-703-8695

March, 2014

Table of contents

1.0 Executive Summary

Union Gas Ltd. (UGL) contracted with SeeLine Group Ltd. (SLG) to provide onsite verification and documentation of results for the Low Income Free Showerhead Installation Initiative.

A total of 13 low Income social and assisted housing multi-family buildings (facilities) were visited and 65 suites were visited onsite to verify the installation of low-flow showerheads, bathroom faucet aerators, and kitchen faucet aerators. The verification effort took place from January to February 2014.

A random sample of facilities was provided to SLG by an independent third party. SLG agents contacted each facility contact person and arranged an inspection time and date. Suites within the sample of facilities were selected at random for verification. The randomly selected suites were inspected for the installation of showerheads and faucet aerators. The data were captured on a summary sheet, which was signed by the inspector as well as the facility supervisor. Photographs of the installed measures were also taken as further proof of installation. Data capture sheets and photographs can be found in the accompanying appendices.

Key results included:

- There were 35 (53.8%) showerheads observed installed and 30 (46.2%) were not.
- There were 16 (24.6%) bathroom aerators observed installed and 49 (75.4%) were not.
- There were 16 (24.6%) kitchen faucet aerators observed installed and 49 (75.4%) were not.

2.0 Background & Objective

The Low Income Free Showerhead Installation Initiative is designed to reduce natural gas usage associated with hot water consumption. The program provides a choice of a suite of measures at no cost to participants including: 1.25gpm showerhead, 1.5gpm kitchen aerator, and a 1.0gpm bathroom aerator for applicable Low Income social and assisted housing multi-family facilities.

The Low Income social and assisted housing multi-family segment is defined as dwellings with more than 3 floors and more than 5 suites owned and operated by non-profit Low Income housing providers. The verification work occurred in one phase in January and February 2014.

2.1 Objective

Through onsite verification, the main goal of this study was to confirm the installation of showerheads and aerators distributed to Free Showerhead Installation Initiative participants.

Through this verification effort, 65 suites were verified at 13 facilities.

UGL also required that SLG quantify the percentage use of installed showerheads for suites that had more than one shower. If a second shower was encountered in a suite, a brief survey questionnaire

3.0 Methodology

A random sample of participants was developed by an independent third party and provided to SLG. To ensure a confidence interval of 90/10 was met, SLG was required to verify 65 suites, across at least 13 facilities. Through this initiative, 13 facilities were visited and 65 suites were inspected.

To ensure adequate geographic reach and to optimize cost effectiveness, it was determined that a maximum of 5 suites was the appropriate limit for verification at each facility.

A meeting request by telephone to verify the installed measures was then placed with the facility contact person. A meeting time and date were arranged. Meeting times and dates were assigned to an SLG agent. The SLG agent made final arrangements with the onsite facility supervisor.

The SLG agent arrived onsite and randomly selected up to 5 suites for verification. A random number generator was used to make the suite selections. The onsite facility supervisor brought the agent to each randomly selected suite. The SLG agent gained access to the suite and searched for the 3 installed measures:

- **1.25gpm showerhead**
- **1.5gpm kitchen faucet aerator**
- **1.0gpm bathroom faucet aerator**

Physical samples of the models were provided to SLG agents by UGL staff prior to the inspections. These models were brought to the field to make direct comparisons. As well, detailed photographs of the measures were provided by UGL, so that SLG agents could positively identify the measures in the field. The models provided through the Free Showerhead Installation Initiative are unique to the Ontario market, so it was assumed that a positively identified measure was only acquired through participation in the initiative. SLG agents also took photographs of the installed measures in the field, so that a visual record would be available after the verification had occurred. A unique identifying tag was affixed to each installed measure for organization. See Appendix F for the photographs.

The verification details were recorded in a data-capture ‘sign-off’ sheet. This document recorded the results of the inspection, and required the facility supervisor to sign off on the inspection along with the SLG agent. See Appendix B for the template of the sign-off sheet, and Appendix D for copies of the completed sign-off sheets.

In total, 13 facilities were visited and 65 suites were verified. Phone calls were placed throughout the months of January and February to arrange meeting times. The verification visits occurred throughout the month of February 2014. All the onsite verification meetings had been concluded by March 2014.

4.0 Results

4.1 Showerheads

Result	Showerheads	
	#	%
Yes	35	53.8%
No	30	46.2%
Total (N)	65	100.0%

Quantitative Findings

A total of 65 bathroom showerheads were inspected. 35 (53.8%) of the installed measures were positively identified as Free Showerhead Installation Initiative showerheads, while 30 (46.2%) were not. Photographs of all the showerheads that were inspected have been provided in the Appendix F.

Qualitative findings

After speaking with facility supervisors and tenants it is clear that the fate of the showerheads is not altogether uniform. Three main outcomes were identified: not installed, installed, and un-installed (removed).

4.2 Bathroom Faucet Aerators

Result	Bathroom Aerators	
	#	%
Yes	16	24.6%
No	49	75.4%
Total (N)	65	100.0%

Quantitative Findings

A total of 65 bathroom faucet aerators were inspected. 16 (24.6%) of the installed measures were positively identified as Free Showerhead Installation Initiative bathroom faucet aerators, while 49 (75.4%) were not. Photographs of all the bathroom faucet aerators that were inspected can be found in Appendix F.

Qualitative findings

The percentage of bathroom faucet installations was lower than that of the showerhead installations, and it was the same as that of the kitchen aerators.

4.3 Kitchen Faucet Aerators

Result	Kitchen Aerators	
	#	%
Yes	16	24.6%
No	49	75.4%
Total (N)	65	100.0%

Quantitative Findings

A total of 65 kitchen faucet aerators were inspected. 16 (24.6%) of the installed measures were positively identified as Free Showerhead Installation Initiative kitchen faucet aerators, while 49 (75.4%) were not. Photographs of all the kitchen faucet aerators that were inspected have been provided in Appendix F.

Qualitative Findings

The percentage of observed installations of kitchen faucet aerators was the same as the bathroom faucet aerators. The percentage of kitchen faucet installations was lower than that of the showerhead installations.

4.4 Second Bathrooms

No suites had a second bathroom in any of the 65 suites that were inspected. The survey was not implemented during this verification effort.

5.0 Conclusion

A total of 65 suites were verified at 13 facilities. The verification effort focused on observing showerhead aerators, bathroom faucet aerators, and kitchen faucet aerators installed in social and assisted housing multi-family buildings for the Low Income segment.

The key findings of the verification effort were:

- Showerheads: 53.8% installations observed (35/65)
- Bathroom Sink Faucet Aerators: 24.6% installations observed (16/65)
- Kitchen Sink Faucet Aerators: 24.6% installations observed (16/65)

Overall, it is clear that Free Showerhead Installation Initiative participants do not just simply order the measures, install them right away, and keep them installed for the life of the model. Some participants never install the measures while others may remove them over time. The installation rate for showerheads is the highest of the 3 measures while both the bathroom and kitchen faucet aerators are relatively lower.

6.0 APPENDICES -

Appendix A – List of Buildings

Appendix B – Sample Sign-Off Sheet

Appendix C – Second Bathroom Survey

Appendix D – Sign-Off Sheets (Field Data)

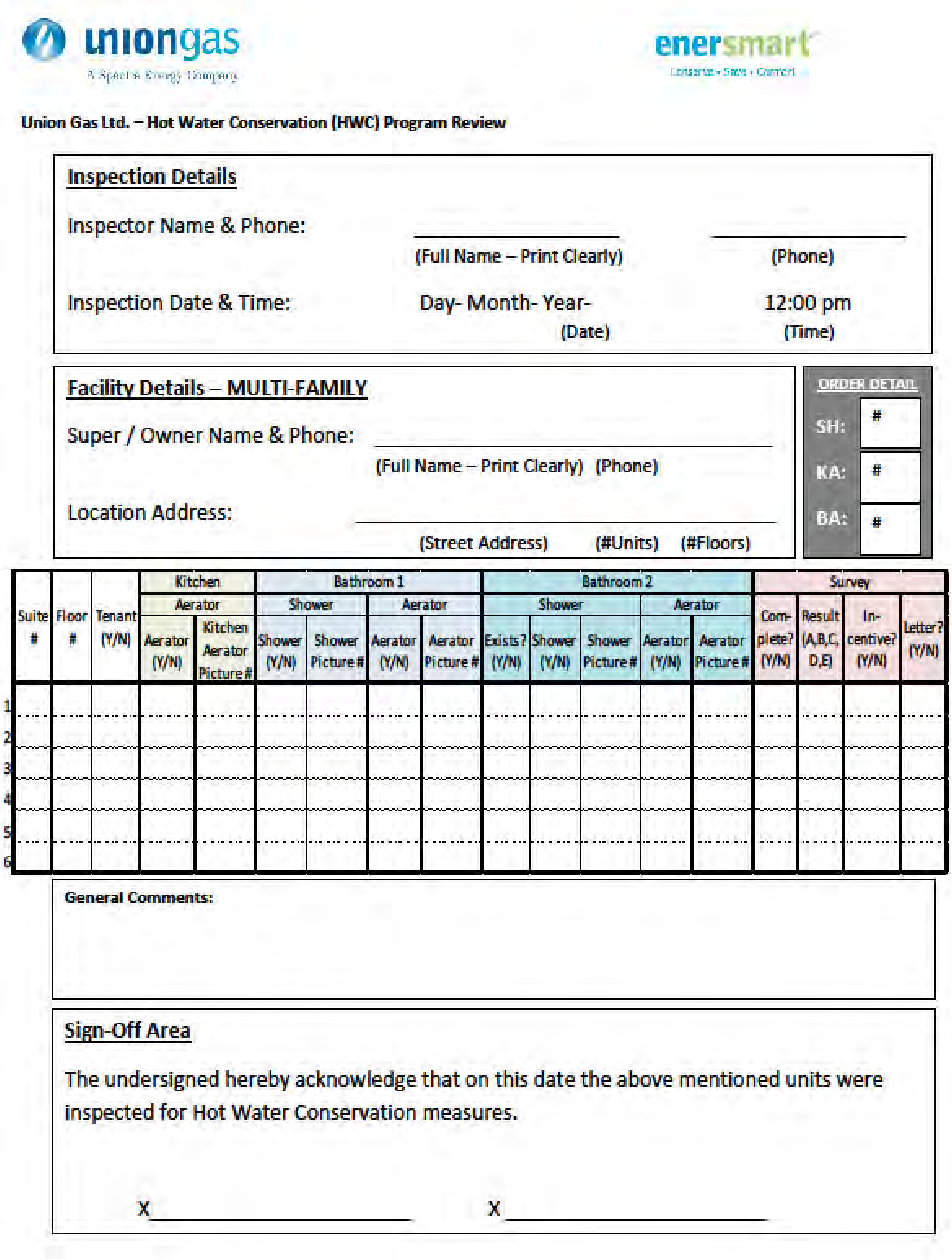
Appendix E – Field Data

Appendix F – Photographs of Installed Measures

Appendix A – List of Buildings

#	TOWN	ADDRESS
1	[redacted]	[redacted]
2	[redacted]	[redacted]
3	[redacted]	[redacted]
4	[redacted]	[redacted]
5	[redacted]	[redacted]
6	[redacted]	[redacted]
7	[redacted]	[redacted]
8	[redacted]	[redacted]
9	[redacted]	[redacted]
10	[redacted]	[redacted]
11	[redacted]	[redacted]
12	[redacted]	[redacted]
13	[redacted]	[redacted]

Appendix B – Sample Sign-Off Sheet



uniongas
A Spectra Energy Company

enersmart
Conserve • Save • Comfort

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: ______________ (Full Name – Print Clearly) ______________ (Phone)

Inspection Date & Time: Day- Month- Year- (Date) 12:00 pm (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & Phone: ______________ (Full Name – Print Clearly) (Phone)

Location Address: ______________ (Street Address) (#Units) (#Floors)

ORDER DETAIL

SH: #

KA: #

BA: #

				Kitchen		Bathroom 1				Bathroom 2					Survey			
				Aerator		Shower		Aerator		Shower			Aerator					
	Suite #	Floor #	Tenant (Y/N)	Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
1																		
2																		
3																		
4																		
5																		
6																		

General Comments:

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X ______________ X ______________

Appendix C – Second Bathroom Survey

Page 1 - Front

A Spectra Energy Company

January YEAR

Dear Valued Union Gas Customer,

We visited your building today as part of Union Gas Ltd.'s ongoing energy savings activities. As a special thank you, a $25 gift certificate, redeemable at Tim Hortons, is available if you call the following phone # and answer our short survey. Please see the survey questions on the back of this page.

Please call:

1-888- 123- 1234

to receive your

$25 Gift Certificate

Confirmation Number: (XY-101)

Please don't wait. We must hear from you before DATE in order to issue you the gift certificate by mail. Please reach us Monday through Friday, 9am- 5pm. Please have your confirmation number ready when you call.

Thank You Kindly,

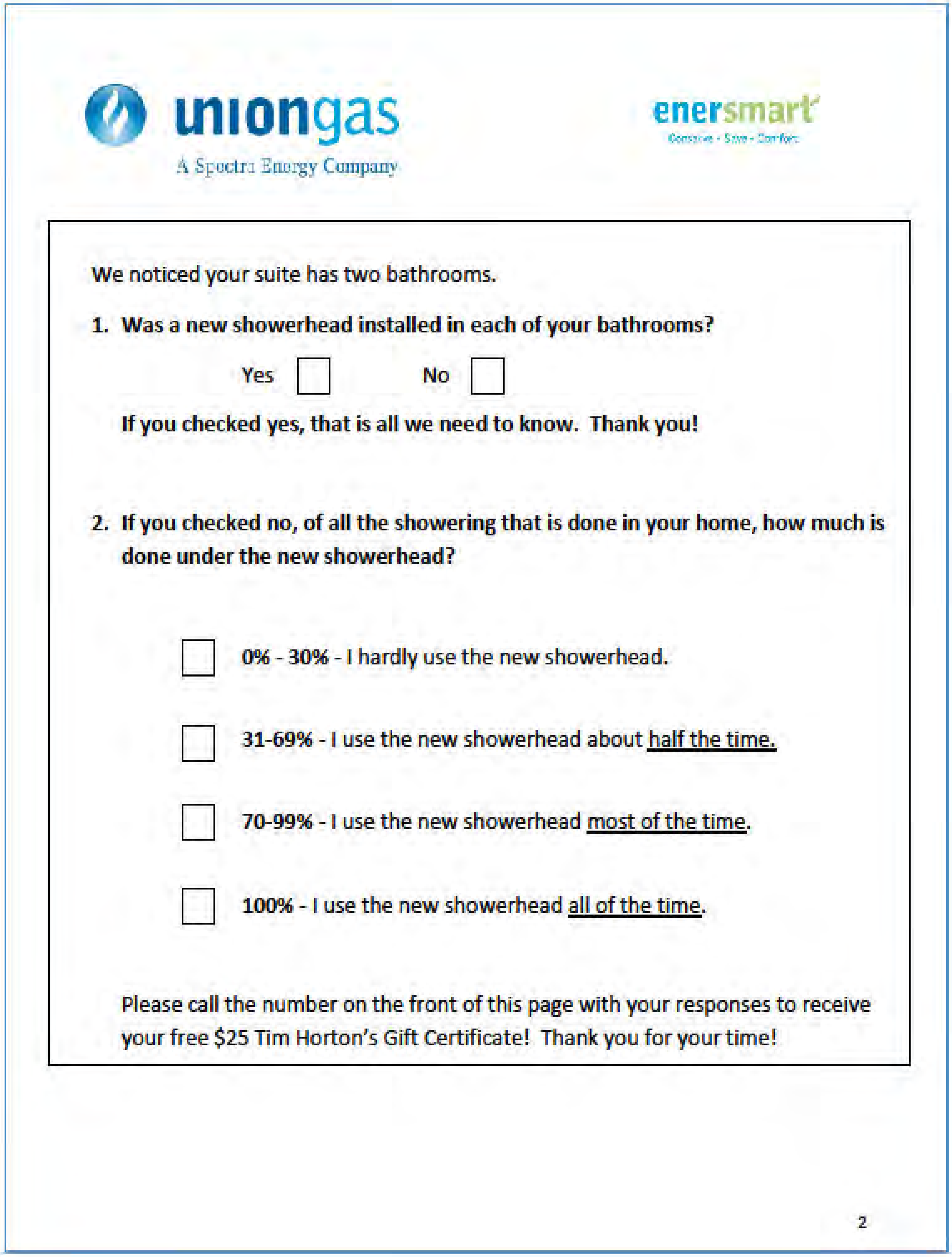
Inspector, SeeLine Group Ltd.

on behalf of

Union Gas Ltd.

1

Page 2 – Back



uniongas

A Spectra Energy Company

enersmart

We noticed your suite has two bathrooms.

1. **Was a new showerhead installed in each of your bathrooms?**

   Yes ☐ No ☐

   If you checked yes, that is all we need to know. Thank you!

2. **If you checked no, of all the showering that is done in your home, how much is done under the new showerhead?**

   ☐ **0% - 30%** - I hardly use the new showerhead.

   ☐ **31-69%** - I use the new showerhead about <u>half the time.</u>

   ☐ **70-99%** - I use the new showerhead <u>most of the time</u>.

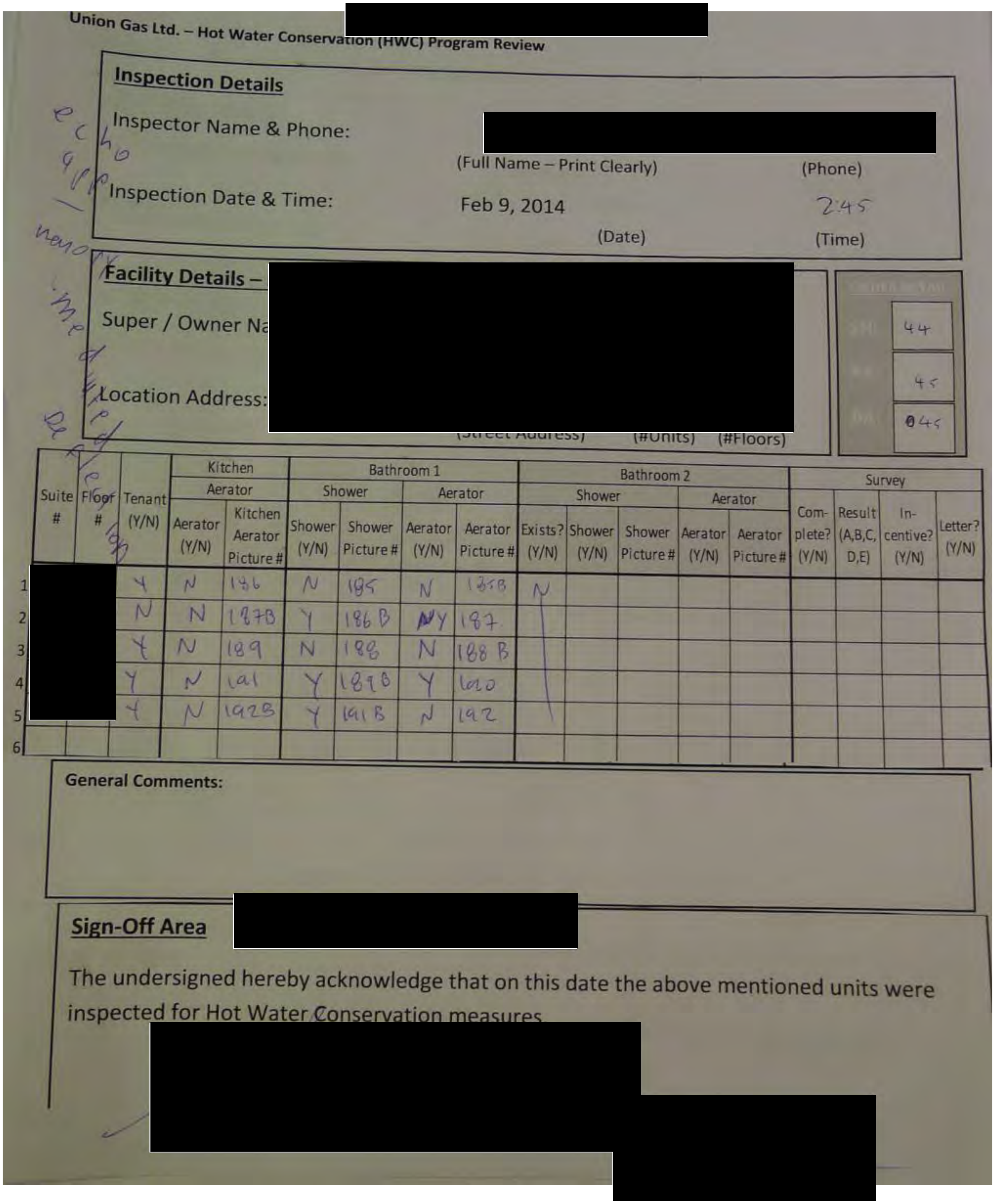
   ☐ **100%** - I use the new showerhead <u>all of the time</u>.

Please call the number on the front of this page with your responses to receive your free $25 Tim Horton's Gift Certificate! Thank you for your time!

2

Appendix D – Sign-Off Sheets (Field Data)

[redacted] [redacted]



Union Gas Ltd. – Hot Water Conservation (HWC) Program Review [redacted]

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Feb 9, 2014 (Date) 2:45 (Time)

Facility Details – [redacted]

Super / Owner Na[redacted]

Location Address: [redacted]
(Street Address) (#Units) (#Floors)

44
45
045

echo agp / nanoy .me d[illegible]

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator: Aerator (Y/N)	Kitchen Aerator: Kitchen Aerator Picture #	Bathroom 1 Shower: Shower (Y/N)	Bathroom 1 Shower: Shower Picture #	Bathroom 1 Aerator: Aerator (Y/N)	Bathroom 1 Aerator: Aerator Picture #	Bathroom 2: Exists? (Y/N)	Bathroom 2 Shower: Shower (Y/N)	Bathroom 2 Shower: Shower Picture #	Bathroom 2 Aerator: Aerator (Y/N)	Bathroom 2 Aerator: Aerator Picture #	Survey: Complete? (Y/N)	Survey: Result (A,B,C,D,E)	Survey: Incentive? (Y/N)	Survey: Letter? (Y/N)
1 [redacted]	[redacted]	Y	N	186	N	185	N	185B	N								
2 [redacted]	[redacted]	N	N	187B	Y	186 B	Y	187									
3 [redacted]	[redacted]	Y	N	189	N	188	N	188 B									
4 [redacted]	[redacted]	Y	N	191	Y	189B	Y	190									
5 [redacted]	[redacted]	Y	N	192B	Y	191 B	N	192									
6																	

General Comments:

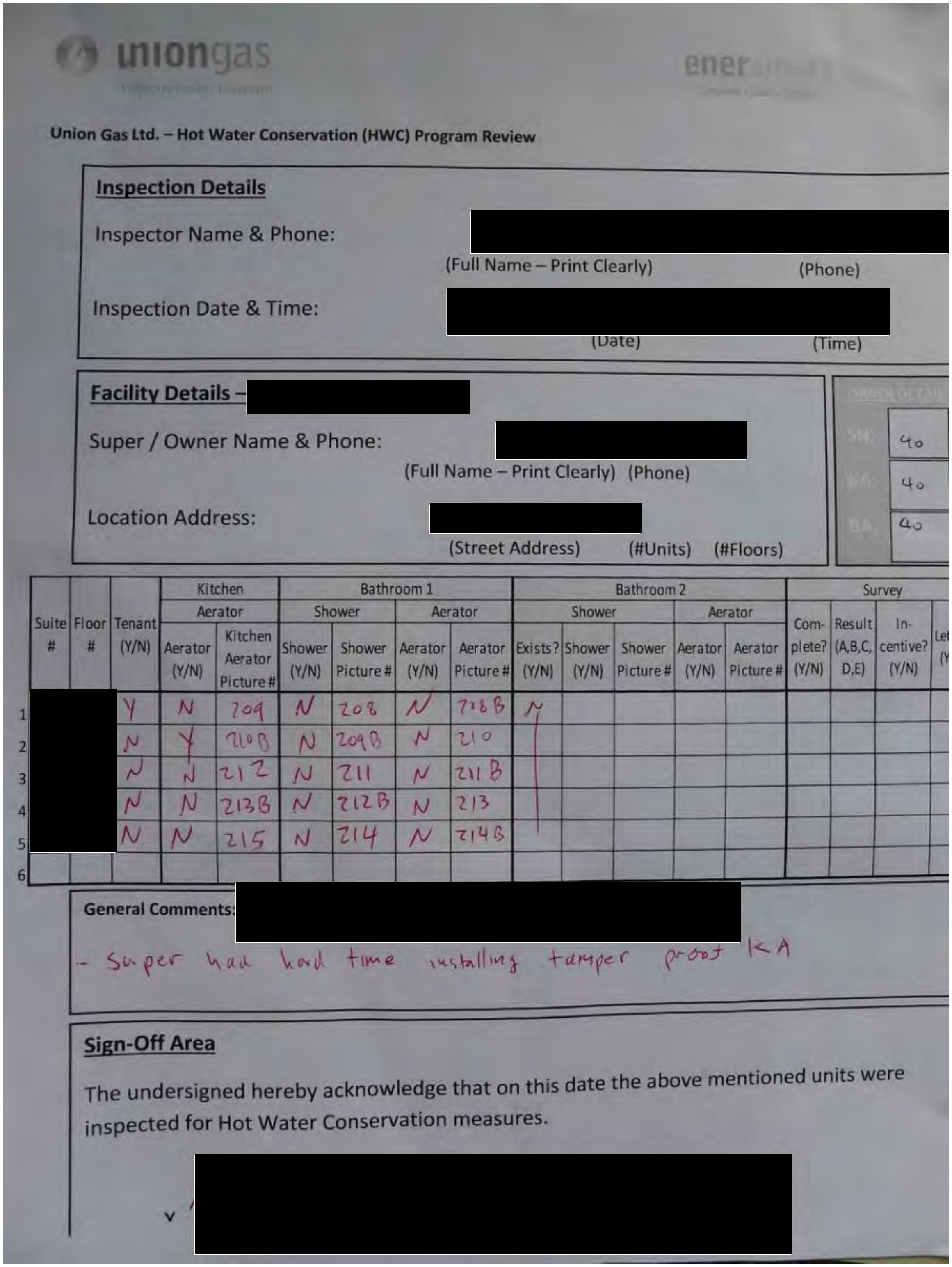
Sign-Off Area [redacted]

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures

[redacted]

[redacted]

[redacted]



Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: [redacted]
(Date) (Time)

Facility Details – [redacted]

Super / Owner Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Location Address: [redacted]
(Street Address) (#Units) (#Floors)

SH: 40
KA: 40
BA: 40

				Kitchen		Bathroom 1				Bathroom 2					Survey			
				Aerator		Shower		Aerator		Shower			Aerator					
	Suite #	Floor #	Tenant (Y/N)	Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Complete? (Y/N)	Result (A,B,C, D,E)	Incentive? (Y/N)	Le (Y
1	[redacted]	[redacted]	Y	N	209	N	208	N	208B	N								
2	[redacted]	[redacted]	N	Y	210B	N	209B	N	210									
3	[redacted]	[redacted]	N	N	212	N	211	N	211B									
4	[redacted]	[redacted]	N	N	213B	N	212B	N	213									
5	[redacted]	[redacted]	N	N	215	N	214	N	214B									
6																		

General Comments: [redacted]

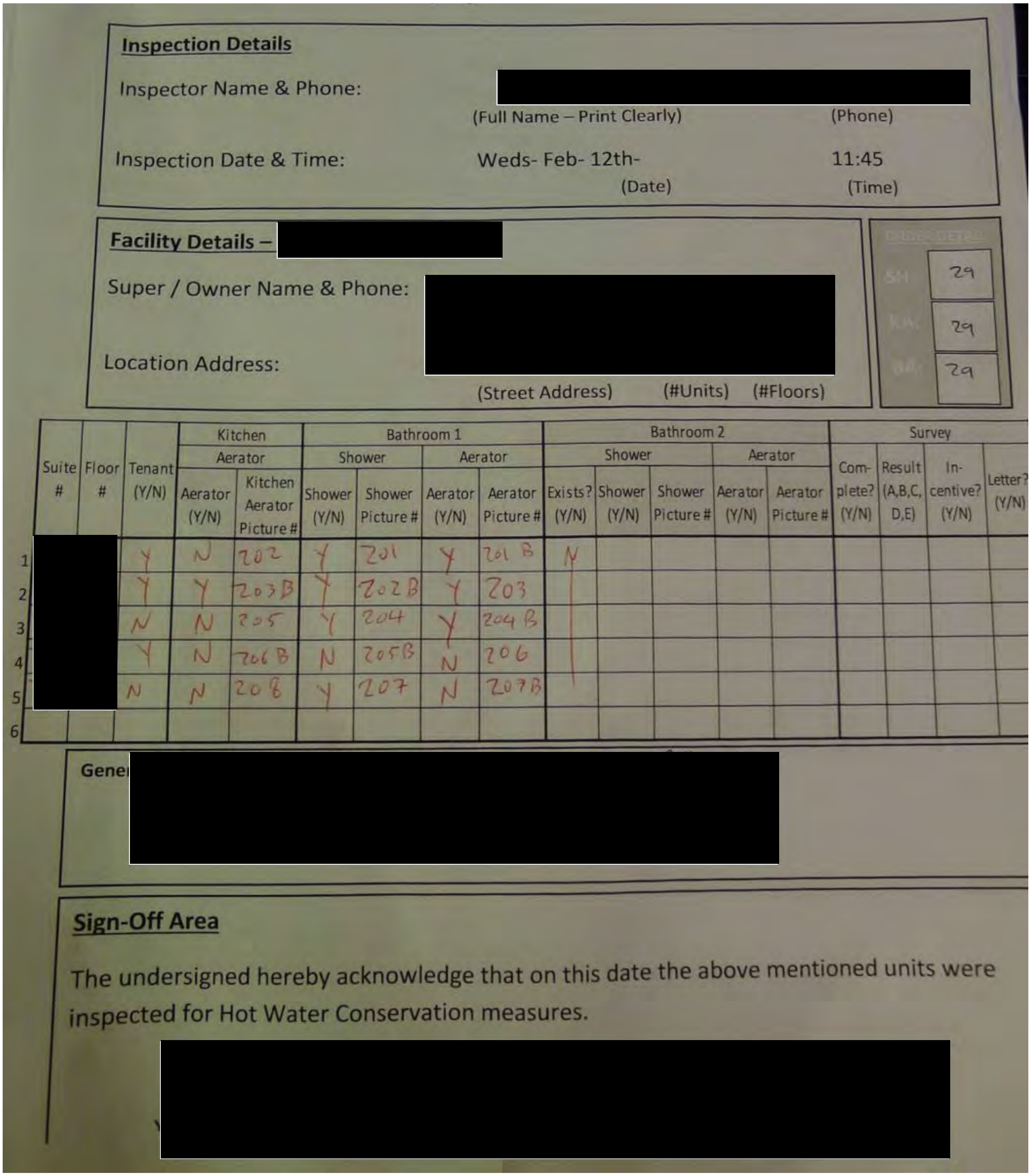
- Super had hard time installing tamper proof KA

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

[redacted]



Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Weds- Feb- 12th- 11:45
(Date) (Time)

Facility Details – [redacted]

Super / Owner Name & Phone: [redacted]

Location Address:
(Street Address) (#Units) (#Floors)

SH 29
KA 29
BA 29

				Kitchen		Bathroom 1				Bathroom 2					Survey			
				Aerator		Shower		Aerator		Shower			Aerator					
	Suite #	Floor #	Tenant (Y/N)	Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Complete? (Y/N)	Result (A,B,C, D,E)	Incentive? (Y/N)	Letter? (Y/N)
1	[redacted]	[redacted]	Y	N	202	Y	201	Y	201 B	N								
2	[redacted]	[redacted]	Y	Y	203B	Y	202B	Y	203									
3	[redacted]	[redacted]	N	N	205	Y	204	Y	204 B									
4	[redacted]	[redacted]	Y	N	206 B	N	205B	N	206									
5	[redacted]	[redacted]	N	N	208	Y	207	N	207B									
6																		

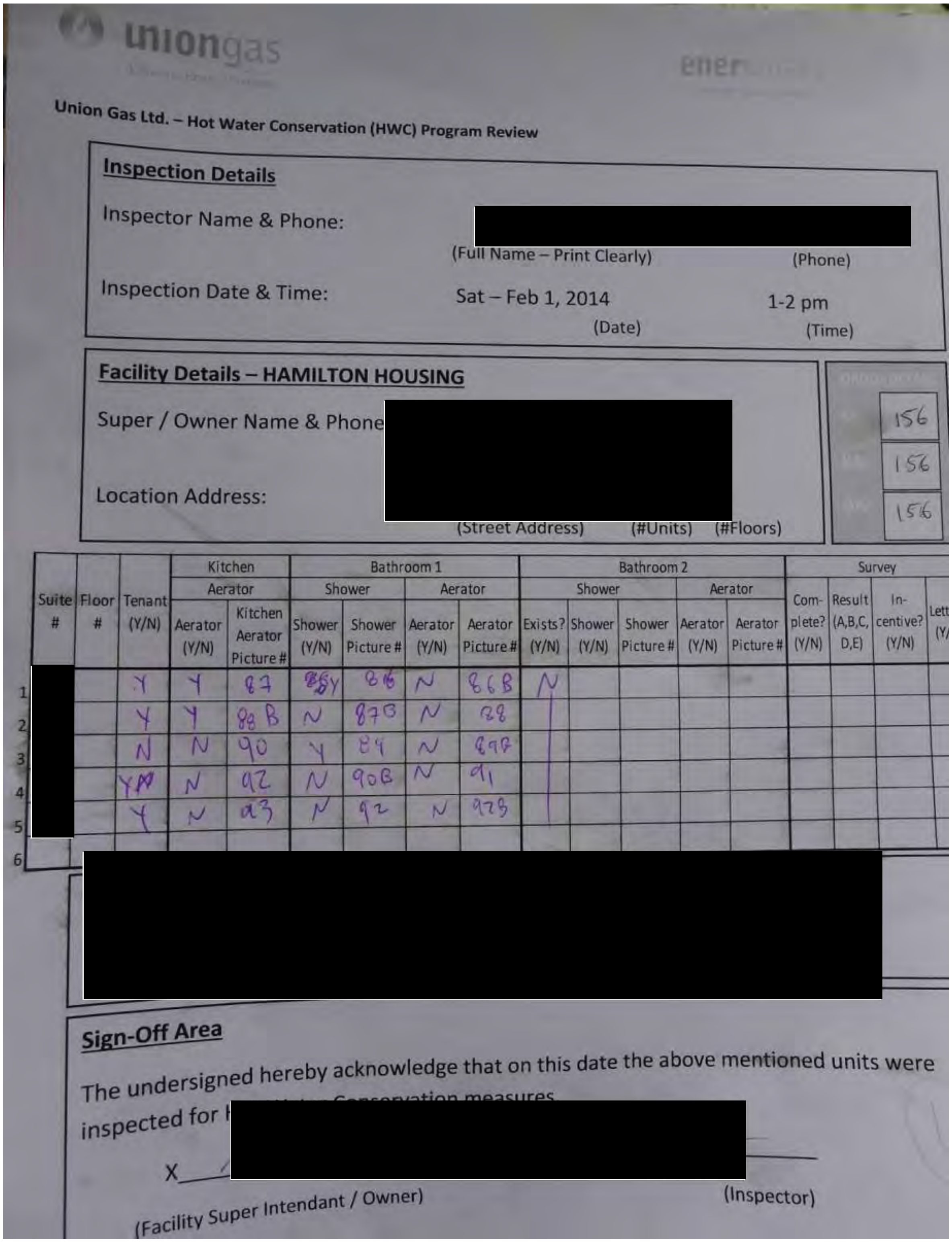
Gene[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

[redacted] [redacted]



uniongas

ener

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Sat – Feb 1, 2014 (Date) 1-2 pm (Time)

Facility Details – HAMILTON HOUSING

Super / Owner Name & Phone [redacted]

Location Address:
(Street Address) (#Units) (#Floors)

156
156
156

				Kitchen		Bathroom 1				Bathroom 2					Survey			
				Aerator		Shower		Aerator			Shower		Aerator					
	Suite #	Floor #	Tenant (Y/N)	Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com- plete? (Y/N)	Result (A,B,C, D,E)	In- centive? (Y/N)	Lett (Y/
1	[redacted]		Y	Y	87	~~88~~Y	86	N	86B	N								
2	[redacted]		Y	Y	88 B	N	87B	N	88									
3	[redacted]		N	N	90	Y	89	N	89B									
4	[redacted]		Y	N	92	N	90B	N	91									
5	[redacted]		Y	N	93	N	92	N	92B									
6		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

[redacted]

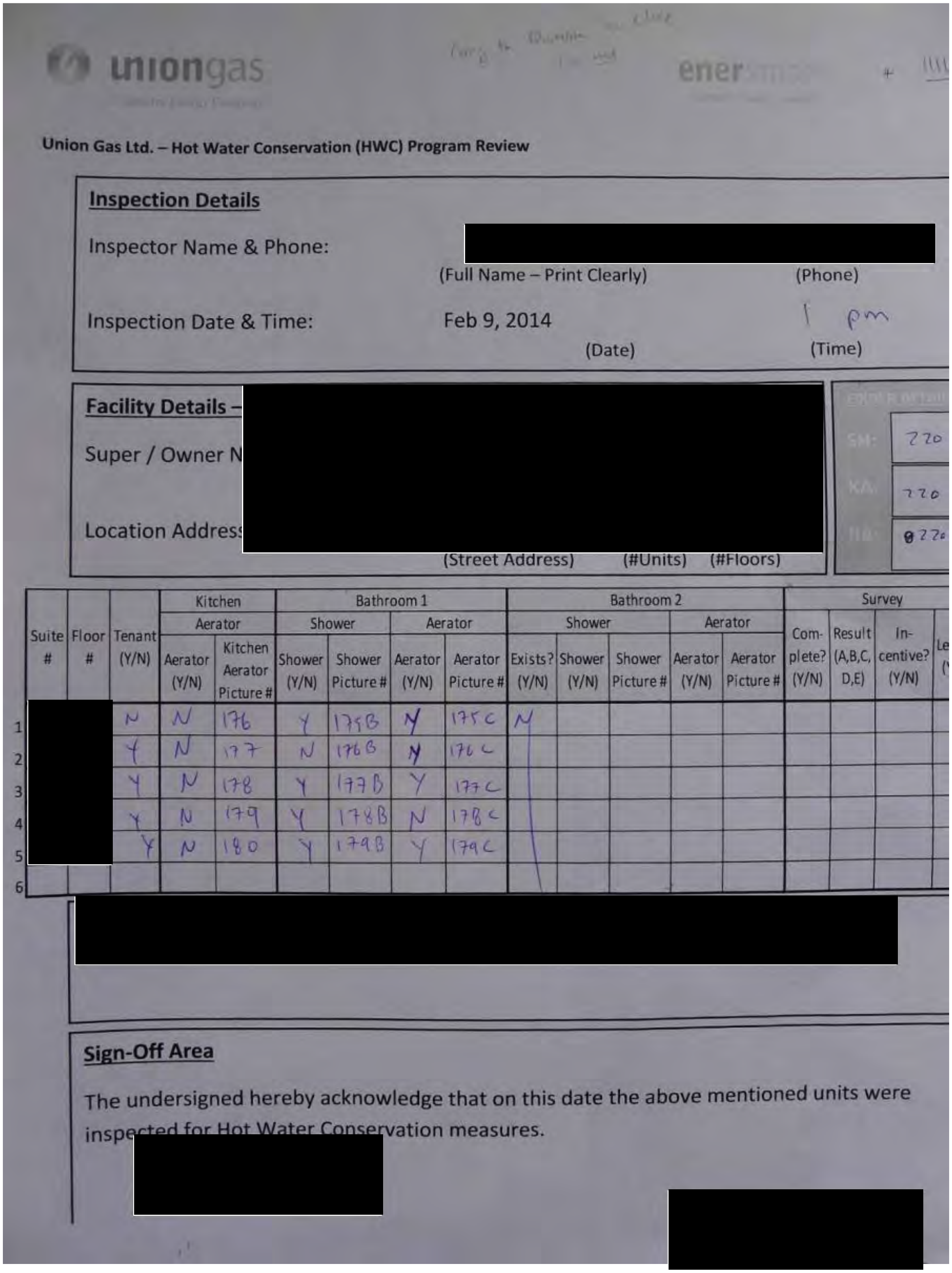
Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for H[redacted] Conservation measures.

X [redacted]

(Facility Super Intendant / Owner) (Inspector)

[redacted] [redacted]



Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Feb 9, 2014 1 pm
(Date) (Time)

Facility Details – [redacted]

Super / Owner N

Location Addres
(Street Address) (#Units) (#Floors)

SM: 220
KA: 220
220

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Le
1	[redacted]	[redacted]	N	N	176	Y	175B	N	175C	N								
2	[redacted]	[redacted]	Y	N	177	N	176B	N	176C									
3	[redacted]	[redacted]	Y	N	178	Y	177B	Y	177C									
4	[redacted]	[redacted]	Y	N	179	Y	178B	N	178C									
5	[redacted]	[redacted]	Y	N	180	Y	179B	Y	179C									
6																		

[redacted]

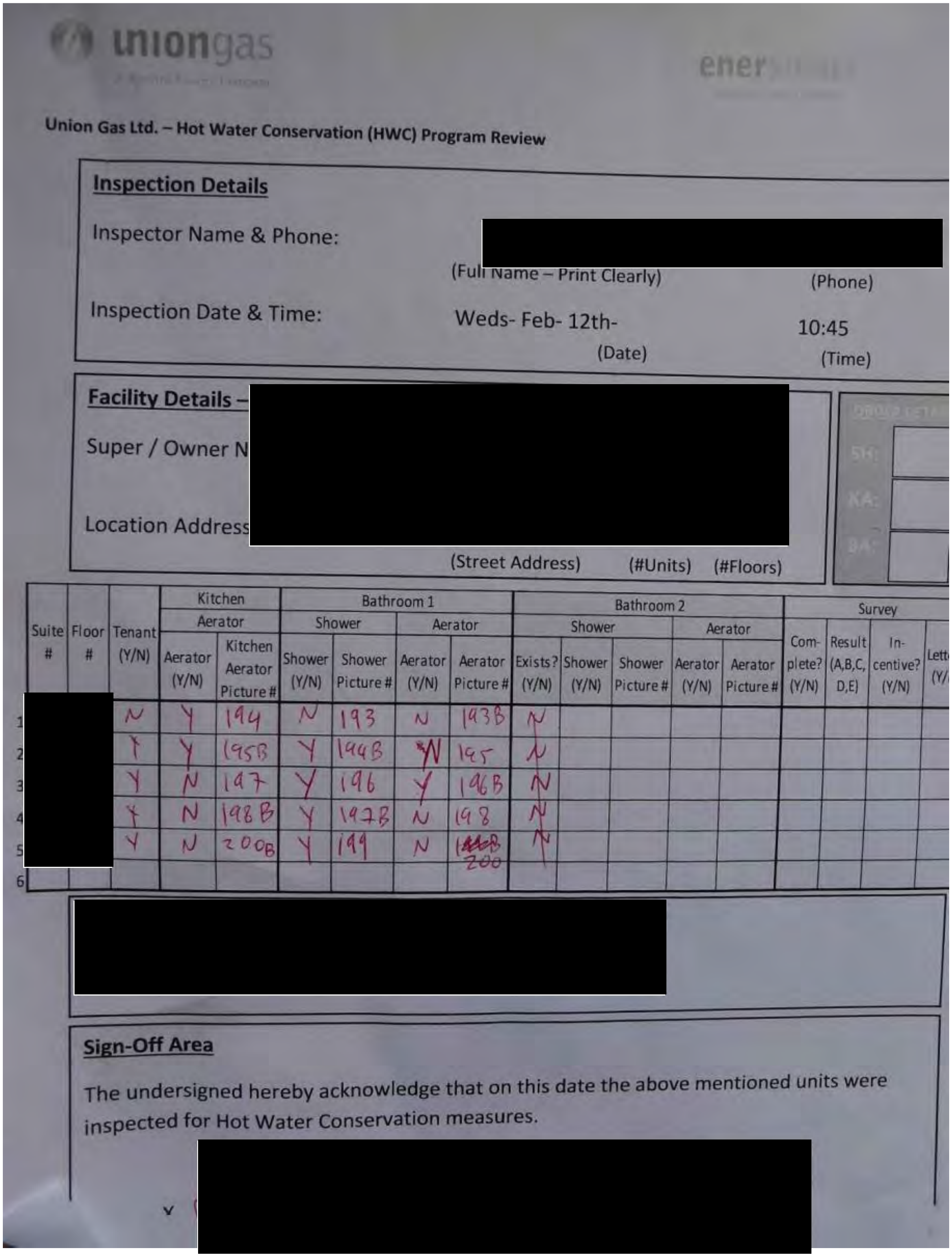
Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

[redacted]

[redacted] [redacted]



uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Weds- Feb- 12th- 10:45

(Date) (Time)

Facility Details – [redacted]

Super / Owner N

Location Address

(Street Address) (#Units) (#Floors)

SH:

KA:

BA:

	Suite #	Floor #	Tenant (Y/N)	Kitchen		Bathroom 1				Bathroom 2					Survey			
				Aerator		Shower		Aerator		Shower			Aerator					
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Lett (Y/
1	[redacted]	[redacted]	N	Y	194	N	193	N	193B	N								
2	[redacted]	[redacted]	Y	Y	195B	Y	194B	N	195	N								
3	[redacted]	[redacted]	Y	N	197	Y	196	Y	196B	N								
4	[redacted]	[redacted]	Y	N	198B	Y	197B	N	198	N								
5	[redacted]	[redacted]	Y	N	200B	Y	199	N	1~~44B~~ 200	N								
6																		

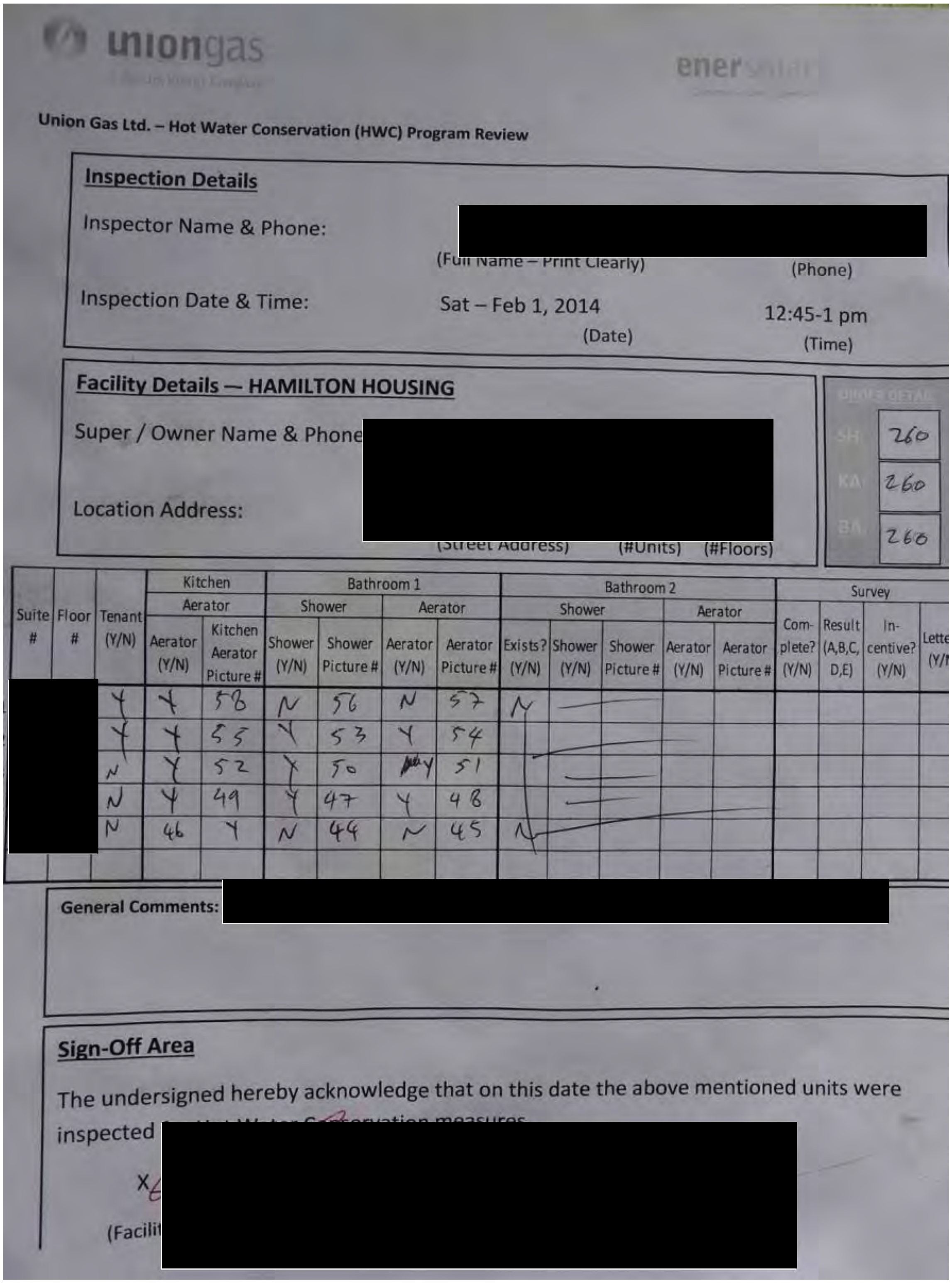
[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

[redacted] [redacted]



unionGas

ener

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Sat – Feb 1, 2014 (Date) 12:45-1 pm (Time)

Facility Details — HAMILTON HOUSING

Super / Owner Name & Phone [redacted]

Location Address:
(Street Address) (#Units) (#Floors)

SH 260
KA 260
BA 260

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
			Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Lette (Y/
[redacted]	[redacted]	Y	Y	58	N	56	N	57	N								
[redacted]	[redacted]	Y	Y	55	Y	53	Y	54									
[redacted]	[redacted]	N	Y	52	Y	50	Y	51									
[redacted]	[redacted]	N	Y	49	Y	47	Y	48									
[redacted]	[redacted]	N	46	Y	N	44	N	45	N								

General Comments: [redacted]

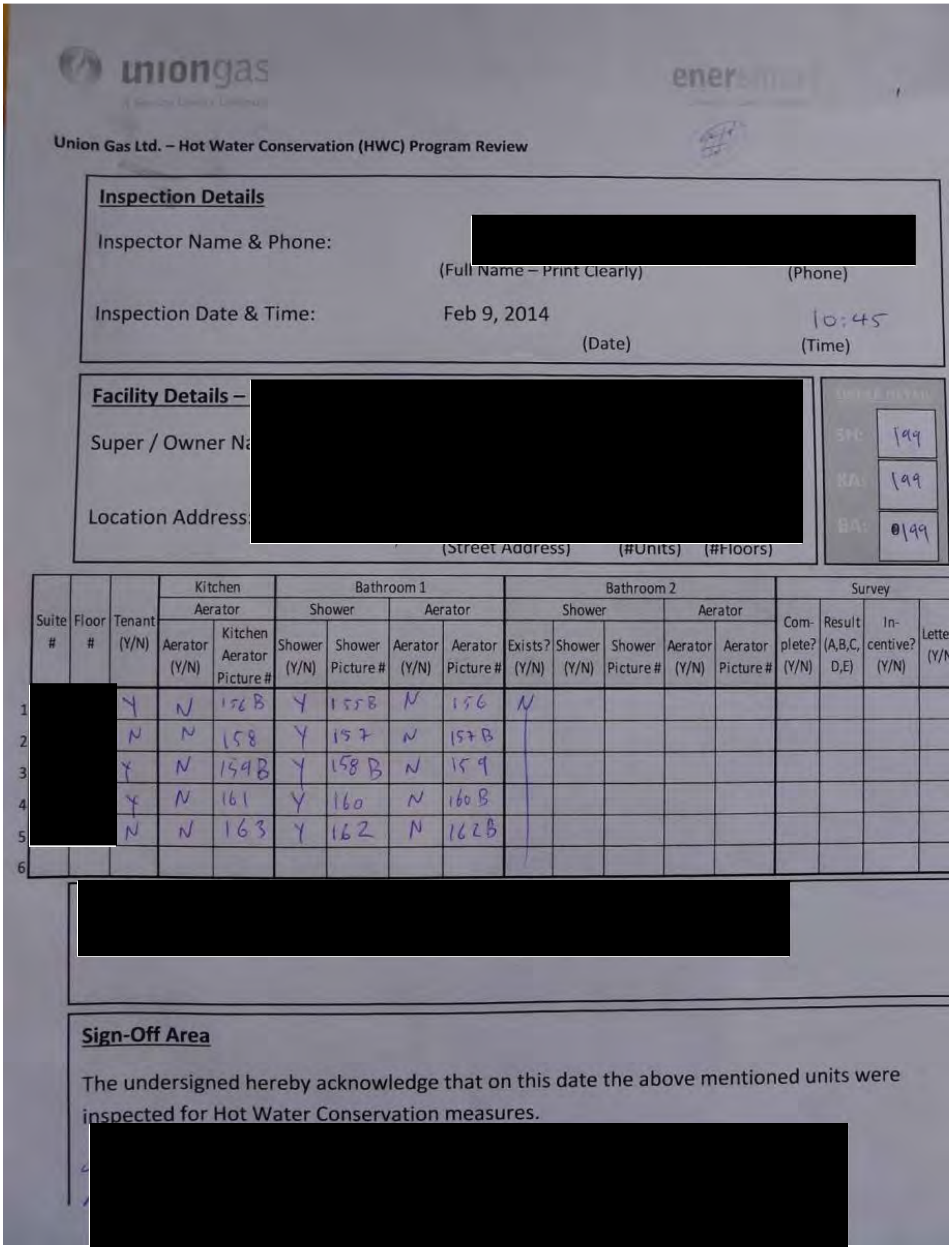
Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected [redacted]

X [redacted]

(Facilit

[redacted] [redacted]



Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Feb 9, 2014 (Date) 10:45 (Time)

Facility Details – [redacted]

Super / Owner Na

Location Address
(Street Address) (#Units) (#Floors)

SH: 199
KA: 199
BA: 0199

	Suite #	Floor #	Tenant (Y/N)	Kitchen		Bathroom 1				Bathroom 2					Survey			
				Aerator		Shower		Aerator		Shower			Aerator					
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Lette (Y/N
1	[redacted]	[redacted]	Y	N	156B	Y	155B	N	156	N								
2	[redacted]	[redacted]	N	N	158	Y	157	N	157B									
3	[redacted]	[redacted]	Y	N	159B	Y	158B	N	159									
4	[redacted]	[redacted]	Y	N	161	Y	160	N	160B									
5	[redacted]	[redacted]	N	N	163	Y	162	N	162B									
6																		

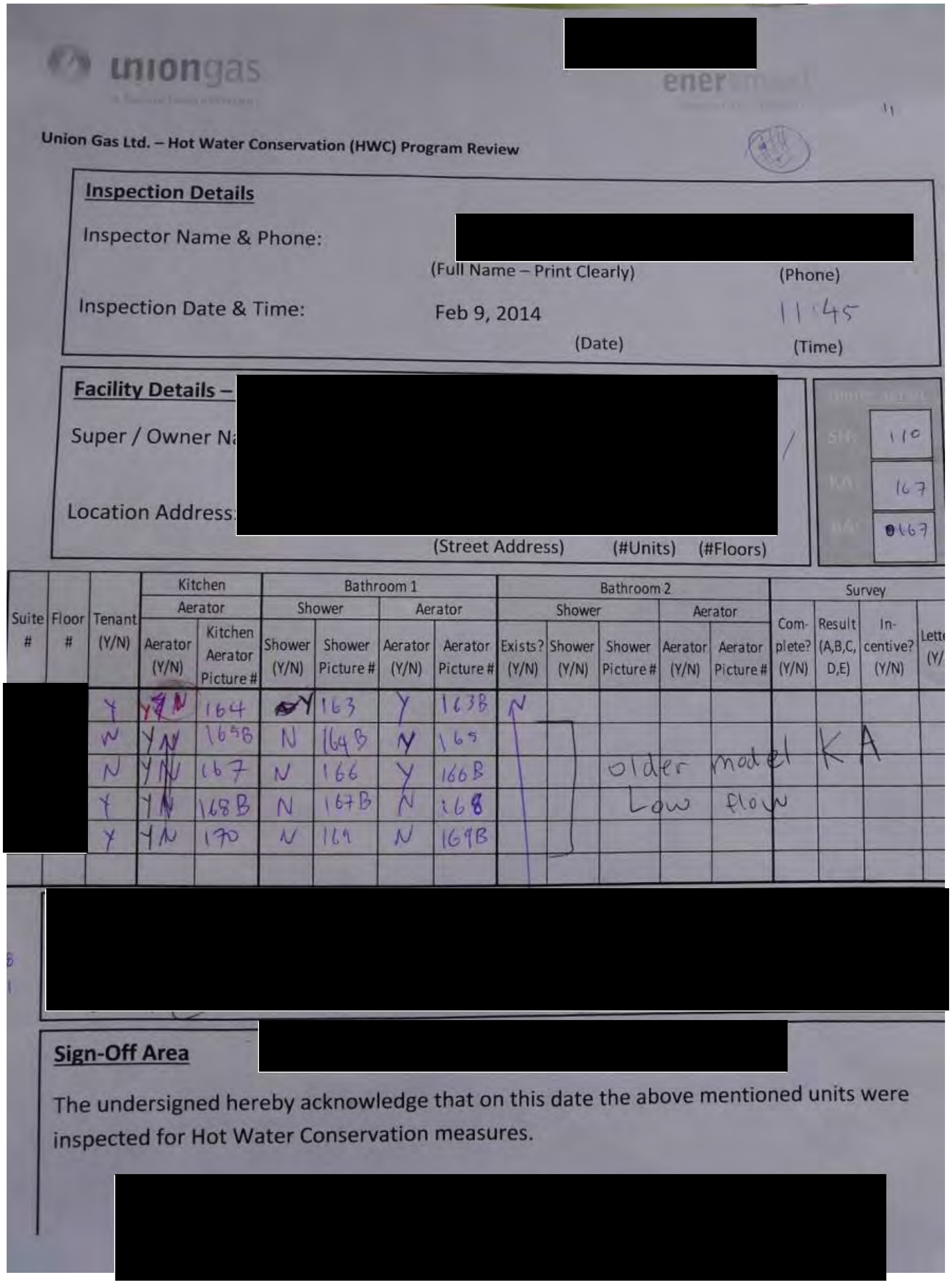
[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

[redacted] [redacted]



[redacted]

unióngas

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Feb 9, 2014 11:45
(Date) (Time)

Facility Details – [redacted]

Super / Owner Na

Location Address:
(Street Address) (#Units) (#Floors)

SH: 110
KA: 167
BA: 0167

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator Aerator (Y/N)	Kitchen Aerator Kitchen Aerator Picture #	Bathroom 1 Shower Shower (Y/N)	Bathroom 1 Shower Shower Picture #	Bathroom 1 Aerator Aerator (Y/N)	Bathroom 1 Aerator Aerator Picture #	Bathroom 2 Shower Exists? (Y/N)	Bathroom 2 Shower Shower (Y/N)	Bathroom 2 Shower Shower Picture #	Bathroom 2 Aerator Aerator (Y/N)	Bathroom 2 Aerator Aerator Picture #	Survey Com-plete? (Y/N)	Survey Result (A,B,C, D,E)	Survey In-centive? (Y/N)	Lett (Y/
[redacted]	[redacted]	Y	Y N	164	Y	163	Y	163B	N								
[redacted]	[redacted]	N	Y N	165B	N	164B	Y	165									
[redacted]	[redacted]	N	Y N	167	N	166	Y	166B			older	model		KA			
[redacted]	[redacted]	Y	Y N	168B	N	167B	N	168			Low	flow					
[redacted]	[redacted]	Y	Y N	170	N	169	N	169B									

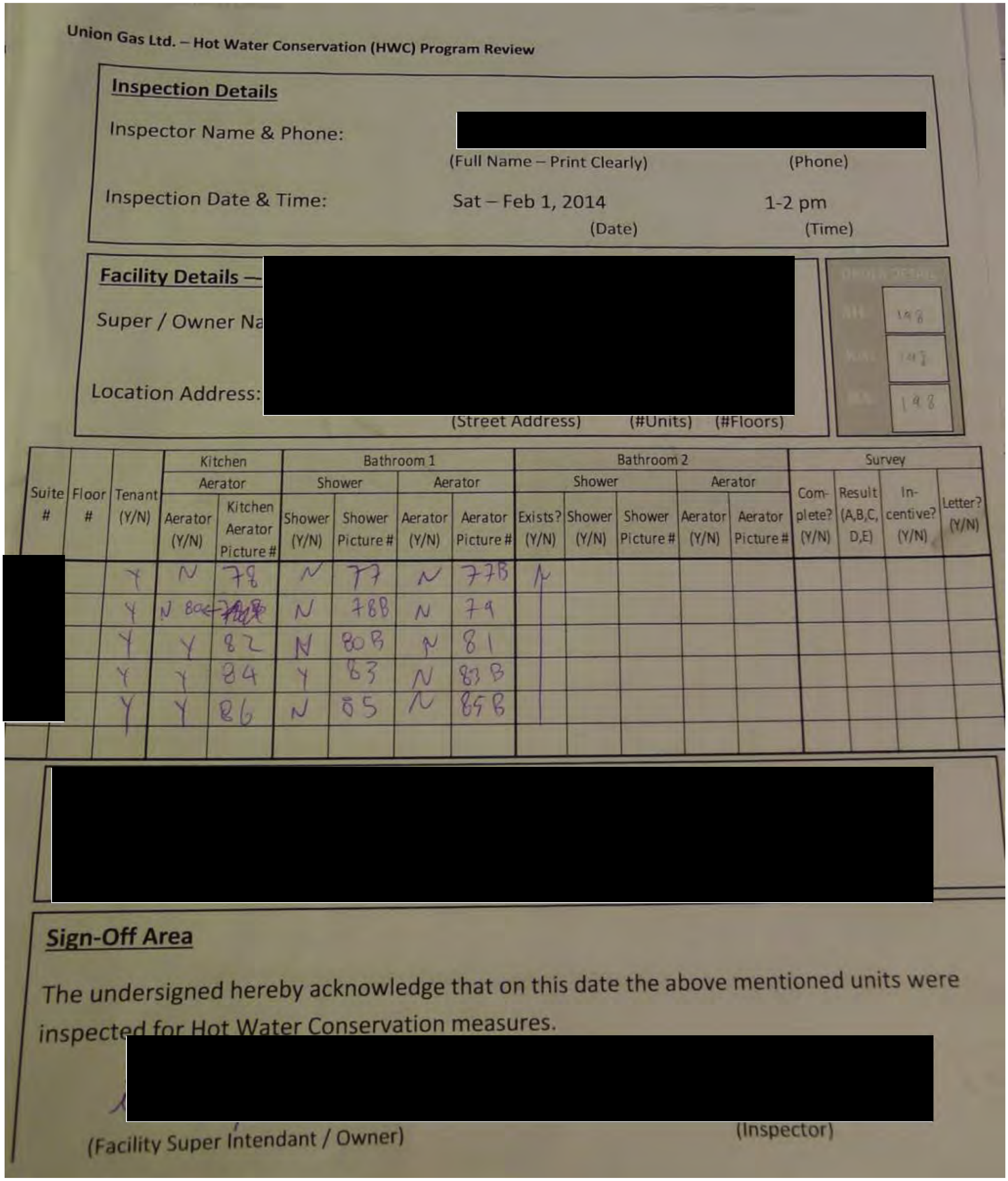
[redacted]

Sign-Off Area [redacted]

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

[redacted] [redacted]



Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Sat – Feb 1, 2014 1-2 pm
(Date) (Time)

Facility Details — [redacted]

Super / Owner Na

Location Address:
(Street Address) (#Units) (#Floors)

198
198
198

Suite #	Floor #	Tenant (Y/N)	Kitchen		Bathroom 1				Bathroom 2					Survey			
			Aerator		Shower		Aerator		Shower			Aerator					
			Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
[redacted]		Y	N	78	N	77	N	77B	N								
[redacted]		Y	N 80		N	78B	N	79									
[redacted]		Y	Y	82	N	80B	N	81									
[redacted]		Y	Y	84	Y	83	N	83B									
[redacted]		Y	Y	86	N	85	N	85B									

[redacted]

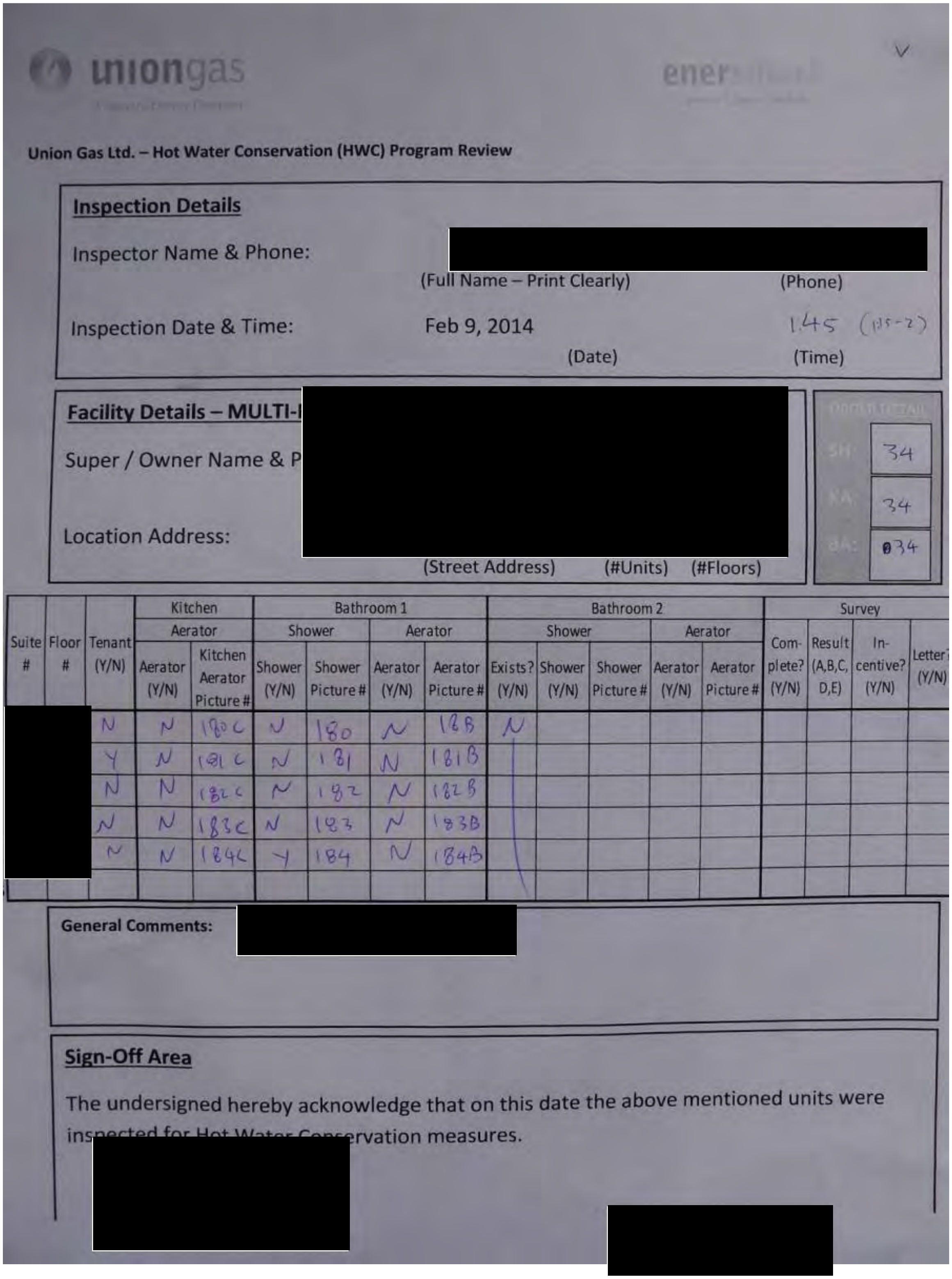
Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

(Facility Super Intendant / Owner) (Inspector)

[redacted] [redacted]



V

uniongas

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Feb 9, 2014 1.45 (1.15-2)
(Date) (Time)

Facility Details – MULTI-[redacted]

Super / Owner Name & P

Location Address:
(Street Address) (#Units) (#Floors)

SH: 34
KA: 34
BA: 034

			Kitchen		Bathroom 1				Bathroom 2					Survey			
			Aerator		Shower		Aerator		Shower			Aerator					
Suite #	Floor #	Tenant (Y/N)	Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter (Y/N)
[redacted]	[redacted]	N	N	180C	N	180	N	18B	N								
[redacted]	[redacted]	Y	N	181C	N	181	N	181B									
[redacted]	[redacted]	N	N	182C	N	182	N	182B									
[redacted]	[redacted]	N	N	183C	N	183	N	183B									
[redacted]	[redacted]	N	N	184C	Y	184	N	184B									

General Comments: [redacted]

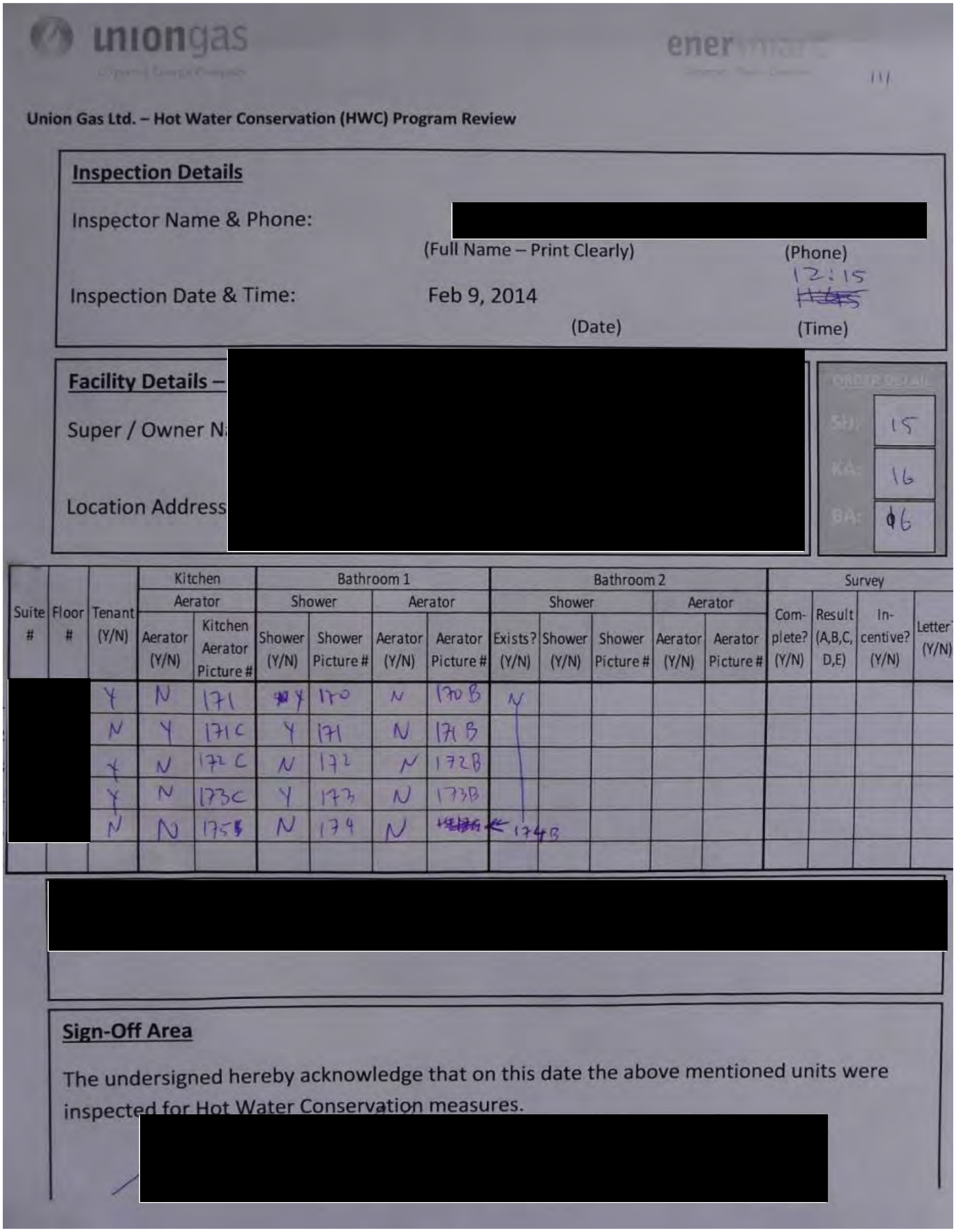
Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

[redacted]

[redacted] [redacted]



111

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Feb 9, 2014 12:15
(Date) (Time)

Facility Details – [redacted]

Super / Owner N

Location Address

ORDER DETAIL
SH: 15
KA: 16
BA: 06

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator Aerator (Y/N)	Kitchen Aerator Kitchen Aerator Picture #	Bathroom 1 Shower Shower (Y/N)	Bathroom 1 Shower Shower Picture #	Bathroom 1 Aerator Aerator (Y/N)	Bathroom 1 Aerator Aerator Picture #	Bathroom 2 Exists? (Y/N)	Bathroom 2 Shower Shower (Y/N)	Bathroom 2 Shower Shower Picture #	Bathroom 2 Aerator Aerator (Y/N)	Bathroom 2 Aerator Aerator Picture #	Survey Com-plete? (Y/N)	Survey Result (A,B,C, D,E)	Survey In-centive? (Y/N)	Survey Letter (Y/N)
[redacted]	[redacted]	Y	N	171	Y	170	N	170 B	N								
[redacted]	[redacted]	N	Y	171C	Y	171	N	171 B									
[redacted]	[redacted]	Y	N	172 C	N	172	N	172B									
[redacted]	[redacted]	Y	N	173C	Y	173	N	173B									
[redacted]	[redacted]	N	N	175B	N	174	N	← 174B									

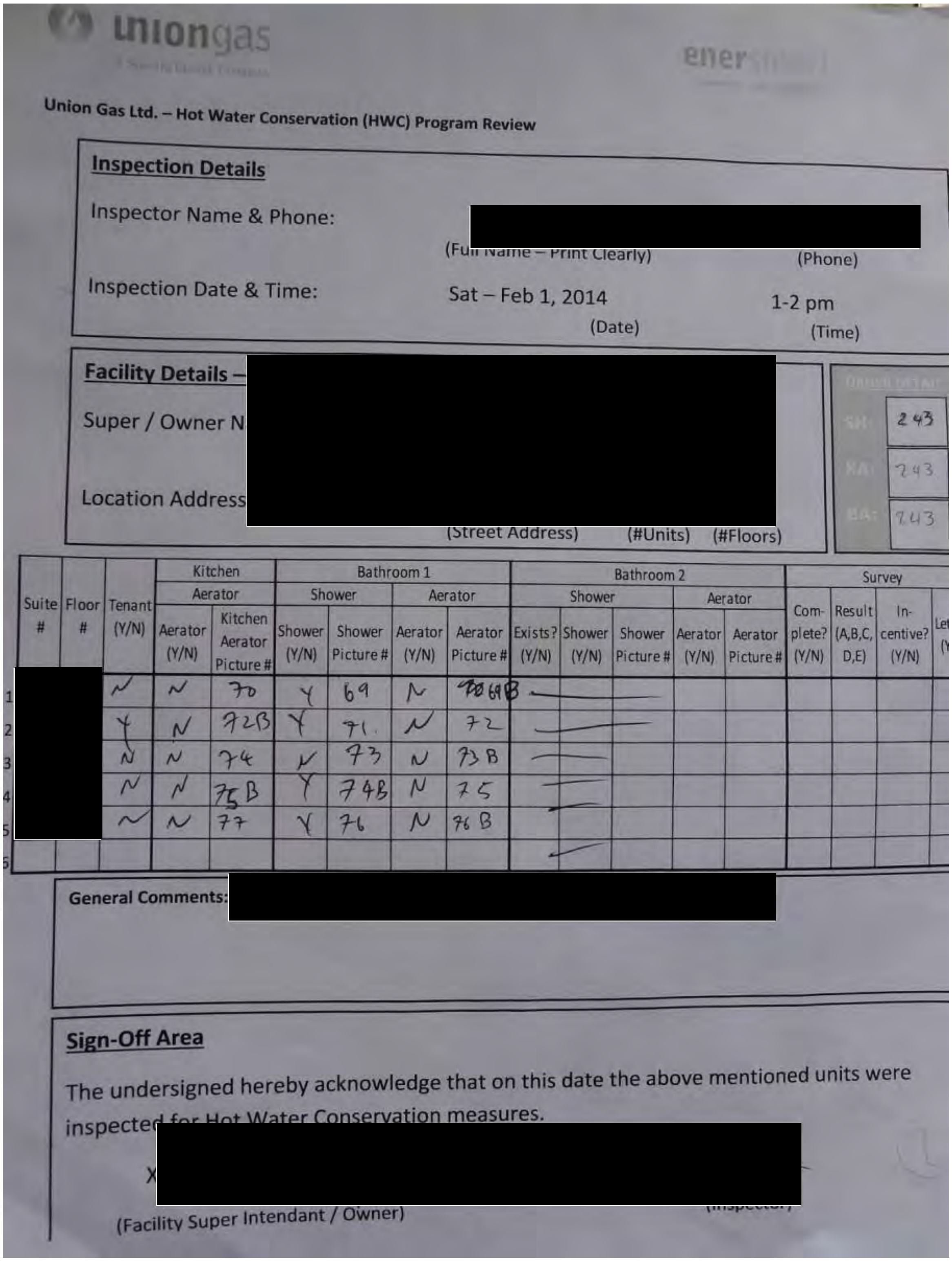
[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

[redacted] [redacted]



uniongas

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Sat – Feb 1, 2014 (Date) 1-2 pm (Time)

Facility Details – [redacted]

Super / Owner N [redacted]

Location Address [redacted]
(Street Address) (#Units) (#Floors)

SH: 243
KA: 243
BA: 243

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2 Shower			Bathroom 2 Aerator		Survey			
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Le
1	[redacted]	[redacted]	N	N	70	Y	69	N	~~70~~ 69B	—	—	—						
2	[redacted]	[redacted]	Y	N	72B	Y	71	N	72	—	—	—						
3	[redacted]	[redacted]	N	N	74	Y	73	N	73 B	—	—							
4	[redacted]	[redacted]	N	N	75B	Y	74B	N	75	—	—							
5	[redacted]	[redacted]	N	N	77	Y	76	N	76 B	—	—							
6										—	—							

General Comments: [redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

(Facility Super Intendant / Owner) (Inspector)

Appendix E – Field Data

Building Address		Unit	Kitchen Aerator (Y/N)	Kitchen Aerator Picture	Shower (Y/N)	Shower Picture	Bathroom Aerator (Y/N)	Bathroom Aerator Picture
[redacted]	[redacted]	[redacted]	N	186	N	185	N	135-B
		[redacted]	N	187-B	Y	186-B	Y	187
		[redacted]	N	189	N	188	N	188-B
		[redacted]	N	191	Y	189-B	Y	190
		[redacted]	N	192-B	Y	191-B	N	192
[redacted]	[redacted]	[redacted]	N	209	N	208	N	208-B
		[redacted]	Y	210-B	N	209-B	N	210
		[redacted]	N	212	N	211	N	211-B
		[redacted]	N	213-B	N	212-B	N	213
		[redacted]	N	213	N	214	N	214-B
[redacted]	[redacted]	[redacted]	N	202	Y	201	Y	201-B
		[redacted]	Y	203-B	Y	202-B	Y	203
		[redacted]	N	205	Y	204	Y	204-B
		[redacted]	N	206-B	N	205-B	N	206
		[redacted]	N	208	Y	207	N	207-B
[redacted]	[redacted]	[redacted]	Y	87	Y	86(1)	N	86-B
		[redacted]	Y	88-B	N	87-B	N	88
		[redacted]	N	90	Y	89	N	89-B
		[redacted]	N	92	N	90-B	N	91
		[redacted]	N	93	N	92	N	92-B
[redacted]	[redacted]	[redacted]	N	176	Y	175-B	Y	175C
		[redacted]	N	177	N	176-B	Y	176C
		[redacted]	N	178	Y	177-B	Y	177C
		[redacted]	N	179	Y	178-B	N	178C
		[redacted]	N	180	Y	179-B	Y	179C
[redacted]	[redacted]	[redacted]	Y	194	N	193	N	193-B
		[redacted]	Y	195-B	Y	194-B	N	195
		[redacted]	N	197	Y	196	Y	196-B
		[redacted]	N	198-B	Y	197-B	N	198
		[redacted]	N	200-B	Y	199	N	200
[redacted]	[redacted]	[redacted]	Y	58	N	56	N	57
		[redacted]	Y	55	Y	53	Y	54
		[redacted]	Y	52	Y	50	Y	51
		[redacted]	Y	49	Y	47	Y	48
		[redacted]	Y	46	N	44	N	45
[redacted]	[redacted]	[redacted]	N	156-B	Y	155-B	N	156
		[redacted]	N	158	Y	157	N	157-B
		[redacted]	N	159-B	Y	158-B	N	159
		[redacted]	N	161	Y	160	N	160-B
		[redacted]	N	163	Y	162	N	162-B
[redacted]	[redacted]	[redacted]	N	164	Y	163	Y	163-B
		[redacted]	Y	165-B	N	164-B	Y	165
		[redacted]	Y	167	N	166	Y	166-B
		[redacted]	Y	168-B	N	167-B	N	168
		[redacted]	Y	170	N	169	N	169-B
[redacted]	[redacted]	[redacted]	N	78	N	77	N	77-B
		[redacted]	N	80	N	78-B	N	79
		[redacted]	N	82	N	80-B	N	81
		[redacted]	N	84	Y	83	N	83-B
		[redacted]	N	86	N	85	N	85-B
[redacted]	[redacted]	[redacted]	N	180C	N	180	N	180-B
		[redacted]	N	181C	N	181	N	181-B
		[redacted]	N	182C	N	182	N	182-B
		[redacted]	N	183C	N	183	N	183-B
		[redacted]	N	184C	Y	184	N	184-B
[redacted]	[redacted]	[redacted]	N	171	Y	170	N	170-B
		[redacted]	Y	171C	Y	171	N	171-B
		[redacted]	N	172C	N	172	N	172-B
		[redacted]	N	173C	Y	173	N	173-B
		[redacted]	N	175	N	175	N	174-B
[redacted]	[redacted]	[redacted]	N	70	Y	69	N	69-B
		[redacted]	N	72-B	Y	71	N	72
		[redacted]	N	74	N	73	N	73-B
		[redacted]	N	75-B	Y	74-B	N	75
		[redacted]	N	77	Y	76	N	76-B

Appendix F – Photographs of Installed Measures

MK-44

MK-45

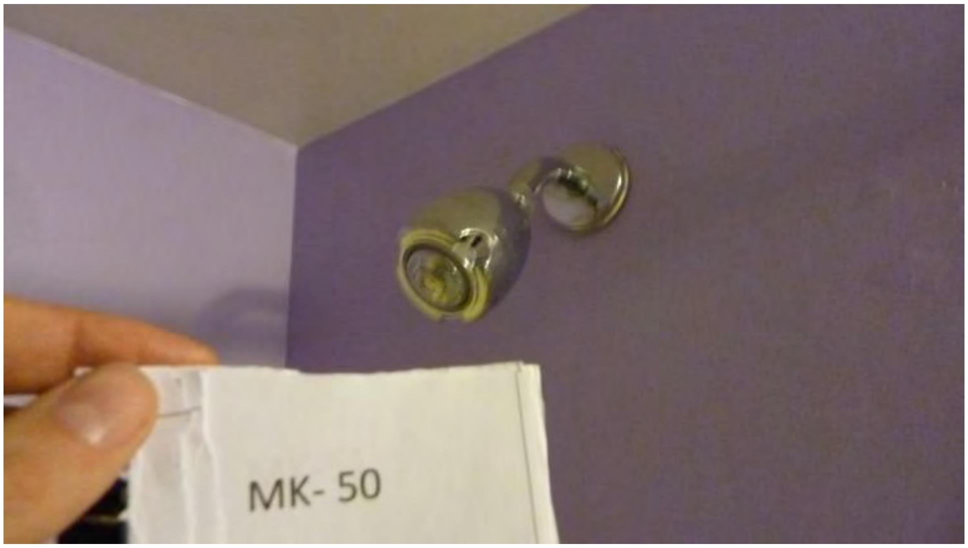
MK-46

MK-47

MK-48

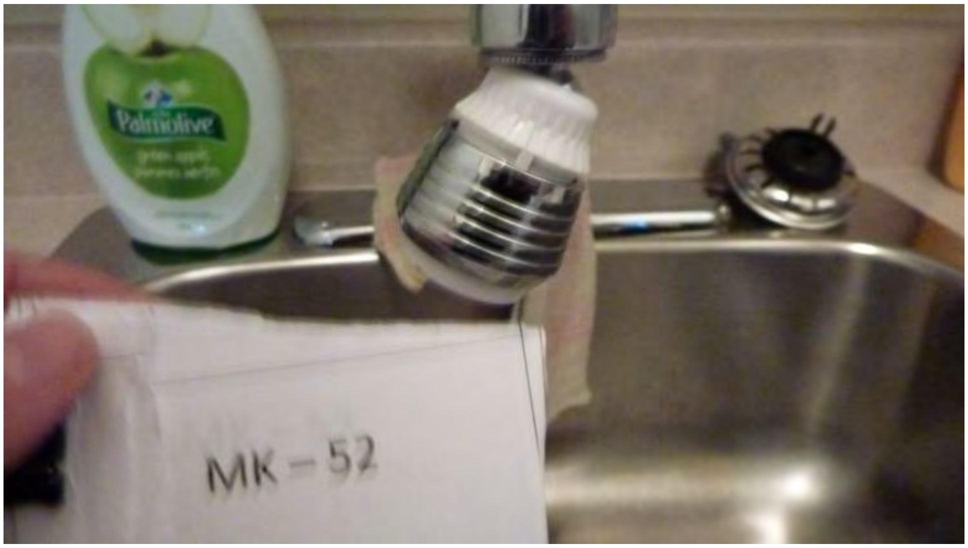
MK-49

MK-50



MK-51

MK-52



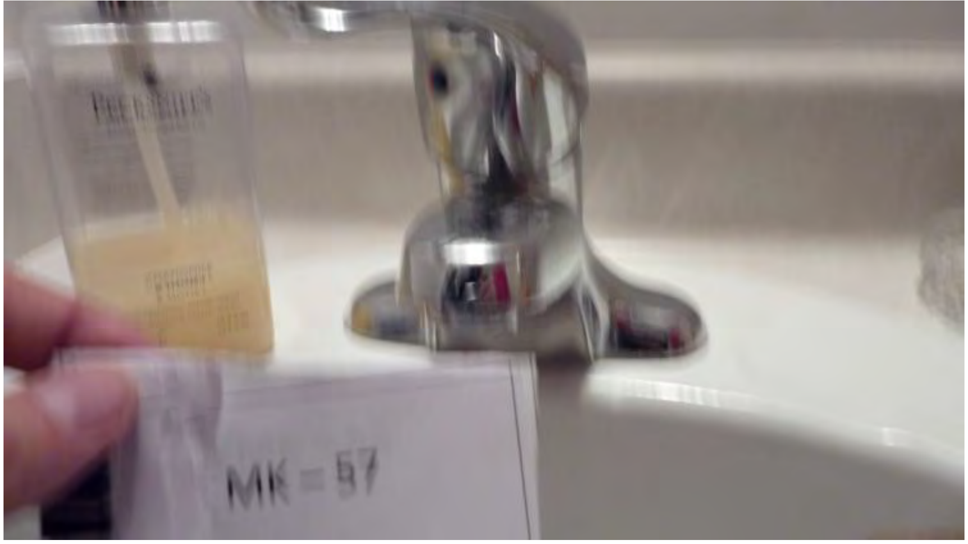
MK-53

MK-54

MK-55

MK-56

MK-57



MK-58

MK-69

MK-69B

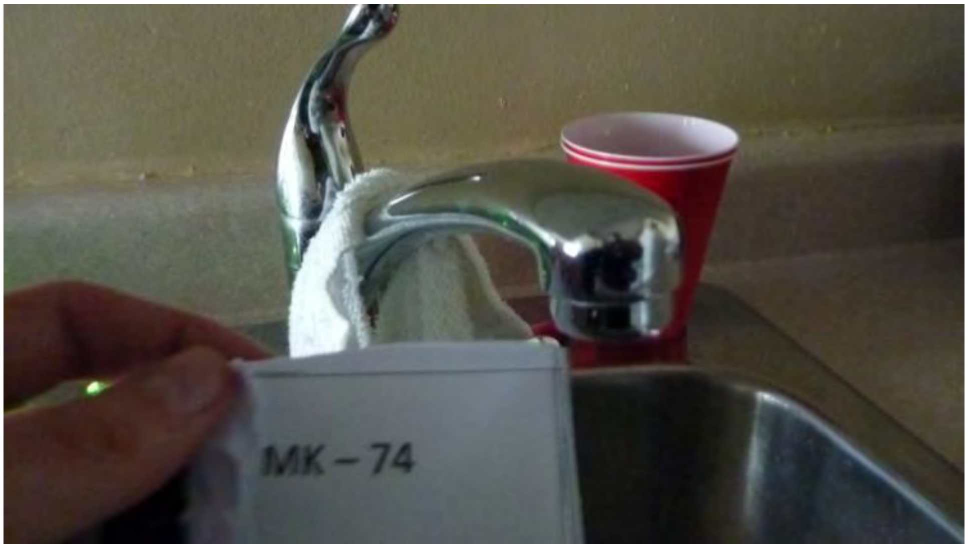
MK-70

MK-71

MK-72

MK-73

MK-74



MK-75

MK-75B

MK-76

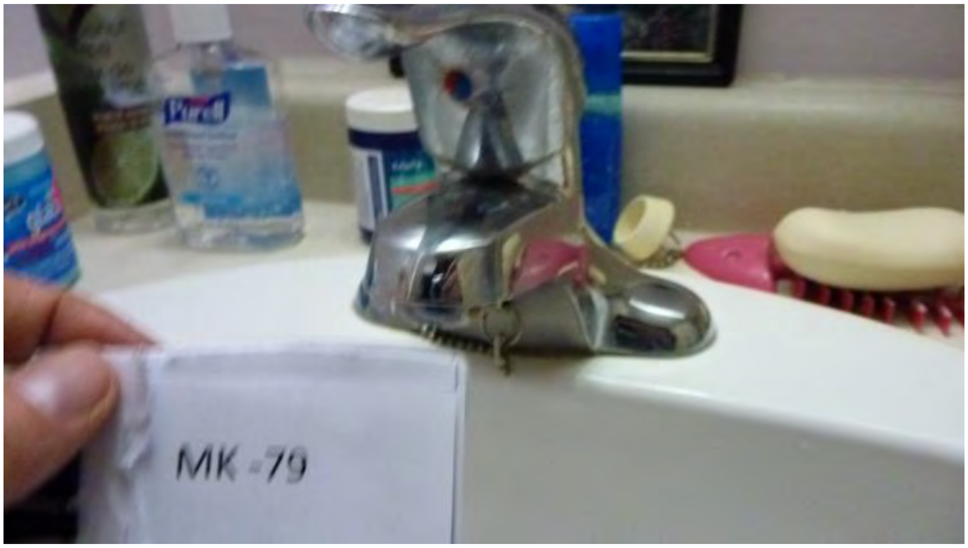
MK-76B

MK-77

MK-77B

MK-78

MK-79



MK-80

MK-81

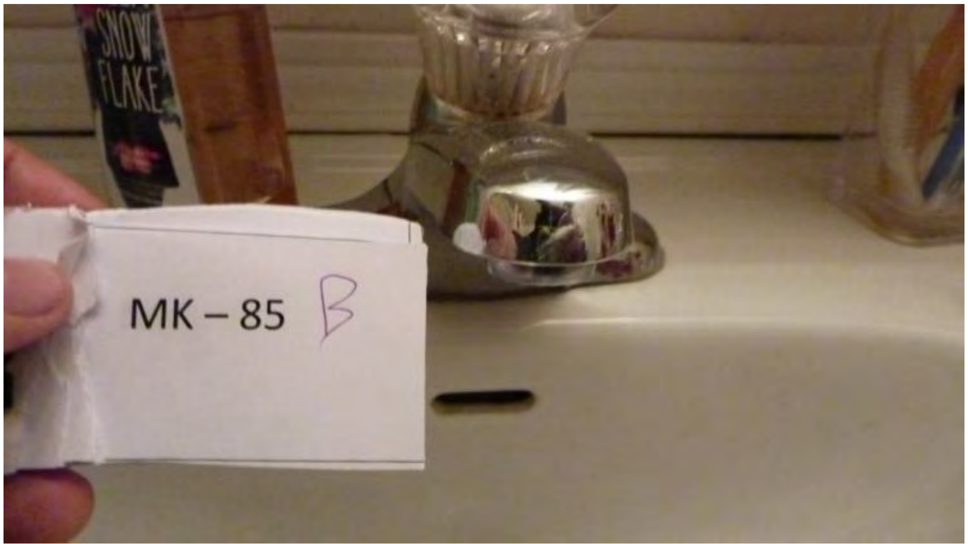
MK-82

MK-83

MK-84

MK-85

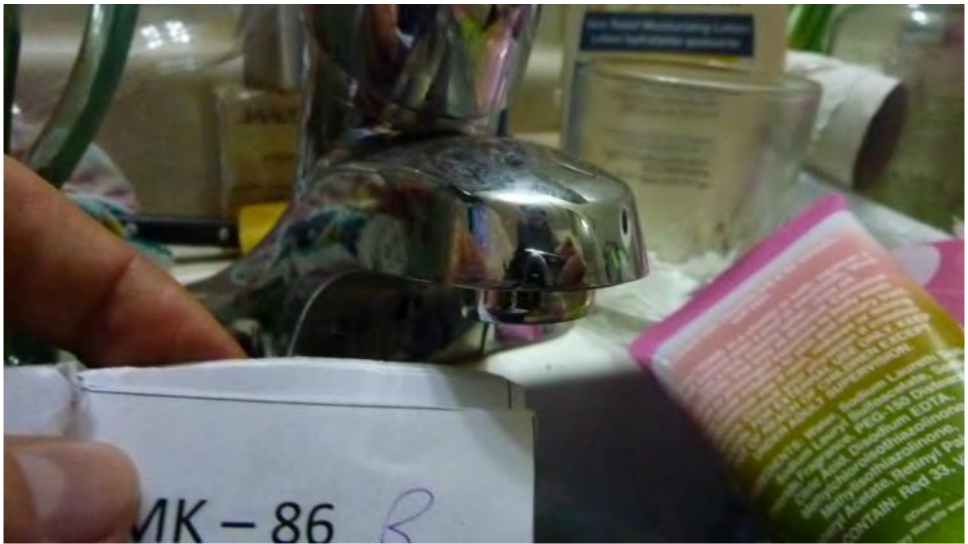
MK-85B



MK-86

MK-86(1)

MK-86B



MK-87

MK-87B

MK-88

MK-88B

MK-89

MK-89B

MK-90

MK-90B

MK-91

MK-92

MK-92

MK-92(1)

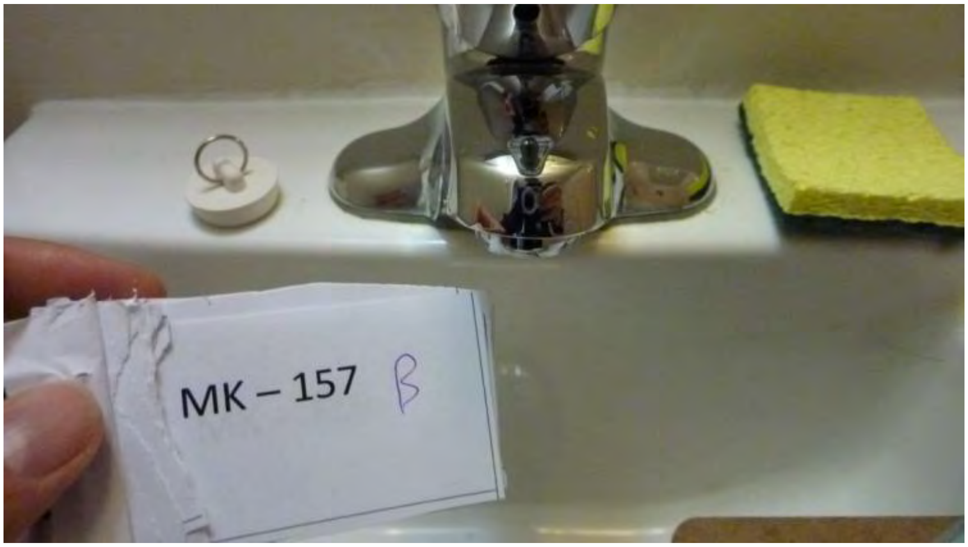
MK-92B

MK-93

MK-156

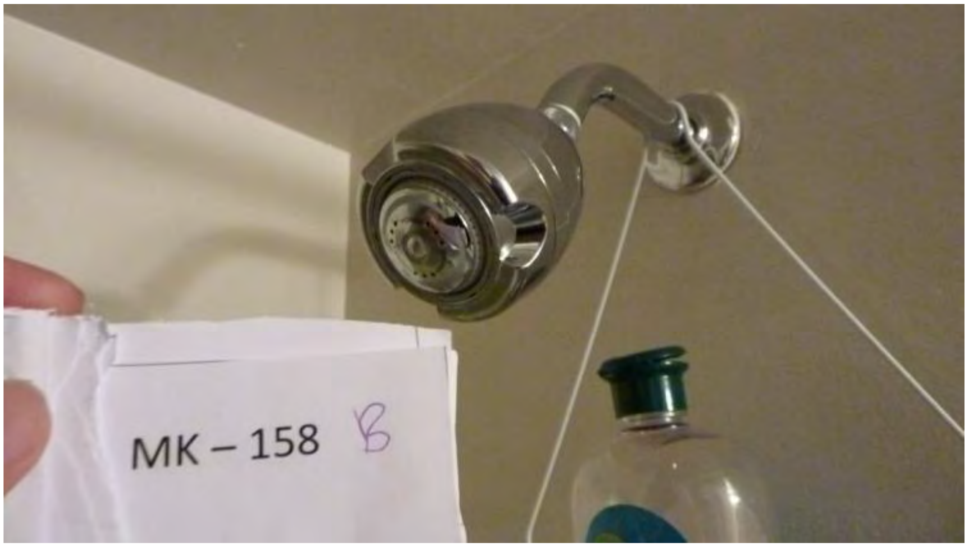
MK-157

MK-157B



MK-158

MK-158B



MK-159

MK-
159B

MK-160

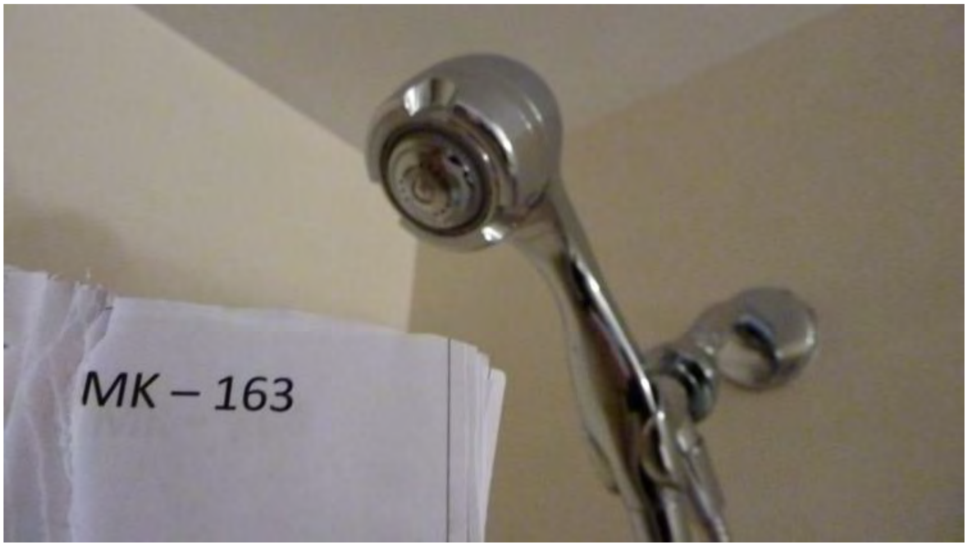
MK-161

MK-162

MK-
162B

MK-163

MK-163(1)



MK-163B

MK-164

MK-164B

MK-165

MK-165B

MK-166

MK-166B

MK-167

MK-167B

MK-168

MK-168B

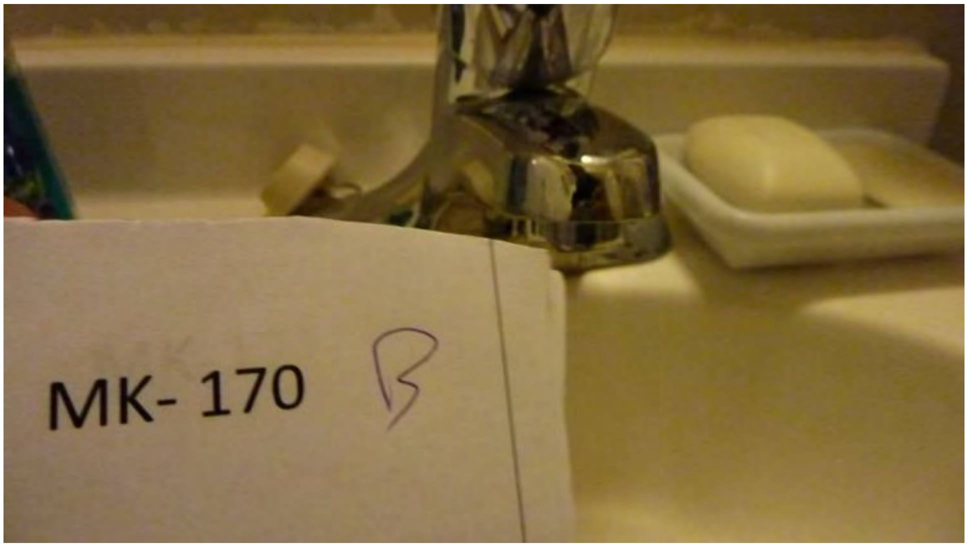
MK-169

MK-169B

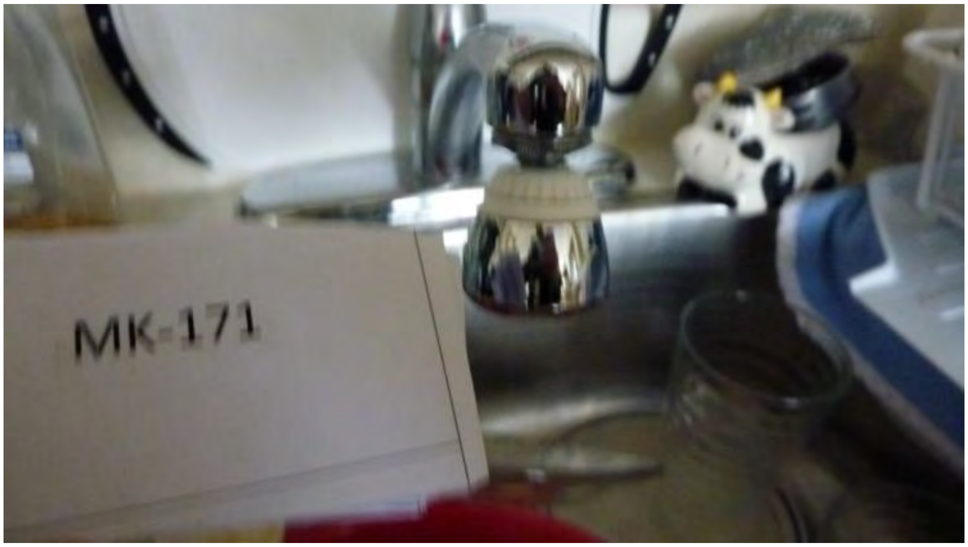
MK-170

MK-170(1)

MK-170B



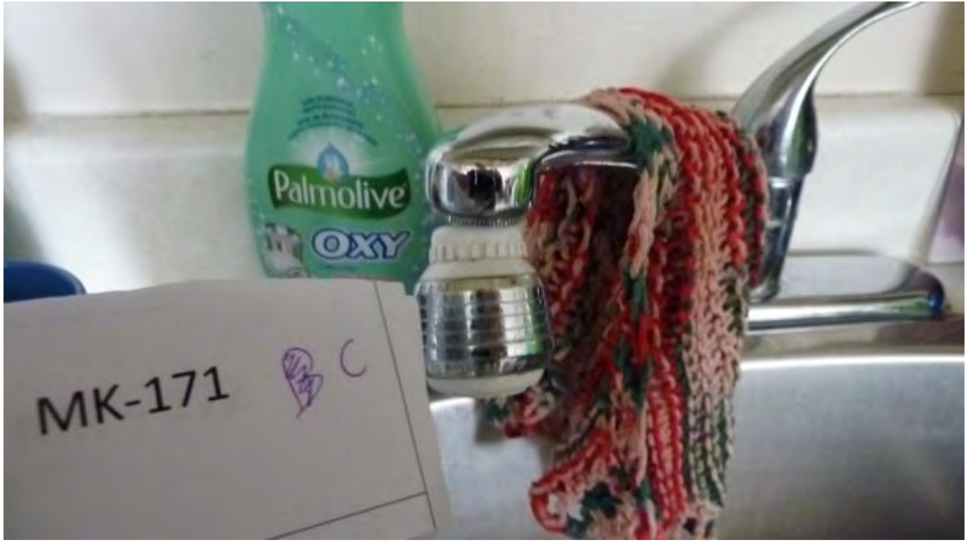
MK-171



MK-171(1)

MK-171B

MK-171C



MK-172

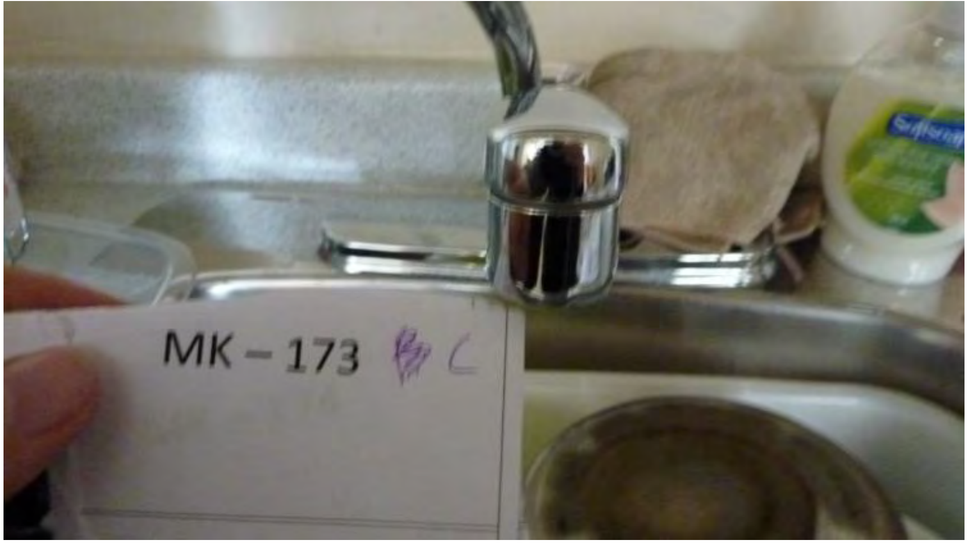
MK-172B

MK-172C

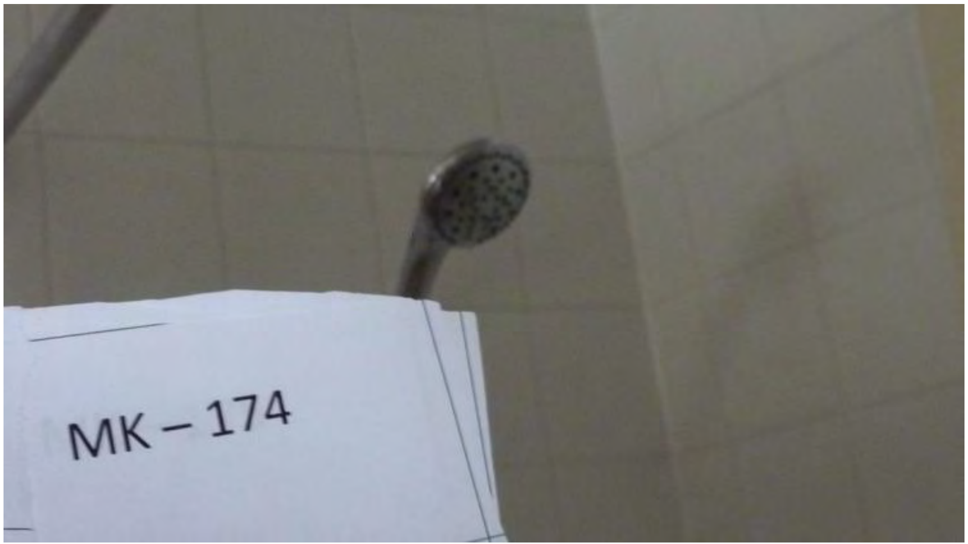
MK-173

MK-173B

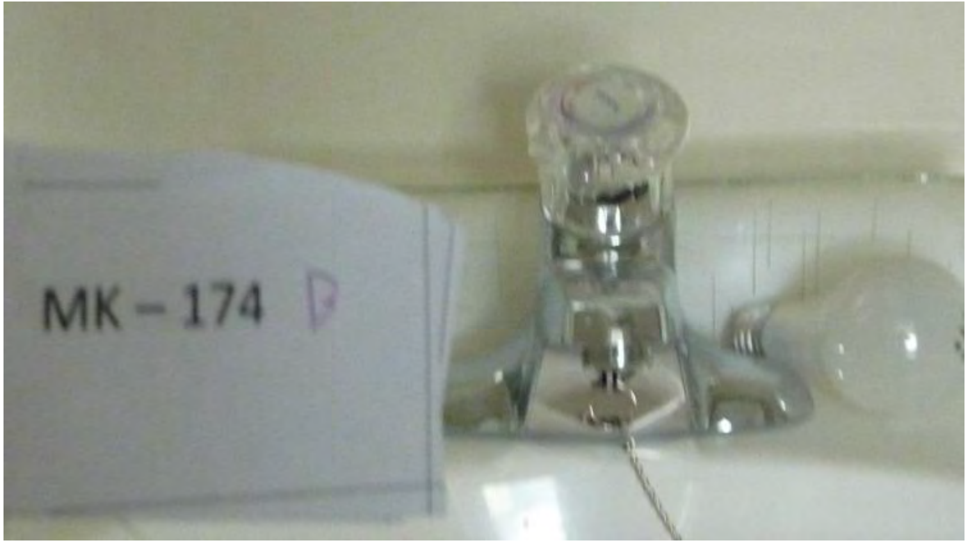
MK-173C



MK-174



MK-174B



MK-175

MK-175B

MK-175C

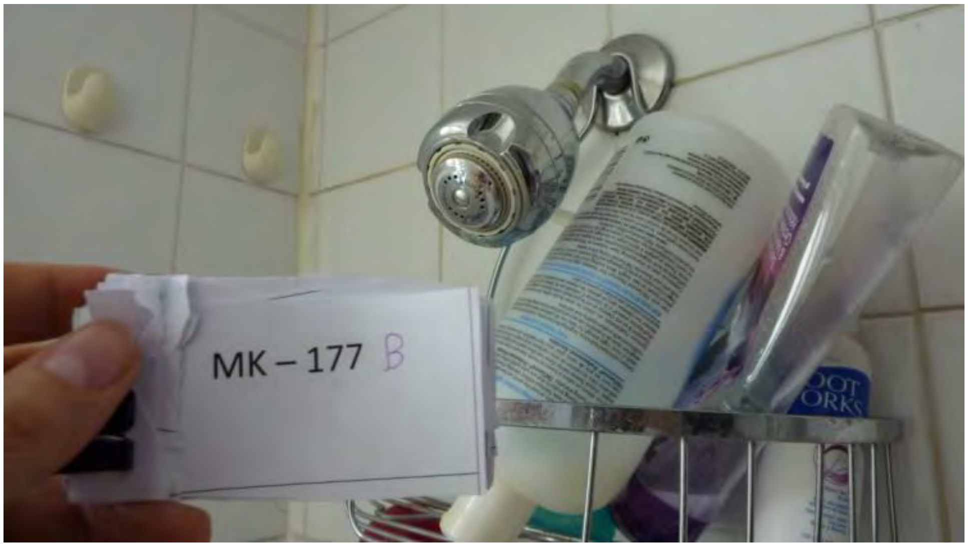
MK-176

MK-176B

MK-176C

MK-177

MK-
177B



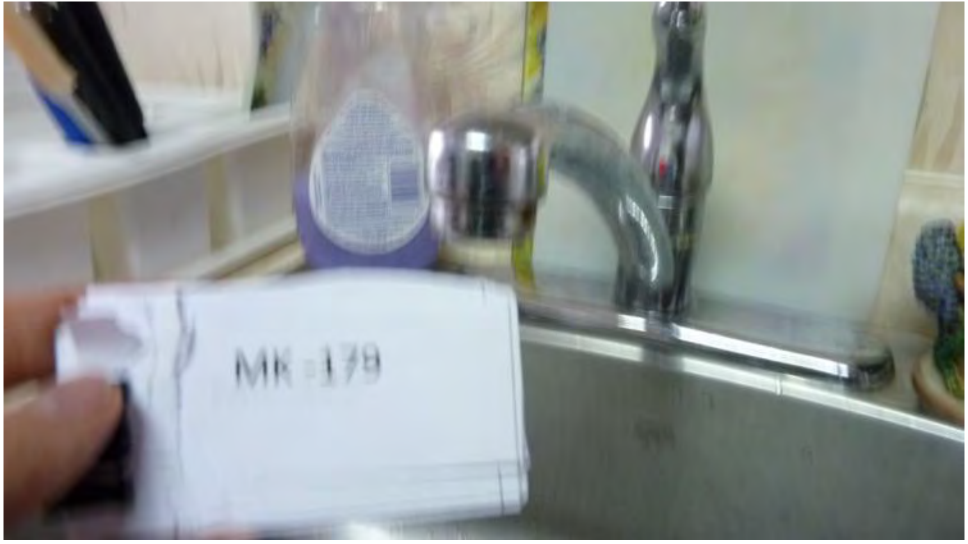
MK-
177C

MK-178

MK-178B

MK-178C

MK-179



MK-179B

MK-179C

MK-180

MK-180(1)

MK-180B

MK-180C

MK-181

MK-181B

MK-181C

MK-182

MK-182B

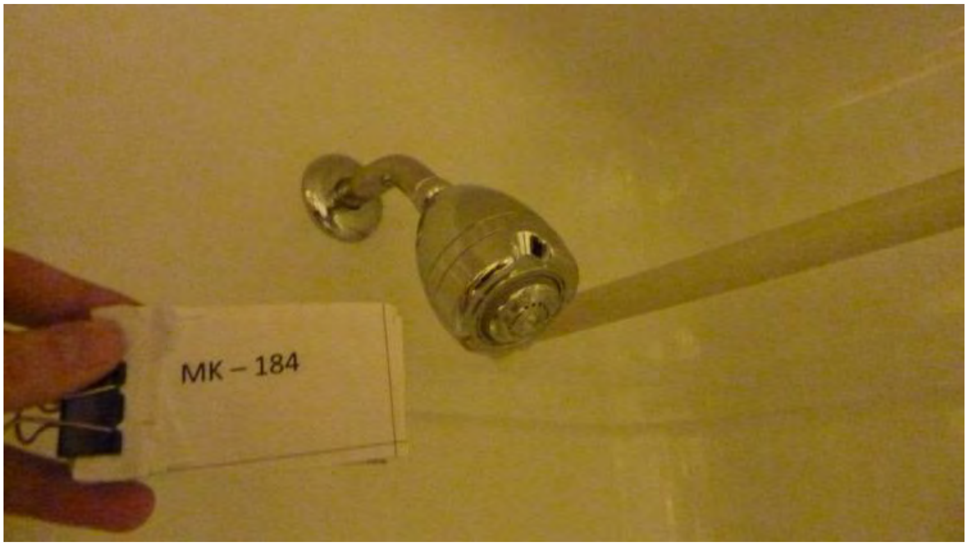
MK-182C

MK-183

MK-183B

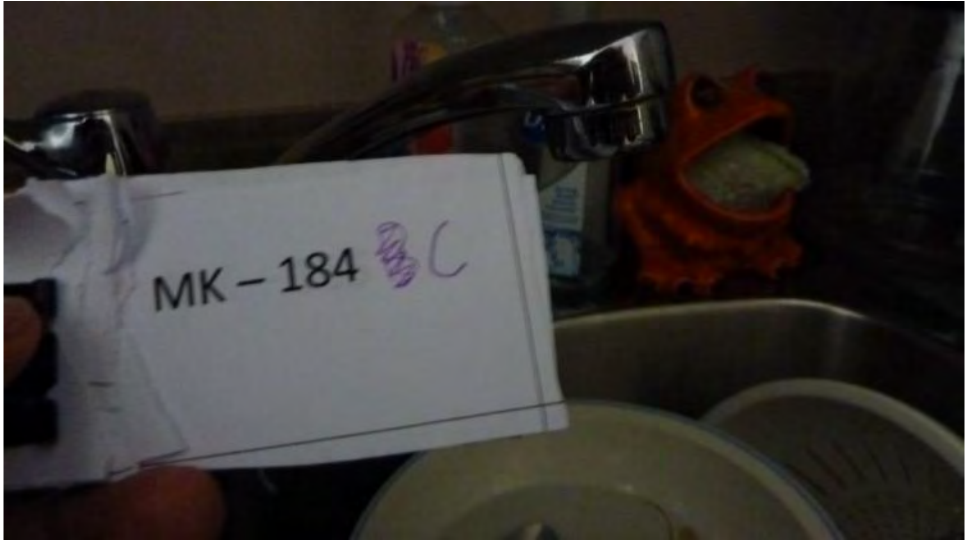
MK-183C

MK-184



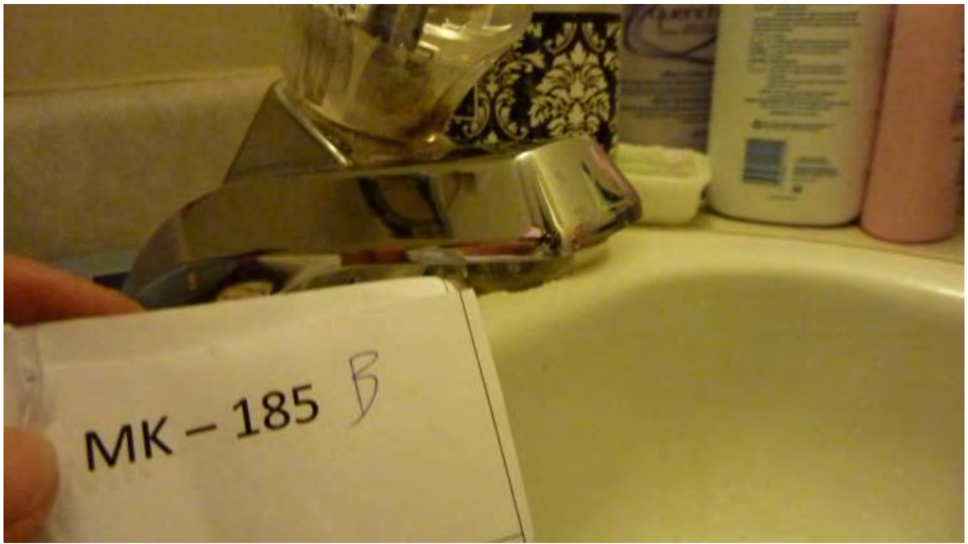
MK-184B

MK-184C



MK-185

MK-185B

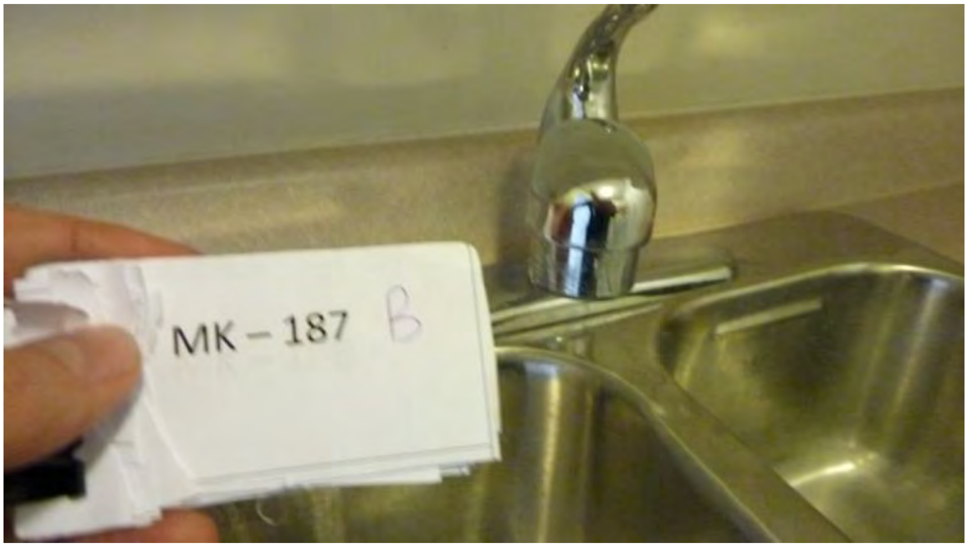


MK-186

MK-186B

MK-187

MK-187B



MK-188

MK-188B

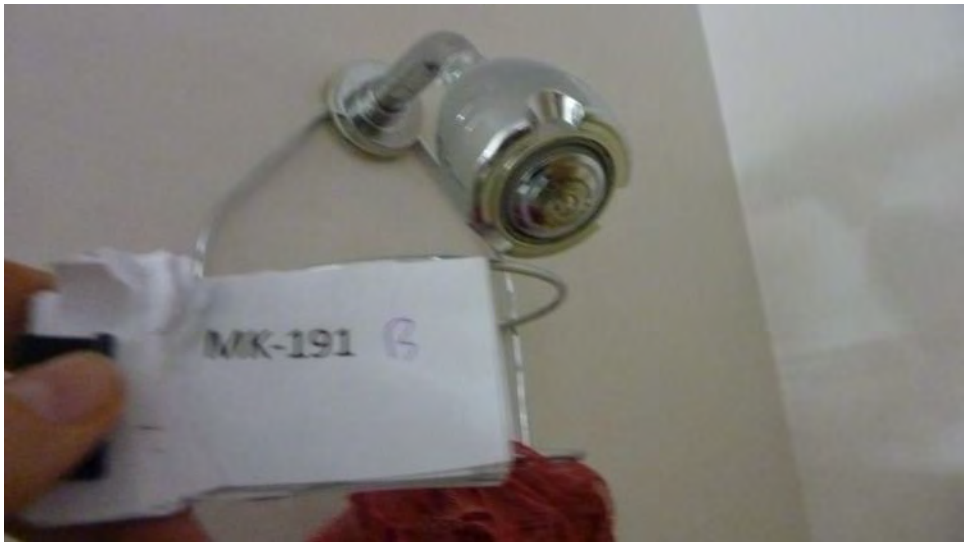
MK-189

MK-
189B

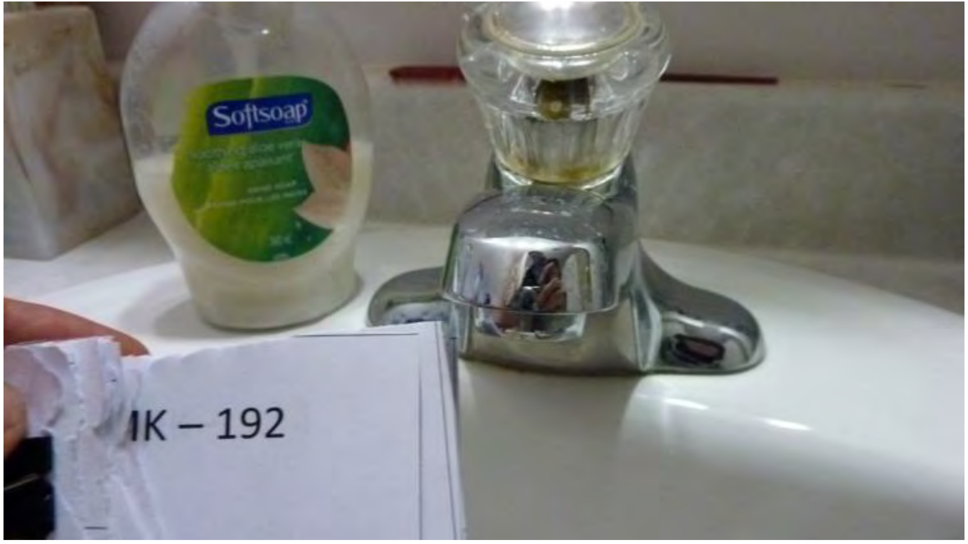
MK-190

MK-191

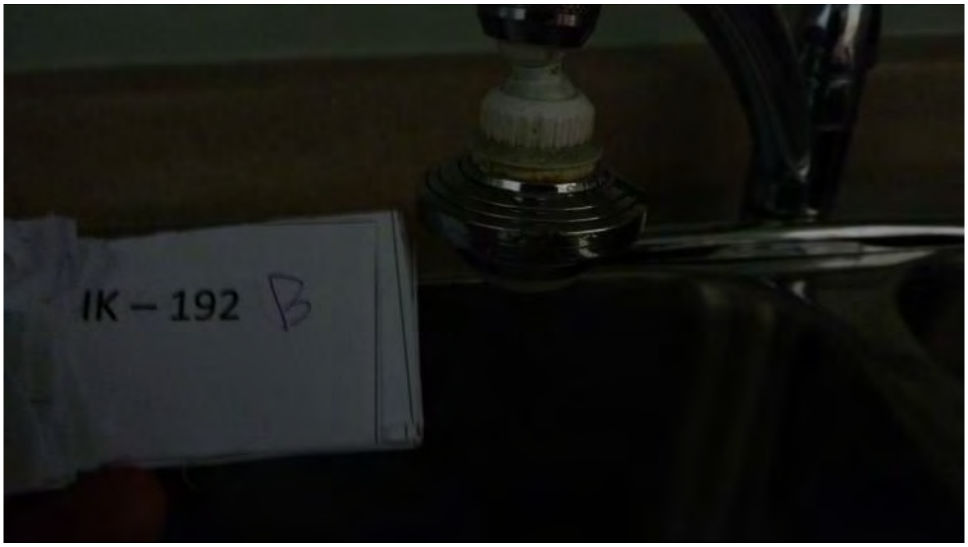
MK-191B



MK-192



MK-192B



MK-193

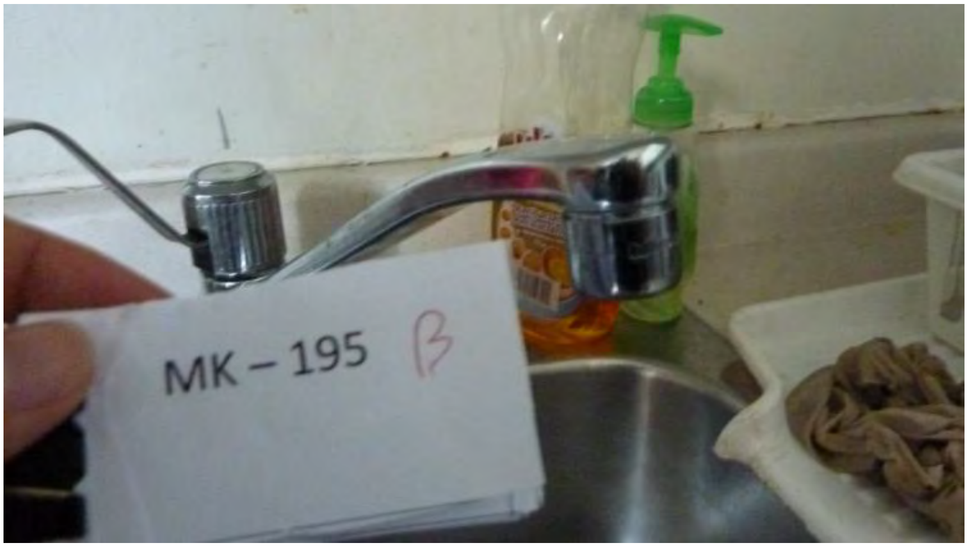
MK-193B

MK-194

MK-194B

MK-195

MK-195B



MK-196

MK-196B

MK-197

MK-197B

MK-198

MK-198B

MK-199

MK-200

MK-
200B

MK-201

MK-201B

MK-202

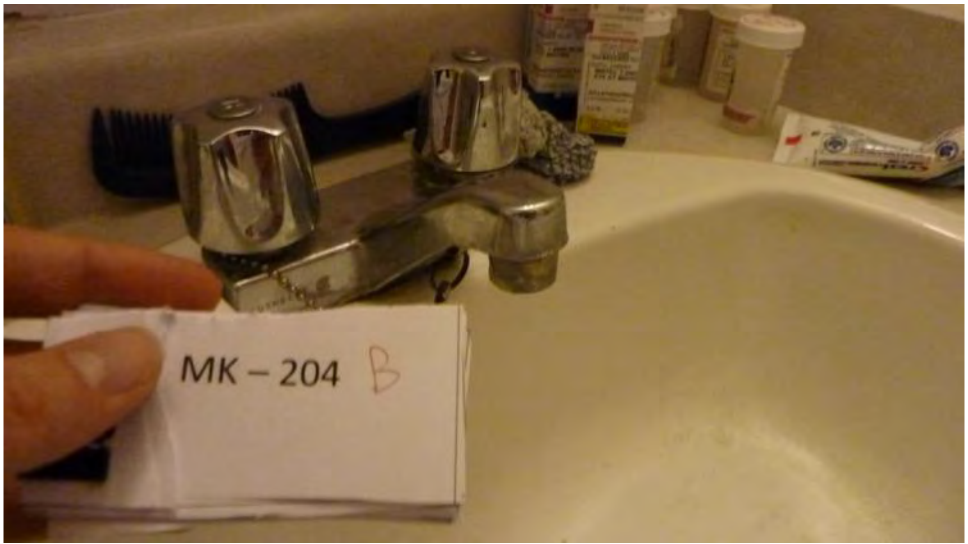
MK-202B

MK-203

MK-203B

MK-204

MK-
204B



MK-205

MK-205B

MK-206

MK-206B

MK-207

MK-207B

MK-208

MK-208(1)

MK-208B

MK-209

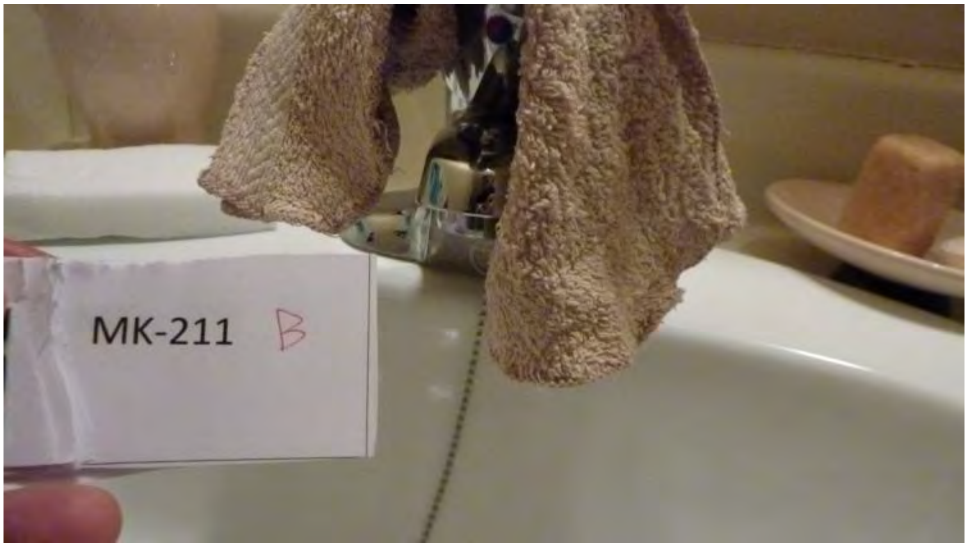
MK-209B

MK-210

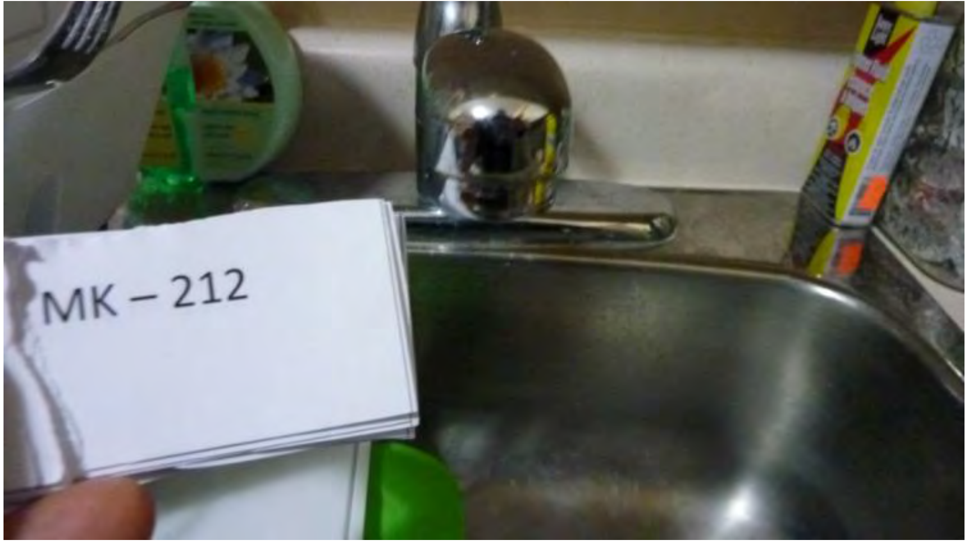
MK-210B

MK-211

MK-
211B



MK-212

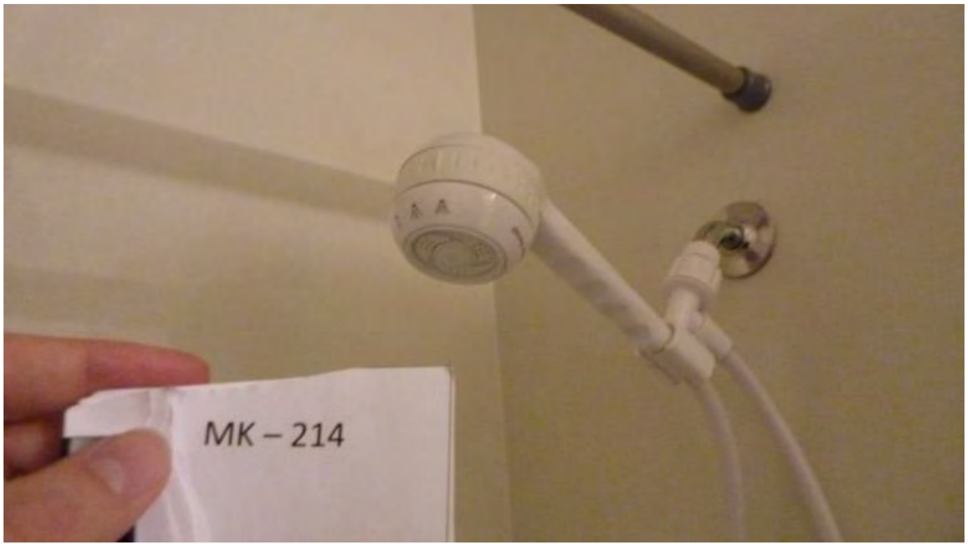


MK-212B

MK-213

MK-213B

MK-214



MK-214B

Appendix M: 2013 Hot Water Conservation Program (HWC) Multi-Family

VERIFICATION RESULTS:

2013 Hot Water Conservation Program (HWC)
Multi-Family

SUBMITTED TO:

Eric Buan

Program Evaluator, DSM Research & Evaluation

Union Gas Ltd., 777 Bay Street, Suite 2901, PO Box 153,
Toronto, Ontario, M5G 2C8

By

SeeLine Group Ltd.

416-703-8695

March, 2014

Table of contents

1.0 Executive Summary

Union Gas Ltd. (UGL) contracted with SeeLine Group Ltd. (SLG) to provide onsite verification and documentation of results for the Commercial Hot Water Conservation (HWC) Initiative (Multi-Family).

A total of 10 multi-family buildings (facilities) were visited and 50 ensuite units were visited onsite to verify the installation of low-flow showerheads, bathroom faucet aerators, and kitchen faucet aerators.

A random sample of facilities was provided to SLG by an independent third party. SLG agents contacted each facility and arranged an inspection time and date with the facility supervisor. Suites within the sample of facilities were selected at random for verification. The randomly selected suites were inspected for the installation of showerheads and faucet aerators. The data were captured on a summary sheet, which was signed by the inspector as well as the facility supervisor. Photos of the installed measures were also taken as further proof of installation. Data capture sheets and photos can be found in the accompanying appendices.

Key results included:

- There were 44 (88.0%) showerheads observed installed and 6 (12.0 %) were not.
- There were 17 (34.0%) bathroom aerators observed installed and 33 (66.0%) were not.
- There were 27 (54.0%) kitchen faucet aerators observed installed and 23 (46.0%) were not.

2.0 Background & Objective

The HWC Initiative (Multi-Family) is designed to reduce natural gas usage associated with hot water consumption. The HWC Initiative (Multi-Family) provides a choice of a suite of measures at no cost to participants including: 1.25gpm showerhead, 1.5gpm kitchen aerator, and a 1.0gpm bathroom aerator for applicable multi-family suites. The multi-family segment is defined as dwellings with more than 3 floors and more than 5 suites.

SLG provided onsite verification and documentation of results for the measures distributed as part of the initiative. The verification work occurred from January to February 2014. All of the data had been collected by March 2014.

2.1 Objective

Through onsite verification, the main goal of this study was to confirm the installation of showerheads and aerators distributed to HWC (Multi-Family) participants. At least 50 suites needed to be verified across 10 different facilities.

Through this effort, 50 suites were verified at 10 facilities.

UGL also required that SLG quantify the percentage use of installed showerheads for suites that had more than one shower. If a second bathroom was encountered in a unit, a brief survey questionnaire would be deployed to the participant to ascertain the percentage of showering in each unique bathroom. No second bathrooms were encountered during this verification effort.

3.0 Methodology

A random sample of participants was developed by an independent third party and provided to SLG. To ensure adequate geographic reach and to optimize cost effectiveness, it was determined that a maximum of 5 suites was the appropriate limit for verification at each facility.

Prior to any customer contact performed by SLG, a letter was sent from UGL to the sample list of customers informing them that their facility could be visited for the purpose of the onsite verification study. A meeting request by telephone to verify the installed measures was then placed with the facility supervisor. A meeting time and date was arranged. Meeting times and dates were assigned to an SLG agent. The SLG agent made final arrangements with the facility supervisor.

The SLG agent arrived onsite and randomly selected up to 5 suites for verification. A random number generator was used to make the unit selections. The facility supervisor brought the agent to each randomly selected unit. The SLG agent gained access to the suites and searched for the 3 installed measures:

- 1.25gpm showerhead
- 1.5gpm kitchen faucet aerator
- 1.0gpm bathroom faucet aerator

Physical samples of the models were provided to SLG agents by UGL staff prior to the inspections. These models were brought to the field to make direct comparisons. As well, detailed photographs of the measures were provided by UGL, so that SLG agents could positively identify the measures in the field. The models provided through the HWC program are unique to the Ontario market, so it was assumed that a positively identified measure was only acquired through participation in the HWC initiative. SLG agents also took detailed photographs of the installed measures in the field, so that a visual record would be available after the verification had occurred. A unique identifying tag was affixed to each installed measure for organization. See Appendix F for the photographs.

The verification details were recorded in a data-capture 'sign-off' sheet. This document recorded the results of the inspection, and required the facility supervisor to sign off on the inspection along with the SLG agent. See Appendix B for the template of the sign-off sheet, as well as Appendix D for copies of the completed sign-off sheets.

A total of 10 facilities were visited and 50 suites were verified. Phone calls were placed in the last 2 weeks of January 2014 to arrange meeting times. The verification visits occurred throughout the month of February. All the onsite verification meetings had been concluded by March 2014.

4.0 Results

4.1 Showerheads

Result	Showerheads	
	#	%
Yes	44	88.0%
No	6	12.0%
Total (N)	50	100.0%

Quantitative Findings

A total of 50 bathroom showerheads were inspected. 44 (88.0%) of the installed measures were positively identified as HWC showerheads, while 6 (12.0%) were not. Photographs of all the showerheads that were inspected have been provided in Appendix F.

Qualitative findings

After speaking with property owners, facility supervisors, and tenants it is clear that the fate of the showerheads is not altogether uniform. Three main outcomes were identified: not installed, installed, and un-installed (removed).

4.2 Bathroom Faucet Aerators

Result	Bathroom Aerators	
	#	%
Yes	17	34.0%
No	33	66.0%
Total (N)	50	100.0%

Quantitative Findings

A total of 50 bathroom faucet aerators were inspected. 17 (34.0%) of the installed measures were positively identified as HWC bathroom faucet aerators, while 33 (66.0%) were not. Photographs of all the bathroom faucet aerators that were inspected can be found in Appendix F.

Qualitative findings

The percentage of bathroom faucet installations was lower than that of the showerhead installations, and also lower than that of the kitchen aerators. A number of possible reasons were identified in the field. One is that bathroom faucet fixtures were quite variable. Not all of the faucet fixtures were compatible with the HWC faucet aerator measure. Another reason was the reported increased 'splash-back' that could occur. This is a potential issue where relatively strong water pressure creates a strong flow into a shallow basin. Compatibility with the fixtures and perceived performance issues may help to explain the low percentage of observed installations.

4.3 Kitchen Faucet Aerators

Result	Kitchen Aerators	
	#	%
Yes	27	54.0%
No	23	46.0%
Total (N)	50	100.0%

Quantitative Findings

A total of 50 kitchen faucet aerators were inspected. 27 (54.0%) of the installed measures were positively identified as HWC kitchen faucet aerators, while 23 (46.0%) were not. Photographs of all the kitchen faucet aerators that were inspected have been provided in Appendix F.

Qualitative Findings

The percentage of observed installations of kitchen faucet aerators was quite high. Kitchen faucets were generally more uniform and there appears to be fewer issues regarding installation and perceived performance. There were some participants who indicated that they had challenges with affixing the measure to the faucet, and some who indicated splash-back occurred (especially with smaller kitchen sinks), however not to the same degree as with bathroom faucets.

4.4 Second Bathrooms

In the field, SLG agents did not encounter any suites with more than one shower. The second bathroom survey was not deployed.

4.5 Second Bathroom Survey

A survey was developed to ascertain the relative use of the second bathroom. SLG agents did not deploy the survey.

5.0 Conclusion

A total of 50 suites were verified at 10 facilities. The verification effort focused on observing showerhead aerators, bathroom faucet aerators, and kitchen faucet aerators installed in multi-family buildings.

The key findings of the verification effort were:

- Showerheads: 88.0% installations observed (44/50)
- Bathroom Sink Faucet Aerators: 34.0% installations observed (17/50)
- Kitchen Sink Faucet Aerators: 54.0% installations observed (27/50)

Overall, it is clear that HWC participants do not just simply order the measures, install them right away, and keep them installed for the life of the model. Some participants never install the measures while others may remove them over time. The installation rate for showerheads is the highest of the 3 measures while the bathroom faucet aerators is relatively low, given its installation and operational challenges.

6.0 APPENDICES –

Appendix A – List of Buildings

Appendix B – Sample Sign-Off Sheet

Appendix C – Second Bathroom Survey

Appendix D – Sign-Off Sheets (Field Data)

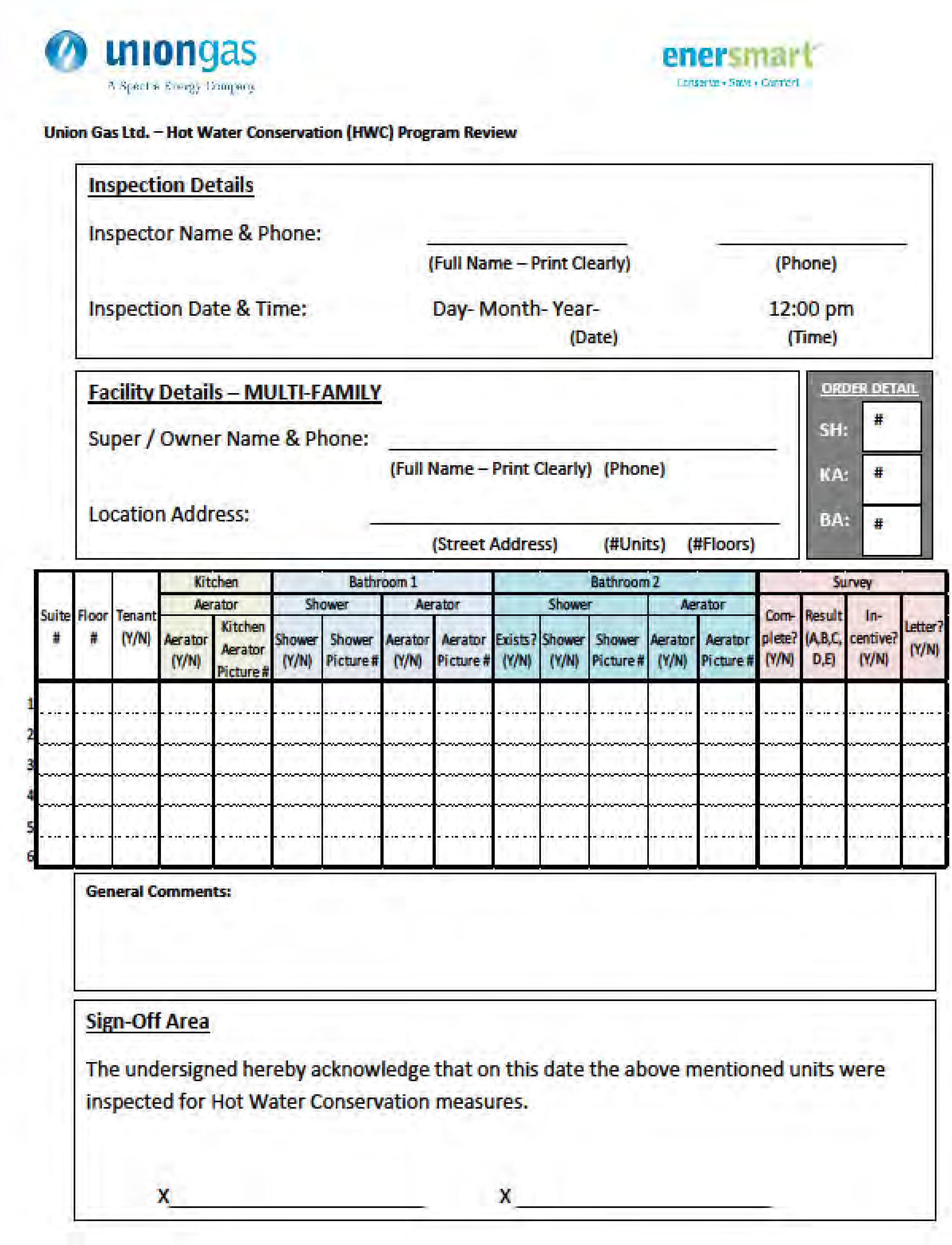
Appendix E – Field Data

Appendix F – Photos of Installed Measures

Appendix A – List of Buildings

#	TOWN	ADDRESS
[redacted]	[redacted]	[redacted]
[redacted]		
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]		
[redacted]	[redacted]	[redacted]
[redacted]		
[redacted]	[redacted]	[redacted]
[redacted]		

Appendix B – Sample Sign-Off Sheet



uniongas
A Spectra Energy Company

enersmart
Conserve • Save • Comfort

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: ____________ ____________
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Day- Month- Year- 12:00 pm
(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & Phone: ____________
(Full Name – Print Clearly) (Phone)

Location Address: ____________
(Street Address) (#Units) (#Floors)

ORDER DETAIL

SH: #
KA: #
BA: #

	Suite #	Floor #	Tenant (Y/N)	Kitchen		Bathroom 1				Bathroom 2					Survey			
				Aerator		Shower		Aerator		Shower			Aerator		Complete? (Y/N)	Result (A,B,C, D,E)	Incentive? (Y/N)	Letter? (Y/N)
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #				
1																		
2																		
3																		
4																		
5																		
6																		

General Comments:

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X ____________ X ____________

Appendix C – Second Bathroom Survey

Page 1 - Front

A Spectra Energy Company

Conserve - Save - Comfort

January YEAR

Dear Valued Union Gas Customer,

We visited your building today as part of Union Gas Ltd.'s ongoing energy savings activities. As a special thank you, a $25 gift certificate, redeemable at Tim Hortons, is available if you call the following phone # and answer our short survey. Please see the survey questions on the back of this page.

Please call:

1-888- 123- 1234

to receive your

$25 Gift Certificate

Confirmation Number: (XY-101)

Please don't wait. We must hear from you before DATE in order to issue you the gift certificate by mail. Please reach us Monday through Friday, 9am- 5pm. Please have your confirmation number ready when you call.

Thank You Kindly,

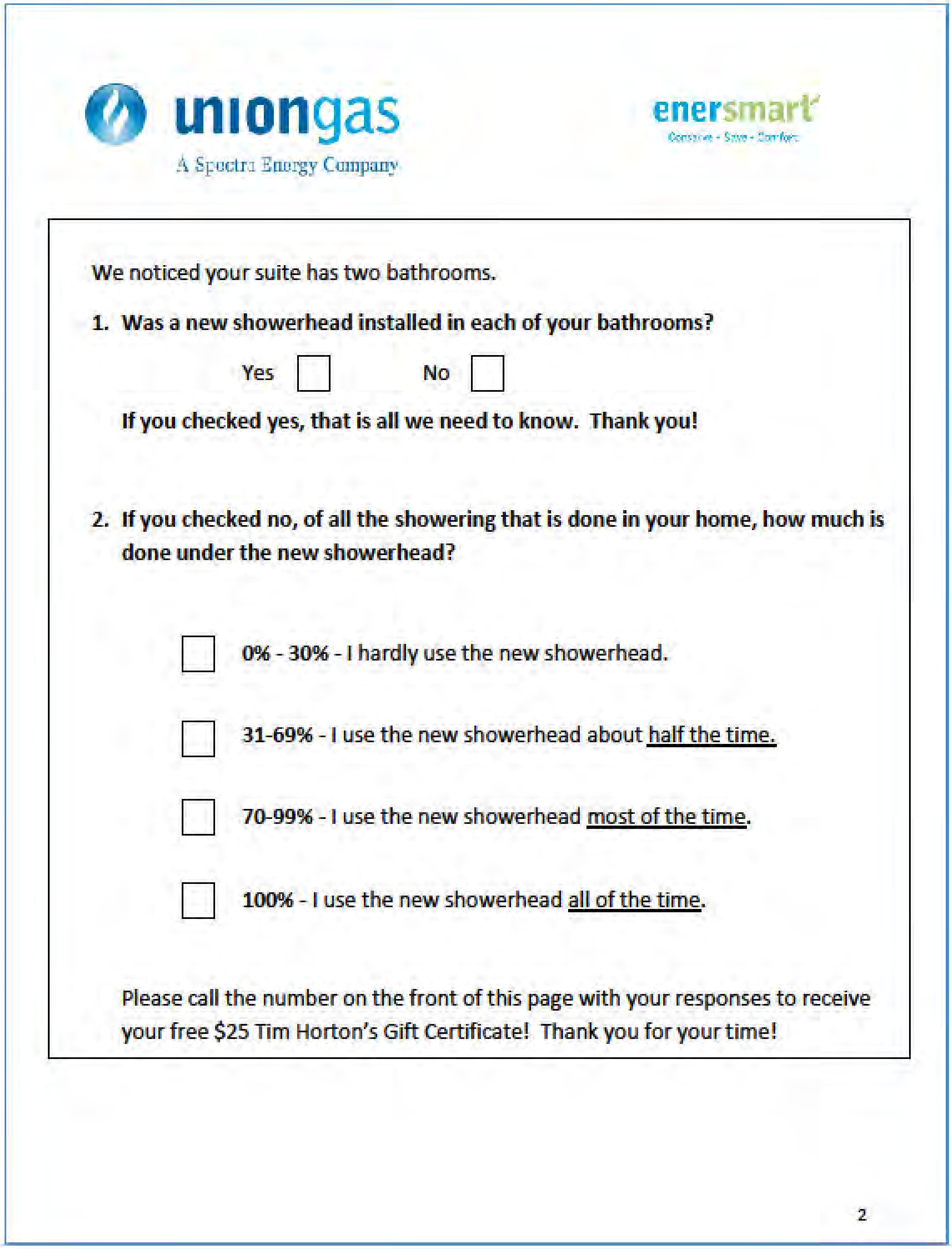
Inspector, SeeLine Group Ltd.

on behalf of

Union Gas Ltd.

1

Page 2 – Back



uniongas
A Spectra Energy Company

enersmart
Conserve · Save · Comfort

We noticed your suite has two bathrooms.

1. **Was a new showerhead installed in each of your bathrooms?**

   Yes ☐ No ☐

   If you checked yes, that is all we need to know. Thank you!

2. **If you checked no, of all the showering that is done in your home, how much is done under the new showerhead?**

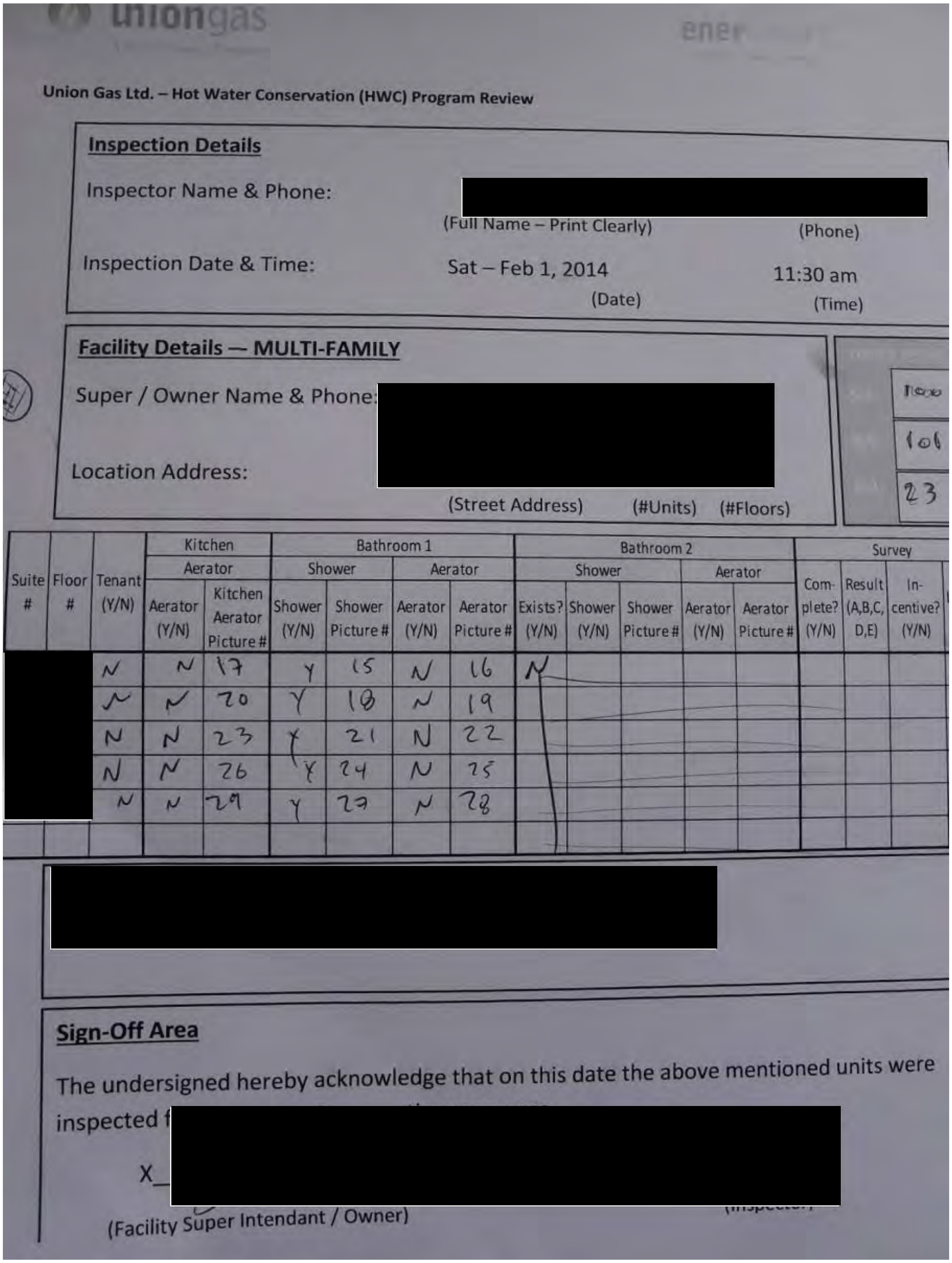
   - ☐ **0% - 30%** - I hardly use the new showerhead.
   - ☐ **31-69%** - I use the new showerhead about half the time.
   - ☐ **70-99%** - I use the new showerhead most of the time.
   - ☐ **100%** - I use the new showerhead all of the time.

Please call the number on the front of this page with your responses to receive your free $25 Tim Horton's Gift Certificate! Thank you for your time!

2

Appendix D – Sign-Off Sheets (Field Data)

[redacted]



unionGas

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Sat – Feb 1, 2014 11:30 am
(Date) (Time)

Facility Details — MULTI-FAMILY

Super / Owner Name & Phone: [redacted]

Location Address:
(Street Address) (#Units) (#Floors)

[illegible]
106
23

Suite #	Floor #	Tenant (Y/N)	Kitchen		Bathroom 1				Bathroom 2					Survey		
			Aerator		Shower		Aerator		Shower			Aerator		Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)
			Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #			
[redacted]	[redacted]	N	N	17	Y	15	N	16	N							
[redacted]	[redacted]	N	N	20	Y	18	N	19								
[redacted]	[redacted]	N	N	23	Y	21	N	22								
[redacted]	[redacted]	N	N	26	Y	24	N	25								
[redacted]	[redacted]	N	N	29	Y	27	N	28								

[redacted]

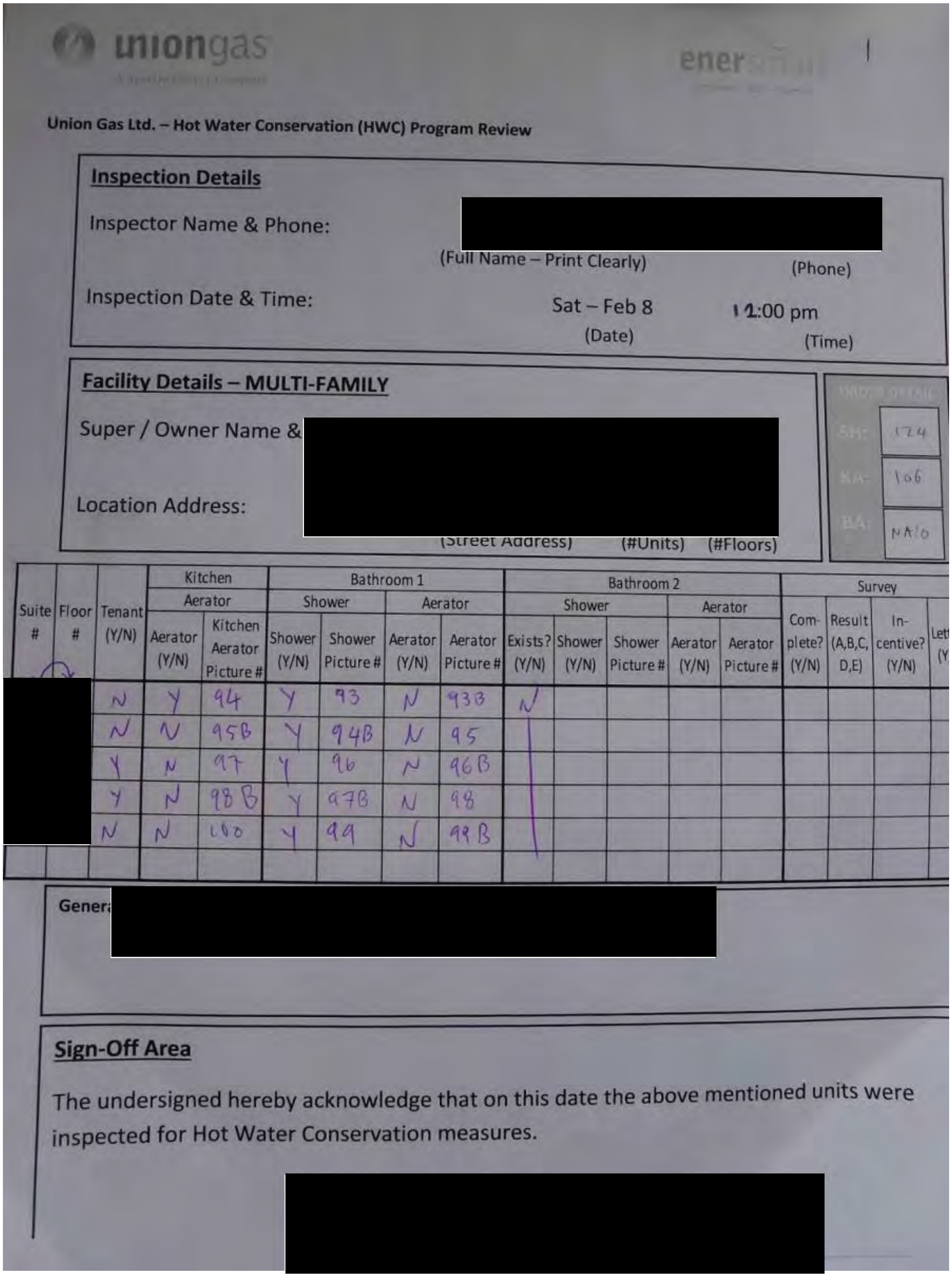
Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected f[redacted]

X[redacted]

(Facility Super Intendant / Owner)

[redacted]



uniongas

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]

(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Sat – Feb 8 12:00 pm

(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & [redacted]

Location Address:

(Street Address) (#Units) (#Floors)

124

106

NA/0

Suite #	Floor #	Tenant (Y/N)	Kitchen		Bathroom 1				Bathroom 2					Survey			
			Aerator		Shower		Aerator		Shower			Aerator					
			Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Complete? (Y/N)	Result (A,B,C, D,E)	Incentive? (Y/N)	Let (Y
[redacted]	[redacted]	N	Y	94	Y	93	N	93B	N								
[redacted]	[redacted]	N	N	95B	Y	94B	N	95									
[redacted]	[redacted]	Y	N	97	Y	96	N	96B									
[redacted]	[redacted]	Y	N	98B	Y	97B	N	98									
[redacted]	[redacted]	N	N	100	Y	99	N	99B									

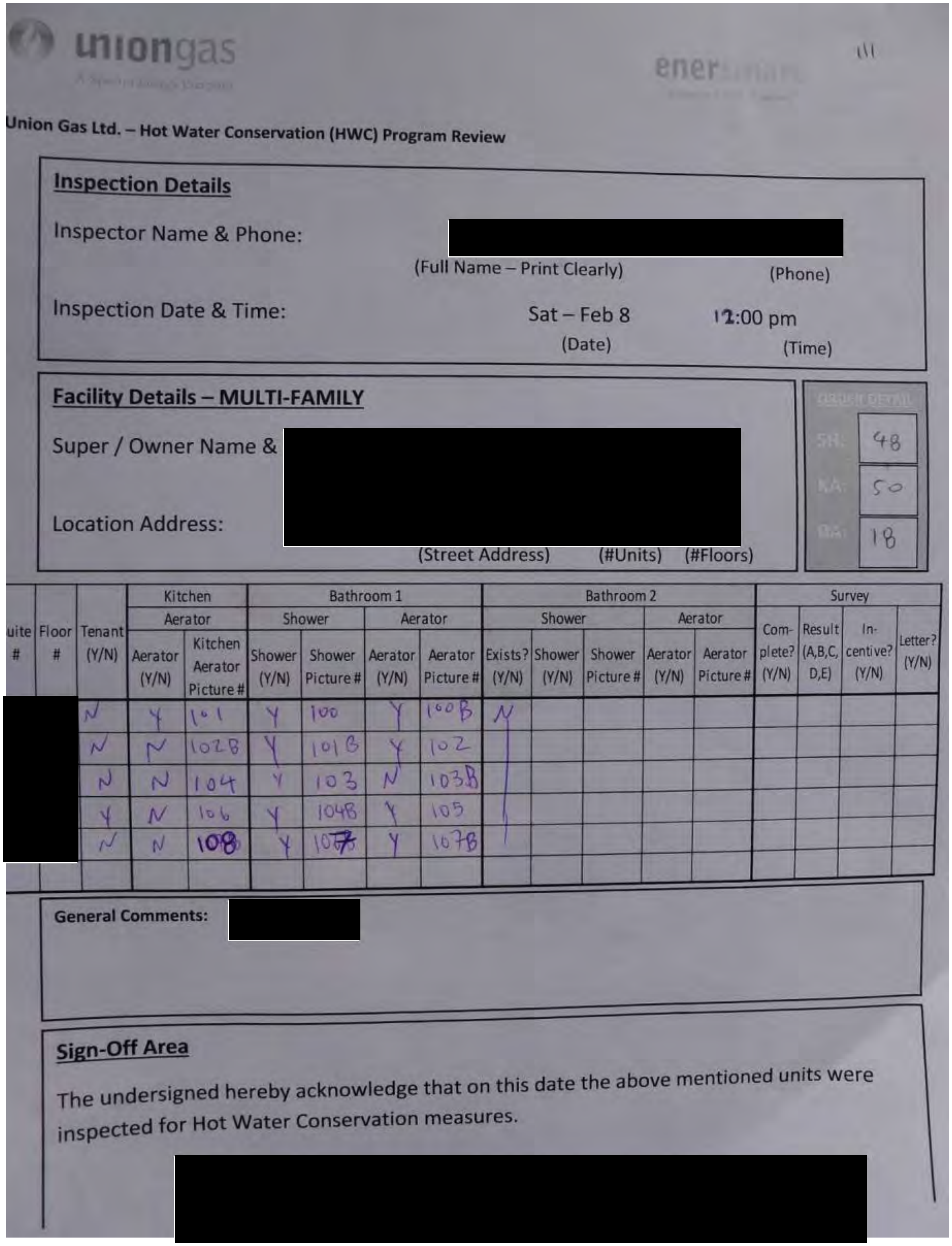
Genera [redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

[redacted]



uniongas

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Sat – Feb 8 12:00 pm
(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & [redacted]

Location Address:
(Street Address) (#Units) (#Floors)

ORDER DETAIL
SH: 48
KA: 50
BA: 18

Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2					Survey			
			Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Complete? (Y/N)	Result (A,B,C, D,E)	Incentive? (Y/N)	Letter? (Y/N)
[redacted]	[redacted]	N	Y	101	Y	100	Y	100B	N								
[redacted]	[redacted]	N	N	102B	Y	101B	Y	102									
[redacted]	[redacted]	N	N	104	Y	103	N	103B									
[redacted]	[redacted]	Y	N	106	Y	104B	Y	105									
[redacted]	[redacted]	N	N	108	Y	107	Y	107B									

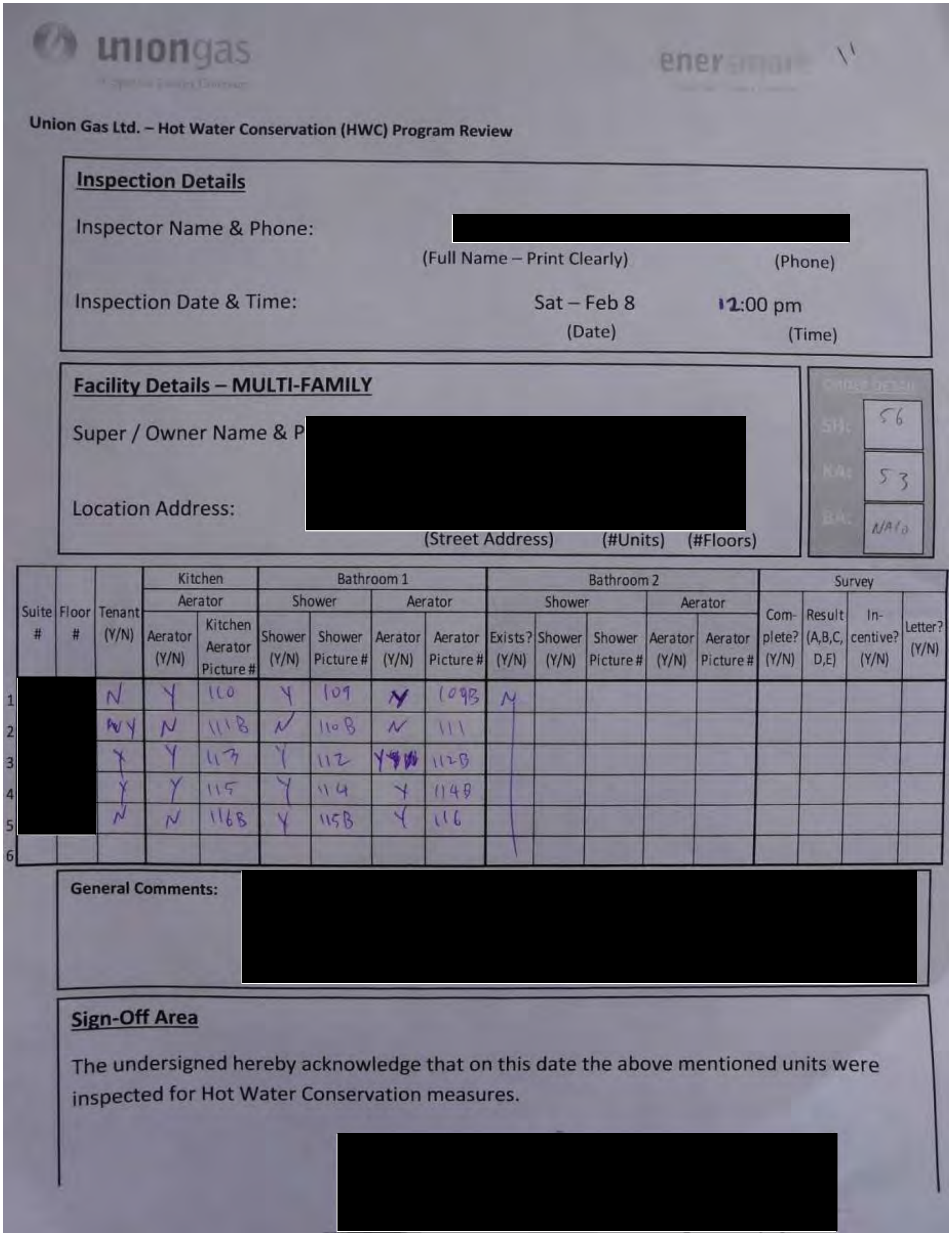
General Comments: [redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

[redacted]



Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Sat – Feb 8 12:00 pm
(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & P [redacted]

Location Address:
(Street Address) (#Units) (#Floors)

SH: 56
KA: 53
BA: NA/0

			Kitchen		Bathroom 1				Bathroom 2					Survey			
			Aerator		Shower		Aerator		Shower			Aerator					
Suite #	Floor #	Tenant (Y/N)	Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
1 [redacted]	[redacted]	N	Y	110	Y	109	Y	109B	N								
2 [redacted]	[redacted]	~~N~~ Y	N	111B	N	110B	N	111									
3 [redacted]	[redacted]	Y	Y	113	Y	112	Y	112B									
4 [redacted]	[redacted]	Y	Y	115	Y	114	Y	114B									
5 [redacted]	[redacted]	N	N	116B	Y	115B	Y	116									
6																	

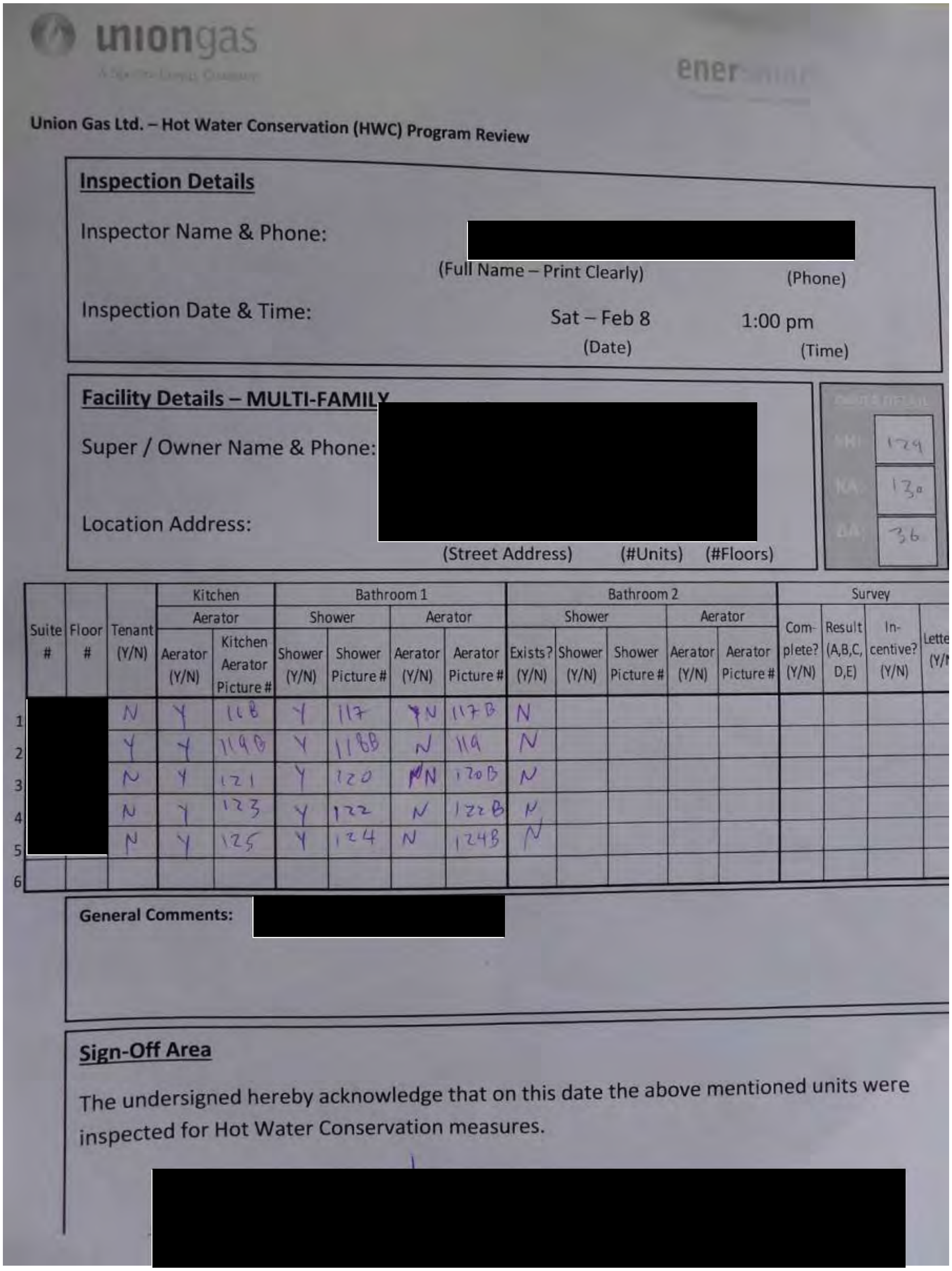
General Comments: [redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

[redacted]



Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Sat – Feb 8 (Date) 1:00 pm (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & Phone: [redacted]

Location Address: (Street Address) (#Units) (#Floors)

SHI: 129
KA: 130
BA: 36

				Kitchen		Bathroom 1				Bathroom 2					Survey			
				Aerator		Shower		Aerator		Shower			Aerator					
	Suite #	Floor #	Tenant (Y/N)	Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Lette (Y/
1	[redacted]	[redacted]	N	Y	118	Y	117	~~Y~~N	117B	N								
2	[redacted]	[redacted]	Y	Y	119B	Y	118B	N	119	N								
3	[redacted]	[redacted]	N	Y	121	Y	120	N	120B	N								
4	[redacted]	[redacted]	N	Y	123	Y	122	N	122B	N								
5	[redacted]	[redacted]	N	Y	125	Y	124	N	124B	N								
6																		

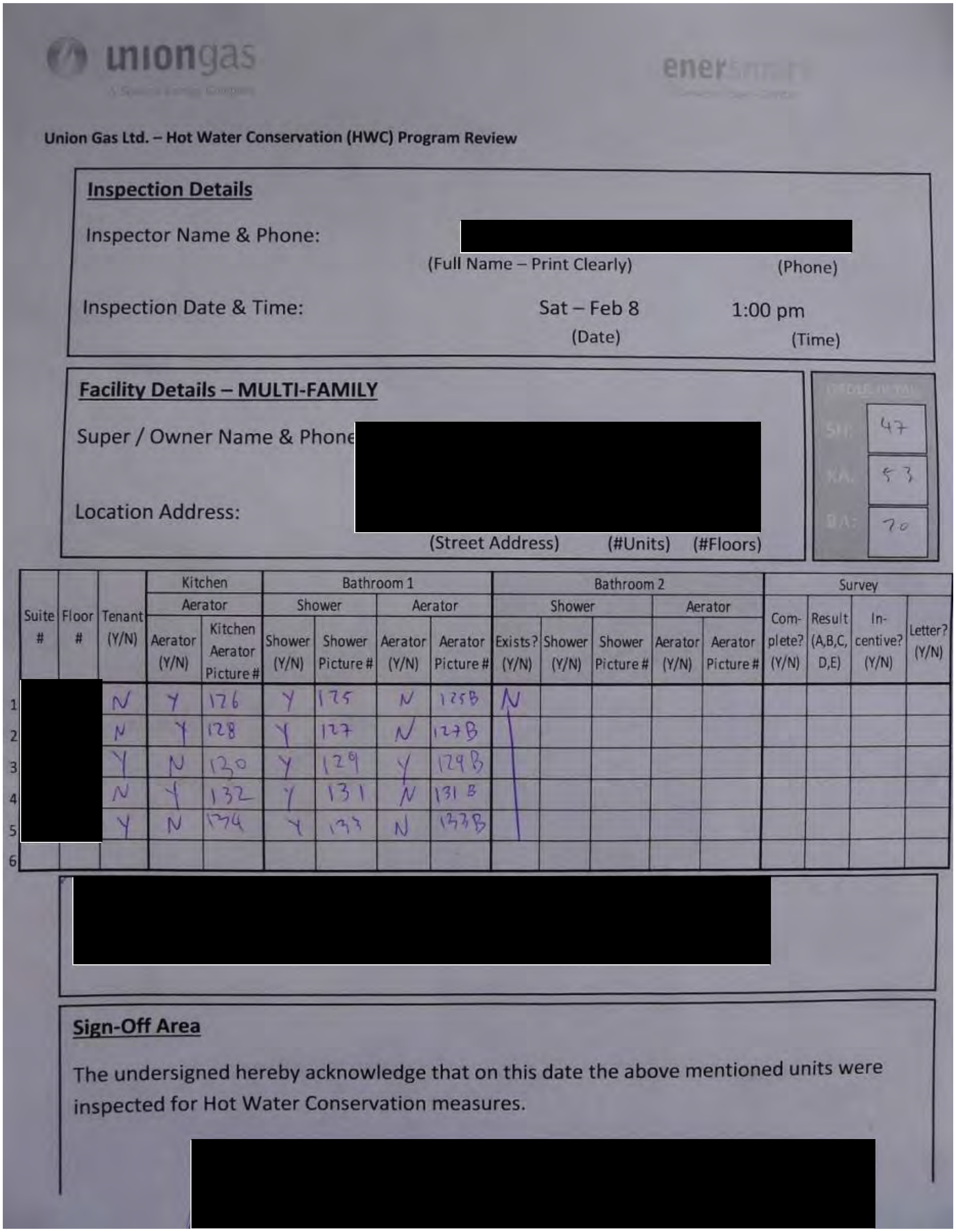
General Comments: [redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

[redacted]



uniongas

enersmart

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Sat – Feb 8 (Date) 1:00 pm (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & Phone [redacted]

Location Address:
(Street Address) (#Units) (#Floors)

SH: 47
KA: 53
BA: 70

				Kitchen		Bathroom 1				Bathroom 2					Survey			
				Aerator		Shower		Aerator		Shower			Aerator					
	Suite #	Floor #	Tenant (Y/N)	Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
1	[redacted]	[redacted]	N	Y	176	Y	175	N	125B	N								
2	[redacted]	[redacted]	N	Y	128	Y	127	N	127B									
3	[redacted]	[redacted]	Y	N	130	Y	129	Y	129B									
4	[redacted]	[redacted]	N	Y	132	Y	131	N	131 B									
5	[redacted]	[redacted]	Y	N	134	Y	133	N	133B									
6																		

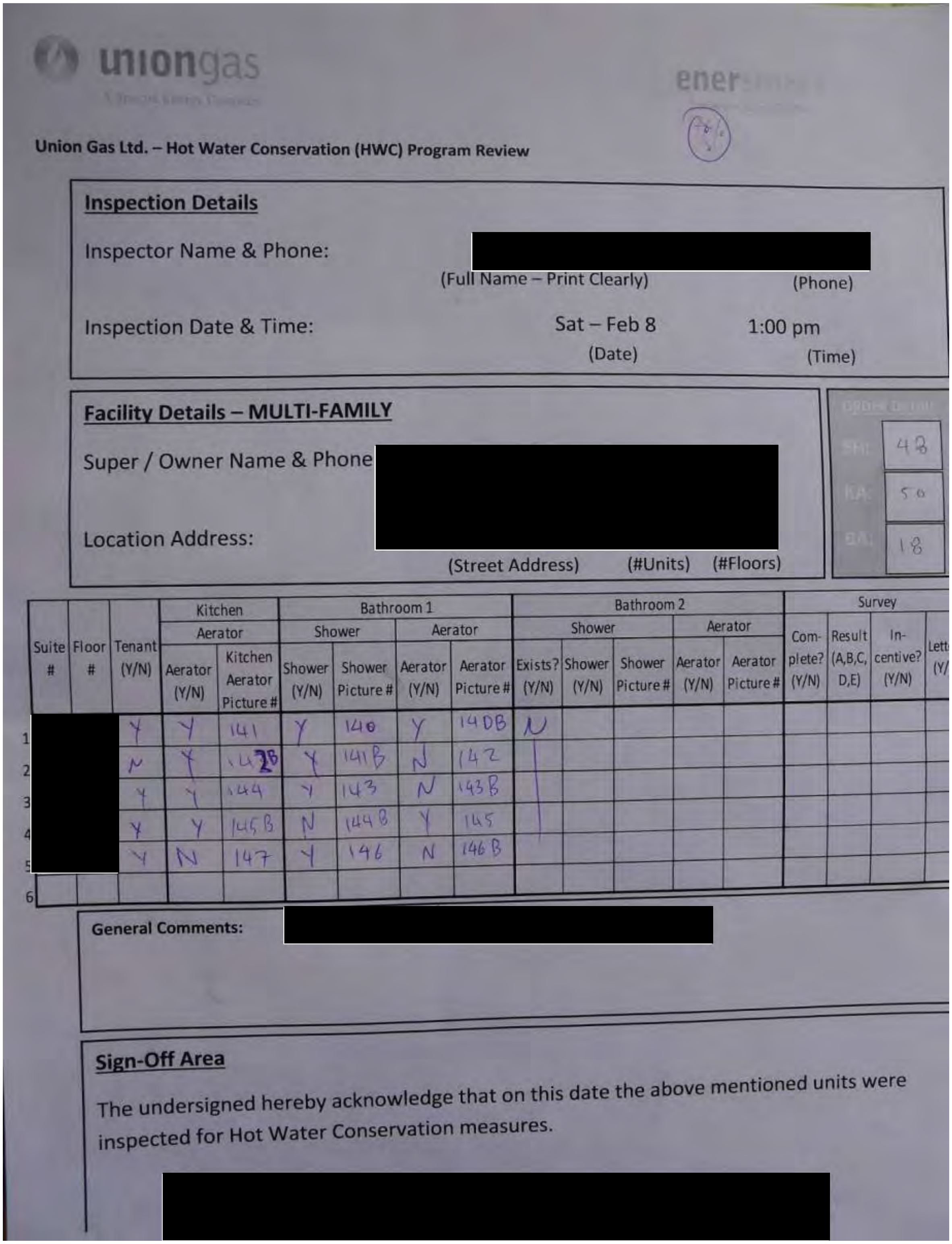
[redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

[redacted]



uniongas

ener

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Sat – Feb 8 1:00 pm
(Date) (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & Phone [redacted]

Location Address:
(Street Address) (#Units) (#Floors)

SH: 43
KA: 50
BA: 18

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1 Shower		Bathroom 1 Aerator		Bathroom 2	Bathroom 2 Shower		Bathroom 2 Aerator		Survey			
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Lett (Y/
1	[redacted]	[redacted]	Y	Y	141	Y	140	Y	140B	N								
2	[redacted]	[redacted]	N	Y	142B	Y	141B	N	142									
3	[redacted]	[redacted]	Y	Y	144	Y	143	N	143B									
4	[redacted]	[redacted]	Y	Y	145B	N	144B	Y	145									
5	[redacted]	[redacted]	Y	N	147	Y	146	N	146B									
6																		

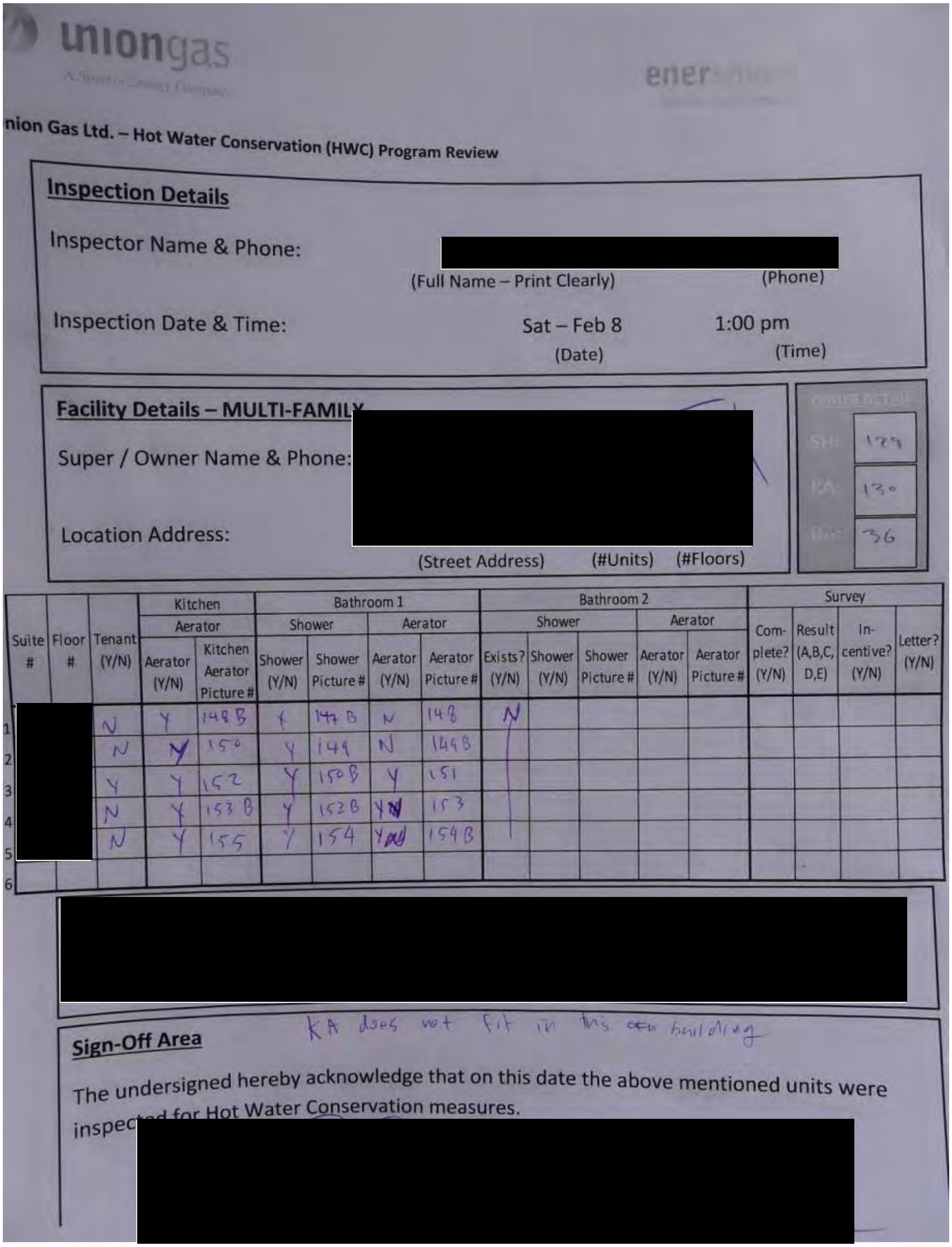
General Comments: [redacted]

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

[redacted]



uniongas

enerShare

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Sat – Feb 8 (Date) 1:00 pm (Time)

Facility Details – MULTI-FAMILY

Super / Owner Name & Phone: [redacted]

Location Address: (Street Address) (#Units) (#Floors)

ORDER DETAIL
SH: 129
KA: 130
BA: 36

	Suite #	Floor #	Tenant (Y/N)	Kitchen Aerator		Bathroom 1				Bathroom 2					Survey			
				Aerator (Y/N)	Kitchen Aerator Picture #	Shower		Aerator		Shower			Aerator		Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter? (Y/N)
						Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #				
1	[redacted]	[redacted]	N	Y	148 B	Y	147 B	N	148	N								
2	[redacted]	[redacted]	N	Y	150	Y	149	N	149 B									
3	[redacted]	[redacted]	Y	Y	152	Y	150 B	Y	151									
4	[redacted]	[redacted]	N	Y	153 B	Y	152 B	Y~~N~~	153									
5	[redacted]	[redacted]	N	Y	155	Y	154	Y	154 B									
6																		

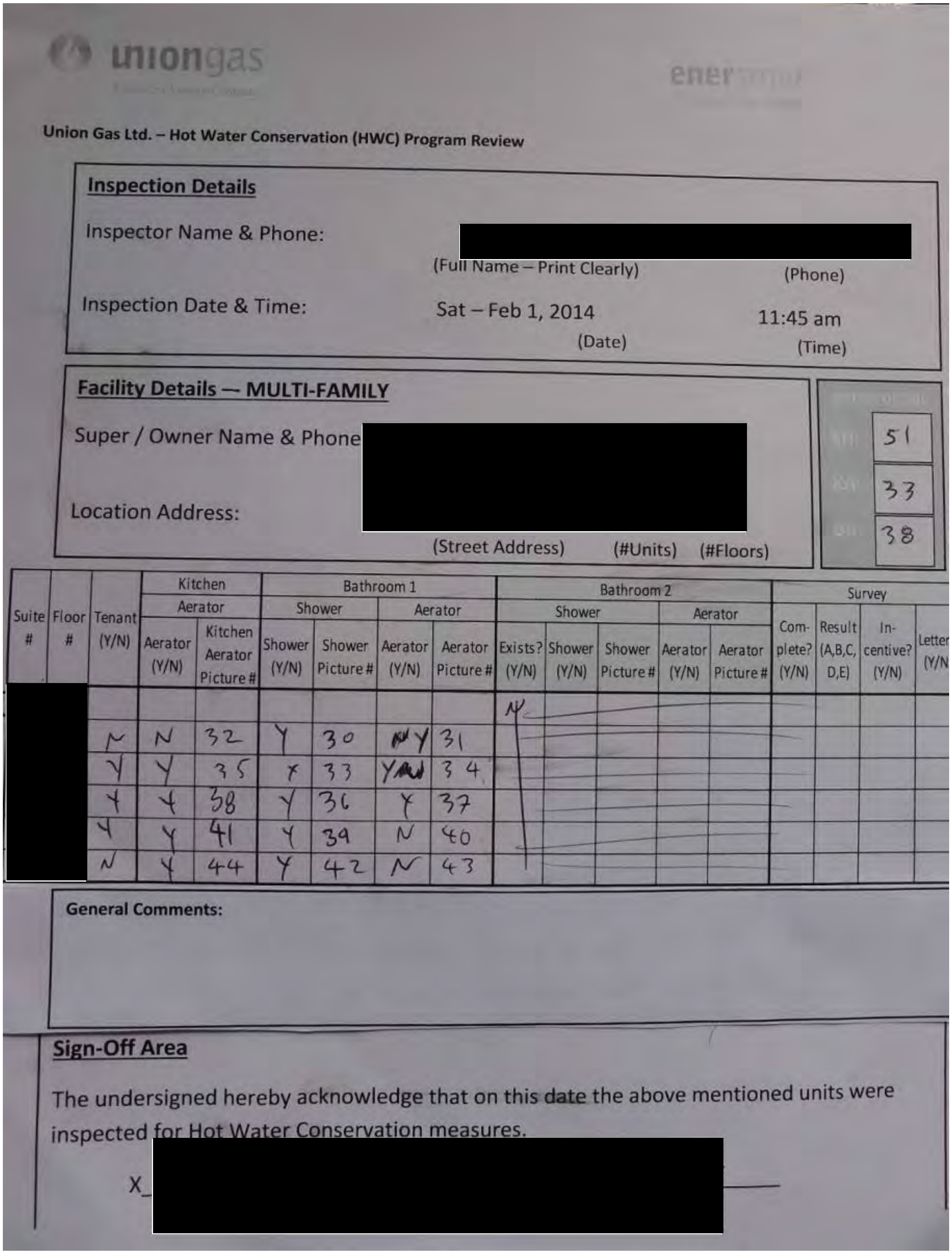
[redacted]

Sign-Off Area KA does not fit in this ~~can~~ building

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

[redacted]



unionGas

Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Sat – Feb 1, 2014 (Date) 11:45 am (Time)

Facility Details — MULTI-FAMILY

Super / Owner Name & Phone [redacted]

Location Address:
(Street Address) (#Units) (#Floors)

51

33

38

Suite #	Floor #	Tenant (Y/N)	Kitchen		Bathroom 1				Bathroom 2					Survey			
			Aerator		Shower		Aerator			Shower		Aerator					
			Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter (Y/N
[redacted]	[redacted]								N								
[redacted]	[redacted]	N	N	32	Y	30	Y	31									
[redacted]	[redacted]	Y	Y	35	x	33	Y	34									
[redacted]	[redacted]	Y	Y	38	Y	36	Y	37									
[redacted]	[redacted]	Y	Y	41	Y	39	N	40									
[redacted]	[redacted]	N	Y	44	Y	42	N	43									

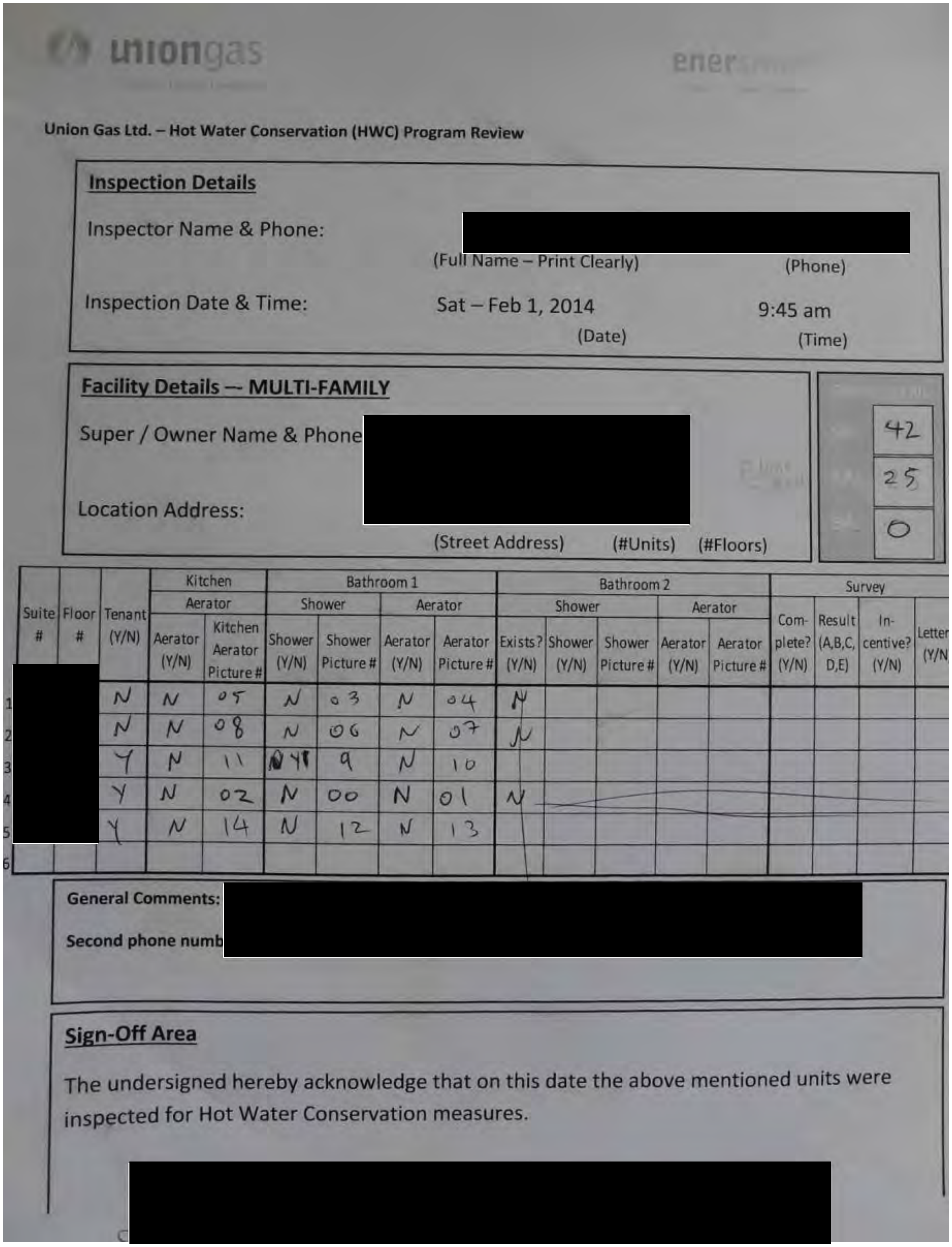
General Comments:

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

X [redacted]

[redacted]



Union Gas Ltd. – Hot Water Conservation (HWC) Program Review

Inspection Details

Inspector Name & Phone: [redacted]
(Full Name – Print Clearly) (Phone)

Inspection Date & Time: Sat – Feb 1, 2014 (Date) 9:45 am (Time)

Facility Details — MULTI-FAMILY

Super / Owner Name & Phone [redacted]

Location Address:
(Street Address) (#Units) (#Floors)

42
25
0

				Kitchen		Bathroom 1				Bathroom 2					Survey			
				Aerator		Shower		Aerator		Shower			Aerator					
	Suite #	Floor #	Tenant (Y/N)	Aerator (Y/N)	Kitchen Aerator Picture #	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Exists? (Y/N)	Shower (Y/N)	Shower Picture #	Aerator (Y/N)	Aerator Picture #	Com-plete? (Y/N)	Result (A,B,C, D,E)	In-centive? (Y/N)	Letter (Y/N
1	[redacted]	[redacted]	N	N	05	N	03	N	04	N								
2	[redacted]	[redacted]	N	N	08	N	06	N	07	N								
3	[redacted]	[redacted]	Y	N	11	Y	9	N	10									
4	[redacted]	[redacted]	Y	N	02	N	00	N	01	N								
5	[redacted]	[redacted]	Y	N	14	N	12	N	13									
6																		

General Comments: [redacted]

Second phone numb

Sign-Off Area

The undersigned hereby acknowledge that on this date the above mentioned units were inspected for Hot Water Conservation measures.

[redacted]

Appendix E – Field Data

Building Address		Unit	Kitchen Aerator (Y/N)	Kitchen Aerator Picture	Shower (Y/N)	Shower Picture	Bathroom Aerator (Y/N)	Bathroom Aerator Picture
[redacted]	[redacted] [redacted]	[redacted]	N	17	Y	15	N	16
		[redacted]	N	20	Y	18	N	19
		[redacted]	N	23	Y	21	N	22
		[redacted]	N	26	Y	24	N	25
		[redacted]	N	29	Y	27	N	28
[redacted]	[redacted] [redacted]	[redacted]	Y	116	Y	117	N	117-B
		[redacted]	Y	119-B	Y	118-B	N	119
		[redacted]	Y	121	Y	120	N	120-B
		[redacted]	Y	123	Y	122	N	122-B
		[redacted]	Y	125	Y	124	N	124-B
[redacted]	[redacted] [redacted]	[redacted]	Y	94	Y	93	N	93-B
		[redacted]	N	95-B	Y	94-B	N	95
		[redacted]	N	97	Y	96	N	96-B
		[redacted]	Y	98-B	Y	97-B	N	98
		[redacted]	N	100	Y	99	N	99-B
[redacted]	[redacted] [redacted]	[redacted]	Y	126	Y	125	N	125-B
		[redacted]	Y	128	Y	127	N	127-B
		[redacted]	N	120	Y	124	Y	129-B
		[redacted]	Y	132	Y	131	N	131-B
		[redacted]	N	134	Y	133	N	133-B
[redacted]	[redacted] [redacted]	[redacted]	Y	101	Y	100	Y	100-B
		[redacted]	N	102-B	Y	101-B	Y	102
		[redacted]	N	104	Y	103	N	103-B
		[redacted]	N	106	Y	104-B	Y	105
		[redacted]	N	108	Y	107	Y	107-B
[redacted]	[redacted] [redacted]	[redacted]	Y	141	Y	140	Y	140-B
		[redacted]	Y	142-B	Y	141-B	N	142
		[redacted]	Y	149	Y	143	N	143-B
		[redacted]	Y	145-B	N	144-B	Y	145
		[redacted]	N	147	Y	146	N	146-B
[redacted]	[redacted] [redacted]	[redacted]	Y	110	Y	109	Y	109-B
		[redacted]	N	111-B	N	110-B	N	111
		[redacted]	Y	113	Y	112	Y	112-B
		[redacted]	Y	115	Y	114	Y	114-B
		[redacted]	N	116-B	Y	115-B	Y	116
[redacted]	[redacted] [redacted]	[redacted]	Y	148-B	Y	147-B	N	148
		[redacted]	Y	150	Y	149	N	149-B
		[redacted]	Y	152	Y	150-B	Y	151
		[redacted]	Y	153-B	Y	152-B	Y	153
		[redacted]	Y	155	Y	154	Y	154-B
[redacted]	[redacted] [redacted]	[redacted]	N	32	Y	30	Y	31
		[redacted]	Y	35	Y	33	Y	34
		[redacted]	Y	38	Y	36	Y	37
		[redacted]	Y	41	Y	39	N	40
		[redacted]	Y	44	Y	42	N	43
[redacted]	[redacted] [redacted]	[redacted]	N	5	N	3	N	4
		[redacted]	N	8	N	6	N	7
		[redacted]	N	11	Y	9	N	10
		[redacted]	N	2	N	0	N	1
		[redacted]	N	14	N	12	N	13

Appendix F – Photos of Installed Measures

MK-
00

MK-1

MK-2

MK-3

MK-4

MK-5

MK-6

MK-7

MK-8

MK-9

MK-10

MK-11

MK-
12

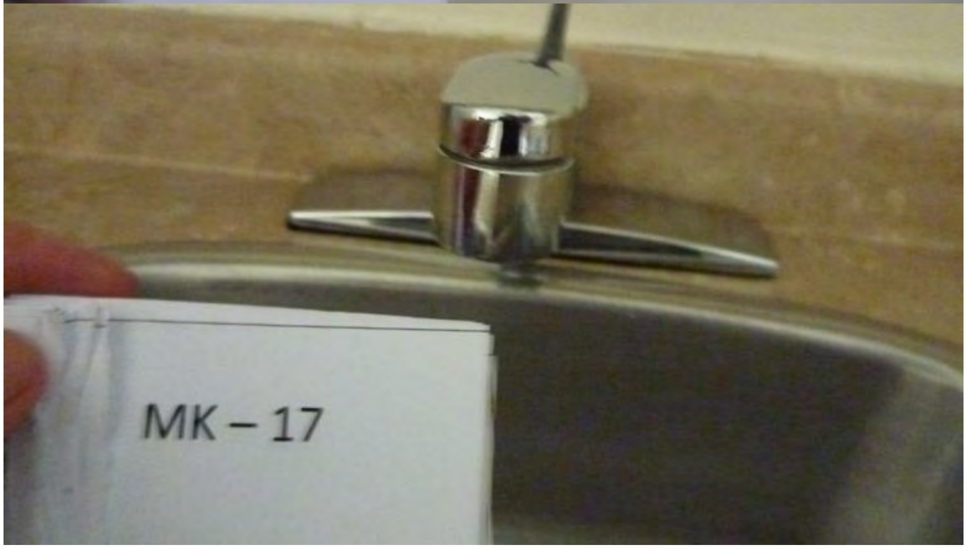
MK-
13

MK-
14

MK-
15

MK-
16

MK-
17



MK-
18

MK-
19

MK-
20

MK-
21

MK-
22

MK-
23

MK-
24

MK-
25

MK-
26

MK-
27

MK-
28

MK-
29

MK-
30

MK-
31

MK-
32

MK-
33

MK-
34

MK-
35

MK-36

MK-37

MK-38

MK-
39

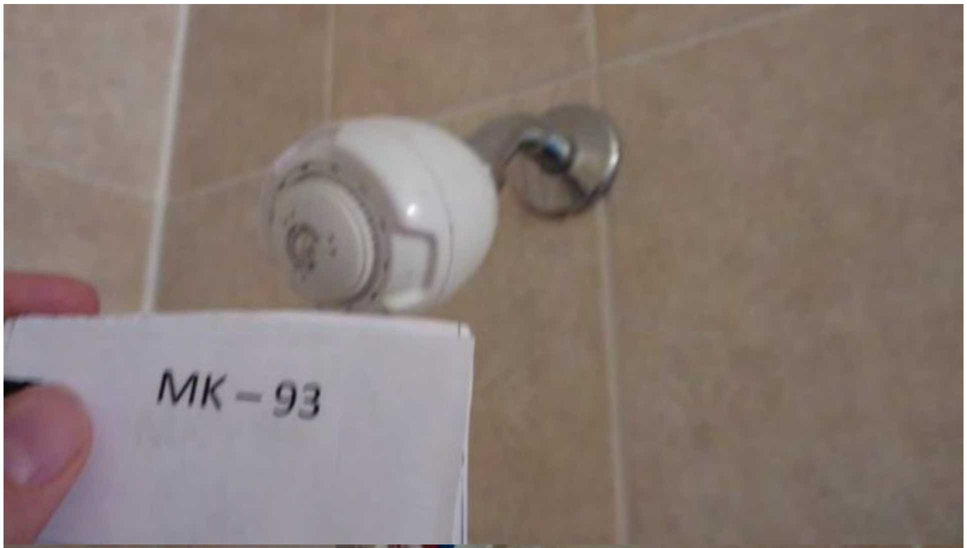
MK-
40

MK-
41

MK-
42

MK-
43

MK-
44



MK-93

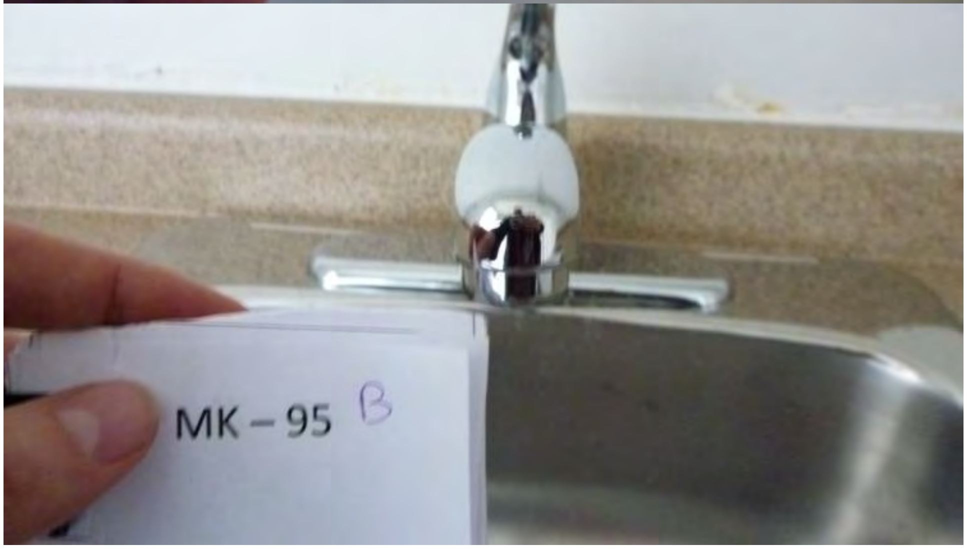
MK-93-B

MK-94

MK-
94-B

MK-
95

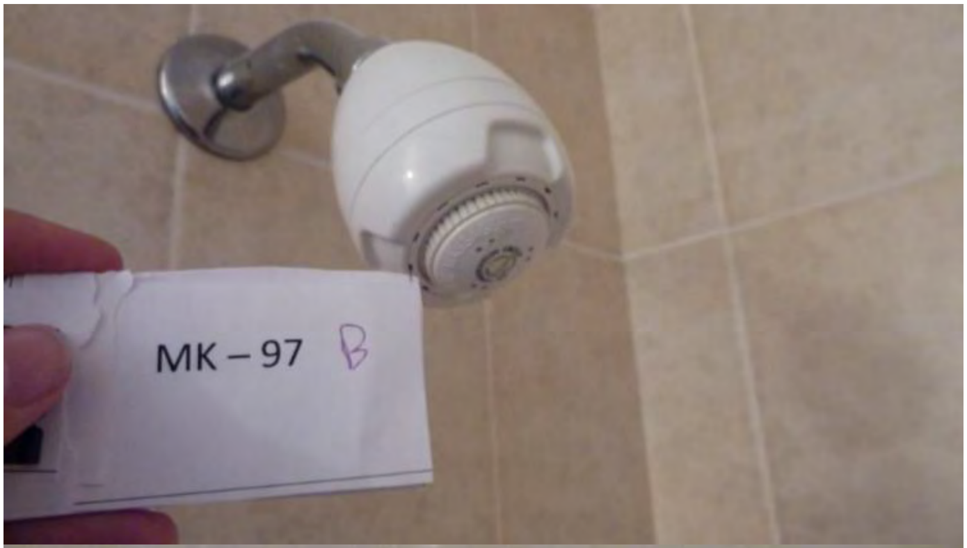
MK-
95-B



MK-96

MK-96-B

MK-97



MK-
97-B

MK-
98

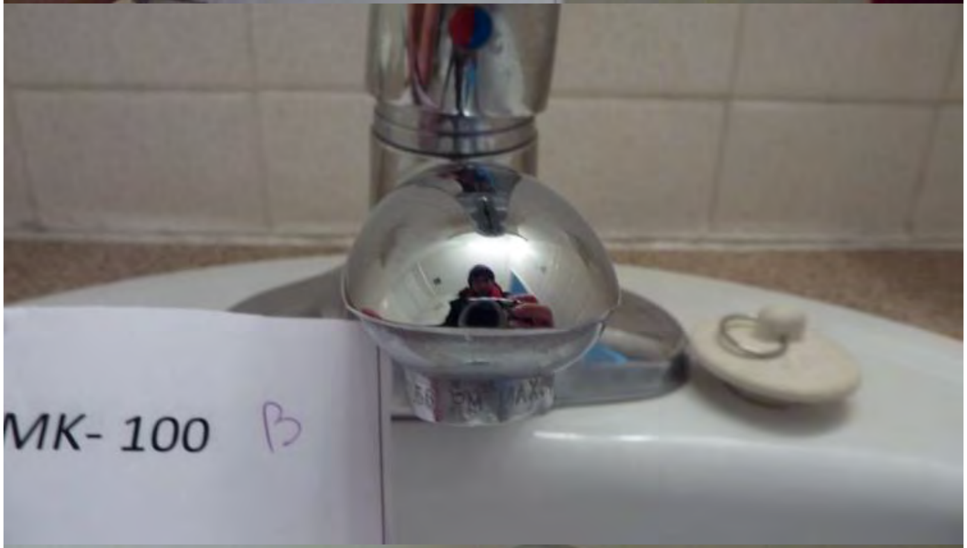
MK-
98-B

MK-
99

MK-
99-B

MK-
100(1)

MK-
100



MK-
100-B

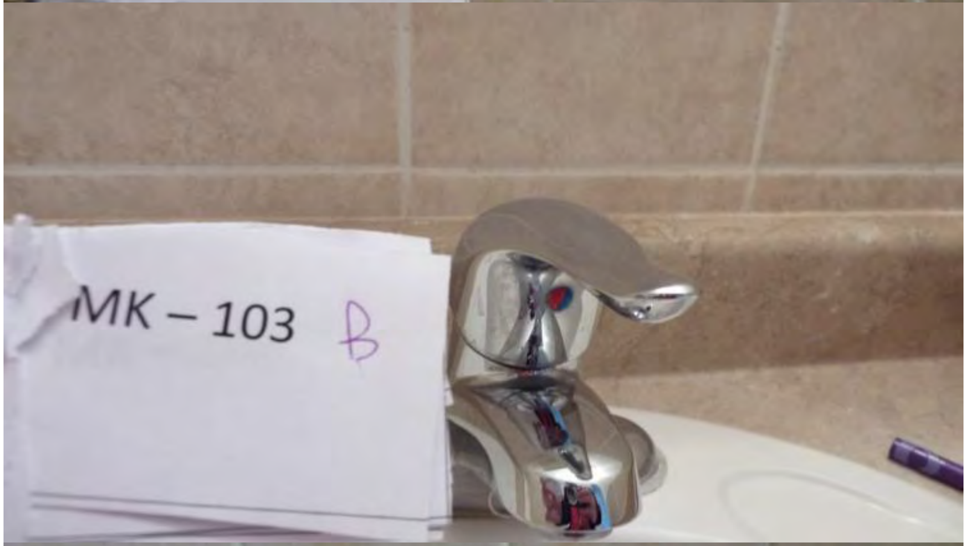
MK-
101

MK-
101-B

MK-
102

MK-
102-B

MK-
103

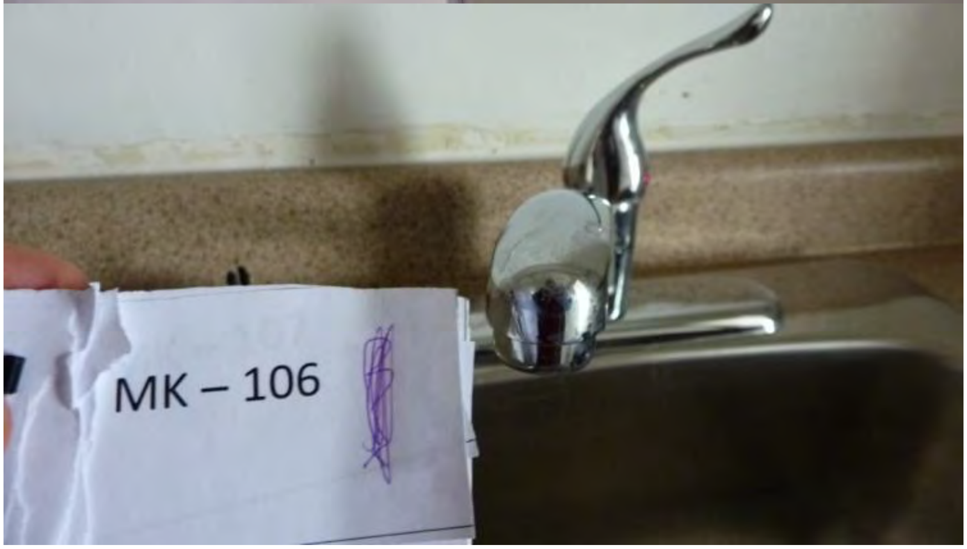


MK-
103-B

MK-
104

MK-
104-B

MK-
105



MK-
106

MK-107

MK-107B

MK-108

MK-
109

MK-
109-B

MK-
110

MK-110-B

MK-111

MK-111B

MK-
112

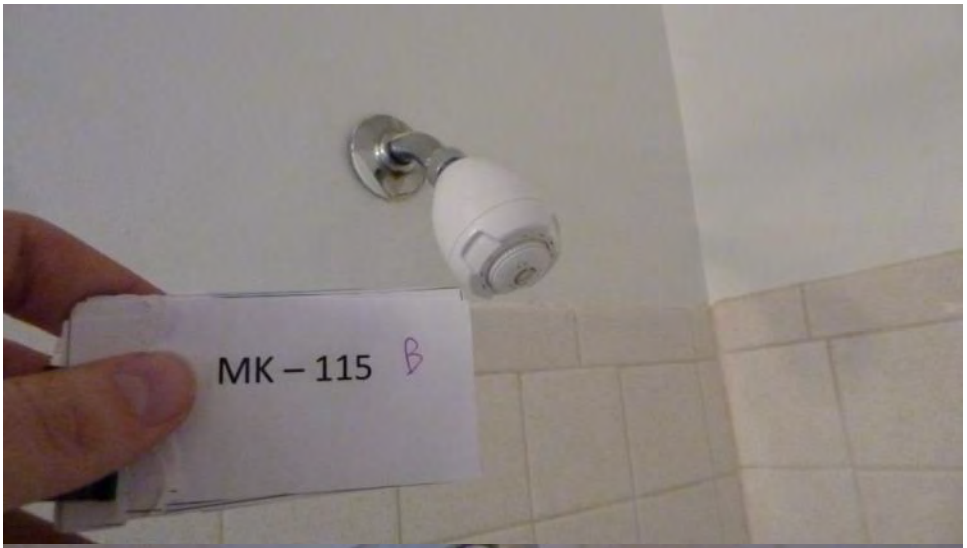
MK-
112-B

MK-
113

MK-
114

MK-
114-B

MK-
115



MK-115-B

MK-116

MK-116B

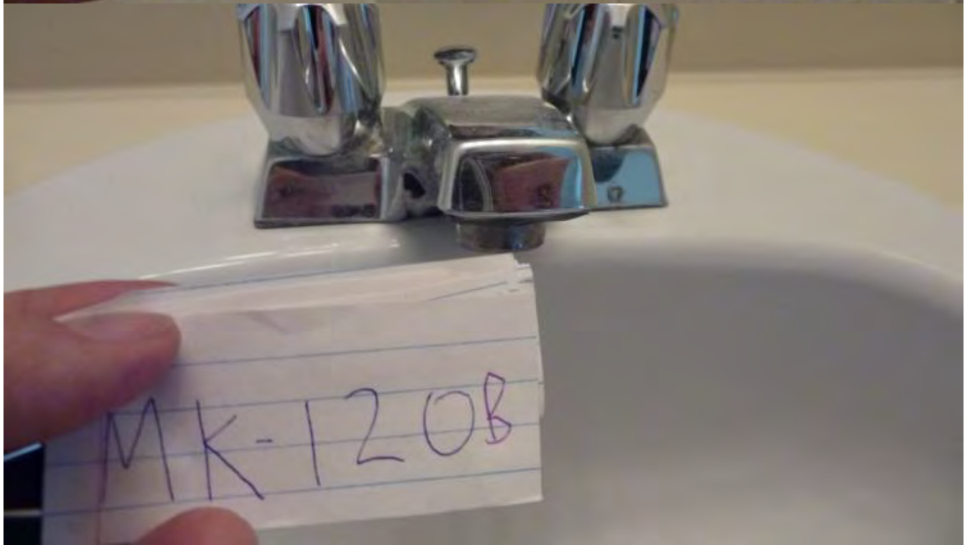
MK-
117

MK-
117-B

MK-
119

MK-119-B

MK-120

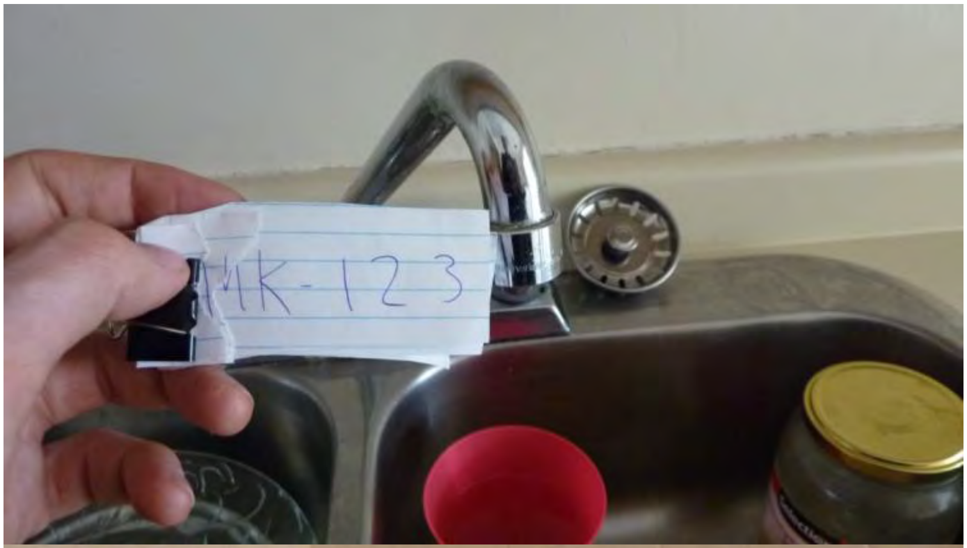


MK-120-B

MK-
121

MK-
122

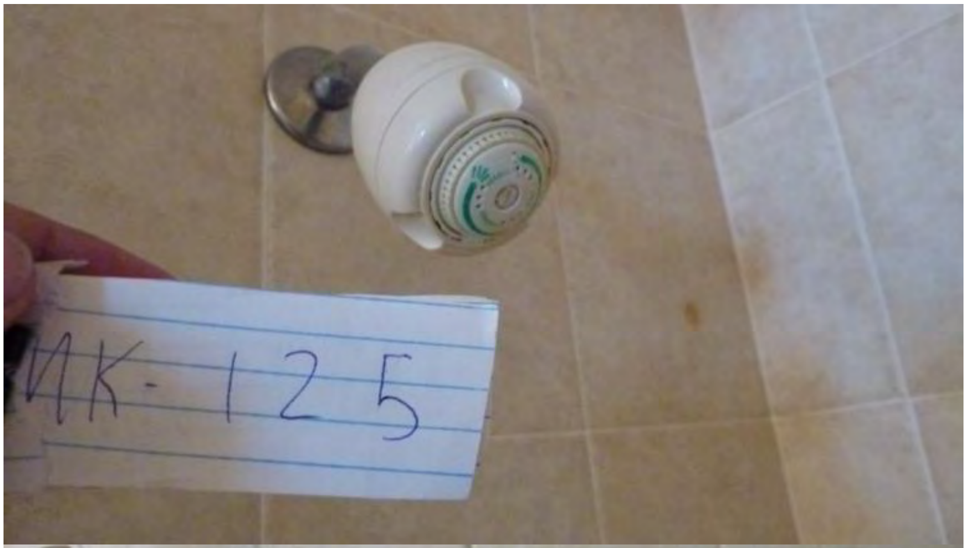
MK-
122B



MK-
123

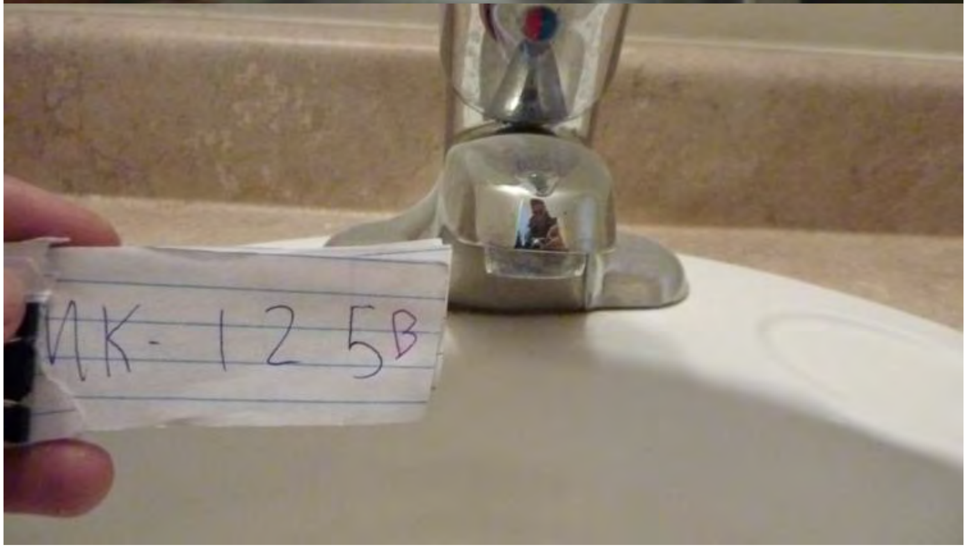
MK-
124

MK-
124-B



MK-
125

MK-
125



MK-
125-B

MK-
126

MK-
127

MK-
127-B

MK-
128

MK-
129

MK-
129-B

MK-
131

MK-
131-B

MK-
132

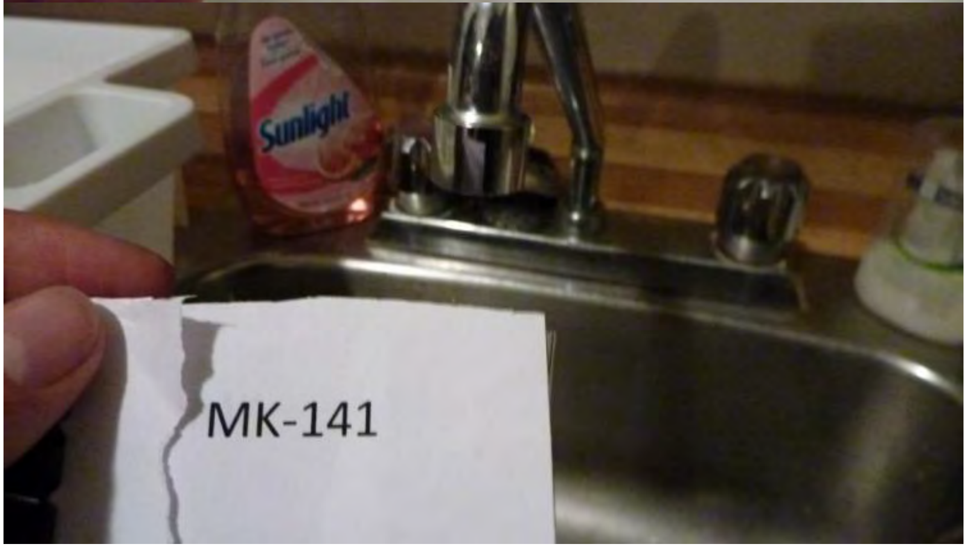
MK-
133

MK-
133-B

MK-
134

MK-
140

MK-
140-B



MK-
141

MK-
141-B

MK-
142

MK-
142-B

MK-
143

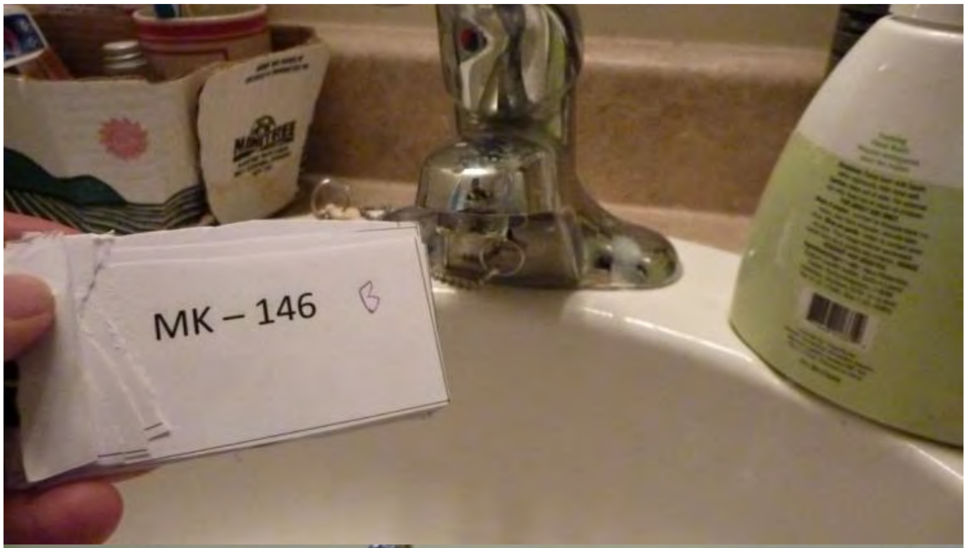
MK-
143-B

MK-
144-B

MK-
145

MK-
145-B

MK-
146

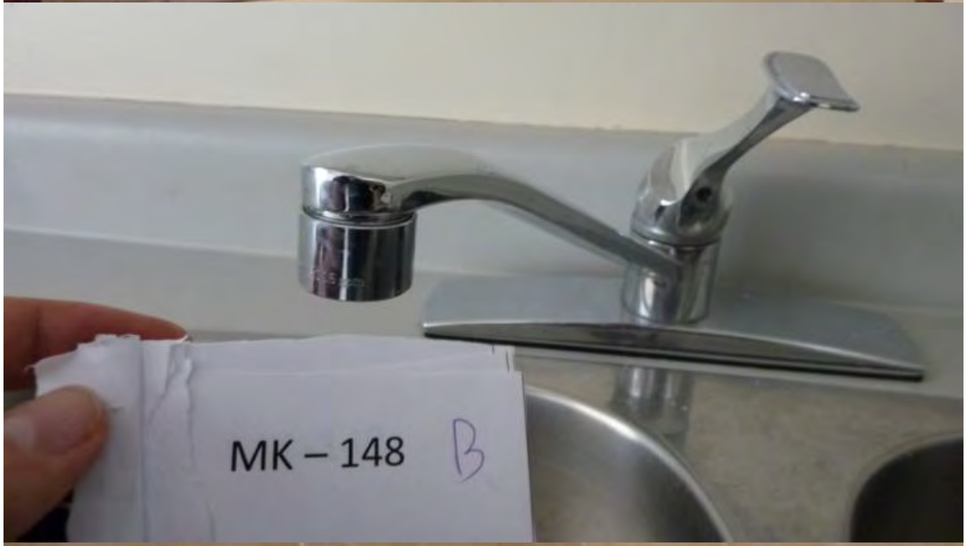


MK-146-B

MK-147

MK-147-B

MK-
148



MK-
148-B

MK-
149

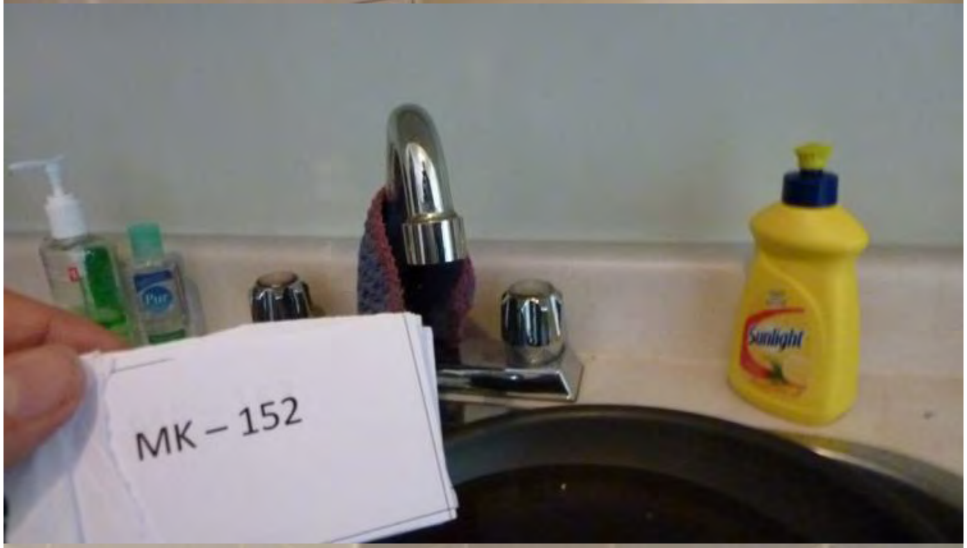
MK-
149-B

MK-
150

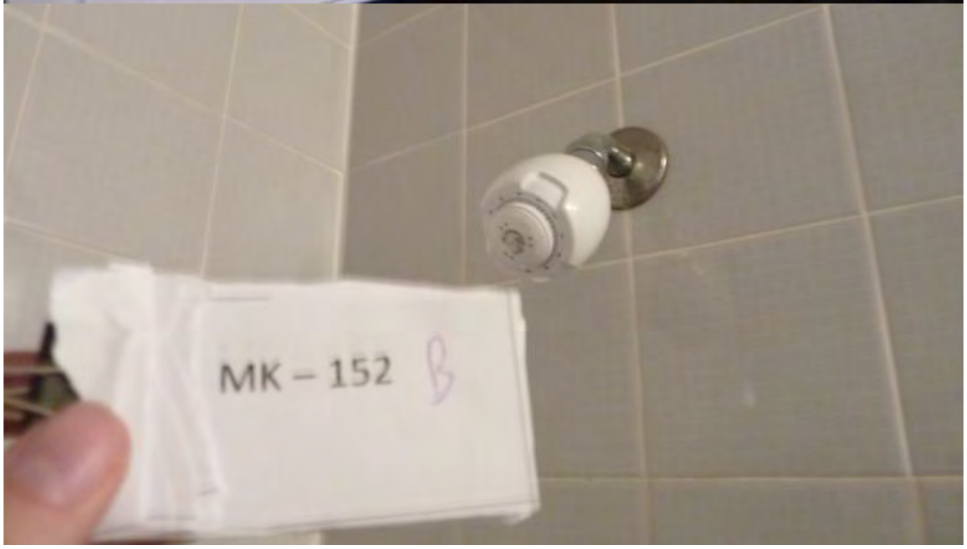
MK-
150-B

MK-
151

MK-
152

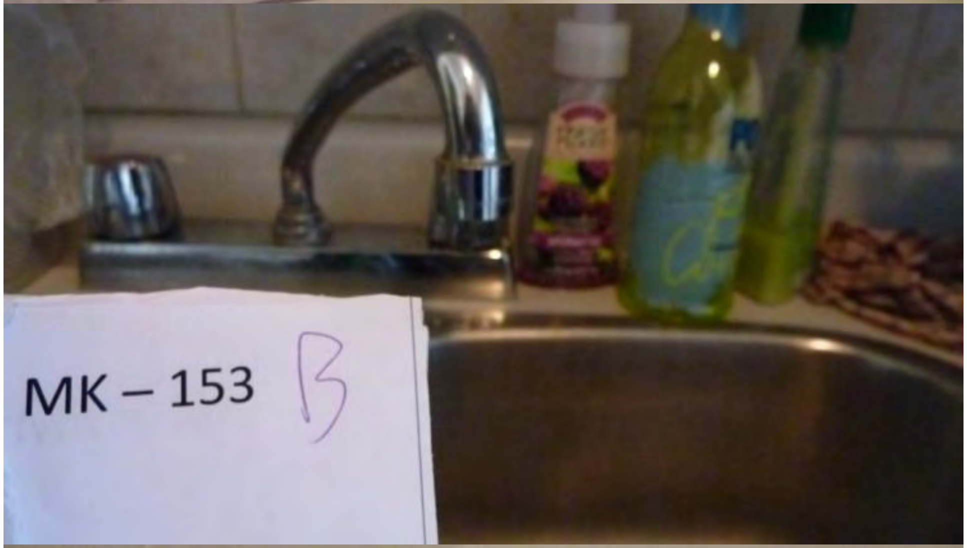


MK-
152-B



MK-
153

MK-
153-B



MK-
154

MK-154-B

MK-155

Appendix N: Union Gas 2013 Low Income Project Verification Final Report

Union Gas
2013 Low Income Project Verification Final Report

24 April 2014

Union Gas

777 Bay Street | Toronto | Ontario
M5G 2C8

Michaels No.: UB513BAN

p 608.785.1900 | 400 Main Street, Suite 200 | La Crosse, WI 54601

MichaelsEnergy

www.michaelsenergy.com

Contents

Executive Summary

Union Gas delivers Demand Side Management (DSM) services to their low income market customers through a Custom Rebate program where incentives are based on claimed savings.

Incentives are based on incremental cost relative to industry standard baselines for new construction and replacement, and on total project cost for retrofit projects. Energy savings are calculated by customers, Union Gas personnel, and business partners.

Union Gas has retained Michaels Energy to verify the reported savings, project costs, and effective useful lives on a representative sample of projects through the use of a customer or business partner interview, a desk review of the project documentation and savings calculations, and on-site verification. This is the final report of verification results for the Union Gas Low Income program in Ontario for projects completed in 2013.

A summary of the reported savings for the projects selected for review is shown in the table below.

Project	Technology	Natural Gas	EUL	Lifetime NG	Electrical	Water	Cost
		(m3)	(Yrs)	(m3)	(kWh)	(L)	($)
COM-0014	High Efficiency Building	30,199	20.0	573,781	-	-	$ 240,000
COM-0013	High Efficiency Building	34,267	17.0	553,412	-	-	$ 240,000
COM-0271	Temperature Controls	23,117	15.0	329,417	-	-	$ 68,100
COM-0218	Windows and doors	17,748	20.0	250,829	-	-	$ 350,641
COM-0239	Windows	9,375	20.0	178,125	-	-	$ 386,303
COM-0172	Windows	7,690	20.0	146,110	-	-	$ 19,500
COM-0130	ERV	7,239	15.0	103,156	-	-	$ 9,720
COM-0240	Pipe Insulation	5,403	20.0	102,657	-	-	$ 48,000
COM-0128	Windows	4,604	20.0	87,476	-	-	$ 91,955
COM-0016	Pipe Insulation	2,541	20.0	48,279	-	-	$ 121,050
COM-0263	Windows	654	20.0	12,426	-	-	$ 33,869

As indicated above, a total of eleven projects were reviewed for the low income program. The projects were reviewed for both technical accuracy and consistency with operational characteristics, as determined from the project documentation, customer interviews, and onsite inspection. Based on the information collected, the calculations for each project were revised as shown in the tables below.

	Technology	Natural Gas (m3)		
		Ex Ante	Verified	RR
COM-0014	High Efficiency Building	30,199	20,757	68.7%
COM-0013	High Efficiency Building	34,267	28,720	83.8%
COM-0271	Temperature Controls	23,117	40,855	176.7%
COM-0218	Windows and doors	17,748	17,935	101.1%
COM-0239	Windows	9,375	5,995	63.9%
COM-0172	Windows	7,690	5,998	78.0%
COM-0130	ERV	7,239	9,665	133.5%
COM-0240	Pipe Insulation	5,403	12,739	235.8%
COM-0128	Windows	4,604	4,614	100.2%
COM-0016	Pipe Insulation	2,541	1,464	57.6%
COM-0263	Windows	654	161	24.6%

No projects claimed any electric savings; however, eight projects were verified to have electric savings associated. Similarly, no projects claimed any water savings; however, two projects were verified to have associated water savings.

	Technology	Electrical (kWh)			Water (L)		
		Ex Ante	Verified	RR	Ex Ante	Verified	RR
COM-0014	High Efficiency Building	-	28,970	N/A	-	219,000	N/A
COM-0013	High Efficiency Building	-	80,860	N/A	-	365,000	N/A
COM-0271	Temperature Controls	-	-	N/A	-	-	N/A
COM-0218	Windows and doors	-	423	N/A	-	-	N/A
COM-0239	Windows	-	316	N/A	-	-	N/A
COM-0172	Windows	-	-	N/A	-	-	N/A
COM-0130	ERV	-	34,718	N/A	-	-	N/A
COM-0240	Pipe Insulation	-	(72,360)	N/A	-	-	N/A
COM-0128	Windows	-	227	N/A	-	-	N/A
COM-0016	Pipe Insulation	-	385	N/A	-	-	N/A
COM-0263	Windows	-	1	N/A	-	-	N/A

Similar to the annual savings values, the effective useful lives claimed, and the resulting lifetime natural gas savings, were reviewed. It should be noted that the lifetime natural gas savings values reflect both the adjustments to the annual natural gas savings presented earlier as well as any changes to the EUL. As shown in the table below, overall, effective useful lives (EUL) of the installed equipment were found to be reasonable and appropriate. However, adjustments were made to the effective useful lives of three projects. All three projects were adjusted due to the original analysis not correctly weighting the EUL for the project based on the EUL of the different equipment installed.

EFFECTIVE USEFUL LIFE AND LIFETIME SAVINGS ADJUSTMENTS

	Technology	EUL		Lifetime NG (m3)		
		Ex Ante	Verified	Ex Ante	Verified	RR
COM-0014	High Efficiency Building	20.0	18.1	573,781	356,031	62.0%
COM-0013	High Efficiency Building	17.0	16.8	553,412	457,139	82.6%
COM-0271	Temperature Controls	15.0	15.0	329,417	582,190	176.7%
COM-0218	Windows and doors	20.0	15.0	250,829	255,822	102.0%
COM-0239	Windows	20.0	20.0	178,125	113,900	63.9%
COM-0172	Windows	20.0	20.0	146,110	113,958	78.0%
COM-0130	ERV	15.0	15.0	103,156	137,732	133.5%
COM-0240	Pipe Insulation	20.0	20.0	102,657	242,047	235.8%
COM-0128	Windows	20.0	20.0	87,476	87,662	100.2%
COM-0016	Pipe Insulation	20.0	20.0	48,279	27,819	57.6%
COM-0263	Windows	20.0	20.0	12,426	3,052	24.6%

After conducting a review of the 2013 projects, the following observations and recommendations were made.

- **Continue Improving the Documentation Levels.** In general, documentation levels have improved from past years, but still were found to be insufficient. For some projects the scope was not clearly defined. For others, equipment specifications or other critical information was missing.
- **Revise templates to preserve all inputs and assumptions.** The window replacement template used to determine the ex ante savings was complex and iterative in nature. The template required the user to overwrite inputs for much of the analysis, which increased the uncertainty level. Whenever possible, input parameters should be preserved within an analysis.
- **Continue Improving the Secondary Benefits Claims.** None of the reviewed projects claimed any electric or water savings or penalties. However, the verification determined that of the eleven projects reviewed, nine were expected to have electric impacts and two were expected to have water impacts.

Introduction

Union Gas delivers Demand Side Management (DSM) to their Ontario low income market customers through a custom rebate program. Incentives are based on energy savings relative to current actual use for retrofit projects, or relative to industry standard baselines in the case of new construction. Energy savings are calculated by trade allies, Union Gas staff, and/or Union Gas customers.

Michaels Energy was retained by Union Gas to perform technical project reviews for the custom rebate portion of their demand side management program. The main objectives of the review are:

> 1) Meet Ontario Energy Board guidelines from the Generic Hearing Decision re: third party or internal audit for custom projects. "A special assessment program must be implemented for custom projects. …..The assessment will focus on verifying the equipment installations and estimates of savings and equipment cost.
>
> 2) To provide an independent objective opinion on the reasonableness of the energy savings, effective useful lives, and equipment costs claimed by the custom projects through a review of a statistically representative sample of projects.
>
> 3) To provide information back to program staff to improve the effectiveness of the custom rebate program.

This is the final report for the review effort.

Verification Methodology

Sample Overview

A total of eleven projects were reviewed for the low income program. The projects were reviewed for both technical accuracy and consistency with operational characteristics, as determined from the project documentation, customer interviews, and onsite inspection.

Ten of the eleven projects were verified through on-site inspections, which were completed in February, 2014. Only one project was verified with a phone interview instead of an on-site inspection. Upon review, project COM-0263 was a window project with low uncertainty and low savings levels. For this project, the customer representative and the facility engineer were interviewed. Additionally, the site was "virtually inspected" through a review of online images of the facility, as well as satellite imagery to verify window sizes and orientations.

A summary of the reported savings for the projects selected for technical review are tabulated in Table 1.

TABLE 1: REPORTED SAVINGS AND COSTS FOR PROJECTS REVIEWED

Project	Technology	Natural Gas	EUL	Lifetime NG	Electrical	Water	Cost
		(m3)	(Yrs)	(m3)	(kWh)	(L)	($)
COM-0014	High Efficiency Building	30,199	20.0	573,781	-	-	$ 240,000
COM-0013	High Efficiency Building	34,267	17.0	553,412	-	-	$ 240,000
COM-0271	Temperature Controls	23,117	15.0	329,417	-	-	$ 68,100
COM-0218	Windows and doors	17,748	20.0	250,829	-	-	$ 350,641
COM-0239	Windows	9,375	20.0	178,125	-	-	$ 386,303
COM-0172	Windows	7,690	20.0	146,110	-	-	$ 19,500
COM-0130	ERV	7,239	15.0	103,156	-	-	$ 9,720
COM-0240	Pipe Insulation	5,403	20.0	102,657	-	-	$ 48,000
COM-0128	Windows	4,604	20.0	87,476	-	-	$ 91,955
COM-0016	Pipe Insulation	2,541	20.0	48,279	-	-	$ 121,050
COM-0263	Windows	654	20.0	12,426	-	-	$ 33,869

It should be noted that none of the projects reviewed had electric or gas savings claimed.

Verification Process

The verification process has up to two stages of review. The first stage is the technical review. The calculations and documentation of all 11 projects were reviewed in depth. The calculations were compared against information provided in the application and equipment data, as well as all other information available for consistency, calculation accuracy, and reasonableness of assumptions. If no calculations ARE provided, the savings were recalculated using any and all information available.

Based on the recommendations of the Independent Auditor of the 2010 DSM verification, site visits were included in the verification process. An on-site inspection and customer interview was performed for any project that it was deemed necessary in order to adequately verify the installation of equipment or to characterize the operation of the installed equipment to determine the savings. During the on-site visits, the installed equipment was visually verified to be installed, and its make and model and any operating characteristics or settings were recorded. The customer was interviewed regarding the operation of the baseline and proposed systems, and any production records or trended data that was available was collected.

For projects where an on-site inspection would provide minimal additional confidence or information for the verification process, a phone interview of the project customer and/or business partner is completed in lieu of an on-site inspection. The customer and/or business partner is interviewed to verify information submitted on the application, as well as to determine the operating conditions of the equipment installed.

For each project, a realization rate is calculated to show the impacts of any adjustments made to the savings during the technical reviews. The project realization rate is calculated by dividing the adjusted savings by the original savings estimate. A project with no adjustments has a realization rate of 100%.

Verification Guidelines

The following guidelines were used during the course of the verification process.

- The original energy savings are determined based on the expected equipment operating conditions at the time of implementation. The verification, however, is based on the actual equipment operation at the time of the verification, after project completion. Adjustments are made if the system or equipment was not operating at the time of verification, as described or portrayed in the original calculations. If the operation at the time of the verification is not considered to be "typical" operation by the customer, the verified savings are based instead on the customer described "typical" operation.
- The verification includes assessment of savings claimed, as well as savings not claimed. Therefore, measures were examined in depth to verify the existence or non-existence of electrical or water savings, regardless if they were claimed in the original analysis.
- The verification includes assessment of costs associated with the projects. Cost will be reviewed for reasonableness. In addition, the baseline and efficient system costs will be reviewed to ensure they are consistent with the equipment used to determine the savings.

Savings Adjustment Categories

Each calculation adjustment has been categorized into one of the following types.

Inappropriate Assumptions:	These are adjustments made because the assumptions used in the savings calculations resulted in unrealistically high or overly conservative energy savings. Unrealistic assumptions result in an incorrect energy use estimate before or after project implementation. Calculations resulting in incorrect savings from

	using the wrong baseline are included in this group.
Tracking Error:	These are adjustments made because the savings in the calculations do not match the savings ultimately used to determine the rebate for the project.
Calculation or Engineering Error:	These are adjustments made because of errors in applying engineering principles or general calculation errors not attributable to operation or installation.
Operated or Installed Differently:	These are adjustments made because based on the description of operation from the interview of the customer and/or business partner, the equipment was installed differently or is operated differently than what was assumed in the savings calculations.
Unknown:	The cause of these adjustments could not be determined. Often this is due to incomplete calculations or project descriptions being provided in the project file.

Project Verification Results

Natural Gas, Electric and Water Savings

As indicated above, a total of eleven projects were reviewed for the low income program. The projects were reviewed for both technical accuracy and consistency with operational characteristics, as determined from the project documentation, customer interviews, and onsite inspection. Based on the information collected, the calculations for each project were revised.

As shown in Table 2 and Table 3 below, individual projects had gas savings realization rates ranging from 24.6% to 235.8% for annual savings. No projects claimed any electric savings; however, eight projects were verified to have electric savings associated. Similarly, no projects claimed any water savings; however, two projects were verified to have associated water savings.

TABLE 2: NATURAL GAS PROJECT REALIZATION RATES

	Technology	Natural Gas (m3)		
		Ex Ante	Verified	RR
COM-0014	High Efficiency Building	30,199	20,757	68.7%
COM-0013	High Efficiency Building	34,267	28,720	83.8%
COM-0271	Temperature Controls	23,117	40,855	176.7%
COM-0218	Windows and doors	17,748	17,935	101.1%
COM-0239	Windows	9,375	5,995	63.9%
COM-0172	Windows	7,690	5,998	78.0%
COM-0130	ERV	7,239	9,665	133.5%
COM-0240	Pipe Insulation	5,403	12,739	235.8%
COM-0128	Windows	4,604	4,614	100.2%
COM-0016	Pipe Insulation	2,541	1,464	57.6%
COM-0263	Windows	654	161	24.6%

TABLE 3: ELECTRIC AND WATER PROJECT REALIZATION RATES

	Technology	Electrical (kWh)			Water (L)		
		Ex Ante	Verified	RR	Ex Ante	Verified	RR
COM-0014	High Efficiency Building	-	28,970	N/A	-	219,000	N/A
COM-0013	High Efficiency Building	-	80,860	N/A	-	365,000	N/A
COM-0271	Temperature Controls	-	-	N/A	-	-	N/A
COM-0218	Windows and doors	-	423	N/A	-	-	N/A
COM-0239	Windows	-	316	N/A	-	-	N/A
COM-0172	Windows	-	-	N/A	-	-	N/A
COM-0130	ERV	-	34,718	N/A	-	-	N/A
COM-0240	Pipe Insulation	-	(72,360)	N/A	-	-	N/A
COM-0128	Windows	-	227	N/A	-	-	N/A
COM-0016	Pipe Insulation	-	385	N/A	-	-	N/A
COM-0263	Windows	-	1	N/A	-	-	N/A

Effective Useful Life and Lifetime Savings Assessment

Similar to the annual savings values, the effective useful lives claimed and the resulting lifetime natural gas savings were reviewed. The expected useful life (EUL) of each project was verified using documentation found from programs in other jurisdictions, research literature currently available, and the customer interview. The original and verified EUL for each project, as well as the resulting lifetime natural gas savings is given in Table 4 below. It should be noted that the lifetime natural gas savings values reflect both the adjustments to the annual natural gas savings presented earlier, as well as any changes to the EUL.

TABLE 4: EFFECTIVE USEFUL LIFE AND LIFETIME SAVINGS ADJUSTMENTS

	Technology	EUL		Lifetime NG (m3)		
		Ex Ante	Verified	Ex Ante	Verified	RR
COM-0014	High Efficiency Building	20.0	18.1	573,781	356,031	62.0%
COM-0013	High Efficiency Building	17.0	16.8	553,412	457,139	82.6%
COM-0271	Temperature Controls	15.0	15.0	329,417	582,190	176.7%
COM-0218	Windows and doors	20.0	15.0	250,829	255,822	102.0%
COM-0239	Windows	20.0	20.0	178,125	113,900	63.9%
COM-0172	Windows	20.0	20.0	146,110	113,958	78.0%
COM-0130	ERV	15.0	15.0	103,156	137,732	133.5%
COM-0240	Pipe Insulation	20.0	20.0	102,657	242,047	235.8%
COM-0128	Windows	20.0	20.0	87,476	87,662	100.2%
COM-0016	Pipe Insulation	20.0	20.0	48,279	27,819	57.6%
COM-0263	Windows	20.0	20.0	12,426	3,052	24.6%

As shown in Table 4 above, overall, effective useful lives (EUL) of the installed equipment were found to be reasonable and appropriate. However, adjustments were made to the effective useful lives of three projects.

Two of the projects (COM-0014 and COM-0013) were high efficiency building projects that included the installation of a water loop heat pump system instead of a conventional boiler system, as well as the installation of wall and roof insulation levels greater than required by code and low flow plumbing fixtures. These projects involved similar buildings constructed in similar locations for the same customer; however, the EUL for these projects was assumed to be different. The EUL for project COM-0014 was assumed to be 20 years, while the EUL for project COM-0013 was only assumed to be 17 years. To determine the useful life of these projects, the EUL for each component was weighted by the verified savings level associated with each portion. The insulation and HVAC components were assumed to have an EUL of 20 years; however, the low flow plumbing fixtures were given lower EULs, at 10 years. The resulting EUL for project COM-0014 was 18.1 years, and the EUL for project COM-0013 was 16.8 years. It should be noted that these values are not the same due to the breakdown of savings between the shell, HVAC, and plumbing fixtures being different for each project, resulting in a different weighted average EUL.

The remaining project (COM-0218) was a window project that included the installation of weatherstripping. The effective useful life claimed for this project was 20 years. This value is reasonable and appropriate for window projects; however, the life of weatherstripping is expected to be significantly less, estimated to be 5 years. To determine the useful life of this project, the EUL for each component was weighted by the verified savings level associated with each portion. The resulting EUL for project COM-0218 was 15 years. It should again be noted, although the EUL is nominally changed, the lifetime savings change is small. It appears that the lifetime savings had been reduced to the equivalent of approximately 15 years, even though the project documentation listed the EUL as 20 years.

Incremental Cost Assessment

Similar to the annual savings values, the incremental cost associated with each project was reviewed. The cost was verified using a combination of the customer interview as well as a literature review. The original and verified incremental cost for each project is given in Table 5 below.

TABLE 5: INCREMENTAL COST ADJUSTMENTS

	Technology	Incremental Cost		
		Ex Ante	Verified	RR
COM-0014	High Efficiency Building	$ 240,000	$ 258,200	107.6%
COM-0013	High Efficiency Building	$ 240,000	$ 254,000	105.8%
COM-0271	Temperature Controls	$ 68,100	$ 71,100	104.4%
COM-0218	Windows and doors	$ 350,641	$ 350,641	100.0%
COM-0239	Windows	$ 386,303	$ 386,303	100.0%
COM-0172	Windows	$ 19,500	$ 148,500	761.5%
COM-0130	ERV	$ 9,720	$ 9,720	100.0%
COM-0240	Pipe Insulation	$ 48,000	$ 48,000	100.0%
COM-0128	Windows	$ 91,955	$ 91,955	100.0%
COM-0016	Pipe Insulation	$ 121,050	$ 121,050	100.0%
COM-0263	Windows	$ 33,869	$ 7,951	23.5%

As shown in Table 5 above, overall, the incremental costs were found to be reasonable. A total of five projects were adjusted. Project COM-0172 had the most significant adjustment. The ex ante costs for this project were based on the incremental cost between the installation of high performance windows and standard windows. However, the analysis was based on the difference between the installed high performance windows and the existing windows. Therefore, the verification set the incremental cost for this project equal to the total project cost.

Projects COM-0014 and COM-0013 both had the incremental costs adjusted slightly. The costs for these projects were based on the cost of the low flow plumbing fixtures and the HVAC system upgrades. However, the project also included the installation of roof and wall insulation levels that exceeded code requirements. The costs for these projects were increased by an estimated $0.35 per square foot of wall and roof area. This was based on the incremental cost of insulation only for the walls and roofs, based on insulation costs as presented by American Building Technologies, LLC.

For project COM-0263, the total project cost for the customer across all buildings upgraded was found to be consistent with the supplied documentation. However, the breakdown of costs between projects and locations was incorrect. The original analysis split the cost evenly among the three locations (the one included in this project and two other completed in other projects). However, the number of windows for this location was less than the other sites. The verification split the costs according to the window area installed at each site.

Finally, project COM-0271 had the incremental cost increased as well. The cost presented for this project was the cost paid to the vendor. However, this did not include any internal costs for the labor for the on-site staff. Based on an estimate of 100 hours, at $30 per hour, the costs were increased by $3,000.

Observations on Specific Projects and Technologies

In order to better understand the trends within the program, the projects were divided and technology-specific realization rates were developed. It should be noted that these technology-specific realization rates represent only the projects selected for the sample, and cannot be readily extrapolated out to the program population. Table 6 includes the reported savings and the technology realization rate for each technology group for all 11 projects reviewed. Specific adjustments by technology are described below.

TABLE 6: SAVINGS BY TECHNOLOGY GROUP

Technology Group	Technical Reviews Completed	Ex Ante Natural Gas Savings	Ex Post Natural Gas Savings	Realization Rate
Efficient Building	2	64,466	49,477	77%
HVAC	2	30,356	50,521	166%
Windows	5	40,071	34,702	87%
Pipe Insulation	2	7,944	14,203	179%

Efficient Building

Two projects reviewed were projects involving the construction of an efficient building. Both of these projects involved the installation of a water loop heat pump system instead of a conventional boiler system, as well as the installation of wall and roof insulation levels greater than required by code and low flow plumbing fixtures. These two projects were also the two largest projects in the sample.

Both of these projects had significant downwards adjustments, averaging an approximate 25%. However, the exact cause of the downwards adjustment could not be determined because the building simulations used to determine the ex ante savings were not able to be utilized for the verification. Based on a review of the model output files supplied, it was clear that the models were very rigorous and appeared to be of generally high quality. However, the projected billed gas consumption from the models was inconsistent with the actual gas usage data supplied by Union Gas. The project gas usage of the models was more than 50% greater than the actual usage, with the projected hot water usage being nearly three times the actual usage, based on the bills. Additionally, based on the on-site, the low-flow showerheads were installed as expected; however, the bathroom faucet aerators installed were standard flow aerators.

The verification completed a calibrated building simulation in eQuest. Equipment efficiencies and outdoor air ventilation levels were taken from the building as-built drawings, supplied by the customer.

HVAC

Two projects reviewed were HVAC projects. Both of these projects had significant upwards adjustments; however, no clear conclusions could be made due to unique circumstances associated with each project.

Project COM-0271 was the installation of an HVAC controller to limit the heat supplied to residential spaces. For this project, the savings were nearly twice the level anticipated in the original analysis, due to site-specific circumstances. Through the installation of the controller, the customer determined that the heating control valves for much of the building were improperly wired, resulting in very poor temperature controls with spaces calling for heat when none was required.

Based on this, it is likely that much of the savings realized on the bill are actually due to the re-wiring of the heating valves rather than the installed controller; however, because the re-wiring was due to the installation of the controller and included as part of the project, all of the savings realized were attributed to the project.

Project COM-0130 consisted of the installation of a VFD to reduce the outdoor air brought in by a make-up air unit. Again, the calculations for this project appeared to be reasonable. However, this customer was very active in monitoring the performance of the HVAC system and aggressive in the level of reduction in ventilation. Because of this, the ventilation level observed while on-site was lower than assumed in the ex ante analysis, resulting in the verified savings being increased.

Windows

Five projects reviewed were window projects. These projects were adjusted both up and down, but overall were found to have project realization rates near 100%. The causes for adjustment on each project varied, but in general tended to be due to changes to assumed window specifications. All project areas and orientations were found to be reasonable.

There was some uncertainty associated with the window projects. The template utilized by Union Gas requires the inputs for much of the analysis to be overwritten, and the original inputs were not recorded or tracked. The verification effort was able to recreate, or nearly recreate, the saving predicted for each project, through trial and error. However, it could not be verified with certainty that the inputs used were the same as in the original analysis.

Pipe Insulation

The lasts two projects reviewed were pipe insulation projects. Both of these projects had significant adjustments; however, the adjustments were in opposite directions. No clear conclusions could be made due to unique circumstances associated with each project.

Project COM-0240 had the savings levels dramatically increased. The scope of work completed was found to be consistent with the project information supplied; however, the heating in the tenant spaces was met with electric resistance heaters. The original analysis did not claim any gas savings for the winter months based on the assumption that the savings for the water heating system would be offset by additional usage by the gas space heating system. Because the space heating system was electric, this offset did not occur. It should be noted that the additional heat load will result in a significant additional electric usage for the facility.

For project COM-0016, the calculation was found to be reasonable, but not consistent with the work completed. Specifically, the customer representative was able to provide piping diagrams. Based on these diagrams, the installed piping was smaller than the claimed pipe size. Although the cause of the discrepancy could not be determined, it is possible that the claimed size may have incorrectly interpreted measured diameters rather than pipe nominal diameters, which would overestimate pipe size.

Observations and Recommendations

After conducting a review of the 2013 projects, the following observations and recommendations were made.

Continue Improving the Documentation Levels. There were continued improvements in the types of documents included in each of the project files evaluated. Several key improvements retained from last year included the use of the Energy Savings Calculation spreadsheet and the Equipment Installation Checklist. However, in general, the documentation level can and should still be improved. Specifically, for many projects the installed equipment could not be clearly identified from the supplied project files. Some examples of this lack of documentation include the new building projects. No clear description of the efficiency measures completed was included in the project file. To identify the efficiency improvements, the verification effort involved reviewing thousands of pages of building simulation output files, as well as as-built blueprints supplied by the customer. It is important to note that this level of effort would also be required by the program in order to complete a substantial internal review. Many of the window projects did not include drawings or specifications for the installed windows. This information should be included for all projects. Including important pieces of documentation, such as those mentioned previously, will allow for not only more accurate verification, but easier and more accurate internal reviews by program staff.

Revise templates to preserve all inputs and assumptions. The window template used to determine the ex ante savings was complex and iterative in nature. Heat loads were calculated for conduction and for infiltration in each direction. The analysis itself appeared reasonable and appropriate; however, the template required an iterative approach where the inputs for each portion of the analysis were overwritten to calculate the next parameter. The inputs were not tracked or recorded, which increased the uncertainty level, especially since many of the values were manually typed in and could include rounding of values or typographical errors. Whenever possible, input parameters should be preserved within an analysis and linked to maintain analysis accuracy and continuity.

Continue Improving the Secondary Benefits Claims. None of the reviewed projects claimed any electric or water savings or penalties. However, the verification determined that of the eleven projects reviewed, nine were expected to have electric impacts and two were expected to have water impacts. It is understood that due to changes to the regulatory structure, secondary benefits are less important to calculate than in prior years. It is recommended that either the secondary benefits be calculated consistently or they be removed entirely.

Appendix A—Project Reports

Reports are provided for each project verified.

A description of the information in each section in the report is provided below:

Measure Description — This section includes a high level description of the efficiency improvements involved in the project including the measure type, and a basic description of how the project was anticipated to reduce energy consumption.

Summary of Ex Ante Calculations — This section describes the methodology and key input assumptions used to determine the savings for the ex ante (original claimed) analysis supplied with the project files.

Description of Verification — This section describes the verification procedure that was used to evaluate the claimed savings. This section also contains the observations and discussion of information or data obtained during a site visit to the customer facility, or information obtained during a phone interview. Any immediate differences between observed or collected information and that found in the original project file may also be discussed.

Summary of Verification Calculations — The final section provides an in-depth discussion of the methodology, calculations, and any assumptions used to determine the verified savings. The discussion includes sources for assumptions, discussion of engineering equations, and key variable definitions, and the reasons for differences between the ex ante and verified savings numbers.

Project ID#:	2013-COM-0014
Measure:	Efficient Building
Ex Ante Savings:	30,199 m3 natural gas; 0 kWh electric, 0 L water
TRC:	-$154,794
Incremental Cost:	$240,000
Facility Usage:	Residential

Measure Description

The customer built a high efficiency building. The project description includes minimal description of what specific efficiency measures were completed for the high efficiency building, with the exception of the installation of a high efficiency boiler, a water loop heat pump system, and low flow plumbing fixtures. Per discussions with Union Gas staff, it is likely that additional efficiency upgrades were completed, but all savings claimed were attributed to the heat pump system and low flow fixtures.

Based on a review of the supplied building models, it appears that the project also included the installation of wall and roof insulation levels above code.

Summary of the Ex Ante Calculations

The savings for this project were calculated using a building simulation completed in EE4. Due to incompatibility issues with EE4 and current Windows versions, it was not possible to fully review the model; however, the output files were reviewed in depth.

Overall, the models were found to be of a high degree of rigor; however, the resulting projected gas consumption for the efficient model was not consistent with the billed consumption provided by Union Gas. Specifically, the summer gas usage projected was nearly three times the actual gas usage and annual gas usage was approximately 50% greater than the actual gas usage.

The summer gas usage appeared to indicate an excessive hot water usage profile in the model; however, this was not able to be confirmed. This comprised the majority of the excess gas usage in the model; however, the HVAC gas usage also appeared mildly excessive.

TABLE 1 EX-ANTE SAVINGS ESTIMATES

	Ex ante Savings
m3 natural gas	30,199
kWh electric	0
L water	0
Incremental Cost	$240,000

The application states that the expected useful life of this measure is 20 years. Based on this EUL, and the incremental costs and savings presented above, the expected TRC for this project is -$154,794.

Description of Verification

An initial site visit to verify the installation of the measure was conducted on February 5, 2014. The site representative was interviewed and a walkthrough of the building was performed. The site representative provided a full set of as-built drawings for the building.

The installation of the water loop heat pump system was verified, both through the inspection of a selection of the heat pumps, as well as through review of the as-built drawings. The boilers and cooling tower for the water loop heat pump were also inspected. The boilers were found to be installed and operating as expected. They were approximately 87% efficient Lochinvar boilers, and supplied 175°F water to a heat exchanger for the building heat pump loop.

During the summer months, the heat pump loop is "tempered" with a Baltimore Air Coil VF1 series closed-circuit cooling tower. The building does not have mechanical cooling for the building loop, other than the cooling tower, which tempers the water for use by the heat pumps, which provide zone cooling.

The installed heat pumps were Climate Master TRM series, ranging from 0.75 ton to 4 ton. These units have an EER of 13 for cooling and a COP of 4.5 to 4.7 for heating, depending on size.

Ventilation for the building is supplied by three gas-fired make-up air units. The make-up air units supply approximately 14,000 cfm of air, pre-conditioned using 80% efficient indirect fired burners.

The insulation for the building was not able to be physically verified; however, based on the supplied as-built drawings, the insulation levels installed exceeded code requirements. Specifically, the wall construction included R-24 insulation, which exceeded the required R-19.

Additionally, the roof construction was predominantly R-19, which also exceeded the required R-15.

Water heating was provided by two 500,000 BTU/hr, 85% efficient hot water boilers. These boilers provide hot water, which is recirculated through the building at 140°F.

Summary of Verification Calculations

The verification used a simplified calibrated building simulation approach to determine the expected savings. The building and HVAC characteristics, such as the system types and efficiencies, were based on the supplied building drawings, as were the insulation levels, floor areas, and other parameters.

The hot water usage profile was then adjusted until the summer gas usage was consistent with the billed usage. The temperature setpoints of the hallways was then slightly adjusted, so that the gas usage for the building was consistent with the billed usage.

For the baseline model, the building was modeled exactly similar to the efficient case model; however, in place of the water-loop heat pump system an 80% efficient boiler was modeled. Additionally, cooling was provided by a centrifugal chiller with an assumed efficiency of 0.57 kW/ton.

Insulation levels were reduced in the baseline model to the code required R-19 for wall and R-15 for the roof.

Finally, the hot water system and usage was modified. The efficient building had an 85% efficient hot water boiler. This was reduced to 80% efficient for the baseline boiler and the hot water usage was increased by 5 gallons of hot water per person to account for the installation of the low flow showerheads.

TABLE 2 EX-POST ENERGY SAVINGS COMPARISON

	Ex ante Savings	Verified Savings	Project Realization Rate
m3 natural gas	30,199	20,757	68.7%
kWh electric	0	28,970	N/A
L water	0	219,000	N/A
Incremental Cost	$240,000	$258,200	107.6%

Primary Cause for Adjustment: Operated or Installed Differently

Project ID#:	2013-COM-0013
Measure:	Efficient Building
Ex Ante Savings:	34,267 m3 natural gas; 0 kWh electric, 0 L water
TRC:	-$150,393
Incremental Cost:	$240,000
Facility Usage:	Residential

Measure Description

The customer built a high efficiency building. The project description includes minimal description of what specific efficiency measures were completed for the high efficiency building with the exception of the installation of a high efficiency boiler, a water loop heat pump system, and low flow plumbing fixtures. Per discussions with Union Gas staff, it is likely that additional efficiency upgrades were completed, but all savings claimed were attributed to the heat pump system and low flow fixtures.

Based on a review of the supplied building models, it appeared that the project also included the installation of wall and roof insulation levels above code.

Summary of the Ex Ante Calculations

The savings for this project were calculated using a building simulation completed in EE4. Due to incompatibility issues with EE4 and current Windows versions, it was not possible to fully review the model; however, the output files were reviewed in depth.

Overall, the models were found to be of a high degree of rigor; however, the resulting projected gas consumption for the efficient model was not consistent with the billed consumption provided by Union Gas. Specifically, the summer gas usage projected was nearly three times the actual gas usage and annual gas usage was approximately 50% greater than the actual gas usage.

The summer gas usage appeared to indicate an excessive hot water usage profile in the model; however, this was not able to be confirmed. This comprised the majority of the excess gas usage in the model; however, the HVAC gas usage also appeared mildly high.

TABLE 1 EX-ANTE SAVINGS ESTIMATES

	Ex ante Savings
m3 natural gas	34,267
kWh electric	0
L water	0
Incremental Cost	$240,000

The application states that the expected useful life of this measure is 17 years. Based on this EUL, and the incremental costs and savings presented above, the expected TRC for this project is -$150,393.

Description of Verification

An initial site visit to verify the installation of the measure was conducted on February 5, 2014. The site representative was interviewed and a walkthrough of the building was performed. The site representative provided a full set of as-built drawings for the building.

The installation of the water loop heat pump system was verified, both through the inspection of a selection of the heat pumps as well as through review of the as-built drawings. The boilers and cooling tower for the water loop heat pump were also inspected. The boilers were found to be installed and operating as expected. They were approximately 87% efficient Lochinvar boilers, and supplied 175°F water to a heat exchanger for the building heat pump loop.

During the summer months, the heat pump loop is "tempered" with a Baltimore Air Coil VF1 series closed-circuit cooling tower. The building does not have mechanical cooling for the building loop, other than the cooling tower, which tempers the water for use by the heat pumps, which provide zone cooling.

The installed heat pumps were Climate Master TRM series, ranging from 0.75 ton to 4 ton. These units have an EER of 13 for cooling and a COP of 4.5 to 4.7 for heating, depending on size.

Ventilation for the building is supplied by two gas-fired make-up air units. The make-up air units supply approximately 14,000 cfm of air, pre-conditioned using 80% efficient indirect fired burners.

The insulation for the building was not able to be physically verified; however, based on the supplied as-built drawings, the insulation levels installed exceeded code requirements. Specifically, the wall construction included R-24 insulation, which exceeded the required R-19. Additionally, the roof construction was predominantly R-19, which also exceeded the required R-15.

Water heating was provided by two 500,000 BTU/hr, 85% efficient hot water boilers. These boilers provide hot water, which is recirculated through the building at 140°F.

Summary of Verification Calculations

The verification used a simplified calibrated building simulation approach to determine the expected savings. The building and HVAC characteristics, such as the system types and efficiencies, were based on the supplied building drawings, as were the insulation levels, floor areas, and other parameters.

The hot water usage profile was then adjusted until the summer gas usage was consistent with the billed usage. The temperature setpoints of the hallways was then slightly adjusted, so that the gas usage for the building was consistent with the billed usage.

For the baseline model, the building was modeled exactly similar to the efficient case model; however, in place of the water-loop heat pump system an 80% efficient boiler was modeled. Additionally, cooling was provided by a centrifugal chiller with an assumed efficiency of 0.57 kW/ton.

Insulation levels were reduced in the baseline model to the code required R-19 for wall and R-15 for the roof.

Finally, the hot water system and usage was modified. The efficient building had an 85% efficient hot water boiler. This was reduced to 80% efficient for the baseline boiler and the hot water usage was increased by 5 gallons of hot water per person to account for the installation of the low flow showerheads.

TABLE 2 EX-POST ENERGY SAVINGS COMPARISON

	Ex ante Savings	Verified Savings	Project Realization Rate
m3 natural gas	34,267	28,720	83.8%
kWh electric	0	80,860	N/A
L water	0	365,000	N/A
Incremental Cost	$240,000	$254,000	105.8%

Primary Cause for Adjustment: Operated or Installed Differently

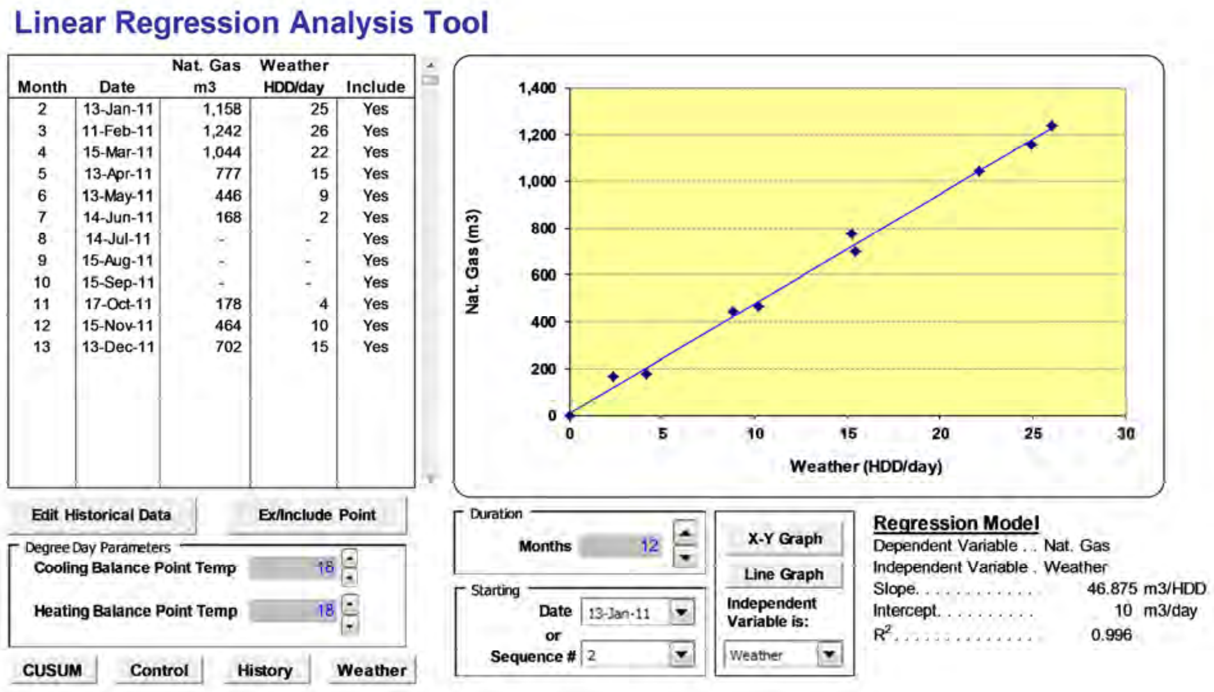
Project ID#:	2013-COM-0271
Measure:	HVAC Temperature Controls
Ex Ante Savings:	23,117 m3 natural gas; 0 kWh electric, 0 L water
TRC:	-$16,317
Incremental Cost:	$68,100
Facility Usage:	Residential

Measure Description

The customer installed a Demtroys control system to improve the efficiency of the heating system for a residential apartment building. The Demtroys system limits the percent of time that heating valves can be open for each apartment building based on outdoor air temperature. This limits the heat output of the system and the potential for space overheating.

Summary of the Ex Ante Calculations

The savings were calculated using a modified CUSUM analysis. For the CUSUM analysis, the expected operation for the building is based on the billed history from 2011, which was related linearly to heating degree days (HDD), as shown in the figure below.



Linear Regression Analysis Tool

Month	Date	Nat. Gas m3	Weather HDD/day	Include
2	13-Jan-11	1,158	25	Yes
3	11-Feb-11	1,242	26	Yes
4	15-Mar-11	1,044	22	Yes
5	13-Apr-11	777	15	Yes
6	13-May-11	446	9	Yes
7	14-Jun-11	168	2	Yes
8	14-Jul-11	-	-	Yes
9	15-Aug-11	-	-	Yes
10	15-Sep-11	-	-	Yes
11	17-Oct-11	178	4	Yes
12	15-Nov-11	464	10	Yes
13	13-Dec-11	702	15	Yes

Degree Day Parameters
Cooling Balance Point Temp 18
Heating Balance Point Temp 18

Duration
Months 12

Starting
Date 13-Jan-11
or
Sequence # 2

Independent Variable is: Weather

Regression Model
Dependent Variable . . Nat. Gas
Independent Variable . Weather
Slope. 46.875 m3/HDD
Intercept. 10 m3/day
R^2. . . . . 0.996

Using this regression, a “baseline” usage was developed for the period from October through December of 2013. This baseline usage was then compared to the actual billed usage for those months to determine the reduction, due to the project, during those months. The baseline and actual billed usage data is given in the table below.

		Actual		Baseline	Difference
	Date	Nat. Gas	Weather	Predicted	(Act - Base)
Month	dd-mmm-yy	m3	HDD	m3	m3
35	10/16/2013	4,218	108	5,341	- 1,124
36	11/14/2013	12,323	330	15,738	- 3,415
37	12/9/2013	17,658	403	19,126	- 1,468

The annual savings were then determined by dividing out the savings for the comparison period by the heating degree days during that period and multiplying by the annual heating degree days, as shown in the formula below.

$$Annual\ Savings = \frac{Period\ Savings}{Period\ HDD} * Annual\ HDD$$

It should be noted that any heating degree days from the months of June, July, and August were removed, as the heating system is not expected to be in operation. The resulting savings are given in the table below.

TABLE 1 EX-ANTE SAVINGS ESTIMATES

	Ex ante Savings
m3 natural gas	23,117
kWh electric	0
L water	0
Incremental Cost	$68,100

The application states that the expected useful life of this measure is 15 years. Based on this EUL, and the incremental costs and savings presented above, the expected TRC for this project is -$16,317.

Description of Verification

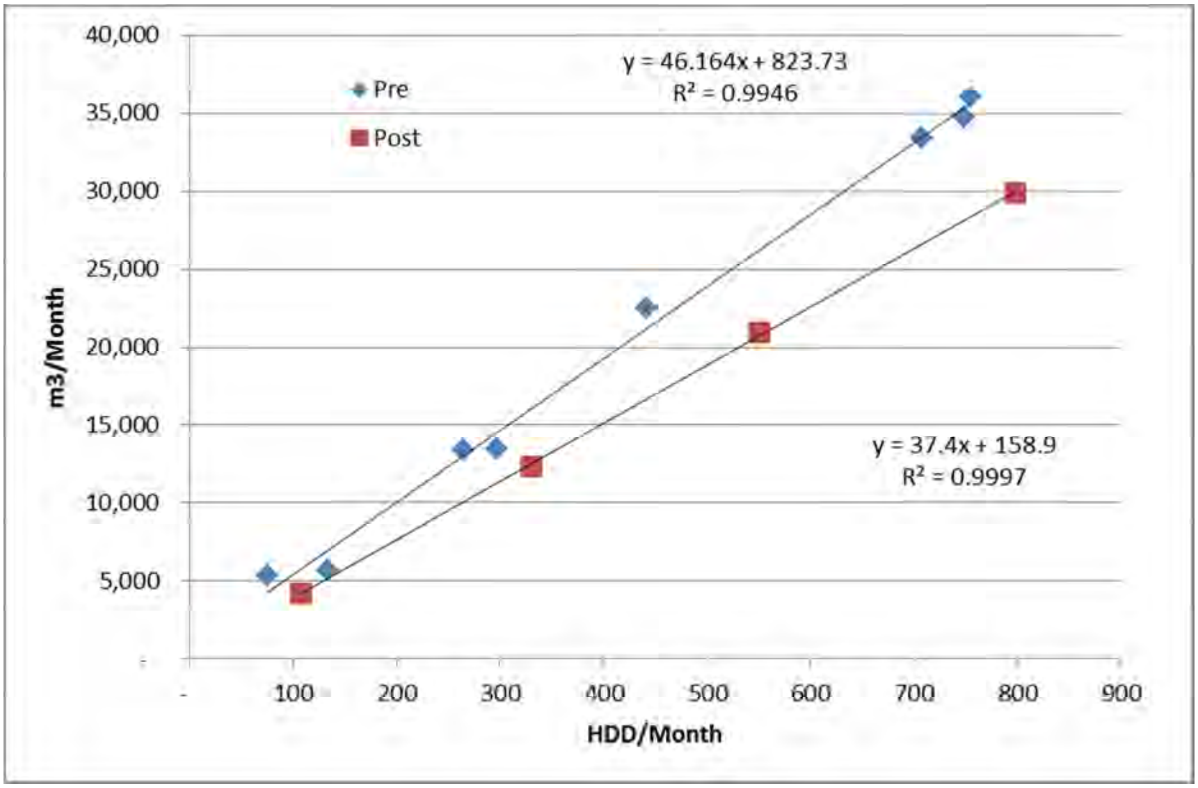
An initial site visit to verify the installation of the Demtroys system conducted on February 4, 2014. The site representative was interviewed and a walkthrough of the building was performed. The customer provided access to both the mechanical rooms for the boilers and the Demtroys system, as well as access to one of the rental units.

The Demtroys system was inspected and found to be installed as expected. The Demtroys system regulates the gas usage of the heating system by limiting the percent of time that the heating valve for a unit can be open, based on outdoor air temperature, and a profile that is programmed into the system.

The customer was interviewed regarding the installation and operation of the system. Per the site representative, the system has reduced has usage and has dramatically improved the temperature control of the building. In the period immediately after the installation of the system, the building had significant temperature control issues. However, during the process of reviewing the operation of the Demtroys system the site representative and the vendor discovered that many of the control valves for the radiant heaters were wired backwards. Due to this, any time the thermostat was calling for heat, the valve on the radiant heaters was being closed. Similarly, when the thermostat was not calling for heat, the valve would open and hot water would flow through the radiators. Therefore, many of the units prior to the installation and rewiring of the valves were very warm much of the time. The valves have since all been rewired to correct the issue. Because fixing the identification of the wiring issue and the subsequent repair was completed through the continued involvement of Union Gas and the vendor, with no additional costs incurred to the customer from the vendor or incentives being provided from Union Gas, the identification and repair is considered to be part of this project.

Summary of Verification Calculations

The verification used a billed data regression analysis to determine the savings. Similar to the original analysis, linear regressions were developed. However, for the verification efforts, separate regressions were developed for the pre-case and the post-case. Both of these regressions are shown in the figure below.



For each case, the annual gas usage was calculated using the formula:

$$Gas\ Usage = Slope\ x\ Annual\ HDD + 9\ x\ Intercept$$

It should be noted that the "9" in the equation above is used because the heating system is turned off for three months per year, resulting in only nine months of savings. The slope and intercept variables are taken from the figure above. The inputs and resulting gas usages for the pre and post-cases are given in the table below.

Case	Slope	Annual HDD	Intercept	Gas Usage
Pre	46.2 m3/HDD	3,979 HDD/year	823.7 m3/month	191,100 m3/year
Post	37.4 m3/HDD	3,979 HDD/year	158.9 m3/month	150,245 m3/year
Savings				40,855 m3/year

Based on this approach, the savings are significantly increased. This increase is likely due to two factors. First, the verification used a larger data set (more months) to develop the post-installation profile. Second, and likely more significantly, the original analysis assumes a constant gas usage per heating degree day. This is not the case for the observed system, as indicated by the non-zero intercept.

The non-uniform gas usage per heating degree day can also clearly be seen by examination of the original data used to determine the savings. If a gas usage per heating degree day column is added, it can clearly be seen that the savings for December were one third of the savings of October.

		Actual		Baseline	Difference	Difference
	Date	Nat. Gas	Weather	Predicted	(Act - Base)	Per HDD
Month	dd-mmm-yy	m3	HDD	m3	m3	m3/HDD
35	10/16/2013	4,218	108	5,341	- 1,124	- 10.4
37	12/9/2013	17,658	403	19,126	- 1,468	- 3.6

The verified savings for this project are given in the table below.

TABLE 2 EX-POST ENERGY SAVINGS COMPARISON

	Ex ante Savings	Verified Savings	Project Realization Rate
m3 natural gas	23,117	40,855	176.7%
kWh electric	0	0	N/A
L water	0	0	N/A
Incremental Cost	$68,100	$71,100	104.4%

Primary Cause for Adjustment: Operated or Installed Differently

Project ID#:	2013-COM-0218
Measure:	Windows and Doors
Ex Ante Savings:	17,748 m3 natural gas; 0 kWh electric, 0 L water
TRC:	-$298,619
Incremental Cost:	$350,641
Facility Usage:	Residential

Measure Description

The customer replaced the windows and doors in 109 townhouses and a community center. A total of 478 windows, 110 front doors without storms, and 110 rear doors with storm doors were replaced.

Summary of the Ex Ante Calculations

This project involved the installation of new windows. Based on the project description a total of 478 windows, and 220 doors were installed. The installed window area and leakage perimeter, by orientation, is given in the table below.

	ENE	SSE	WSW	NNW
Window Area (ft^2)	2,287	1,765	2,150	1,661
Window Leakage Perimeter (ft)	76.1	76.1	76.1	76.1
Door Area (ft^2)	1031	800	1139	845
Door Leakage Perimeter (ft)	881	683	971	721

The leakage area is the area around the slider for the window, rather than the perimeter of the window itself. It should be noted that the leakage perimeter is the same for each orientation, even though the window areas differ.

In addition to the window size and perimeter information given above, a U-value (conduction coefficient) and leakage rate was given for the doors and windows, for both the baseline and the efficient case. The U-values and leakage information given is listed in the table below.

	Baseline Windows	Proposed Windows
U-Value	0.62	0.35
Window Leakage Rate (cfm/ft)	0.7	0.07
Door Leakage Rate (cfm/ft)	1.4	0.3

No U-value information was given for the doors.

The savings were calculated using a template developed for Union Gas for window projects. The template calculates the savings due to the conduction as well as the infiltration by orientation. The calculations also account for the solar gains transmitted into the space, due to the solar heat gain coefficient for each window. Overall project savings are then calculated using the equation:

$$Savings_{Total} = Savings_{Conduction} + Savings_{Infiltration} - Added\ Usage_{Solar\ Gains}$$

To determine the savings associated with the conduction, a heat load is calculated using the window area and U-value (heat transfer coefficient), and the difference in temperature between the inside space and the temperature at the design conditions, based on the specific area, using the equation:

$$Design\ Heat\ Load = U_{window}\ x\ Area_{Window}\ x\ (T_{inside} - T_{design})$$

Where:

- U_{window} is the U-value of the window, as given in the tables above.
- $Area_{window}$ is the area of all orientations of windows, as given in the tables above.
- T_{inside} is the interior space temperature, or 72°F.
- T_{design} is the outdoor air temperature at the design conditions, based on the locations. For this project, the design outdoor air temperature is -0.9°F.

This design heat load is then applied to an ASHRAE simplified bin analysis method, where the expected gas usage for the baseline and efficient new window condition is calculated for each temperature bin, using the equation:

$$Gas\ Usage_{conduction} = \sum_{i=-22}^{68} Design\ Heat\ Load\ x\ \frac{(T_{inside} - T_{bin-i})}{(T_{inside} - T_{design})}\ x\ \frac{Hours_{Bin-i}}{Eff_{Bin-i}}$$

Where:

- i is the average temperature for each temperature bin for the ASHRAE simplified bin analysis, ranging from -13°F to 63.5°F, in 4.5°F increments.
- $Hours_{Bin-i}$ is the hours per year that occur within the temperature bin with an average temperature of i, based on typical meteorological year data.
- Eff_{Bin-i} is the heating efficiency at the bin temperature i. The heating efficiency is 80% for the lowest temperature, but decreases to 39% at the highest bin. No explanation or justification w as given for the efficiency curve used.

Similar to conduction, a design heat load for each direction was also calculated for the baseline and the efficient installed windows for infiltration. The design heat load was based on

$$Design\ Heat\ Load_{Direction-j} = Leakage_j\ x\ Perimeter_j\ x\ 1.08\ x\ \left(T_{inside} - T_{design}\right) x\ Pressure\ Correction$$

Where:

- *j* specifies the direction (N, S, E, W) that the installed windows face. A separate design heat load is calculated for each direction.
- *Leakage* is the window leakage rate for the windows facing orientation j, in cfm/ft, as given in the tables above
- *Perimeter* is the leakage perimeter for all windows facing orientation j, in ft., as given in the tables above.

In the above equation, the leakage is defined as a cfm per linear foot of perimeter. Additionally, the 1.08 is a factor to account for units and for density, where the resulting design heat load is in BTUs per hour. The pressure correction factor is used to correct for the differences in observed pressure on the windows due to wind versus the leakage at the rating pressure for the windows, and is simply a ratio of the wind pressure expected by location based on the average wind speed and the rating pressure for window leakage (0.3 in W.C.). For this location, the expected wind velocity is 13 mpg, resulting in a wind pressure of 0.09 in W.C.

The gas usage resulting from infiltration in each direction can then be calculated:

$$Gas\ Usage_{infiltration-j} = Design\ Heat\ Load_{Direction-j}\ x\ \frac{\left(T_{inside} - T_{bin-i}\right)}{\left(T_{inside} - T_{design}\right)}\ x\ \frac{Hours_{Bin-i}}{Eff_{Bin-i}}\ x\ \%Wind_{Direction-j}$$

In the equation above, the $\%Wind_{Direction-j}$ factor accounts for the percent of time that the wind is blowing from direction j, that the window is facing. This value is determined based on location, from typical meteorological data.

The gas usages are then summed for all directions to determine the total usage associated with the infiltration levels. For this project, the total gas usage for the base case windows was 212 m3, and the total gas usage for the infiltration in the efficient case windows was 44 m3. This results in a total reduction in gas usage of 168 m3, due to reduced infiltration.

For the doors, a similar analysis was completed, using the equations above and the leakage rates and perimeter values from the tables above. Based on this data, the total gas usage for the base case door was 7,858 m3, and the total gas usage for the infiltration in the efficient case doors was 1,796 m3. This results in a total reduction in gas usage of 6,062 m3, due to reduced infiltration.

Radiation heat gains are calculated by month. To determine the heat gain due to radiation, the incident solar radiation (BTU/sf), by month, is multiplied by the area of the windows, by an orientation factor, and the area by orientation, as given in the equation below:

$$Solar\ Gain = \ Incident\ Solar\ x\ Area\ x\ Orientation\ Factor\ x\ Clearness\ Fraction\ x\ SC$$

Where:

- *Incident solar* specifies the incident solar radiation is based on the location, and is interpolated from 1997 ASHRAE Fundamentals Handbook.
- The area is the total window area, as given in the tables above.
- *Clearness fraction* is based on the location, and specifies the percent of incident solar radiation that is not blocked by the atmosphere and cloud cover. This data is taken from NASA surface meteorology and solar energy data.
- *SC* is the window shading coefficient. This is a property of the installed windows, and is essentially the percentage of incident solar radiation that is passed to the interior space.

For the base case, the solar gains are expected to offset 24,418 m3 of natural gas usage, and for the efficient case, the solar gains are only expected to offset 19,229 m3 of natural gas usage. This results in an overall gas usage increase of 5,182 m3.

It should be noted that due to the nature of the template, which requires the user to overwrite the inputs for the analysis multiple times, the verification could not with confidence determine what values were used to calculate the original savings estimates in all cases.

TABLE 1 EX-ANTE SAVINGS ESTIMATES

	Ex ante Savings
m3 natural gas	17,748
kWh electric	0
L water	0
Incremental Cost	$350,641

The application states that the expected useful life of this measure is 20 years. Based on this EUL, and the incremental costs and savings presented above, the expected TRC for this project is -$298,619

Description of Verification

An initial site visit to verify the installation of the windows and doors was conducted on February 4, 2014. The site representative was interviewed and a walkthrough of the building was performed. The customer provided access to one rental unit for inspection of the windows as well as the heating equipment.

All of the windows and doors were found to be installed as expected. The windows and doors are installed in residential units. They were found to be double-pane, insulated glass windows with PVC frames. The operable windows were slider-style windows. The doors installed were steel-faced insulated doors.

The removed windows were not available for inspection; however, per the site representative, the windows were the original windows for the units, which were built in the 1970's. They were single-paned windows with cedar frames.

Heating for the units is met with standard efficiency (80%) forced air furnaces. No central cooling is installed; however, the site representative estimated that approximately 20% of the units install window air conditioning units.

Summary of Verification Calculations

The verification used a modified version of the Union Gas template to calculate the savings. The same calculation methodology was used; however, the template was modified to eliminate the "iterative" approach that required the overwriting of the inputs to preserve the analysis in full.

Additionally, no changes were made to the U-values or areas for the baseline or installed windows. The removed windows were aluminum faced cedar framed windows, with exterior storm windows. Based on this, the 0.62 U-value for the existing windows in the original analysis was reasonable. The 0.35 U-value for the proposed windows is consistent with the provided specifications and the types of windows observed.

Similarly, no change was made to the leakage rate for the existing case. The 0.7 cfm/ft value is high, however, reasonable for older windows. However, the 0.07 cfm/ft value for the installed efficient window appeared excessively low and was not supported from the provided specifications. This value was increased to 0.2 cfm/ft, which was consistent with the recommended values for leakage for new windows, as specified in the template. This value was also more consistent with expected values, based on a review of literature.

Additionally, the furnace efficiency used in the analysis was modified. The original analysis used a curve that "derated" the efficiency as the temperature increased, and the furnace was expected to be less lightly loaded. Based on this curve, at outdoor air temperatures of 63°F, the furnace was only expected to be 39% efficient. This derating appeared excessive. The verification retained the curve used in the original analysis; however, set a limit on the efficiency to not be derated below 70% efficient.

Finally, the original analysis used the entire window area as the area for the solar gains. However, a portion of this area is taken up by the window frames, which do not allow any solar heat transfer. Therefore, the verification reduced the area for the solar gains by 13%, which was estimated based on the window sizes.

No changes were made to the door savings calculations. However, the savings for the door infiltration did decrease by approximately 2%, due to the limitation on the furnace efficiency derating and the "linking" of the parameters which eliminated rounding in the analysis.

The original analysis did not claim any electric savings. The verification effort did analyze the projects for electric savings potential. For the window projects, no electric savings were credited for the infiltration or the conduction, since the temperature differential between the inside and outside was expected to be small. However, the solar gains were calculated for the summer months. For 20% of the spaces, this additional load was assumed to be met by a window air conditioning unit, with an EER of 6. The window air conditioner was only assumed to operate 500 hours per year.

It should be noted that for this project, the original analysis claimed an EUL of 20 years. However, in the original calculation workbook, they specify that 11,686 m3 of the savings is associated with the windows, which have an EUL of 20 years. The remaining 6,062 m3 of savings is associated with the door weatherstripping, which has an EUL of only 5 years. Based on this, the EUL for this project is only 14.9 years. Due to small changes in savings associated with each portion of the project, the verified EUL is slightly increased, to 15.0 years.

The verified savings for this project are given in the table below.

TABLE 2 EX-POST ENERGY SAVINGS COMPARISON

	Ex ante Savings	Verified Savings	Project Realization Rate
m3 natural gas	17,748	17,935	101.1%
kWh electric	0	423	N/A
L water	0	0	N/A
Incremental Cost	$350,641	$350,641	100%

Primary Cause for Adjustment: Unknown

Project ID#:	2013-COM-0239
Measure:	Windows
Ex Ante Savings:	9,375 m3 natural gas; 0 kWh electric, 0 L water
TRC:	-$343,641
Incremental Cost:	$386,303
Facility Usage:	Residential

Measure Description

The customer replaced 450 windows in a 61 unit townhouse complex with efficient ENERGY STAR windows.

Summary of the Ex Ante Calculations

This project involved the installation of new windows. Based on the project description, a total of 450 windows in 61 residential townhouse units were replaced. The installed window area and leakage perimeter, by orientation, is given in the table below.

	N	NE	SE	S	SW	NW
Window Area (ft^2)	783	735	1418	954	1694	1107
Window Leakage Perimeter (ft)	422	303	889	676	855	572

The leakage area is the area around the slider for the window, rather than the perimeter of the window itself.

In addition to the window size and perimeter information given above, a U-value (conduction coefficient) and leakage rate was given for the windows, for both the baseline and the efficient case. The U-values and leakage information given is listed in the table below.

	Baseline Windows	Proposed Windows
U-Value	0.5	0.31
Window Leakage Rate (cfm/ft)	0.7	0.1

The savings were calculated using a template developed for Union Gas for window projects. The template calculates the savings due to the conduction, as well as the infiltration by orientation. The calculations also account for the solar gains transmitted into the space, due to the solar heat gain coefficient for each window. Overall project savings are then calculated using the equation:

$$Savings_{Total} = Savings_{Conduction} + Savings_{Infiltration} - Added\ Usage_{Solar\ Gains}$$

To determine the savings associated with the conduction a heat load is calculated using the window area and U-value (heat transfer coefficient), and the difference in temperature between the inside space and the temperature at the design conditions, based on the specific area, using the equation:

$$Design\ Heat\ Load = U_{window}\ x\ Area_{Window}\ x\ (T_{inside} - T_{design})$$

Where:

- U_{window} is the U-value of the window, as given in the tables above.
- $Area_{window}$ is the area of all orientations of windows, as given in the tables above.
- T_{inside} is the interior space temperature, or 72°F.
- T_{design} is the outdoor air temperature at the design conditions, based on the locations. For this project, the design outdoor air temperature is -0.9°F.

This design heat load is then applied to an ASHRAE simplified bin analysis method, where the expected gas usage for the baseline and efficient new window condition is calculated for each temperature bin, using the equation:

$$Gas\ Usage_{conduction} = Design\ Heat\ Load\ x\ \frac{(T_{inside} - T_{bin-i})}{(T_{inside} - T_{design})}\ x\ \frac{Hours_{Bin-i}}{Eff_{Bin-i}}$$

In the equation above, the efficiency was changed based on the outdoor air temperature; however, no explanation or justification was given for the efficiency changes.

Similar to conduction, a design heat load was also calculated for the baseline and the efficient installed windows for infiltration. The design heat load was based on

$$Design\ Heat\ Load = Leakage\ x\ Perimeter\ x\ 1.08\ x\ (T_{inside} - T_{design})\ x\ Pressure\ Correction$$

In the above equation, the leakage is defined as a cfm per linear foot of perimeter. Additionally, the 1.08 is a factor to account for units and for density, where the resulting design heat load is in BTUs per hour. The pressure correction factor is used to correct for the differences in observed pressure on the windows due to wind versus the leakage at the rating pressure for the windows, and is simply a ratio of the wind pressure expected by location based on the average wind speed and the rating pressure for window leakage (0.3 in W.C.).

This value is then use similarly to the conduction heat loss using the equation below:

$$Gas\ Usage_{conduction} = \sum_{i=-22}^{68} Design\ Heat\ Load\ x\ \frac{(T_{inside} - T_{bin-i})}{(T_{inside} - T_{design})}\ x\ \frac{Hours_{Bin-i}}{Eff_{Bin-i}}$$

Where:

- *i* is the average temperature for each temperature bin for the ASHRAE simplified bin analysis, ranging from -13°F to 63.5°F, in 4.5°F increments.
- $Hours_{Bin-i}$ is the hours per year that occur within the temperature bin with an average temperature of i, based on typical meteorological year data.
- Eff_{Bin-i} is the heating efficiency at the bin temperature i. The heating efficiency is 80% for the lowest temperature, but decreases to 37% at the highest bin. No explanation or justification w as given for the efficiency curve used.

Similar to conduction, a design heat load for each direction was also calculated for the baseline and the efficient installed windows for infiltration. The design heat load was based on

$$Design\ Heat\ Load_{Direction-j} = Leakage_j\ x\ Perimeter_j\ x\ 1.08\ x\ \left(T_{inside} - T_{design}\right)\ x\ Pressure\ Correction$$

Where:

- *j* specifies the direction (N, S, E, W) that the installed windows face. A separate design heat load is calculated for each direction.
- *Leakage* is the window leakage rate for the windows facing orientation j, in cfm/ft, as given in the tables above
- *Perimeter* is the leakage perimeter for all windows facing orientation j, in ft., as given in the tables above.

In the above equation, the leakage is defined as a cfm per linear foot of perimeter. Additionally, the 1.08 is a factor to account for units and for density, where the resulting design heat load is in BTUs per hour. The pressure correction factor is used to correct for the differences in observed pressure on the windows due to wind versus the leakage at the rating pressure for the windows, and is simply a ratio of the wind pressure expected by location based on the average wind speed and the rating pressure for window leakage (0.3 in W.C.). For this location, the expected wind velocity is 13 mpg, resulting in a wind pressure of 0.09 in W.C.

The gas usage resulting from infiltration in each direction can then be calculated:

$$Gas\ Usage_{infiltration-j} = Design\ Heat\ Load_{Direction-j}\ x\ \frac{\left(T_{inside} - T_{bin-i}\right)}{\left(T_{inside} - T_{design}\right)}\ x\ \frac{Hours_{Bin-i}}{Eff_{Bin-i}}\ x\ \%Wind_{Direction-j}$$

In the equation above, the $\%Wind_{Direction-j}$ factor accounts for the percent of time that the wind is blowing from the direction j, that the window is facing. This value is determined based on location, from typical meteorological data.

The gas usages are then summed for all directions to determine the total usage associated with the infiltration levels. For this project, the total gas usage for the base case windows was 1,534 m3, and the total gas usage for the infiltration in the efficient case windows was 655 m3. This results in a total reduction in gas usage of 879 m3, due to reduced infiltration.

Radiation heat gains are calculated by month. To determine the heat gain due to radiation, the incident solar radiation (BTU/sf), by month, is multiplied by the area of the windows, by an orientation factor, and the area by orientation, as given in the equation below:

$$Solar\ Gain = \ Incident\ Solar\ x\ Area\ x\ Orientation\ Factor\ x\ Clearness\ Fraction\ x\ SC$$

Where:

- *Incident solar* specifies the incident solar radiation is based on the location, and is interpolated from 1997 ASHRAE Fundamentals Handbook.
- The area is the total window area, as given in the tables above.
- *Clearness fraction* is based on the location, and specifies the percent of incident solar radiation that is not blocked by the atmosphere and cloud cover. This data is taken from NASA surface meteorology and solar energy data.
- *SC* is the window shading coefficient. This is a property of the installed windows, and is essentially the percentage of incident solar radiation that is passed to the interior space.

For the base case, the solar gain are expected to offset 24,883 m3 of natural gas usage, and for the efficient case, the solar gains are only expected to offset 23,328 m3 of natural gas usage. This results in an overall gas usage increase of 1,555 m3.

It should be noted that due to the nature of the template, which requires the user to overwrite the inputs for the analysis multiple times, the verification could not with confidence determine what values were used to calculate the original savings estimates in all cases.

TABLE 1 EX-ANTE SAVINGS ESTIMATES

	Ex ante Savings
m3 natural gas	9,375
kWh electric	0
L water	0
Incremental Cost	$386,303

The application states that the expected useful life of this measure is 20 years. Based on this EUL, and the incremental costs and savings presented above, the expected TRC for this project is -$343,641.

Description of Verification

An initial site visit to verify the installation of the windows was conducted on February 7, 2014. The site representative was interviewed and a walkthrough of the building was performed. The customer provided access to one rental unit for inspection of the windows as well as the heating equipment.

All of the windows were found to be installed as expected. The windows are installed in residential units. They were found to be double-pane, argon-filled, insulated glass windows with vinyl frames. The operable windows were slider-style windows.

The removed windows were not available for inspection; however, per the site representative, the windows were the original windows for the units, which were built in 1994. They were double-pane, aluminum framed windows.

Heating for the units is met with standard efficiency (80%) forced air furnaces. No central cooling is installed; however, the site representative estimated that approximately 15% of the units install window air conditioning units.

Summary of Verification Calculations

The verification used a modified version of the Union Gas template to calculate the savings. Essentially, the same calculation methodology was used; however, the template was modified to eliminate the "iterative" approach that required the overwriting of the inputs to preserve the analysis in full.

Additionally, no changes were made to the U-values or areas for the baseline or installed windows. The removed windows were double-pane aluminum windows. It was assumed that the aluminum windows had a thermal break due to the age. Based on this, the 0.5 U-value for the existing windows in the original analysis was reasonable. The 0.31 U-value for the proposed windows is consistent with the provided specifications.

Similarly, no change was made to the leakage rate for the existing case. The 0.7 cfm/ft value is high; however, reasonable for older windows. However, the original analysis appeared to use a 0.3 cfm/ft leakage rate for the proposed windows. This value was not consistent with the provided specification sheets, which indicated a lower leakage rate, at 0.1 cfm/ft.

Additionally, the furnace efficiency used in the analysis was modified. The original analysis used a curve that "derated" the efficiency as the temperature increased, and the furnace was expected to be less lightly loaded. Based on this curve, at outdoor air temperatures of 63°F the furnace was only expected to be 37% efficient. This derating appeared excessive. The verification retained the curve used in the original analysis; however, set a limit on the efficiency to not be derated below 70% efficient.

The original analysis used the entire window area as the area for the solar gains. However, a portion of this area is taken up by the window frames, which do not allow any solar heat transfer. Therefore, the verification reduced the area for the solar gains by 13%, which was estimated based on the window sizes.

Finally, no changes were made to the baseline window shading coefficient of 0.8. However, the original analysis assumed a proposed case shading coefficient of 0.75. This was inconsistent with the provided specification sheets, which indicate a shading coefficient of 0.63.

The original analysis did not claim any electric savings. The verification effort did analyze the projects for electric savings potential. For the window projects, no electric savings were credited for the infiltration or the conduction, since the temperature differential between the inside and outside was expected to be small. However, the solar gains were calculated for the summer months. For 15% of the spaces, this additional load was assumed to be met by a window air conditioning unit, with an EER of 6. The window air conditioner was only assumed to operate 500 hours per year.

The verified savings for this project are given in the table below.

TABLE 2 EX-POST ENERGY SAVINGS COMPARISON

	Ex ante Savings	Verified Savings	Project Realization Rate
m3 natural gas	9,375	5,995	63.9%
kWh electric	0	316	N/A
L water	0	0	N/A
Incremental Cost	$386,303	$386,303	100%

Primary Cause for Adjustment: Unknown

Project ID#:	2013-COM-0172
Measure:	Windows and Doors
Ex Ante Savings:	7,690 m3 natural gas; 0 kWh electric, 0 L water
TRC:	$626
Incremental Cost:	$19,500
Facility Usage:	Residential

Measure Description

The customer replaced 180 windows and 40 doors with new high performance windows and doors.

Summary of the Ex Ante Calculations

This project involved the installation of new windows. Based on the project description a total of 180 windows, and 40 doors were installed. The installed window and door area and leakage perimeter, by orientation, is given in the table below. It should be noted that because the doors are sliding patio doors, they were treated in the analysis as equivalent to a window.

	NNE	ESE	SSW	WNW
Window Area (ft^2)	873	973	656	863
Window Leakage Perimeter (ft)	501	532	394	471

The leakage area is the area around the slider for the window, rather than the perimeter of the window itself.

In addition to the window size and perimeter information given above, a U-value (conduction coefficient) and leakage rate was given for the windows, for both the baseline and the efficient case. The U-values and leakage information given is listed in the table below.

	Baseline Windows	Proposed Windows
U-Value	0.76	0.35
Window Leakage Rate (cfm/ft)	0.6	0.2

It should be noted that the leakage perimeter is the same for each orientation, even though the window areas differ due to only some of the windows. Also, no U-value information was given for the doors.

The savings were calculated using a template developed for Union Gas for window projects. The template calculates the savings due to the conduction as well as the infiltration by orientation. The calculations also account for the solar gains transmitted into the space, due to the solar heat gain coefficient for each window. Overall project savings are then calculated using the equation:

$$Savings_{Total} = Savings_{Conduction} + Savings_{Infiltration} - Added\ Usage_{Solar\ Gains}$$

To determine the savings associated with the conduction a heat load is calculated using the window area and U-value (heat transfer coefficient), and the difference in temperature between the inside space and the temperature at the design conditions, based on the specific area, using the equation:

$$Design\ Heat\ Load = U_{window}\ x\ Area_{Window}\ x\ (T_{inside} - T_{design})$$

Where:

- U_{window} is the U-value of the window, as given in the tables above.
- $Area_{window}$ is the area of all orientations of windows, as given in the tables above.
- T_{inside} is the interior space temperature, or 72°F.
- T_{design} is the outdoor air temperature at the design conditions, based on the locations. For this project, the design outdoor air temperature is 2.4°F.

This design heat load is then applied to an ASHRAE simplified bin analysis method, where the expected gas usage for the baseline and efficient new window condition is calculated for each temperature bin, using the equation:

$$Gas\ Usage_{conduction} = Design\ Heat\ Load\ x\ \frac{(T_{inside} - T_{bin-i})}{(T_{inside} - T_{design})}\ x\ \frac{Hours_{Bin-i}}{Eff_{Bin-i}}$$

In the equation above, the efficiency was changed based on the outdoor air temperature; however, no explanation or justification was given for the efficiency changes.

Similar to conduction, for infiltration a design heat load was also calculated for the baseline and the efficient installed windows. The design heat load was based on

$$Design\ Heat\ Load = Leakage\ x\ Perimeter\ x\ 1.08\ x\ (T_{inside} - T_{design})\ x\ Pressure\ Correction$$

In the above equation, the leakage is defined as a cfm per linear foot of perimeter. Additionally, the 1.08 is a factor to account for units and for density, where the resulting design heat load is in BTUs per hour. The pressure correction factor is used to correct for the differences in observed pressure on the windows due to wind versus the leakage at the rating pressure for the windows, and is simply a ratio of the wind pressure expected by location based on the average wind speed and the rating pressure for window leakage (0.3 in W.C.).

This value is then use similarly to the conduction heat loss using the equation below:

$$Gas\ Usage_{conduction} = \sum_{i=-22}^{68} Design\ Heat\ Load\ x\ \frac{(T_{inside} - T_{bin-i})}{(T_{inside} - T_{design})}\ x\ \frac{Hours_{Bin-i}}{Eff_{Bin-i}}$$

Where:

- *i* is the average temperature for each temperature bin for the ASHRAE simplified bin analysis, ranging from -13°F to 63.5°F, in 4.5°F increments.
- $Hours_{Bin-i}$ is the hours per year that occur within the temperature bin with an average temperature of i, based on typical meteorological year data.
- Eff_{Bin-i} is the heating efficiency at the bin temperature i. The heating efficiency is 80% for the lowest temperature, but decreases to 70% at the highest bin. No explanation or justification was given for the efficiency curve used.

Similar to for conduction, for infiltration a design heat load for each direction was also calculated for the baseline and the efficient installed windows. The design heat load was based on the equation:

$$Design\ Heat\ Load_{Direction-j} = Leakage_j\ x\ Perimeter_j\ x\ 1.08\ x\ (T_{inside} - T_{design})\ x\ Pressure\ Correction$$

Where:

- *j* specifies the direction (N, S, E, W) that the installed windows face. A separate design heat load is calculated for each direction.
- *Leakage* is the window leakage rate for the windows facing orientation j, in cfm/ft, as given in the tables above
- *Perimeter* is the leakage perimeter for all windows facing orientation j, in ft., as given in the tables above.

In the above equation, the leakage is defined as a cfm per linear foot of perimeter. Additionally, the 1.08 is a factor to account for units and for density, where the resulting design heat load is in BTUs per hour. The pressure correction factor is used to correct for the differences in observed pressure on the windows due to wind versus the leakage at the rating pressure for the windows, and is simply a ratio of the wind pressure expected by location based on the average wind speed and the rating pressure for window leakage (0.3 in W.C.). For this location, the expected wind velocity is 12 mpg, resulting in a wind pressure of 0.07 in W.C.

The gas usage resulting from infiltration in each direction can then be calculated:

$$Gas\ Usage_{infiltration-j} = Design\ Heat\ Load_{Direction-j}\ x\ \frac{(T_{inside} - T_{bin-i})}{(T_{inside} - T_{design})}\ x\ \frac{Hours_{Bin-i}}{Eff_{Bin-i}}\ x\ \%Wind_{Direction-j}$$

In the equation above, the $\%Wind_{Direction-j}$ factor accounts for the percent of time that the wind is blowing from the direction j, that the window is facing. This value is determined based on location, from typical meteorological data.

The gas usages are then summed for all directions to determine the total usage associated with the infiltration levels. For this project, the total gas usage for the base case windows was 709 m3, and the total gas usage for the infiltration in the efficient case windows was 416 m3. This results in a total reduction in gas usage of 293 m3, due to reduced infiltration.

Radiation heat gains are calculated by month. To determine the heat gain due to radiation, the incident solar radiation (BTU/sf), by month, is multiplied by the area of the windows, by an orientation factor, and the area by orientation, as given in the equation below:

$$Solar\ Gain = \ Incident\ Solar\ x\ Area\ x\ Orientation\ Factor\ x\ Clearness\ Fraction\ x\ SC$$

Where:

- *Incident solar* specifies the incident solar radiation is based on the location, and is interpolated from 1997 ASHRAE Fundamentals Handbook.
- The area is the total window area, as given in the tables above.
- *Clearness fraction* is based on the location, and specifies the percent of incident solar radiation that is not blocked by the atmosphere and cloud cover. This data is taken from NASA surface meteorology and solar energy data.
- *SC* is the window shading coefficient. This is a property of the installed windows, and is essentially the percentage of incident solar radiation that is passed to the interior space.

For the base case, the solar gain are expected to offset 8,242 m3 of natural gas usage, and for the efficient case, the solar gains are only expected to offset 7,600 m3 of natural gas usage. This results in an overall gas usage increase of 642 m3.

It should be noted that due to the nature of the template, which requires the user to overwrite the inputs for the analysis multiple times, the verification could not with confidence determine what values were used to calculate the original savings estimates in all cases. For this project, the verification was not able to fully recreate the original savings estimates.

TABLE 1 EX-ANTE SAVINGS ESTIMATES

	Ex ante Savings
m3 natural gas	7,690
kWh electric	0
L water	0
Incremental Cost	$19,500

The application states that the expected useful life of this measure is 20 years. Based on this EUL, and the incremental costs and savings presented above, the expected TRC for this project is $626.

Description of Verification

An initial site visit to verify the installation of the windows and doors was conducted on February 6, 2014. The site representative was interviewed and a walkthrough of the building was performed. The customer provided access to one rental unit for inspection of the windows as well as the heating equipment.

All of the windows and doors were found to be installed as expected. The windows and doors are installed in residential units. They were found to be double-pane, insulated glass windows with aluminum frames. The operable windows were slider-style windows.

The removed windows were not available for inspection, however, per the site representative, the windows were the original windows for the units, which were built in the 1980's. They were singe-paned windows with aluminum and wood frames.

Heating for the units is met with standard efficiency (80%) forced air furnaces. No central cooling is installed; however, the site representative estimated that approximately 20% of the units install window air conditioning units.

Summary of Verification Calculations

The verification used a modified version of the Union Gas template to calculate the savings. Essentially, the same calculation methodology was used; however, the template was modified to eliminate the "iterative" approach that required the overwriting of the inputs to preserve the analysis in full.

Additionally, no changes were made to the U-values or areas for the baseline windows. The removed windows were aluminum faced cedar framed windows. Based on this, the 0.76 U-value for the existing windows in the original analysis was reasonable. No specifications for the installed windows were provided, however, based on the observed aluminum windows the 0.35 U-value used in the analysis appears aggressive. The verification instead used an assumed 0.5 U-value for aluminum framed windows with thermal break.

Similarly, no change was made to the leakage rate for the existing case. The 0.6 CFM/ft value is high, however, reasonable for older windows. Similarly, the 0.2 CFM/ft value for the installed efficient windows was consistent with the recommended values for leakage for new windows, as specified in the template. This value was also consistent with expected values, based on a review of literature.

The original analysis used the entire window area as the area for the solar gains. However, a portion of this area is taken up by the window frames, which do not allow any solar heat transfer. Therefore, the verification reduced the area for the solar gains by 13%, which was estimated based on the window sizes.

Finally, the original analysis neglected to use a heating efficiency when determining the heating penalty associated with the low-e windows. The verification added in this efficiency value to the analysis, which was based on the weighted average efficiency through the year.

It should be noted that for this project, the original analysis claimed an incremental cost of $19,500. This was the incremental cost between the installed high performance windows and standard windows. However, the savings were based on the difference between the installed high performance windows and doing nothing. Therefore, the incremental cost for the verification was increased to $148,500.

The verified savings for this project are given in the table below.

TABLE 2 EX-POST ENERGY SAVINGS COMPARISON

	Ex ante Savings	Verified Savings	Project Realization Rate
m3 natural gas	7,690	5,998	78.0%
kWh electric	0	0	N/A
L water	0	0	N/A
Incremental Cost	$19,500	$148,500	761.5%

Primary Cause for Adjustment: Unknown

Project ID#:	2013-COM-0130
Measure:	VFD on ERV
Ex Ante Savings:	7,239 m3 natural gas; 0 kWh electric, 0 L water
TRC:	$5,915
Incremental Cost:	$9,720
Facility Usage:	Residential

Measure Description

The customer installed a VFD to reduce the ventilation level supplied by a 7,000 make-up air unit. The ventilation level was assumed to be reduced by 30%.

Summary of the Ex Ante Calculations

This project involved the installation of a VFD and controls for a make up air unit with integrated heat recovery. The VFD and controls will reduce the ventilation level supplied to a residential building by 30%.

The gas usage for the baseline and efficient case is calculated using an ASHRAE simplified bin analysis. The annual weather is broken down into 5°F outdoor air temperature bins. For each temperature bin (i), the gas usage is calculated using the equation:

$$Gas\ Usage_i = \sum_{i=-22}^{64} \frac{1.08\ x\ CFM\ x\ (75 - T_i)\ x\ Hrs_i}{Eff_i}\ x\ (1 - HR\%)$$

In the equation above Hrs_i is the hours per year expected to occur within the temperature bin (i). Also, the HR% is the effectiveness of the heat exchanger, or 62%. It should also be noted that the heating efficiency (Eff) is varied based on the bin temperature. At low temperatures, the heating efficiency is given as 80%. At higher temperature bins, and the heating unit is less highly loaded, the efficiency is decreased somewhat. At the highest bins in the analysis (63°F), the efficiency is reduced to 70%.

For the baseline condition, the cfm used in the analysis is 7,000 cfm, but in the proposed case, this is reduced to 4,900 cfm. The resulting savings are given in the table below.

TABLE 1 EX-ANTE SAVINGS ESTIMATES

	Ex ante Savings
m3 natural gas	7,239
kWh electric	0
L water	0
Incremental Cost	$9,720

The application states that the expected useful life of this measure is 15 years. Based on this EUL, and the incremental costs and savings presented above, the expected TRC for this project is $5,915.

Description of Verification

An initial site visit to verify the installation of the VFD controls was conducted on February 6, 2014. The site representative was interviewed and a walkthrough of the building was performed. The customer provided access to the controller for the make up air unit as well as to the make up air unit itself.

The VFD and equipment were found to be installed as expected. The speed of the VFD is controlled based on a set schedule, which is programmed into the controls. The programmed schedule is shown in the table below. All days of the week have the same schedule.

Hour	Hz	Hour	Hz	Hour	Hz	Hour	Hz
1	30	7	45	13	45	19	60
2	30	8	45	14	45	20	30
3	30	9	45	15	45	21	30
4	30	10	45	16	60	22	30
5	30	11	45	17	60	23	30
6	30	12	45	18	60	24	30

The 7,000 cfm for the unit, at full flow condition was found to be reasonable for the observed unit. Heating was provided by an indirect fired burner, which was 80% efficient. However, much of the heat is provided by the heat recovery wheel. Based on the conditions observed while onsite, the heat recovery wheel was slightly less effective than expected, at 57%.

Summary of Verification Calculations

The verification used the same approach as the ex ante analysis. However, three notable changes were made. First, based on the site observations, the heat recovery effectiveness was decreased from 62% to 57%. For a heat recovery unit with balanced flows, the heat recovery effectiveness can be calculated using the equation:

$$Effectiveness = \frac{HRT - OAT}{RAT - OAT}$$

At the time of the site visit, the air temperature of the supply airstream after the heat exchanger, but before the burner (HRT) was 9.2°C. The outdoor air temperature (OAT) was -6.7°C and the return air temperature (RAT) was 21.1°C. Inserting these values into the equation above results in an effectiveness of 57%.

Second, the discharge air temperature was decreased from 75°F to 74°F, based on the observed setpoint for the discharge air temperature during the onsite inspection.

Finally, the post-case cfm (with the VFD installed) was modified based on the verified Hz profile. To determine the average flow, with the VFD installed, the affinity relationships were used. Based on the affinity relationships, flow is proportional to speed. Therefore, the average cfm, with the VFD installed can be calculated using the equation:

$$CFM_{Post} = 7{,}000\ CFM\ x\ \frac{Average\ Scheduled\ Hz}{60\ Hz}$$

Based on the observed operation schedule, presented in the table above, the average speed (Hz) level for the system with the VFD installed is 40.6 Hz. This results in an average cfm for the system of 4,739. This is less than the 4,900 cfm assumed in the original analysis.

Additionally, the original analysis did not calculate any electrical savings. The verification effort did quantify the expected electrical savings. The installed make-up air unit had a 10 HP supply fan motor. Based on typical loading, this was assumed to be 80% loaded when running at full speed, or 6.4 kW. For each hour of the day, the proposed kW was determined based on the fan speed in the schedule and the affinity relationships. Using the approach, the electric savings are 34,718 kWh.

The verified savings for this project are given in the table below.

TABLE 2 EX-POST ENERGY SAVINGS COMPARISON

	Ex ante Savings	Verified Savings	Project Realization Rate
m3 natural gas	7,239	9,665	133.5%
kWh electric	0	34,718	N/A
L water	0	0	N/A
Incremental Cost	$9,720	$9,720	100%

Primary Cause for Adjustment: Operated or Installed Differently

Project ID#:	2013-COM-0240
Measure:	Pipe Insulation
Ex Ante Savings:	5,403 m3 natural gas; 0 kWh electric, 0 L water
TRC:	-$32,145
Incremental Cost:	$48,000
Facility Usage:	Residential

Measure Description

The customer installed pipe insulation of 5,779 ft of domestic hot water piping.

Summary of the Ex Ante Calculations

This project involved the installation of 1" insulation on domestic hot water piping for a residential building. On 967 ft of horizontal piping, the installed piping replaced existing insulation that was in poor condition. This insulation was estimated to provide only 50% of the insulation level of new insulation. On the 4,312 ft of vertical piping no insulation had been installed prior to the completion of this project. The specific lengths and orientations of piping that had insulation installed are described in the table below.

#	Component	Dimensions of		Layout
		length (feet)	diameter (in)	
1	Hot water lines	630.60	0.5"	Vertical
2	Hot water lines	147.25	0.5"	Horizontal
3	Hot water lines	2,399.40	0.75"	Vertical
4	Hot water lines	0.00	0.75"	Horizontal
5	Hot water lines	981.00	1"	Vertical
6	Hot water lines	246.50	1"	Horizontal
7	Hot water lines	197.80	1.25"	Vertical
8	Hot water lines	72.50	1.25"	Horizontal
9	Hot water lines	0.00	1.5"	Vertical
10	Hot water lines	231.50	1.5"	Horizontal
11	Hot water lines	103.20	2"	Vertical
12	Hot water lines	120.00	2"	Horizontal
13	Hot water lines	0.00	2.5"	Vertical
14	Hot water lines	112.00	2.5"	Horizontal
15	Hot water lines	0.00	3"	Vertical
16	Hot water lines	37.50	3"	Horizontal

For each pipe section in the table, a heat loss value was determined using NAIMA 3E+.

The savings were then the difference between the heat loss for the pipe with and without the insulation installed, using the equation:

$$Savings = \frac{(Heat\ Loss_{Pre} - Heat\ Loss_{Post})}{Water\ Heating\ Efficiency}\ x\ Hours\ x\ (1 - \%Heating)$$

In the equation above, the water heating efficiency used was 80% and the hour is 8,760 hours per year. The %Heating is the percent of the year that the building is expected to be in heating mode. No savings are claimed during the heating season, since it is expected that the heat loss during the heating season would displace heat that otherwise would be met by the HVAC system. Since the efficiencies are the same, no savings are expected.

TABLE 1 EX-ANTE SAVINGS ESTIMATES

	Ex ante Savings
m3 natural gas	5,403
kWh electric	0
L water	0
Incremental Cost	$48,000

The application states that the expected useful life of this measure is 20 years. Based on this EUL, and the incremental costs and savings presented above, the expected TRC for this project is -$32,145.

Description of Verification

An initial site visit to verify the installation of the pipe insulation was conducted on February 6, 2014. The site representative was interviewed and a walkthrough of the building was performed. The customer provided access to the ceiling spaces where the piping was installed as well as to the mechanical rooms with the water heating units. Additionally, the customer provided drawings of the domestic hot water piping layout. All of the pipe insulation was found to be installed as expected.

The heating for the hallway spaces is provided by the make-up air unit. The make-up air unit provides conditioned air into the hallways. No thermostats or temperature feedback for the hallways is installed. Rather, the temperature of the discharge is controlled to a setpoint. After being discharged into the hallways, the ventilation is exhausted from the kitchen and bathroom exhaust units in the apartments. Heating in the apartments is provided by electric resistance baseboard heaters.

Summary of Verification Calculations

The verification used a similar approach as the original analysis; however, several changes were made. First, the original analysis calculated the heat loss of the pipe using NAIMA 3E+, assuming a hot water temperature of 120°F and a space temperature of 76°F. Based on the onsite findings, the hot water temperature observed (at the boilers) was 140°F. For the base case, it was assumed that there would be an average temperature reduction of 10°F from that setting for the pipe. For the proposed case (because of the insulation) the temperature drop was assumed to be only 5°F. Also, because of the reduced heat loss, in the base case the ambient temperature was assumed to be 86°F, but in the proposed case, it was decreased to 80°F. The lengths of each pipe size and orientation, along with the heat loss values for the baseline and efficient cases (from NAIMA 3E+) are presented in the table below. Additionally, the resulting natural gas usage (m3) savings and kWh savings are also presented, based on a hot water heater with an 87% recovery efficiency (based on the manufacturer heater specifications) and electric resistance heating for the space.

#	Component	Dimensions of		Layout	BTU/Yr Pre (130F water/ 86F air)	BTU/Yr Post (135F water/ 80F air)	BTU/Hr Reduction	m3 Savings	kWh Savings
		length (feet)	diameter (in)						
1	Hot water lines	630.60	0.5"	Vertical	107,900	47,610	60,290	1,220	-7,145
2	Hot water lines	147.25	0.5"	Horizontal	54,060	48,020	6,040	29	-167
3	Hot water lines	2,399.40	0.75"	Vertical	134,800	57,120	77,680	5,980	-35,029
4	Hot water lines	0.00	0.75"	Horizontal	61,350	57,710	3,640	0	0
5	Hot water lines	981.00	1"	Vertical	168,900	59,520	109,380	3,443	-20,166
6	Hot water lines	246.50	1"	Horizontal	71,770	59,990	11,780	93	-546
7	Hot water lines	197.80	1.25"	Vertical	213,200	76,370	136,830	868	-5,087
8	Hot water lines	72.50	1.25"	Horizontal	89,000	77,120	11,880	28	-162
9	Hot water lines	0.00	1.5"	Vertical	244,000	77,470	166,530	0	0
10	Hot water lines	231.50	1.5"	Horizontal	99,930	78,090	21,840	162	-950
11	Hot water lines	103.20	2"	Vertical	304,900	90,600	214,300	710	-4,156
12	Hot water lines	120.00	2"	Horizontal	110,500	91,300	19,200	74	-433
13	Hot water lines	0.00	2.5"	Vertical	369,100	104,200	264,900	0	0
14	Hot water lines	112.00	2.5"	Horizontal	128,900	104,900	24,000	86	-505
15	Hot water lines	0.00	3"	Vertical	449,300	123,300	326,000	0	0
16	Hot water lines	37.50	3"	Horizontal	163,900	124,200	39,700	48	-280
Total								12,739	-74,627

It should be noted that the natural gas savings presented in the table above are much greater than the original savings estimates; however, there is a significant electrical usage increase also projected. In the original analysis, the savings were set to zero during the heating season (5,619 hours per year), since the heat loss would be offset by gas usage by the HVAC heating system. However, it was determined that there was no temperature feedback for the hallway spaces. Therefore, with less heat loss to the space from the pipes, the space would be cooler, but the gas usage would not be affected. Since the ventilation is exhausted from the apartments, the cooler air would infiltrate into the apartments, resulting in colder space temperatures in the apartments. The heating in the apartments is met by electric resistance baseboard heaters (COP=1.0). Therefore, the reduction in heat loss to the hallway space would result in an increase in electric usage for the electric heaters in the apartments, but no increase in the HVAC gas usage for the hallway make up air units. The verification analysis credits gas savings for the hot water heaters throughout the year (8,760 hours per year), but also accounts for increased electric usage during the winter months (5,619 hours per year). This change dramatically increases the gas savings.

The verified savings for this project are given in the table below.

TABLE 2 EX-POST ENERGY SAVINGS COMPARISON

	Ex ante Savings	Verified Savings	Project Realization Rate
m3 natural gas	5,403	12,739	235.8%
kWh electric	0	-72,360	N/A
L water	0	0	N/A
Incremental Cost	$48,000	$48,000	100%

Primary Cause for Adjustment: Operated or Installed Differently

Project ID#:	2013-COM-0128
Measure:	Windows
Ex Ante Savings:	4,604 m3 natural gas; 0 kWh electric, 0 L water
TRC:	-$75,892
Incremental Cost:	$91,955
Facility Usage:	Residential

Measure Description

The customer replaced 319 windows at two townhouse complexes with high performance windows.

Summary of the Ex Ante Calculations

This project involved the installation of new windows. Based on the project description a total of 319 windows were installed. The installed window area and leakage perimeter, by orientation, is given in the table below. Additionally, weatherstripping was installed around the windows to reduce leakage.

	N	E	S	W
Window Area (ft^2)	1,007	644	1,045	662
Window Leakage Perimeter (ft)	810	423	695	422
Weatherstripping Perimeter (ft)	693	1,848	3,059	1,000

The leakage area is the area around the slider for the window, rather than the perimeter of the window itself.

In addition to the window size and perimeter information given above, a U-value (conduction coefficient) and leakage rate was given for the windows, for both the baseline and the efficient case. The U-values and leakage information given is listed in the table below.

	Baseline Windows	Proposed Windows
U-Value	0.5	0.38
Window Leakage Rate (cfm/ft)	0.45-0.55	0.3

It should be noted that the leakage perimeter is the same for each orientation, even though the window areas differ due to only some of the windows. It should also be noted that it appeared than the North-facing windows were assumed to have a leakage rate of 0.55 cfm/ft, while all other orientations appeared to have a leakage rate of 0.45 cfm/ft.

The savings were calculated using a template developed for Union Gas for window projects. The template calculates the savings due to the conduction as well as the infiltration by orientation. The calculations also account for the solar gains transmitted into the space, due to the solar heat gain coefficient for each window. Overall project savings are then calculated using the equation:

$$Savings_{Total} = Savings_{Conduction} + Savings_{Infiltration} - Added\ Usage_{Solar\ Gains}$$

To determine the savings associated with the conduction a heat load is calculated using the window area and U-value (heat transfer coefficient), and the difference in temperature between the inside space and the temperature at the design conditions, based on the specific area, using the equation:

$$Design\ Heat\ Load = U_{window}\ x\ Area_{Window}\ x\ (T_{inside} - T_{design})$$

Where:

- U_{window} is the U-value of the window, as given in the tables above.
- $Area_{window}$ is the area of all orientations of windows, as given in the tables above.
- T_{inside} is the interior space temperature, or 72°F.
- T_{design} is the outdoor air temperature at the design conditions, based on the locations. For this project, the design outdoor air temperature is 2.4°F.

This design heat load is then applied to an ASHRAE simplified bin analysis method, where the expected gas usage for the baseline and efficient new window condition is calculated for each temperature bin, using the equation:

$$Gas\ Usage_{conduction} = Design\ Heat\ Load\ x\ \frac{(T_{inside} - T_{bin-i})}{(T_{inside} - T_{design})}\ x\ \frac{Hours_{Bin-i}}{Eff_{Bin-i}}$$

In the equation above, the efficiency was changed based on the outdoor air temperature; however, no explanation or justification was given for the efficiency changes.

Similar to for conduction, for infiltration a design heat load was also calculated for the baseline and the efficient installed windows. The design heat load was based on the equation:

$$Design\ Heat\ Load = Leakage\ x\ Perimeter\ x\ 1.08\ x\ (T_{inside} - T_{design})\ x\ Pressure\ Correction$$

In the above equation, the leakage is defined as a cfm per linear foot of perimeter. Additionally, the 1.08 is a factor to account for units and for density, where the resulting design heat load is in BTUs per hour. The pressure correction factor is used to correct for the differences in observed pressure on the windows due to wind versus the leakage at the rating pressure for the windows, and is simply a ratio of the wind pressure expected by location based on the average wind speed and the rating pressure for window leakage (0.3 in W.C.).

This value is then use similarly to the conduction heat loss using the equation below:

$$Gas\ Usage_{conduction} = \sum_{i=-22}^{68} Design\ Heat\ Load\ x\ \frac{(T_{inside} - T_{bin-i})}{(T_{inside} - T_{design})}\ x\ \frac{Hours_{Bin-i}}{Eff_{Bin-i}}$$

Where:

- *i* is the average temperature for each temperature bin for the ASHRAE simplified bin analysis, ranging from -13°F to 63.5°F, in 4.5°F increments.
- $Hours_{Bin-i}$ is the hours per year that occur within the temperature bin with an average temperature of i, based on typical meteorological year data.
- Eff_{Bin-i} is the heating efficiency at the bin temperature i. The heating efficiency is 80% for the lowest temperature, but decreases to 35% at the highest bin. No explanation or justification w as given for the efficiency curve used.

Similar to conduction, a design heat load for each direction was also calculated for the baseline and the efficient installed windows for infiltration. The design heat load was based on the equation:

$$Design\ Heat\ Load_{Direction-j} = Leakage_j\ x\ Perimeter_j\ x\ 1.08\ x\ (T_{inside} - T_{design})\ x\ Pressure\ Correction$$

Where:

- *j* specifies the direction (N, S, E, W) that the installed windows face. A separate design heat load is calculated for each direction.
- *Leakage* is the window leakage rate for the windows facing orientation j, in cfm/ft, as given in the tables above
- *Perimeter* is the leakage perimeter for all windows facing orientation j, in ft., as given in the tables above.

In the above equation, the leakage is defined as a cfm per linear foot of perimeter. Additionally, the 1.08 is a factor to account for units and for density, where the resulting design heat load is in BTUs per hour. The pressure correction factor is used to correct for the differences in observed pressure on the windows due to wind versus the leakage at the rating pressure for the windows, and is simply a ratio of the wind pressure expected by location based on the average wind speed and the rating pressure for window leakage (0.3 in W.C.). For this location, the expected wind velocity is 13 mpg, resulting in a wind pressure of 0.09 in W.C.

The gas usage resulting from infiltration in each direction can then be calculated:

$$Gas\ Usage_{infiltration-j} = Design\ Heat\ Load_{Direction-j}\ x\ \frac{(T_{inside} - T_{bin-i})}{(T_{inside} - T_{design})}\ x\ \frac{Hours_{Bin-i}}{Eff_{Bin-i}}\ x\ \%Wind_{Direction-j}$$

In the equation above, the $\%Wind_{Direction\text{-}j}$ factor accounts for the percent of time that the wind is blowing from the direction j, that the window is facing. This value is determined based on location, from typical meteorological data.

The gas usages are then summed for all directions to determine the total usage associated with the infiltration levels. For this project, the total gas usage for the base case windows was 846 m3, and the total gas usage for the infiltration in the efficient case windows was 597 m3. This results in a total reduction in gas usage of 249 m3, due to reduced infiltration.

This project also claimed savings for weatherstripping around the windows. For the weatherstripping, a similar analysis was completed, using the equations above and the leakage rates and perimeter values from the tables above. Based on this data, the total gas usage for the base case window was 2,393 m3, and the total gas usage for the infiltration in the efficient case windows was 379 m3. This results in a total reduction in gas usage of 2,014 m3, due to reduced infiltration.

Radiation heat gains are calculated by month. To determine the heat gain due to radiation, the incident solar radiation (BTU/sf), by month, is multiplied by the area of the windows, by an orientation factor, and the area by orientation, as given in the equation below:

$$Solar\ Gain = \ Incident\ Solar\ x\ Area\ x\ Orientation\ Factor\ x\ Clearness\ Fraction\ x\ SC$$

Where:

- *Incident solar* specifies the incident solar radiation is based on the location, and is interpolated from 1997 ASHRAE Fundamentals Handbook.
- The area is the total window area, as given in the tables above.
- *Clearness fraction* is based on the location, and specifies the percent of incident solar radiation that is not blocked by the atmosphere and cloud cover. This data is taken from NASA surface meteorology and solar energy data.
- *SC* is the window shading coefficient. This is a property of the installed windows, and is essentially the percentage of incident solar radiation that is passed to the interior space.

For the base case, the solar gains are expected to offset 11,200 m3 of natural gas usage, and for the efficient case, the solar gains are only expected to offset 10,400 m3 of natural gas usage. This results in an overall gas usage increase of 800 m3.

It should be noted that due to the nature of the template, which requires the user to overwrite the inputs for the analysis multiple times, the verification could not with confidence determine what values were used to calculate the original savings estimates in all cases.

TABLE 1 EX-ANTE SAVINGS ESTIMATES

	Ex ante Savings
m3 natural gas	4,604
kWh electric	0
L water	0
Incremental Cost	$91,955

The application states that the expected useful life of this measure is 20 years. Based on this EUL, and the incremental costs and savings presented above, the expected TRC for this project is -$75,892

Description of Verification

An initial site visit to verify the installation of the windows was conducted on February 4, 2014. The site representative was interviewed and a walkthrough of the building was performed. The customer provided access to one rental unit for inspection of the windows as well as the heating equipment.

All of the windows were found to be installed as expected. The windows are installed in residential units. They were found to be double-pane, insulated glass windows with aluminum frames. The operable windows were slider-style windows.

The removed windows were not available for inspection, however, per the site representative, the windows were the original windows for the units, which were built in approximately 1989. They were singe-paned vinyl windows.

Heating for the units is met with standard efficiency (80%) forced air furnaces. No central cooling is installed; however, the site representative estimated that approximately 70% of the units install window air conditioning units.

Summary of Verification Calculations

The verification used a modified version of the Union Gas template to calculate the savings. Essentially, the same calculation methodology was used; however, the template was modified to eliminate the "iterative" approach that required the overwriting of the inputs to preserve the analysis in full.

Additionally, no changes were made to the U-values or areas for the baseline or installed windows. The removed windows were single-pane vinyl windows. Based on this, the 0.5 U-value for the existing windows in the original analysis was reasonable. The 0.38 U-value for the proposed windows is consistent with the provided specifications and the types of windows observed.

Similarly, no change was made to the leakage rate for the existing case. The 0.45 to 0.55 cfm/ft value is low, however, reasonable for older windows. Additionally, the 0.3 cfm/ft was reasonable for non-ENERGY STAR new windows.

Additionally, the furnace efficiency used in the analysis was modified. The original analysis used a curve that "derated" the efficiency as the temperature increased, and the furnace was expected to be less lightly loaded. Based on this curve, at outdoor air temperatures of 63°F the furnace was only expected to be 35% efficient. This derating appeared excessive. The verification retained the curve used in the original analysis; however, set a limit on the efficiency to not be derated below 70% efficient.

Finally, the original analysis used the entire window area as the area for the solar gains. However, a portion of this area is taken up by the window frames, which do not allow any solar heat transfer. Therefore, the verification reduced the area for the solar gains by 13%, which was estimated based on the window sizes.

The original analysis did not claim any electric savings. The verification effort did analyze the projects for electric savings potential. For the window projects, no electric savings were credited for the infiltration or the conduction, since the temperature differential between the inside and outside was expected to be small. However, the solar gains were calculated for the summer months. For 70% of the spaces, this additional load was assumed to be met by a window air conditioning unit, with an EER of 6. The window air conditioner was only assumed to operate 500 hours per year.

The verified savings for this project are given in the table below.

TABLE 2 EX-POST ENERGY SAVINGS COMPARISON

	Ex ante Savings	Verified Savings	Project Realization Rate
m3 natural gas	4,604	4,614	100.2%
kWh electric	0	227	N/A
L water	0	0	N/A
Incremental Cost	$91,955	$91,955	100%

Primary Cause for Adjustment: Unknown

Project ID#:	2013-COM-0016
Measure:	Pipe Insulation
Ex Ante Savings:	2,541 m3 natural gas; 0 kWh electric, 0 L water
TRC:	-$108,669
Incremental Cost:	$121,050
Facility Usage:	Residential

Measure Description

The customer installed pipe insulation of 935 ft of domestic hot water piping.

Summary of the Ex Ante Calculations

This project involved the installation of 1” insulation on domestic hot water piping for a residential building. On 235 ft of horizontal piping and 700 ft of vertical piping, no insulation had been installed prior to the completion of this project. The specific lengths and orientations of piping that had insulation installed are described in the table below.

#	**Component**	**Dimensions of**		**Layout**
		length	diameter	
		(feet)	(in)	
5	Hot water lines	540.00	1"	Vertical
6	Hot water lines	90.00	1"	Horizontal
9	Hot water lines	60.00	1.5"	Vertical
10	Hot water lines	145.00	1.5"	Horizontal
11	Hot water lines	100.00	2"	Vertical

For each pipe section in the table above, a heat loss value was determined using NAIMA 3E+.

The savings were then the difference between the heat loss for the pipe with and without the insulation installed, using the equation:

$$Savings = \frac{(Heat\ Loss_{Pre} - Heat\ Loss_{Post})}{Water\ Heating\ Efficiency}\ x\ Hours\ x\ (1 - \%Heating)$$

In the equation above, the water heating efficiency used was 80% and the hour is 8,760 hours per year. The %Heating is the percent of the year that the building is expected to be in heating mode. No savings are claimed during the heating season, since it is expected that the heat loss during the heating season would displace heat that otherwise would be met by the HVAC system. Since the efficiencies are the same, no savings are expected.

TABLE 1 EX-ANTE SAVINGS ESTIMATES

	Ex ante Savings
m3 natural gas	2,541
kWh electric	0
L water	0
Incremental Cost	$121,050

The application states that the expected useful life of this measure is 20 years. Based on this EUL, and the incremental costs and savings presented above, the expected TRC for this project is -$108,669.

Description of Verification

An initial site visit to verify the installation of the pipe insulation was conducted on February 6, 2014. The site representative was interviewed and a walkthrough of the building was performed. The customer provided access to the ceiling spaces where the piping was installed, as well as to the mechanical rooms with the water heating units. Additionally, the customer provided drawings of the domestic hot water piping layout. All of the pipe insulation was found to be installed as expected.

The heating for the hallway spaces is provided by the make-up air unit. The make-up air unit provides conditioned air into the hallways. No thermostats or temperature feedback for the hallways is installed; rather, the temperature of the discharge is controlled to a setpoint. After being discharged into the hallways, the ventilation is exhausted from the kitchen and bathroom exhaust units in the apartments. Heating in the apartments is provided by an 80% efficient hot water boiler.

Summary of Verification Calculations

The verification used a similar approach as the original analysis however several changes were made. First, the original analysis calculated the heat loss of the pipe using NAIMA 3E+, assuming a hot water temperature of 120°F and a space temperature of 76°F for all piping. However, based on the onsite findings, the hot water temperature setpoint observed (at the boilers) was 140°F. In the base case in the verification analysis, it was assumed that the average water temperature of the system would be 10°F colder than the setpoint. For the proposed case, because of the insulation, less heat loss from the piping is expected and the water temperature is expected to be warmer than without the insulation. The verification analysis assumed a temperature drop of only 5°F, for a water temperature of 135°F.

The space temperatures were adjusted in the verification analysis. The original analysis assumed a space temperature of 76°F. This was reasonable for the space, however, the horizontal piping was located in a space above the suspended ceiling and the vertical piping was located in encloses spaces in the wall construction. The verification assumed that due to the low heat loss in the proposed case, the 76°F temperature was reasonable, however in the base case, the ambient temperature of the ceiling area was assumed to be 81°F and the wall spaces were assumed to be 89°F.

Based on the customer supplied piping diagrams, it appeared that the pipe sizes claimed were inconsistent with the actual pipe sizes. The lengths of each pipe size and orientation, along with the heat loss values for the baseline and efficient cases (from NAIMA 3E+) are presented in the table below. Additionally, the resulting natural gas usage (m3) savings and kWh savings are also presented, based on a hot water heater with an 80% recovery efficiency (based on the manufacturer heater specifications) and electric resistance heating for the space. Similar to the original analysis, the savings were set to zero during the heating season (5,619 hours per year), since the heat loss would be offset by gas usage by the HVAC heating system.

#	**Component**	**Dimensions of**		**Layout**	**BTU/Yr Pre (130F water/ 81F air)**	**BTU/Yr Pre (130F water/ 89F air)**	**BTU/Yr Post (135F water/ 76F air)**	**BTU/Hr Reduction**	**m3 Savings**
		length (feet)	diameter (in)						
1	Hot water lines	210	3/4"	Vertical		164,800	61,057	103,743	257
2	Hot water lines	0	3/4"	Horizontal	247,032		61,670	185,362	0
5	Hot water lines	140	1"	Vertical		206,300	63,590	142,710	235
6	Hot water lines	90	1"	Horizontal	301,100		64,090	237,010	251
9	Hot water lines	100	1.25"	Vertical		260,500	82,760	177,740	209
10	Hot water lines	145	1.25"	Horizontal	382,400		83,440	298,960	511
11	Hot water lines	0	2"	Vertical		372,700	96,790	275,910	0
Total									1,464

Due to the smaller pipe sizes, the savings for the project were reduced. Although the cause of the discrepancy is unclear, it is possible that the pipe diameters claimed were based on a measured outer diameter of the pipe rather than the pipe size. Due to the smaller pipe size, the natural gas savings presented in the table above are less than the original estimates.

The original analysis did not claim any electric savings. The verification effort did analyze the projects for electric savings potential. For 20% of the spaces, this additional load was assumed to be met by a window air conditioning unit, with an EER of 6. The window air conditioner was only assumed to operate 500 hours per year.

The verified savings for this project are given in the table below.

TABLE 2 EX-POST ENERGY SAVINGS COMPARISON

	Ex ante Savings	Verified Savings	Project Realization Rate
m3 natural gas	2,541	1,464	57.6%
kWh electric	0	385	N/A
L water	0	0	N/A
Incremental Cost	$121,050	$121,050	100%

Primary Cause for Adjustment: Inappropriate Assumption

Project ID#:	2013-COM-0263
Measure:	Windows
Ex Ante Savings:	654 m3 natural gas; 0 kWh electric, 0 L water
TRC:	-$30,547
Incremental Cost:	$33,869
Facility Usage:	Residential

Measure Description

The customer replaced the windows in a number of townhouses. A total of 91 windows were replaced, however, these replacements took place at three different addresses. This project accounts for the windows installed at one of the three locations, assumed to be one third of the total windows installed.

Summary of the Ex Ante Calculations

This project involved the installation of new windows. The installed window area and leakage perimeter, by orientation, for all three locations, is given in the table below.

	NNE	ESE	SSW	WNW
Window Area (ft^2)	250	190	618	231
Window Leakage Perimeter (ft)	205	151	349	114

The leakage area is the area around the slider for the window, rather than the perimeter of the window itself.

In addition to the window size and perimeter information given above, a U-value (conduction coefficient) and leakage rate was given for the windows, for both the baseline and the efficient case. The U-values and leakage information given is listed in the table below.

	Baseline Windows	Proposed Windows
U-Value	0.5	0.37
Window Leakage Rate (cfm/ft)	0.6	0.3

The savings were calculated using a template developed for Union Gas for window projects. The template calculates the savings due to the conduction as well as the infiltration by orientation. The calculations also account for the solar gains transmitted into the space, due to the solar heat gain coefficient for each window. Overall project savings are then calculated using the equation:

$$Savings_{Total} = Savings_{Conduction} + Savings_{Infiltration} - Added\ Usage_{Solar\ Gains}$$

To determine the savings associated with the conduction a heat load is calculated using the window area and U-value (heat transfer coefficient), and the difference in temperature between the inside space and the temperature at the design conditions, based on the specific area, using the equation:

$$Design\ Heat\ Load = U_{window}\ x\ Area_{Window}\ x\ (T_{inside} - T_{design})$$

Where:

- U_{window} is the U-value of the window, as given in the tables above.
- $Area_{window}$ is the area of all orientations of windows, as given in the tables above.
- T_{inside} is the interior space temperature, or 72°F.
- T_{design} is the outdoor air temperature at the design conditions, based on the locations. For this project, the design outdoor air temperature is -11.1°F for the base case windows and -0.9°F for the high performance windows.

This design heat load is then applied to an ASHRAE simplified bin analysis method, where the expected gas usage for the baseline and efficient new window condition is calculated for each temperature bin, using the equation:

$$Gas\ Usage_{conduction} = Design\ Heat\ Load\ x\ \frac{(T_{inside} - T_{bin-i})}{(T_{inside} - T_{design})}\ x\ \frac{Hours_{Bin-i}}{Eff_{Bin-i}}$$

In the equation above, the efficiency was changed based on the outdoor air temperature; however, no explanation or justification was given for the efficiency changes.

Similar to conduction, a design heat load was also calculated for the baseline and the efficient installed windows for infiltration. The design heat load was based on

$$Design\ Heat\ Load = Leakage\ x\ Perimeter\ x\ 1.08\ x\ (T_{inside} - T_{design})\ x\ Pressure\ Correction$$

In the above equation, the leakage is defined as a cfm per linear foot of perimeter. Additionally, the 1.08 is a factor to account for units and for density, where the resulting design heat load is in BTUs per hour. The pressure correction factor is used to correct for the differences in observed pressure on the windows due to wind versus the leakage at the rating pressure for the windows, and is simply a ratio of the wind pressure expected by location based on the average wind speed and the rating pressure for window leakage (0.3 in W.C.).

This value is then use similarly to the conduction heat loss using the equation below:

$$Gas\ Usage_{conduction} = \sum_{i=-22}^{68} Design\ Heat\ Load\ x\ \frac{(T_{inside} - T_{bin-i})}{(T_{inside} - T_{design})}\ x\ \frac{Hours_{Bin-i}}{Eff_{Bin-i}}$$

Where:

- *i* is the average temperature for each temperature bin for the ASHRAE simplified bin analysis, ranging from -22°F to 63.5°F, in 4.5°F increments.
- *Hours*$_{Bin-i}$ is the hours per year that occur within the temperature bin with an average temperature of i, based on typical meteorological year data.
- *Eff*$_{Bin-i}$ is the heating efficiency at the bin temperature i. The heating efficiency is 80% for the lowest temperature, but decreases to 12% at the highest bin. No explanation or justification w as given for the efficiency curve used.

Similar to conduction, a design heat load for each direction was also calculated for the baseline and the efficient installed windows for infiltration. The design heat load was based on the equation:

$$Design\ Heat\ Load_{Direction-j} = Leakage_j\ x\ Perimeter_j\ x\ 1.08\ x\ \left(T_{inside} - T_{design}\right)\ x\ Pressure\ Correction$$

Where:

- *j* specifies the direction (N, S, E, W) that the installed windows face. A separate design heat load is calculated for each direction.
- *Leakage* is the window leakage rate for the windows facing orientation j, in cfm/ft, as given in the tables above
- *Perimeter* is the leakage perimeter for all windows facing orientation j, in ft., as given in the tables above.

In the above equation, the leakage is defined as a cfm per linear foot of perimeter. Additionally, the 1.08 is a factor to account for units and for density, where the resulting design heat load is in BTUs per hour. The pressure correction factor is used to correct for the differences in observed pressure on the windows due to wind versus the leakage at the rating pressure for the windows, and is simply a ratio of the wind pressure expected by location based on the average wind speed and the rating pressure for window leakage (0.3 in W.C.). For this location, the expected wind velocity is 5 mpg, resulting in a wind pressure of 0.06 in W.C..

The gas usage resulting from infiltration in each direction can then be calculated:

$$Gas\ Usage_{infiltration-j} = Design\ Heat\ Load_{Direction-j}\ x\ \frac{\left(T_{inside} - T_{bin-i}\right)}{\left(T_{inside} - T_{design}\right)}\ x\ \frac{Hours_{Bin-i}}{Eff_{Bin-i}}\ x\ \%Wind_{Direction-j}$$

In the equation above, the %Wind$_{\text{Direction-j}}$ factor accounts for the percent of time that the wind is blowing from the direction j, that the window is facing. This value is determined based on location, from typical meteorological data.

The gas usages are then summed for all directions to determine the total usage associated with the infiltration levels. For this project, the total gas usage for the base case windows was 267 m3, and the total gas usage for the infiltration in the efficient case windows was 145 m3. This results in a total reduction in gas usage of 123 m3, due to reduced infiltration.

Radiation heat gains are calculated by month. To determine the heat gain due to radiation, the incident solar radiation (BTU/sf), by month, is multiplied by the area of the windows, by an orientation factor, and the area by orientation, as given in the equation below:

$$Solar\ Gain = \ Incident\ Solar\ x\ Area\ x\ Orientation\ Factor\ x\ Clearness\ Fraction\ x\ SC$$

Where:

- *Incident solar* specifies the incident solar radiation is based on the location, and is interpolated from 1997 ASHRAE Fundamentals Handbook.
- The area is the total window area, as given in the tables above.
- *Clearness fraction* is based on the location, and specifies the percent of incident solar radiation that is not blocked by the atmosphere and cloud cover. This data is taken from NASA surface meteorology and solar energy data.
- *SC* is the window shading coefficient. This is a property of the installed windows, and is essentially the percentage of incident solar radiation that is passed to the interior space.

For the base case, the solar gain are expected to offset 6,322 m3 of natural gas usage, and for the efficient case, the solar gains are only expected to offset 5,927 m3 of natural gas usage. This results in an overall gas usage increase of 395 m3.

It should be noted that due to the nature of the template, which requires the user to overwrite the inputs for the analysis multiple times, the verification could not with confidence determine what values were used to calculate the original savings estimates in all cases.

TABLE 1 EX-ANTE SAVINGS ESTIMATES

	Ex ante Savings
m3 natural gas	654
kWh electric	0
L water	0
Incremental Cost	$33,869

The application states that the expected useful life of this measure is 20 years. Based on this EUL, and the incremental costs and savings presented above, the expected TRC for this project is -$30,547

Description of Verification

This project was verified through a phone interview, completed on February 19, 2014. Upon review, this project had low uncertainty and low savings levels. The customer representative as well as the engineer was interviewed. Additionally, the site was "virtually inspected" through a review of online images of the facility as well as satellite imagery to verify window sizes and orientations.

Based on that interview, all of the windows were found to be installed as expected. The windows are installed in residential units. They were found to be double-pane, insulated glass windows with wood frames. The operable windows were slider-style windows.

Per the site representative, the windows were the original windows for the units, and were double-panes vinyl windows.

Heating for the units is met with standard efficiency (80%) forced air furnaces. No central cooling is installed; however, the site representative estimated that approximately 10% of the units install window air conditioning units.

Summary of Verification Calculations

The verification used a modified version of the Union Gas template to calculate the savings. Essentially, the same calculation methodology was used; however, the template was modified to eliminate the "iterative" approach that required the overwriting of the inputs to preserve the analysis in full.

Additionally, no changes were made to the U-values for the baseline or installed windows. The removed windows were double-pane vinyl windows. Based on this, the 0.5 U-value for the existing windows in the original analysis was high, but not unreasonable. The 0.37 U-value for the proposed windows is was inconsistent with the provided specifications, which indicated a U-value of 0.31.

Similarly, no change was made to the leakage rate for the existing case. The 0.6 cfm/ft value is high, however, reasonable for older windows. Also, the 0.3 cfm/ft value for the proposed windows was consistent with the recommended values for leakage for new windows, as specified in the template. This value was also consistent with expected values, based on a review of literature.

The area for the project was modified. The original analysis examined the windows installed at three locations (the location included in this project and two additional locations). The savings were split evenly among the sites. However, based on the provided data, the area installed at this location was less than installed at the other sites. The window area for the original and verification analysis is given in the table below.

	NNE	ESE	SSW	WNW
Original Window Area (ft^2)	250	190	618	231
Original Site Window Area (ft^2)	83.3	63.3	206	77
Verified Site Window Area (ft^2)	54.6	0	46.3	0

Additionally, the furnace efficiency used in the analysis was modified. The original analysis used a curve that "derated" the efficiency as the temperature increased, and the furnace was expected to be less lightly loaded. Based on this curve, at outdoor air temperatures of 63°F the furnace was only expected to be 12% efficient. This derating appeared excessive. The verification retained the curve used in the original analysis; however, set a limit on the efficiency to not be derated below 70% efficient.

Changes were made to the window shading coefficient for both the baseline and proposed cases. For the baseline case, the shading coefficient was decreased from the assumed value of 0.8 to 0.65, based on the customer description of these windows being double-paned. For the proposed case, the shading coefficient was decreased from 0.75 used in the original analysis to 0.61, based on the supplied documentation.

Finally, the original analysis used the entire window area as the area for the solar gains. However, a portion of this area is taken up by the window frames, which do not allow any solar heat transfer. Therefore, the verification reduced the area for the solar gains by 13%, which was estimated based on the window sizes.

It should be noted that there was a calculation error in the original analysis. The heat loads calculated for the baseline condition assume a design temperature of -11°F, however, the proposed case design temperature is -0.9°F.

The changes made nearly completely cancel out. The verified savings for this project are given in the table below.

The original analysis did not claim any electric savings. The verification effort did analyze the projects for electric savings potential. For the window projects, no electric savings were credited for the infiltration or the conduction, since the temperature differential between the inside and outside was expected to be small. However, the solar gains were calculated for the summer months. For 20% of the spaces, this additional load was assumed to be met by a window air conditioning unit, with an EER of 6. The window air conditioner was only assumed to operate 500 hours per year.

TABLE 2 EX-POST ENERGY SAVINGS COMPARISON

	Ex ante Savings	Verified Savings	Project Realization Rate
m3 natural gas	654	161	24.6%
kWh electric	0	1	N/A
L water	0	0	N/A
Incremental Cost	$33,869	$7,951	23.5%

Primary Cause for Adjustment: Unknown

Appendix O: Engineering Review of 2013 Commercial/Industrial Custom Projects Review of Random Sample Files

Engineering Review of
2013 Commercial/Industrial Custom Projects
Review of Random Sample Files

FINAL Report

April 29, 2014 *(supersedes April 14,2014 submission)*

Prepared for:

unionigas
A Spectra Energy Company

Union Gas Limited
DSM Research and Evaluation Department
2901 - 777 Bay Street | Toronto, ON M5G 2C8

Prepared by:

Byron Landry, P. Eng., CEM, CEA

BYRON J. LANDRY
& ASSOCIATES INC.
1498 York Mills Drive | Ottawa, ON K4A 2N4

Table of Contents

EXECUTIVE SUMMARY

Byron J. Landry & Associates Inc. was contracted by Union Gas Limited to complete an engineering review of (21) Custom Application Commercial/Industrial Energy Efficiency Projects spanning the Year 2013 and the results are presented in this report.

The objectives of these reviews are to verify that the energy efficiency projects were installed and are operational, and to estimate the gas volume savings of the projects as implemented compared to the estimated savings in the project application submission.

It is noted that this assignment was completed within the stated scope of work and does not constitute a detailed engineering study. This assignment was limited to observations at readily accessible locations, interviews with site personnel and a review of data provided.

Because of the variability of energy rates, this report is based on projected savings in units of energy (i.e. cubic meters of natural gas).

The results of the Year 2013 review of the sample files are summarized in the table on the following page, for reference. Overall, a downward adjustment of 231,200 m^3/yr (-1.1% overall variance) for natural gas savings was made. Overall net adjustments to measure life, however, have yielded an upward adjustment of 3,850,612 m^3 of cumulative natural gas savings (+2.2% overall variance).

For all cases reviewed, the customer's site contacts expressed satisfaction regarding the installation and operation of the implemented measures and the level of technical/financial support they have received from Union Gas. In general, the energy saving projections in the Custom Application files were well supported with background documentation that was based on sound engineering practice. In some of the reviews, additional information from plant energy information systems (PLC, DCS, SCADA) needed to be requested on site to view key operating parameters which formed the basis of the calculation summaries that were presented in the Union Gas file. Since this type of data is only available post-installation for the energy measure, this emphasizes the value of a mandatory site visit in the review process.

The (3) projects that experienced considerable downward adjustment in natural gas savings projections are explained as follows:

CI08 - 2013-IND-0046

Due to an increase in gas consumption at the dryer (that is attached to the air preheater) over a broad range of production volumes, a review of most recent Year 2013 energy intensity data revealed that a deterioration occurred in dryer performance over the first year in service. An adjustment to the savings claim is made on the basis of the revised calculations and updated data, until the full performance level can be restored following maintenance to investigate and remediate the cause of the reduced performance.

CI07 - 2013-IND-0037

The reviewer found two aspects of the analysis that warranted adjustment. The insulation analysis on the hot oil pipes assumes a constant 450°F fluid temperature for the entire year. During the site visit, while the plant was in winter operating mode, observed hot oil temperature was 395 °F. Plant management confirmed that this is indicative of winter operation for at least [redacted] of the year, prior to ramping up in [redacted]. Since the heat loss coefficients used in the analysis are dependent on pipe fluid temperature, readjustments were made to reflect a nominal 400°F hot oil temperature for [redacted] months. The second aspect that warranted adjustment concerns the heat loss coefficients that were input for the ½" insulation Base Case appeared to be too high. The reviewer re-calculated new heat loss coefficients (factoring monthly average ambient temperatures and wind speeds originally used in the analysis).

CI16 - 2013-COM-0026

([redacted] for this enterprise may have altered the direction of future types of grain handling, lower than those originally identified in the project file). The file calculations were based on future anticipated throughput of a variety of grains, including [redacted]. A review of production data on site confirmed that no wheat or soy was processed and only [redacted] was expected to be received in the next few years (at approximately 2013 throughput levels). This automatically reduces the major component of energy savings projected in the project file. The savings calculations also are also based on the expectation that the manufacturer's published fuel input per lb of H_2O evaporated would be achieved in practice. Revised coefficients were applied, based on actual metered and archived production data obtained during the site survey.

It should be noted that (2) projects were found to be out of service during the site visit. Related details are outlined as follows:

(CI08 - 2013-IND-0045)

Due to safety issues, the equipment had to be removed from service until valving and lockout safeties are installed on *associated* piping. This prompted the reviewer to request a written commitment from the Customer as to if and when this equipment will be returned to service. The Customer has responded with a written confirmation that the necessary engineering drawings, parts procurement and TSSA approval have been received to allow the plant to proceed with remedial work. The estimated time frame stated by the Customer places the likely reinstatement back to service within one year of the initial downtime. Given that the energy performance of the system was tracking expectations prior to the removal from service and given the strong likelihood that this equipment should be returned to service, there is no compelling reason to adjust the *annual* savings estimate at this time. The one year downtime, however, does trigger a corresponding one year downward adjustment to measure life (EUL).

CI15 - 2013-IND-0042

A heat exchanger that formed a key component of the energy savings was found to be out of service due to the re-emergence of leakage in its coil. In order to gauge the likelihood of this situation being remediated, the reviewer requested written confirmation from the Customer regarding their efforts to return this equipment to service. The Customer responded in writing that a replacement heat exchanger has been acquired and then stated their expectations that the work would be completed by the end of April 2014. The downtime incurred to date prompts the reviewer to reduce the EUL from 20 years to 19.5 years.

Feedback received from the sites reinforce the view that the Union Gas DSM Programs continue to be well managed and all customers acknowledged that these incentive programs were key to overcoming internal capital constraint barriers to implementing the energy efficiency projects in their organizations. In many cases, this support has motivated businesses to select higher initial cost, energy efficient technologies over conventional designs or to probe deeper into their operating behavior to realize improved life cycle performance through energy efficiency. Additional positive feedback includes the following:

- Union Gas customer reps know the industrial setting and context. This increases customer confidence in the assistance being received.
- The interface between Union Gas customer reps and the plant contacts is perceived as an extension of the plant's "Energy Team", offering an educational aspect that the plant would not otherwise have access to under the current environment of limited time and resources.
- Union Gas is equipped with the portable measurement devices (eg. combustion analyzers) that the plant would not likely have.

Estimates of equipment useful life were generally in conformance with industry accepted values and reference sources. The review resulted in (4) projects being adjusted downward and (2) projects being adjusted upwards, as illustrated in the following summary Table.

With respect to claimed savings on other utilities, an upward adjustment of 7,978 kWh/yr for electricity and 147,696 L of water savings was made, on the basis of observed lower condensate return rate (and higher steam leakage) on project CI17-2013-IND-0064.

2014 Independent Review of Random Sample Custom Commercial & Industrial Projects (Union Gas)

Union Gas Project	Sector	Measure	Equipment Useful Life (yrs)		Annual Savings			Overall Cumulative Savings		
					Natural Gas (m3)			Natural Gas (m3)		
			UG file	Reviewer Adjusted	UG file	Reviewer Adjusted	% variance	UG file	Reviewer Adjusted	% variance
CI01 - 2013-IND-0455	Manufacturing	HVAC Improvement	18		5,927,716	5,927,716		49,081,488	49,081,488	
CI02 - 2013-IND-0013	Manufacturing	[redacted] [redacted] (new boiler and process impacts)	20		2,864,979	2,864,979		26,357,807	26,357,807	
CI03 - 2013-IND-0267	Agriculture	New Greenhouse Expansion [redacted]) (Ref: Note 1)	14	18	3,085,122	3,085,122		19,868,186	25,544,810	29%
CI04 - 2013-IND-0185	Manufacturing	HVAC Improvement - Space Heating	20		1,741,055	1,741,055		16,017,706	16,017,706	
CI05 - 2013-IND-0083	Agriculture	GH - New Multi-Measure	20		1,531,967	1,531,967		14,094,096	14,094,096	
CI06 - 2013-IND-0186	Manufacturing	Line Speed Improvements	20		1,112,600	1,112,600		10,235,920	10,235,920	
CI07 - 2013-IND-0037	Manufacturing	Tank & Hot Oil Pipe Insulation	20		889,373	830,131	-7%	8,182,232	7,637,205	-7%
CI08 - 2013-IND-0045	Manufacturing	Starch Dryer Steam Preheat (Ref: Note 2)	20	19	651,488	651,488		5,993,690	5,694,005	-5%
CI09 - 2013-IND-0457	Manufacturing	Process Improvement	20		544,277	544,277		5,007,348	5,007,348	
CI10 - 2013-IND-0046	Manufacturing	Spray Dryer Steam Coil Preheat (Ref: Note 3)	20		472,215	402,543	-15%	4,344,378	3,703,396	-15%
CI11 - 2013-IND-0177	Agriculture	GH - New Expansion [redacted]) (Ref: Note 1)	15	18	567,304	567,304		3,914,398	4,697,277	20%
CI12 - 2013-IND-0055	Education	Pipe and Vessel Insulation	20		381,402	373,648	-2%	3,508,898	3,437,562	-2%
CI13 - 2013-COM-0162	Retail	Dock Door Seals	15		349,726	342,886	-2%	2,413,109	2,365,913	-2%
CI14 - 2013-IND-0256	Agriculture	GH - New Expansion [redacted]) (Ref: Note 1)	16	15	321,889	321,889		2,369,103	2,221,034	-6%
CI15 - 2013-IND-0042	Manufacturing	Steam Leakage Repair (Ref: Note 3)	20	19.5	178,289	158,733	-11%	1,640,259	1,423,835	-13%
CI16 - 2013-COM-0026	Agriculture	Grain Dryer Replacement	20		79,769	11,633	-85%	733,875	107,024	-85%
CI17 - 2013-IND-0064	Education	Steam Trap Replacement	7		172,935	172,935		556,851	556,851	
CI18 - 2013-IND-0196	Manufacturing	Gas Leak Repairs	20		24,260	24,260		223,192	223,192	
CI19 - 2013-COM-0149	Retail	Heat Transfer Improvement	15		25,660	25,660		177,054	177,054	
CI20 - 2013-COM-0069	Multi-Family	Window and Door Replacement (Ref: Note 4)	22	20	14,480	14,480		146,538	133,216	-9%
CI21 - 2013-COM-0101	Retail	Upgraded Roof Insulation	20		13,924	13,924		128,101	128,101	
				TOTAL	20,950,430	20,719,230	-1.1%	174,994,228	178,844,840	2.2%

Variances -231,200 m^3

Variances 3,850,612 m^3

Notes:

1. Based on weighted cost average of Mechanical vs Structural components.
2. Reflects 1 year downtime of preheater due to safety related work on auxiliary piping.
3. Savings claim is contingent on outcome of maintenance repairs, scheduled to occur after the submission of this report.
4. Adjusted to conform to Union Gas 20 year limit and consistency with reporting of other measures.

2014 Random Sample Custom Commercial & Industrial Projects Independent Review (Electricity & Water Utility Savings)

Union Gas Project	Sector	Measure	Equipment Useful Life (yrs)		Electricity (kWh)			Water (L)		
			UG file	Reviewer Adjusted	UG file	Reviewer Adjusted	% variance	UG file	Reviewer Adjusted	% variance
CI01 - 2013-IND-0455	Manufacturing	HVAC Improvement	18							
CI02 - 2013-IND-0013	Manufacturing	[redacted] (new boiler and process impacts)	20							
CI03 - 2013-IND-0267	Agriculture	New Greenhouse Expansion [redacted])	14	18						
CI04 - 2013-IND-0185	Manufacturing	HVAC Improvement - Space Heating	20							
CI05 - 2013-IND-0083	Agriculture	GH - New Multi-Measure	20							
CI06 - 2013-IND-0186	Manufacturing	Line Speed Improvements	20							
CI07 - 2013-IND-0037	Manufacturing	Tank & Hot Oil Pipe Insulation	20							
CI08 - 2013-IND-0045	Manufacturing	Starch Dryer Steam Preheat	20	19						
CI09 - 2013-IND-0457	Manufacturing	Process Improvement	20							
CI10 - 2013-IND-0046	Manufacturing	Spray Dryer Steam Coil Preheat	20							
CI11 - 2013-IND-0177	Agriculture	GH - New Expansion [redacted]	15	18						
CI12 - 2013-IND-0055	Education	Pipe and Vessel Insulation	20							
CI13 - 2013-COM-0162	Retail	Dock Door Seals	15		61,961	61,961				
CI14 - 2013-IND-0256	Agriculture	GH - New Expansion [redacted])	16	15						
CI15 - 2013-IND-0042	Manufacturing	Steam Leakage Repair	20	19.5				2,010,869	2,010,869	
CI16 - 2013-COM-0026	Agriculture	Grain Dryer Replacement	20							
CI17 - 2013-IND-0064	Education	Steam Trap Replacement	7		11,397	19,375	70%	210,995	358,691	70%
CI18 - 2013-IND-0196	Manufacturing	Gas Leak Repairs	20							
CI19 - 2013-COM-0149	Retail	Heat Transfer Improvement	15							
CI20 - 2013-COM-0069	Multi-Family	Window and Door Replacement	22	20						
CI21 - 2013-COM-0101	Retail	Upgraded Roof Insulation	20							
				TOTAL	73,358	81,336	10.9%	2,221,864	2,369,560	6.6%

Variances 7,978 kWh ***Variances*** 147,696 L

1. INTRODUCTION AND SCOPE OF REVIEW

Union Gas Limited encourages its customers to efficiently utilize natural gas. Demand Side Management (DSM) energy efficiency programs of Union Gas include educational materials, technical assistance and financial incentives. These programs offer energy efficiency audits/studies and financial support in implementing an energy management project. Industrial applications are referred to as Custom Applications Projects with the savings for each project requirement determined separately, based on project specifics.

Byron J. Landry & Associates Inc. was contracted by Union Gas Limited to complete a third party engineering review of the results of (21) Custom Applications Projects in the Industrial and Commercial sectors, applying to Year 2013.

This report provides an independent review of the Union Gas selected, random sample projects. The following are the primary objectives of this report:

- verify that the energy efficiency project was installed;
- verify that the system is operational; and
- estimate the gas volume savings of the project as implemented compared to the original project savings included in the application form.

The general approach used for the evaluation consisted of:

- review of the original application submission from which the savings were estimated;
- conduct a site visit to verify that the project was implemented, determine operating practices, collect design and operating data, discuss the project with the plant staff; and
- review available information to estimate the actual savings.

It is noted that this assignment was completed within the stated scope of work and does not constitute a detailed engineering study. It was limited to observations at readily accessible locations, interviews with site personnel and a review of data provided.

The random sampling process for Custom Application file selection for review was completed by a separate 3rd party consultant retained by Union Gas. The selected files were then forwarded to Byron J. Landry & Associates Inc. for review according to the following submission dates:

- (Q1-Q4): (21) files (January 16, 2014)

Because of the potential variability of energy rates, this report is based on projected savings in units of energy (i.e. cubic meters of natural gas).

This report is confidential and contains sensitive information about the operations of the Customers. It is intended only for internal use within Union Gas and review by its external auditor for the DSM Program.

During the development of this report, some projects warranted inclusion of an Appendix, while others did not. For instances where the supporting calculations outlined in the Union Gas file were sufficiently detailed and were deemed by the reviewer to be sound, these calculations were not repeated in an Appendix.

2. Opinion of Equipment Useful Life (EUL)

It must be emphasized that the evaluation of the sustainability or life of an energy efficiency measure is not a precise exercise. It is based on limited information and in many instances is influenced by factors that have not yet occurred. (An example would include retroactive rulings by regulatory agencies that would require immediate upgrade or replacement of equipment). The evaluation that was conducted as part of this assignment represents a *technical* judgment based on accepted industry published data, the visually observed condition of the system and previous experience with similar systems in similar applications. This assessment is contingent on the assumption that regular preventive maintenance of the system will be carried out for the duration of its estimated life.

All stated EUL's were examined, resulting in (4) projects being adjusted downward and (2) projects being adjusted upwards, according to the rationale that is outlined as follows:

CI08 - 2013-IND-0045

Due to safety issues, the equipment had to be removed from service until valving and lockout safeties are installed on associated piping. The reviewer requested, and received, a written communication from the Customer, outlining their commitment to restarting the system as well as a status update of the permit involved with piping modifications that will allow them to safely run the system. Given the estimated time frame for re-introduction back into service is approximately one month short of this equipment's removal from service, the reviewer must deduct one year of measure life from 20 years to 19 years.

CI15 - 2013-IND-0042

A heat exchanger that formed a key component of the energy savings was found to be out of service due to the re-emergence of leakage in its coil. In order to gauge the likelihood of this situation being remediated, the reviewer requested written confirmation from the Customer regarding their efforts to return this equipment to service. The Customer responded in writing that a replacement heat exchanger has been acquired and then stated their expectations that the work would be completed by the end of April 2014. The downtime incurred to date prompts the reviewer to reduce the EUL from 20 years to 19.5 years.

CI20 - 2013-COM-0069

Measure life estimate was reduced from 22 years to 20 years in order to conform to the Union Gas 20 year limit and consistency with reporting of other measures.

Three greenhouse projects received adjustments to their EULs, on the basis of the approximate weighted average of Mechanical and Structural components that comprise the total measure. Without embarking on detailed design engineering, component line items from the project file cost summaries were used to indicate a proportion between the hardware components of the greenhouse installation. Weighted average was then factored against respective component EULs as follows:

CI14 - 2013-IND-0256

Heating & Controls ~ 65% of Mech/Struct sum cost with 20 year EUL ; (*Double IR poly*) Envelope ~ 35% of Mech/Struct sum cost with (5) year EUL.

Weighted Avg: 0.65 x 20 yrs = 13 yrs

0.35 x 5 yrs = 2 yrs

15 yrs (reduced from 16 years)

CI03 - 2013-IND-0267

Heating & Controls ~ 65% of Mech/Struct sum cost with 20 year EUL ; (*Triple poly carbonate*) Envelope & Energy Curtains ~ 35% of Mech/Struct sum cost with (10 – 20) year EUL.

Weighted Avg: 0.65 x 20 yrs = 13 yrs

0.35 x 15 yrs = 5 yrs

18 yrs (increased from 14 years)

CI11 - 2013-IND-0177

Heating & Controls (and HW storage tank)~ 60% of Mech/Struct sum cost with 20 year EUL; (*Triple poly carbonate*) Envelope & Energy Curtains ~ 40% of Mech/Struct sum cost with (10 – 20) year EUL

Weighted Avg: 0.60 x 20 yrs = 12 yrs

0.40 x 15 yrs = 6 yrs

18 yrs (increased from 15 years)

The assignment's terms of reference also request comment on the "reasonableness of the designation of *advancement* where applicable". In this context, the reviewer interprets the term "advancement" to mean an early replacement of systems or equipment for the customer to realize energy savings from increased efficiencies sooner, rather than later. The following Table addresses the applicability of *advancement* and associated reasonableness with respect to each project.

Commentary on "Advancement" Aspect of Projects and Related Applicability

Union Gas Project	Measure	Comments
CI01 - 2013-IND-0455	HVAC Improvement	Not applicable. Roofing was partially a safety issue and remaining measures were repairs. No context to indicate an acceleration of a future planned replacement.
CI02 - 2013-IND-0013	[redacted] (new boiler and process impacts)	Not applicable. New equipment.
CI03 - 2013-IND-0267	New Greenhouse Expansion [redacted])	Not applicable. New equipment.
CI04 - 2013-IND-0185	HVAC Improvement - Space Heating	Not applicable. Programming of HVAC, dock door closures, coil maintenance and filter replacements were operational enhancements. No context to indicate an acceleration of a future planned replacement.
CI05 - 2013-IND-0083	GH - New Multi-Measure	Not applicable. New equipment.
CI06 - 2013-IND-0186	Line Speed Improvements	Not applicable. No evidence to indicate that re-tooling would have been accelerated by DSM program efforts.
CI07 - 2013-IND-0037	Tank & Hot Oil Pipe Insulation	Not applicable. New equipment.
CI08 - 2013-IND-0045	Starch Dryer Steam Preheat	Not applicable. Re-instatement of existing preheat coils back into service. No context to indicate an acceleration of a future planned replacement.
CI09 - 2013-IND-0457	Process Improvement	Not applicable. New equipment.
CI10 - 2013-IND-0046	Spray Dryer Steam Coil Preheat	Not applicable. Re-instatement of existing preheat coils back into service. No context to indicate an acceleration of a future planned replacement.
CI11 - 2013-IND-0177	GH - New Expansion	Not applicable. New equipment.
CI12 - 2013-IND-0055	Pipe and Vessel Insulation	Not applicable. New equipment.
CI13 - 2013-COM-0162	Dock Door Seals	Not applicable. New equipment.
CI14 - 2013-IND-0256	GH - New Expansion	Not applicable. New equipment.
CI15 - 2013-IND-0042	Steam Leakage Repair	Leaking HX was traced as source of hard water scale up of boiler so it was replaced and retained, in lieu of venting , so that heat capture could be continued. No context to indicate acceleration of a future planned replacement.
CI16 - 2013-COM-0026	Grain Dryer Replacement	"Advancement" originally applied as the prospects of handling increased throuput, at improved fuel efficiency, prompted enquiries by customer on DSM incentives. Program efforts appeared to have a role in accelerating purchase. (Ref: Note 1 below)
CI17 - 2013-IND-0064	Steam Trap Replacement	Not applicable. Operational enhancement. No context to indicate an acceleration of a future planned replacement.
CI18 - 2013-IND-0196	Gas Leak Repairs	Not applicable. Repair item. No context to indicate an acceleration of a future planned replacement.
CI19 - 2013-COM-0149	Heat Transfer Improvement	Not applicable. New heat recovery coil and reset controls to optimize heat capture. No context to indicate an acceleration of a future planned replacement.
CI20 - 2013-COM-0069	Window and Door Replacement	"Advancement" applies as the measure appears to have been accelerated by DSM program efforts. (Ref: Note 2 below)
CI21 - 2013-COM-0101	Upgraded Roof Insulation	Not applicable. New roof.

Notes

1. Context has changed for this project due to change of ownership and operating profile. Original expectation that production levels would increase from processing additional types of grain. All assumptions that prompted the new purchase never occurred and have low likelihood of occurring in near future. Factoring these realities into consideration has already led the reviewer to apply a significant downward adjustment to the savings calculations, with Base Case reversion to actual metered performance of old equipment. Existing operating realities make the evaluation of "advancement" a moot point. Higher efficiency comparison is made on the continuation of identical grain type at similar production and moisture levels.
2. Any further evaluation as to the applicability of "advancement" would be academic given the conservatism adopted toward measure life. Door and window frames and glazing could be expected to have a service life of 40 years. Union Gas have adopted a 22 year EUL in the project file, which was subsequently reduced to 20 years by the reviewer, to conform to their 20 year limit. Any further adjustment would add onerous, compound contingencies.

3. Opinion of Installed or Incremental Cost

The opinions of how reasonable were the installed or incremental costs stated in the project files are developed by the reviewer in the absence of detailed engineering design and quantity survey (beyond the scope of this assignment). Due to the susceptibility of pricing to variable market conditions, the nature of the review is focused on a "high level" assessment as to whether the stated costs appear to fall within a reasonable order-of-magnitude, based on the reviewer's experience with similar projects and published data such as Means or Hanscomb.

The extent of supporting cost information in the files varied. In some cases, the project costs were very well supported in the files by the inclusion of line item breakdowns of labour and material from the vendor or installer. In other project files, total costs were simply stated as a single line item. Usually, this may have been due to circumstances where the project measure was but one component of several other site works, where this would have been difficult to split out shared piping, valving, etc. Otherwise, the plant or facility may have expressed strong sensitivities or concerns on not having this key information potentially leaked to their competitors and would then view the pursuit of any further detail by an outsider to be intrusive.

The reviewer's related observations that are outlined in each project summary Table have factored the considerations that are expressed in the foregoing.

4. INDUSTRIAL CUSTOM PROJECT REVIEW SUMMARIES

Detailed summaries for each Industrial Custom Application project, with review comments and adjustments, are presented below.

Sector: Manufacturing

<table>
<tr><th colspan="4">UNION GAS
DSM, Research and Evaluation Review of 2013 Custom Projects</th></tr>
<tr><td>Union Gas Project Code:</td><td colspan="3">CI01 - 2013-IND-0455</td></tr>
<tr><td>Site Verification Date:</td><td colspan="3">February 25, 2014</td></tr>
<tr><td>Site Measurements:</td><td colspan="3">(Not applicable).</td></tr>
<tr><td>Equipment Useful Life:</td><td>18 years</td><td>Reviewer's Technical Opinion:</td><td>Blended average is reasonable.</td></tr>
<tr><td>Installed/Incremental Cost:</td><td>$497,200</td><td>Reviewer's Observations:</td><td>Component cost breakdowns sum up to reasonable order-of-magnitude.</td></tr>
<tr><td>Project Measure:</td><td colspan="3">HVAC Improvement</td></tr>
<tr><td>Project Description:</td><td colspan="3">The company set a target of a 25% energy reduction in five years. Current score cards track 22.3% as of July 2013 (electrical and gas consumption). Target for 2013 was 14.2%. Implement energy initiatives to curtail natural gas usage per unit sold over a three year plan. These changes are to be completed via dock doors seals, optimized control of rail doors - ensuring they are closed, closing of truck dock door, heating ventilation equipment, hot water tempering elimination, zip door installation, [redacted], new roofing and Jordan motor repairs on dampers.</td></tr>
<tr><td>Commissioned Date:</td><td>September 3, 2013</td><td>AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS</td><td>AGREED</td></tr>
<tr><th colspan="4">GROSS ANNUAL NATURAL GAS (m³) SAVINGS PROJECTIONS</th></tr>
<tr><td colspan="2">Union Gas File:
5,927,716</td><td colspan="2">Reviewer Adjusted:
No adjustments.</td></tr>
<tr><th colspan="4"><i>OVERALL CUMULATIVE NATURAL GAS (m³) SAVINGS PROJECTIONS</i></th></tr>
<tr><td colspan="2">Union Gas File:
49,081,488</td><td colspan="2">Reviewer Adjusted:
No adjustments.</td></tr>
<tr><td colspan="4">OBSERVATIONS & REASON FOR AGREEMENT:
The project file includes a CUSUM and Regression analysis that is rigorous and indicates a strong correlation of natural gas consumption to weather data. Any apparent anomalies (eg. Energy savings leveling off) were well explained (seasonality and construction effects). This analysis is deemed to be sound. Within the aggregate nature of the utility billing and</td></tr>
</table>

weather analysis, the component Energy Efficiency measures essentially comprise:

- complete re-roofing with upgraded insulation in select areas of the plant
- repair of existing damper control (Jordan) motors to enable air control modulation to be restored
- removal and sealing of (3) roof exhaust fans; (2) of which operated continuously with the 3rd abandoned and open to atmosphere through the roof
- repair and replacement of bay doors and dock seals, plus improved door closure control
- temperature setbacks on zone ventilation

The reviewer completed a cursory analysis of the energy saving potential of the component measures (which can more readily be quantified) to independently verify if the claimed savings are in agreement within a reasonable order-of-magnitude. This rationalization is included in Appendix "A" for reference. The reviewer's evaluation was supported by observations made during the site visit and archived trend data to demonstrate that the temperature setback programming is operating as intended and to offer an insight into the impact of restoring proper air damper control in the Air Handling Units. The analysis can readily account for 6 million compared to the claimed 5.9 million m^3 savings, without factoring bay door replacement and dock sealing. Given the CUSUM analysis (based on actual metered data) would also reflect behavioral aspects and weather variables that could also differ from the assumptions necessary to the reviewer's analysis, the savings claim may be supported without adjustment.

FILE SUPPORTING DOCUMENTATION:

Project file includes calculation spreadsheet CUSUM and Regression analysis and summary, with explanatory notes. Installation and repair costs are itemized as line items in the file's project description worksheet.

REVIEWED BY: Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.	**REFERENCE APPENDIX FOR AGREEMENT RATIONALE: 'Appendix A'**

<table>
<tr><th colspan="4">UNION GAS
DSM, Research and Evaluation Review of 2013 Custom Projects</th></tr>
<tr><td>Union Gas Project Code:</td><td colspan="3">CI02 - 2013-IND-0013</td></tr>
<tr><td>Site Verification Date:</td><td colspan="3">February 26, 2014</td></tr>
<tr><td>Site Measurements:</td><td colspan="3">(No measurement devices permitted in the plant)</td></tr>
<tr><td>Equipment Useful Life:</td><td>20 years</td><td>Reviewer's Technical Opinion:</td><td>Reasonable.</td></tr>
<tr><td>Installed/Incremental Cost:</td><td>$2,874,132</td><td>Reviewer's Observations:</td><td>Indeterminate. Capital Investment line item stated but no details supplied.</td></tr>
<tr><td>Project Measure:</td><td colspan="3">[redacted]</td></tr>
<tr><td>Project Description:</td><td colspan="3">Install [redacted] Project.</td></tr>
<tr><td>Commissioned Date:</td><td>February 6, 2012</td><td>AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS</td><td>AGREED</td></tr>
<tr><td colspan="4">GROSS ANNUAL NATURAL GAS (m^3) SAVINGS PROJECTIONS</td></tr>
<tr><td colspan="2">Union Gas File:
2,864,979</td><td colspan="2">Reviewer Adjusted:
No adjustments.</td></tr>
<tr><td colspan="4"><i>OVERALL CUMULATIVE NATURAL GAS (m^3) SAVINGS PROJECTIONS</i></td></tr>
<tr><td colspan="2">Union Gas File:
26,357,807</td><td colspan="2">Reviewer Adjusted:
No adjustments.</td></tr>
</table>

OBSERVATIONS & REASON FOR AGREEMENT:

The project file outlines a comprehensive analysis that correlates monthly "before/after" production , natural gas and steam quantities. Natural gas savings are realized from (3) component aspects, namely:

- Replacement of less efficient [redacted] boiler with higher efficiency [redacted] boiler, equipped with combustion air preheater. The air preheater was designed to increase efficiency by up to 7.5%, based on performance at other similar company plants. The file calculations factored 5%, which was prudently conservative. (Site observations of temperature gauges noted a 170 ˚F ΔT as a *spot check*. Using an approximation of a 1% efficiency improvement for every 40 ˚F air temperature rise would yield a 4.25% improvement, which is sufficiently close to the 5% used). The efficiency of the new [redacted] Boiler enabled production to be accomplished by operating a single boiler, with the older boiler relegated to standby duty.
- Sparge steam requirements to the process were reduced with the new system.
- The process requires vacuum, generated by steam ejectors. Lower vacuum requirements associated with the project (from shutdown of one [redacted]) increased the downtime of its associated steam ejector. A viewing of the operating vacuum parameters on the plant DCS confirmed that vacuum is either meeting or improving upon required setpoints , thus indicating no compromise to the process from the steam reduction. While steam flow is not metered to the ejectors, site observations of line size and steam pressure confirmed that the flows used in the calculations were within a reasonable range.

A review of the file's sound calculations, coupled with the reviewer's site observations leads

to the support of the stated savings claim without adjustment. (Also, actual Year 2013 metered natural gas consumption data is in very close agreement with the projected higher efficiency option fuel consumption in the project files).	
FILE SUPPORTING DOCUMENTATION: Project file includes calculation spreadsheet analysis and summary. Installed cost outlines capital investment summary.	
REVIEWED BY: Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.	**REFERENCE APPENDIX FOR AGREEMENT RATIONALE: N/A**

<table>
<tr><th colspan="4">UNION GAS
DSM, Research and Evaluation Review of 2013 Custom Projects</th></tr>
<tr><td>Union Gas Project Code:</td><td colspan="3">CI04 - 2013-IND-0185</td></tr>
<tr><td>Site Verification Date:</td><td colspan="3">February 11, 2014</td></tr>
<tr><td>Site Measurements:</td><td colspan="3">(Not applicable)</td></tr>
<tr><td>Equipment Useful Life:</td><td>20 years</td><td>Reviewer's Technical Opinion:</td><td>Reasonable.</td></tr>
<tr><td>Installed/Incremental Cost:</td><td>$83,870</td><td>Reviewer's Observations:</td><td>Extra commitment of labour and programming is clearly outlined.</td></tr>
<tr><td>Project Measure:</td><td colspan="3">HVAC Improvement - Space Heating</td></tr>
<tr><td>Project Description:</td><td colspan="3">Operate in efficient manner including the following:
• Make-up Air Units - Temperature setback reduction during non-production 21C to 18C. Programming and daily system monitoring. Facility group lead oversight.
• Air House PM Coil Maintenance and Filter Replacements. Removing debris from air ways. Possible dampers open in some cases, filter and removal of debris. One hour per shift for 240 days a year.
• Dock Doors. Closed all dock doors during shut-down. Some dock doors with low material turnover rate are closed during production. 6 days vs 7 days open; 35% doors closed during production. All dock door openings programed with an update for operator to override and allow the doors to be closed even while the trailers are docked. (not able to close the doors for safety reasons prior to 2012).</td></tr>
<tr><td>Commissioned Date:</td><td>November 30, 2012</td><td>AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS</td><td>AGREED</td></tr>
<tr><th colspan="4">GROSS ANNUAL NATURAL GAS (m³) SAVINGS PROJECTIONS</th></tr>
<tr><td colspan="2">Union Gas File:
1,741,055</td><td colspan="2">Reviewer Adjusted:
No adjustments.</td></tr>
<tr><th colspan="4"><i>OVERALL CUMULATIVE NATURAL GAS (m³) SAVINGS PROJECTIONS</i></th></tr>
<tr><td colspan="2">Union Gas File:
16,017,706</td><td colspan="2">Reviewer Adjusted:
No adjustments.</td></tr>
<tr><td colspan="4">OBSERVATIONS & REASON FOR AGREEMENT:
The project file includes a CUSUM and Regression analysis that is rigorous and indicates a strong correlation of natural gas consumption to weather data. This analysis is deemed to be sound. The measure was further confirmed on site with a review of trend data to demonstrate that the temperature setback programming is operating as intended. Random views of related trend data are included in Appendix "B" for reference to illustrate that the controlled temperature profiles are in general conformance with the scheduled production and non-production hours that are outlined in the file documentation.
To ensure that the discipline of dock door closures is maintained during non-production</td></tr>
</table>

periods, plant supervisors are mandated to ensure these are closed through the issuance of a written work instruction. (Appendix "B" includes a copy of the plant's weekend and shut-down check sheets). As for maintaining dock door closure discipline during normal operating hours, the team leads train each of the operators to ensure they are closed at all times as well. (There is not a specific work instruction for this but handled through operator training and random confirmations by the team lead personnel). On the basis of the foregoing, the reviewer supports the savings projections as outlined in the project file.

FILE SUPPORTING DOCUMENTATION:
Project file includes calculation spreadsheet CUSUM and Regression analysis and summary, with explanatory notes.

REVIEWED BY:	**REFERENCE APPENDIX FOR AGREEMENT RATIONALE: "Appendix B"**
Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.	

UNION GAS
DSM, Research and Evaluation Review of 2013 Custom Projects

Union Gas Project Code:	CI06 - 2013-IND-0186		
Site Verification Date:	February 11, 2014		
Site Measurements:	(Not applicable)		
Equipment Useful Life:	20 years	**Reviewer's Technical Opinion:**	Reasonable.
Installed/Incremental Cost:	$9,291,256	**Reviewer's Observations:**	Well itemized and supported by work order references.
Project Measure:	Line Speed Improvements		
Project Description:	The project consists of decreasing the overall energy intensity of [redacted] production (cubic meter natural gas/[redacted]. This is to be completed via tooling upgrades, carrier modification, and decrease in pitch in the [redacted]. Overall [redacted] volume to increase from ~900 units to ~1150 units utilizing approximately the same amount energy. This ramp up in volume is to occur over a two-year period. In 2013, the Energy Intensity has increased due to the addition of two new ventilation exhaust fans in [redacted] to improve quality. This resulted in an increase of natural gas usage. Additional to this, to improve quality, the temperature supplied to the [redacted] was raised from 42°C to 50°C. This also resulted in an increase of natural gas. (It is important to understand that if the savings of natural gas were not completed in 2011 and 2012, this could have resulted in very high gas consumption).		
Commissioned Date:	January 14, 2013	**AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS**	**AGREED**

GROSS ANNUAL NATURAL GAS (m^3) SAVINGS PROJECTIONS

Union Gas File:	**Reviewer Adjusted:**
1,112,600	No adjustments.

OVERALL CUMULATIVE NATURAL GAS (m^3) SAVINGS PROJECTIONS

Union Gas File:	**Reviewer Adjusted:**
10,235,920	No adjustments.

OBSERVATIONS & REASON FOR AGREEMENT:

The projected savings for this process improvement were calculated on the basis of an Energy Intensity analysis of natural gas consumption vs production, since the production changes were mandated. This analysis was reviewed and is sound. The calculations prudently focused the analysis on the non-heating sensitive months of June-August in order to focus on pure production data. Competitive pressures in the industry and constraints in existing plant footprint offered the customer a *compelling* reason to *proactively* increase product throughput, thereby reducing the Energy Intensity of the process. The on-site meeting with the customer's technical support team enabled viewing of the relevant

documentation and production enhancements to fully support the measure. This included the visual confirmation of positioning detection systems added to the [redacted] area and [redacted] systems to reduce transfer and cycle times. Also viewed was the reinstatement of an oven that was previously removed from service to extend product movement by over 50% without increasing heat intensity. (Specific details are highly confidential and cannot be included in this report). Given the plant has demonstrated its ability to sustain the projected savings and is tracking both operation and production levels that were used as the basis of the file's savings estimates, this review enables the author to support the calculation estimates presented, without a suggested variance.	
FILE SUPPORTING DOCUMENTATION: Project file includes work order number references for retrofit measures, production systems description narrative and illustrations, Energy Intensity calculation spreadsheet analysis and cost summaries by line item.	
REVIEWED BY: Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.	**REFERENCE APPENDIX FOR AGREEMENT RATIONALE: N/A**

UNION GAS
DSM, Research and Evaluation Review of 2013 Custom Projects

Union Gas Project Code:	CI07 - 2013-IND-0037		
Site Verification Date:	February 6, 2014		
Site Measurements:	Spot checks of tank and pipe surface temperature with IR Temperature Gun.		
Equipment Useful Life:	20 years	**Reviewer's Technical Opinion:**	Reasonable.
Installed/Incremental Cost:	$790,008	**Reviewer's Observations:**	Incremental cost properly applied. Itemized according to PO# references.
Project Measure:	Tank & Hot Oil Pipe Insulation		
Project Description:	Insulate top and walls of 3 new fluid storage tanks with 4" thick Mineral Fiber on tank walls and equivalent 5.5" thick Mineral Fiber on Tank Top which will capture 97% heat loss. Tanks affected by insulation installation include: Tank 201, Tank 202 and Tank R1 Insulate approximately 4000 ft of 6" diameter hot oil piping used to transport hot oil to and from storage tanks. Pipework was insulated with 2" thick Mineral fiber insulation, which results in a 95% insulation efficiency.		
Commissioned Date:	March 1, 2012	**AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS**	**Decrease annual natural gas avoidance by 59,242 m³.**

GROSS ANNUAL NATURAL GAS (m³) SAVINGS PROJECTIONS	
Union Gas File: 889,373	**Reviewer Adjusted:** 830,131
OVERALL CUMULATIVE NATURAL GAS (m³) SAVINGS PROJECTIONS	
Union Gas File: 8,182,232	**Reviewer Adjusted:** 7,637,205

OBSERVATIONS & REASON FOR ADJUSTMENT:

A walk-through visit of the site and review of insulation engineering specifications and drawings confirmed that insulation on hot oil piping and storage tanks was installed to the stated thicknesses. Measurements of surface temperature readings were close to ambient temperatures and demonstrated the effectiveness of the insulation. While the energy savings calculations in the file are modeled on a reputable insulation software package, the reviewer found two aspects of the analysis that warranted adjustment. The insulation analysis on the hot oil pipes assumes a constant 450°F fluid temperature for the entire year. During the site visit, while the plant was in winter operating mode, observed hot oil temperature was 395 °F, as illustrated in the photo capture in Appendix 'C'. Plant management confirmed that this is indicative of winter operation for at least 3 months of the year, prior to ramping up in March for the seasonal demand of product. Since the heat loss coefficients used in the analysis are dependent on pipe fluid temperature, readjustments were made and are highlighted in red color in Appendix 'C' to reflect a nominal 400°F hot oil temperature for (3) months. The second aspect that warranted adjustment concerns the heat loss coefficients that were input for the ½" insulation Base Case appeared to be too high. (Perhaps this was an input error from previous templates). The reviewer re-calculated new heat loss coefficients (factoring monthly average ambient temperatures and wind speeds originally used in the analysis) and these are also highlighted in red color in Appendix 'C'. No change was warranted for the storage tank insulation savings projections, due to relatively constant storage temperatures throughout the year.

FILE SUPPORTING DOCUMENTATION:

Project file includes calculation spreadsheet analysis and summary, and heater efficiency data. Installed cost is supported by copies of contractor's Purchase Orders to Customer.

REVIEWED BY: Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.	**REFERENCE APPENDIX FOR ADJUSTMENT RATIONALE: 'Appendix C'**

UNION GAS **DSM, Research and Evaluation Review of 2013 Custom Projects**			
Union Gas Project Code:	CI08 - 2013-IND-0045		
Site Verification Date:	February 21, 2014		
Site Measurements:	(Not applicable).		
Equipment Useful Life:	20 years	**Reviewer's Technical Opinion:**	Adjust to 19 years to reflect 1 year downtime for safety work on auxiliary piping.
Installed/Incremental Cost:	$95,169	**Reviewer's Observations:**	Shown as line item in plant screen capture of distributed costs. No breakdown.
Project Measure:	Starch Dryer Steam Preheater		
Project Description:	As part of a plant wide process optimization effort in 2012, total [redacted] steam consumption was reduced which freed up enough steam to recommission every steam coil preheater, including that ducted to the R2 starch dryer.		
Commissioned Date:	June 26, 2012	**AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS**	**AGREED**
GROSS ANNUAL NATURAL GAS (m^3) SAVINGS PROJECTIONS			
Union Gas File: 651,488		**Reviewer Adjusted:** No adjustments	
OVERALL CUMULATIVE NATURAL GAS (m^3) SAVINGS PROJECTIONS			
Union Gas File: 5,993,690		**Reviewer Adjusted:** 5,694,005	

OBSERVATIONS & REASON FOR ADJUSTMENT:

Supporting calculations (energy intensity and regression analysis) in the project file offer a strong correlation between energy and production data and are based on sound analysis. In addition to the energy improvement, the preheater added an operational benefit by stabilizing the dryer, enabling inlet dampers to remain in one position rather than requiring frequent manual adjustment. ***Due to safety issues, the steam coil preheater had to be removed from service*** until valving and lockout safeties are installed on associated piping. This occurred in mid-June 2013, indicating that almost a full year of savings were being realized until the preheater outage. (A review of requested data, subsequent to the site visit, confirmed that the calculated savings were tracking very closely to actual performance until the safety outage).

The equipment outage observed during the site visit prompted the reviewer to request a written commitment from the Customer as to if and when this equipment will be returned to service. The Customer has responded with a written confirmation that the necessary engineering drawings, parts procurement and TSSA approval have been received to allow the plant to proceed with remedial work. The estimated time frame stated by the Customer places the likely reinstatement back to service within one year of the initial downtime. Given that the energy performance of the system was tracking expectations prior to the removal from service and given the strong likelihood that this equipment should be returned to service, there is no compelling reason to adjust the *annual* savings estimate at this time.

FILE SUPPORTING DOCUMENTATION:
Project file includes (energy intensity and regression analysis) calculation spreadsheet and historical energy and production data. Installed cost is supported by line items identified from plant master records.

REVIEWED BY: Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.	**REFERENCE APPENDIX FOR ADJUSTMENT RATIONALE: N/A**

UNION GAS
DSM, Research and Evaluation Review of 2013 Custom Projects

Union Gas Project Code:	CI09 - 2013-IND-0457		
Site Verification Date:	February 13, 2014		
Site measurements:	(Not applicable)		
Equipment Useful Life:	20 years	**Reviewer's Technical Opinion:**	Reasonable.
Installed/Incremental Cost:	$3,200,000	**Reviewer's Observations:**	Customer stated cost based on contractor invoicing.
Project Measure:	Process Improvement		
Project Description:	Construction of a new [redacted] plant to replace production at [redacted]. Energy saving measures included; 1) [redacted] dryer with improved heat transfer design [redacted] arrangement) 2) High efficiency burner on [redacted] dryer 3) [redacted] storage tanks with greater insulation 4) Hot oil lines with greater insulation 5) Smaller equipment footprint for reduced heat loss 6) Improved operating control flexibility		
Commissioned Date:	September 1, 2013	**AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS**	**AGREED**

GROSS ANNUAL NATURAL GAS (m^3) SAVINGS PROJECTIONS

Union Gas File:	**Reviewer Adjusted:**
544,277 m^3	No adjustment.

OVERALL CUMULATIVE NATURAL GAS (m^3) SAVINGS PROJECTIONS

Union Gas File:	**Reviewer Adjusted:**
5,007,348	No adjustments.

OBSERVATIONS & REASON FOR AGREEMENT/ADJUSTMENT:

The project file is well documented and visual observations of implemented measures during the site visit confirmed the energy efficient features of the new installation; namely, the increased resistance to flow of flue gas in the dryer drum to improve heat retention, the storage buffer offered by the holding silos that enables continuous operation vs the start/stop operation of the old design, mixing is concentrated in one location to offer improved heat and mass transfer, portable equipment reduces the size of plant footprint and line losses, 2" to 4" mineral fibre insulation reduces thermal loss in hot oil lines and storage tanks, respectively. All observations increased the confidence level of the reviewer. As the plant was visited during [redacted], it was not possible to view control room instrumentation parameters (e.g. temperatures, etc.). As such, the verification relies heavily on the project file's regression analysis of natural gas consumption versus production, setting the most recent complete years (2011/2012) of actual metered data for the old plant as the baseline. (An R^2 value of 0.98 indicated a strong correlation). Actual gas consumption and production metered over a 3-month period following commissioning showed a steady performance coefficient improvement for comparison to the old plant baseline. The analysis was reviewed and appears sound, enabling support of the savings claim without adjustment.

FILE SUPPORTING DOCUMENTATION:
The project file correlates actual natural gas consumption with production levels along with records of energy intensity (m^3 of natural gas/[redacted]. Installed cost is supported by cost summary tab in spreadsheet and e-mail confirmation.

REVIEWED BY: Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.	**REFERENCE APPENDIX FOR AGREEMENT RATIONALE: N/A**

<table>
<tr><th colspan="4">UNION GAS
DSM, Research and Evaluation Review of 2013 Custom Projects</th></tr>
<tr><td>Union Gas Project Code:</td><td colspan="3">CI08 - 2013-IND-0046</td></tr>
<tr><td>Site Verification Date:</td><td colspan="3">February 21, 2014</td></tr>
<tr><td>Site Measurements:</td><td colspan="3">(Not applicable)</td></tr>
<tr><td>Equipment Useful Life:</td><td>20 years</td><td>Reviewer's Technical Opinion:</td><td>Reasonable.</td></tr>
<tr><td>Installed/Incremental Cost:</td><td>$95,131</td><td>Reviewer's Observations:</td><td>Shown as line item in plant screen capture of distributed costs. No breakdown.</td></tr>
<tr><td>Project Measure:</td><td colspan="3">Spray Dryer Steam Coil Preheat</td></tr>
<tr><td>Project Description:</td><td colspan="3">As part of a plant wide process optimization effort in 2012, total [redacted] steam consumption was reduced, which freed up enough steam to recommission every steam coil preheater, including the [redacted] spray dryer.</td></tr>
<tr><td>Commissioned Date:</td><td>June 13, 2012</td><td>AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS</td><td>Decrease annual natural gas avoidance by 69,672 m³.</td></tr>
<tr><th colspan="4">GROSS ANNUAL NATURAL GAS (m³) SAVINGS PROJECTIONS</th></tr>
<tr><td colspan="2">Union Gas File:
472,215</td><td colspan="2">Reviewer Adjusted:
402,543</td></tr>
<tr><th colspan="4"><i>OVERALL CUMULATIVE NATURAL GAS (m³) SAVINGS PROJECTIONS</i></th></tr>
<tr><td colspan="2">Union Gas File:
4,344,378</td><td colspan="2">Reviewer Adjusted:
3,703,396</td></tr>
</table>

OBSERVATIONS & REASON FOR ADJUSTMENT:

Prior plant operating history indicated that the spray dryer consumed an additional 4.1 MMBH without air preheating. This offered a compelling reason to re-instate this equipment into service when surplus steam became available. Supporting calculations (energy intensity and regression analysis) in the project file were reviewed and the methodology is based on sound analysis.

The review of updated Year 2013 energy and production data following the original file analysis prompted a re-examination of the projected energy savings. The results of the evaluation, performed in conjunction with the Project Manager, revealed a deterioration occurred in [redacted] spray dryer performance over the previous year and supporting data analysis is included in Appendix "D" for reference. No obvious operational anomalies were observed during the site visit and preheat coil outlet temperatures were 50 °C, displayed on plant instrumentation (within the expected range of (50 to 55) °C with the dryer operating at 207 °C). Possible explanations of energy performance decline could point to fouling of heat transfer surfaces or other maintenance issues. This warrants further investigation by plant personnel and would require the programming of remedial work into their maintenance schedules once the cause of performance degradation has been established; however, a final conclusion was not available at the time of writing this report. Accordingly, an adjustment to the savings claim is made on the basis of the revised calculations and updated data illustrated in Appendix "D".

FILE SUPPORTING DOCUMENTATION: Project file includes (energy intensity and regression analysis) calculation spreadsheet and historical energy and production data. Installed cost is supported by line items identified from plant master records.	
REVIEWED BY: Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.	**REFERENCE APPENDIX FOR ADJUSTMENT RATIONALE: 'Appendix D'**

UNION GAS
DSM, Research and Evaluation Review of 2013 Custom Projects

Union Gas Project Code:	CI15 - 2013-IND-0042		
Site Verification Date:	February 7, 2014		
Site Measurements:	(Not applicable)		
Equipment Useful Life:	20 years	**Reviewer's Technical Opinion:**	Adjust to 19.5 years to reflect 1/2 year downtime for HX replacement.
Installed/Incremental Cost:	$8,793	**Reviewer's Observations:**	Supported in detail by contractor invoice.
Project Measure:	Steam Leakage Repair		
Project Description:	Repaired ongoing steam leaks, resulting in reduced natural gas consumption by steam system.		
Commissioned Date:	August 30, 2012	**AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS**	**Decrease annual natural gas avoidance by 19,556 m³.**

GROSS ANNUAL SAVINGS PROJECTIONS

Natural Gas (m³)		**Water (L)**	
Union Gas File	**Reviewer Adjustment**	**Union Gas File**	**Reviewer Adjustment**
178,289	158,733	2,010,869	No adjustment.

OVERALL CUMULATIVE NATURAL GAS (m³) SAVINGS PROJECTIONS

Union Gas File:	**Reviewer Adjusted:**
1,640,259	1,423,835

OBSERVATIONS & REASON FOR ADJUSTMENT:

The energy saving measures largely comprise the repair of leaking steam valve stems that are located on the main header, replacement of PRV that failed in the "open" position plus leakage repair of the condensate tank flash steam heat exchanger that captures heat for process water. The calculation methodology from the project file was reviewed and is sound. A plant walk-through confirmed the stoppage of steam leaks from the main header valves and the replacement of the failed PRV. Visual observations of the extent of flash steam vented from the condensate tank offered an indicator that the associated heat exchanger was bypassed. Plant personnel confirmed that the heat exchanger was out of service due to the re-emergence of leakage in its coil.

It must be emphasized that plant personnel expressed during the site visit a strong intent to restore the flash steam heat recovery vessel back into service as soon as possible, given the loss of energy savings in the plant. Another compelling reason warranting attention on their part is that leakage on the water side of the exchanger was previously linked to hard water scaling of the boilers and a repeat of this condition cannot be tolerated. In order to gauge the likelihood of this situation being remediated, the reviewer requested written confirmation from the Customer regarding their efforts to return this equipment to service. The Customer responded in writing that a replacement heat exchanger has been acquired and then stated their expectations that the work would be completed by the end of April 2014.

The file calculations are based on an assumed boiler efficiency of 84%. In the reviewer's opinion, this relatively high efficiency factor will negatively bias the energy saving estimates of the remaining (steam leakage repair) measures. The reviewer's site observations of key steam system operating parameters (eg. makeup and boiler blowdown rates, deaerator pressure, etc.) and site review of past boiler combustion analyser printouts enabled steam/fuel efficiency to be calculated. The results of this analysis, included in Appendix "E" for reference, suggest a steam/fuel efficiency closer to 78%. Accordingly, the estimated energy savings for the remaining steam leakage repair measures have been adjusted and are outlined in Appendix "E" supporting calculations.

Another aspect of the original calculations that warranted adjustment relates to the enthalpy of the flash steam venting avoidance for when the heat exchanger is in operation. Pertinent details are outlined in Appendix "E" for reference.

FILE SUPPORTING DOCUMENTATION:
Project file includes calculation spreadsheet analysis and summary, technical data on steam leak quantification, description of each measure.

REVIEWED BY: Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.	**REFERENCE APPENDIX FOR ADJUSTMENT RATIONALE: 'Appendix E'**

UNION GAS
DSM, Research and Evaluation Review of 2013 Custom Projects

Union Gas Project Code:	CI18 - 2013-IND-0196		
Site Verification Date:	February 13, 2014		
Site Measurements:	(Not applicable)		
Equipment Useful Life:	20 years	**Reviewer's Technical Opinion:**	Reasonable.
Installed/Incremental Cost:	$3,000	**Reviewer's Observations:**	Supported by contractor invoice.
Project Measure:	Gas Leak Repairs		
Project Description:	Completed a leak survey on the rooftop gas main system using a gas detector and uncovered several leak spots at piping & fitting locations which were previously undetected by maintenance personnel. Replaced sections of piping and several fittings to eliminate leak spots.		
Commissioned Date:	June 10, 2013	**AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS**	**AGREED**

GROSS ANNUAL NATURAL GAS (m^3) SAVINGS PROJECTIONS

Union Gas File:	**Reviewer Adjusted:**
24,260	No adjustments.

OVERALL CUMULATIVE NATURAL GAS (m^3) SAVINGS PROJECTIONS

Union Gas File:	**Reviewer Adjusted:**
223,192	No adjustments.

OBSERVATIONS & REASON FOR AGREEMENT/ADJUSTMENT:
The gas flow calculations that are outlined in the project file were reviewed and found to be based on sound engineering principles. A review of Work Order Instructions at the plant gave the reviewer a high degree of confidence that annual soap tests and tagging of any pipe leaks is included in the annual Preventive Maintenance schedule and that this measure is sustainable. The reviewer supports the savings estimate identified in the project file without any adjustment.

FILE SUPPORTING DOCUMENTATION:
Project file includes a rigorous gas flow calculation spreadsheet analysis and detailed data from 2013 natural gas leak repair survey. Repair cost is supported by repair contractor's invoice copy.

REVIEWED BY:	**REFERENCE APPENDIX FOR AGREEMENT RATIONALE: N/A**
Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.	

5. Agricultural CUSTOM PROJECT REVIEW SUMMARIES

Detailed summaries for each Industrial Custom Application project, with review comments and adjustments, are presented below.

<table>
<tr><th colspan="4">UNION GAS
DSM, Research and Evaluation Review of 2013 Custom Projects</th></tr>
<tr><td>Union Gas Project Code:</td><td colspan="3">CI03 - 2013-IND-0267</td></tr>
<tr><td>Site Verification Date:</td><td colspan="3">January 30, 2014</td></tr>
<tr><td>Site Measurements:</td><td colspan="3">(Viewed archived data from Priva system)</td></tr>
<tr><td>Equipment Useful Life:</td><td>14 years</td><td>Reviewer's Technical Opinion:</td><td>Weighted average justifies 18 years.</td></tr>
<tr><td>Installed/Incremental Cost:</td><td>$3,844,283</td><td>Reviewer's Observations:</td><td>This incremental cost well supported by component cost breakdown.</td></tr>
<tr><td>Project Measure:</td><td colspan="3">New Greenhouse Expansion [redacted]</td></tr>
<tr><td>Project Description:</td><td colspan="3">The site constructed a brand new [redacted] Greenhouse. This GH consists of the following energy efficient components:
• Roof Glass
• Triple Poly Carbonate Side-wall
• [redacted] [redacted] Energy Curtains - on entire [redacted] * 2 Crone Boilers
• 2 Flue Gas Condensers
• 2 Vithotherm Burners
• 2 Autoflame Linkageless Control Units * 1 Heat Storage tank
• 2 [redacted] CO₂ Dosing System
• [redacted] Connext Climate Control System</td></tr>
<tr><td>Commissioned Date:</td><td>July 5, 2013</td><td>AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS</td><td>AGREED</td></tr>
<tr><td colspan="4">GROSS ANNUAL NATURAL GAS (m³) SAVINGS PROJECTIONS</td></tr>
<tr><td colspan="2">Union Gas File:
3,085,122</td><td colspan="2">Reviewer Adjusted:
No adjustments.</td></tr>
<tr><td colspan="4"><i>OVERALL CUMULATIVE NATURAL GAS (m³) SAVINGS PROJECTIONS</i></td></tr>
<tr><td colspan="2">Union Gas File:
19,868,186</td><td colspan="2">Reviewer Adjusted:
25,544,810</td></tr>
<tr><td colspan="4">OBSERVATIONS & REASON FOR AGREEMENT:
The analysis is based on energy modeling derived from a reputable software package (Virtual Grower) which factors fuel input to boilers and solar energy input. The database for VG also includes historic solar data for various cities (Windsor ON data was used). The</td></tr>
</table>

project file illustrates the key inputs and calculated outputs in very comprehensive detail. Key input values to the calculations appear to be conservative, so as not to risk overestimation of savings. For example, an Air Exchange rate of 0.55 was used for the Base Case, whereas a value of over 1 air change per hour could have been used for glass structures vs triple-poly. Similarly, an Air Exchange rate of 0.5 was used for the Energy Efficient Case, whereas this value is higher than even double-poly structures (at 0.3) vs triple-poly structure that was installed.

While the greenhouse operation was not in planting or growing mode during the site visit, the facility was still able to still draw heat from the buffer storage tank (which captured boiler heat during times of CO_2 demand during the greenhouse crop cycle). This is a positive indicator that the heat storage tank is being utilized effectively. Archived performance data was viewed on the [redacted] system, revealing both a downward trend in space temperatures during the planting/growing cycle and the "open/close" control patterns on the energy curtains. Pertinent graphical data, included in Appendix "F" for reference, supports the view that the systems are operating as intended. These site observations and a review of the file calculations lead the reviewer to support the energy savings claim without adjustment.

FILE SUPPORTING DOCUMENTATION:

Project file includes Virtual Grower software calculations files and spreadsheet summary, photographs, schematics plus equipment and structural specification data. Installed cost is supported by detailed invoice data.

REVIEWED BY: Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.	**REFERENCE APPENDIX FOR AGREEMENT RATIONALE: 'Appendix F'**

UNION GAS
DSM, Research and Evaluation Review of 2013 Custom Projects

Union Gas Project Code:	CI05 - 2013-IND-0083		
Site Verification Date:	January 31 2014		
Site Measurements:	(Viewed data from [redacted] system and boiler/economizer temperature gauges).		
Equipment Useful Life:	20 years	**Reviewer's Technical Opinion:**	Reasonable, given that the measure focuses on Mechanical equipment.
Installed/Incremental Cost:	$1,188,285	**Reviewer's Observations:**	Supported by installed cost line items for major equipment, by contractor.
Project Measure:	GH - New Multi-Measure		
Project Description:	Customer built state-of- the-art high-efficiency [redacted]) greenhouse with high efficiency equipment.		
Commissioned Date:	February 15, 2012	**AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS**	**AGREED**

GROSS ANNUAL NATURAL GAS (m^3) SAVINGS PROJECTIONS	
Union Gas File: 1,531,967	**Reviewer Adjusted:** No adjustments.

OVERALL CUMULATIVE NATURAL GAS (m^3) SAVINGS PROJECTIONS	
Union Gas File: 14,094,096	**Reviewer Adjusted:** No adjustments.

OBSERVATIONS & REASON FOR AGREEMENT/ADJUSTMENT:
The primary greenhouse performance modeling software for this site was proprietary but the summary of inputs and monthly results were rigorously outlined. This modeling approach appears to be credible in that the predicted results were in close agreement to actual 2013 natural gas volume data that was obtained at the request of the reviewer. As a cross-check to the proprietary modeling effort, the project file includes the results of an evaluation using the Virtual Grower software, which projected energy savings within 12% of the proprietary model. Likely sources of variance between the two energy models include the fact that the Virtual Grower software does not account for heat (and CO_2) vented from the greenhouse at times when the roof is open, which is difficult to estimate. This may account for some or all of the difference between the calculated heat balance and the actual natural gas metered volume. Also, humidity control appears to be modeled more comprehensively in the proprietary software, accounting for some of the shortfall in the Virtual Grower modeling effort compared to the metered volumes. A "snapshot " screen capture of heating and ventilation control limits revealed that a "day/night" control strategy with setbacks has been adopted through the [redacted] system. Visual observations of plant instrumentation at the high efficiency boiler (with Autoflame control), CO_2 condensing economizer and hot water storage tank were in general conformance with the input

parameters for the modeling analysis. The close correlation of the modeling effort to actual measured volumes and operating parameters observed during the site visit support agreement with the savings claim, without adjustment.

FILE SUPPORTING DOCUMENTATION:
Project file includes copies of installer's proprietary calculation spreadsheet analysis and cross-check using Virtual Grower software. Installed cost is supported by contractor's major equipment cost breakdown.

REVIEWED BY: Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.	**REFERENCE APPENDIX FOR AGREEMENT RATIONALE: Appendix 'G'**

<table>
<tr><th colspan="4">UNION GAS
DSM, Research and Evaluation Review of 2013 Custom Projects</th></tr>
<tr><td>Union Gas Project Code:</td><td colspan="3">CI11 - 2013-IND-0177</td></tr>
<tr><td>Site Verification Date:</td><td colspan="3">January 31, 2014</td></tr>
<tr><td>Site measurements:</td><td colspan="3">(Viewed archived data from [redacted] system and column-mounted thermostats).</td></tr>
<tr><td>Equipment Useful Life:</td><td>15 years</td><td>Reviewer's Technical Opinion:</td><td>Weighted average justifies 18 years.</td></tr>
<tr><td>Installed/Incremental Cost:</td><td>$339,980</td><td>Reviewer's Observations:</td><td>This incremental cost well supported by component cost breakdown.</td></tr>
<tr><td>Project Measure:</td><td colspan="3">GH - New Expansion ([redacted])</td></tr>
<tr><td>Project Description:</td><td colspan="3">The site has an existing [redacted] Greenhouse. As of June 15 2013, they have commissioned a new [redacted] expansion. The [redacted] expansion consists of the following energy efficient components:
• Roof Glass
• Triple Poly Carbonate Side-wall
• [redacted] Energy Curtains - on entire [redacted]
• Priva Climate Control System
Note: In 2010, the site installed a 600 BHP Boiler with [redacted] Burner and [redacted] Condenser. Union Gas funded this project via AIMS project #: [redacted].</td></tr>
<tr><td>Commissioned Date:</td><td>June 15, 2013</td><td>AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS</td><td>AGREED</td></tr>
<tr><td colspan="4">GROSS ANNUAL NATURAL GAS (m³) SAVINGS PROJECTIONS</td></tr>
<tr><td colspan="2">Union Gas File:
567,304</td><td colspan="2">Reviewer Adjusted:
No adjustments.</td></tr>
<tr><td colspan="4"><i>OVERALL CUMULATIVE NATURAL GAS (m³) SAVINGS PROJECTIONS</i></td></tr>
<tr><td colspan="2">Union Gas File:
3,914,398</td><td colspan="2">Reviewer Adjusted:
4,697,277</td></tr>
<tr><td colspan="4">OBSERVATIONS & REASON FOR AGREEMENT:
The analysis is based on energy modeling derived from a reputable software package (Virtual Grower) which factors fuel input to boilers and solar energy input. The database for VG also includes historic solar data for various cities (Windsor ON data was used). The project file illustrates the key inputs and calculated outputs in very comprehensive detail. Key input values to the calculations appear to be conservative, so as not to risk overestimation of savings. For example, an Air Exchange rate of 0.55 was used for the Base Case, whereas a value of over 1 air change per hour could have been used for glass structures vs triple-poly. Similarly, an Air Exchange rate of 0.5 was used for the Energy Efficient Case, whereas this value is higher than even double-poly structures (at 0.3) vs triple-poly structure that was installed. A boiler efficiency of 85% was maintained for both case comparisons, based on the high efficiency boiler/burner installation in Year 2010 (as</td></tr>
</table>

referenced in the above).

The greenhouse operation was in crop growing mode during the site visit. Observation of column-mounted thermostats positioned in the new expansion consistently showed a space temperature of 18 °C was being maintained. By comparison, a walk-through of the old facility (adjacent to the new one) revealed 21°C temperature being concurrently maintained. (Comparative photos are included in Appendix "H" for reference. The observed 3 degree temperature difference exceeds the 1 degree difference that forms the basis of the calculations, suggesting that the calculations are likely conservative. Appendix "H" also includes archived performance data that was viewed on the [redacted] system, revealing the sustainability of the 18 °C temperature setpoint during time intervals where the energy curtain was closed and also indicating the effectiveness of the curtain. These site observations and a review of the file calculations lead the reviewer to support the energy savings claim without adjustment.

FILE SUPPORTING DOCUMENTATION:

Project file includes Virtual Grower software calculations files and spreadsheet summary, photographs, schematics plus equipment and structural specification data. Installed cost is supported by e-mail cost confirmations from installer.

REVIEWED BY: Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.	**REFERENCE APPENDIX FOR AGREEMENT RATIONALE: 'Appendix H'**

<table>
<tr><td colspan="4">**UNION GAS**
DSM, Research and Evaluation Review of 2013 Custom Projects</td></tr>
<tr><td>**Union Gas Project Code:**</td><td colspan="3">CI14 - 2013-IND-0256</td></tr>
<tr><td>**Site Verification Date:**</td><td colspan="3">January 31, 2014</td></tr>
<tr><td>**Site Measurements:**</td><td colspan="3">Spot checks of boiler and heating system pipe surface temperatures with IR Temperature Gun.</td></tr>
<tr><td>**Equipment Useful Life:**</td><td>16 years</td><td>**Reviewer's Technical Opinion:**</td><td>Adjusted to 15 years from component weighted average.</td></tr>
<tr><td>**Installed/Incremental Cost:**</td><td>$342,070</td><td>**Reviewer's Observations:**</td><td>Component cost breakdown is well outlined.</td></tr>
<tr><td>**Project Measure:**</td><td colspan="3">GH - New Expansion [redacted]</td></tr>
<tr><td>**Project Description:**</td><td colspan="3">The site has an existing [redacted] Greenhouse. As of January 2013 (1st crop was February 6, 2013), they have commissioned a new [redacted] expansion. The [redacted] expansion consists of the following energy efficient components:
• Double IR Poly Roof and Side-walls
• [redacted] CO2 Flue Gas Condenser
• New 600 BHP CB Reconditioned Boiler (Hot Water) * [redacted] Climate Control System</td></tr>
<tr><td>**Commissioned Date:**</td><td>February 6, 2013</td><td>**AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS**</td><td>**AGREED**</td></tr>
<tr><td colspan="4">**GROSS ANNUAL NATURAL GAS (m^3) SAVINGS PROJECTIONS**</td></tr>
<tr><td colspan="2">**Union Gas File:**
321,899</td><td colspan="2">**Reviewer Adjusted:**
No adjustments.</td></tr>
<tr><td colspan="4">***OVERALL CUMULATIVE NATURAL GAS (m^3) SAVINGS PROJECTIONS***</td></tr>
<tr><td colspan="2">**Union Gas File:**
2,369,103</td><td colspan="2">**Reviewer Adjusted:**
2,221,034</td></tr>
<tr><td colspan="4">**OBSERVATIONS & REASON FOR AGREEMENT:**
The analysis is based on energy modeling derived from a reputable software package (Virtual Grower) which factors fuel input to boilers and solar energy input. The database for VG also includes historic solar data for various cities (Windsor ON data was used). The project file illustrates the key inputs and calculated outputs in very comprehensive detail. Key input values to the calculations appear to be conservative, so as not to risk overestimation of savings. For example, an Air Exchange rate of 0.95 was used for the Base Case, whereas a value of 1.5 air change per hour could have been used for glass structures vs double-poly. Similarly, a modestly different Air Exchange rate of 0.855 was used for the Energy Efficient Case, whereas a lower value in the (0.5 to 0.3) range for double-poly structures could have been used.
The greenhouse operation was in crop growing mode during the site visit. The [redacted] control system screen displays and print function were under repair during the site visit, so the review had to rely on spot checks of boiler and heating system pipe surface</td></tr>
</table>

temperatures with IR Temperature Gun and site gauge readings of the boiler and economizer equipment. Operating temperatures were found to be in a reasonable range that correspond to the analysis. These site observations and rigor of the file calculations lead the reviewer to support the energy savings claim without adjustment.

FILE SUPPORTING DOCUMENTATION:
Project file includes Virtual Grower software calculations files and spreadsheet summary, photographs, plus equipment and structural specification data. Installed cost is supported by copies of installer's invoices.

REVIEWED BY: Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.	**REFERENCE APPENDIX FOR AGREEMENT RATIONALE: N/A**

<table>
<tr><th colspan="4">UNION GAS
DSM, Research and Evaluation Review of 2013 Custom Projects</th></tr>
<tr><td>Union Gas Project Code:</td><td colspan="3">CI16 - 2013-COM-0026</td></tr>
<tr><td>Site Verification Date:</td><td colspan="3">February 26, 2014</td></tr>
<tr><td>Site Measurements:</td><td colspan="3">Viewed archived data from dryer controller PLC.</td></tr>
<tr><td>Equipment Useful Life:</td><td>20 years</td><td>Reviewer's Technical Opinion:</td><td>Reasonable.</td></tr>
<tr><td>Installed/Incremental Cost:</td><td>$58,560</td><td>Reviewer's Observations:</td><td>Incremental cost over less efficient model supported by vendor quotation.</td></tr>
<tr><td>Project Measure:</td><td colspan="3">Grain Dryer Replacement</td></tr>
<tr><td>Project Description:</td><td colspan="3">Installation of a new [redacted] high efficiency tower dryer processing [redacted]. According to manufacturer's rating the dryer will operate at an efficiency of [redacted] Btu/lb water removed.
Efficiency gains occur from the following areas:
1. Higher Efficient Grid Burner Technology
2. Overall improved dryer air flow
3. Waste Heat Recovery using hot exhaust directed back through the product at the base of the tower to slowly preheat the product.
This same recovered airflow is then directed back to the burner to preheat combustion air resulting in reduced natural gas consumption.</td></tr>
<tr><td>Commissioned Date:</td><td>September 28, 2012</td><td>AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS</td><td>Decrease annual natural gas avoidance by 68,136 m³.</td></tr>
<tr><td colspan="4">GROSS ANNUAL NATURAL GAS (m³) SAVINGS PROJECTIONS</td></tr>
<tr><td colspan="2">Union Gas File:
79,769</td><td colspan="2">Reviewer Adjusted:
11,633</td></tr>
<tr><td colspan="4"><i>OVERALL CUMULATIVE NATURAL GAS (m³) SAVINGS PROJECTIONS</i></td></tr>
<tr><td colspan="2">Union Gas File:
733,875</td><td colspan="2">Reviewer Adjusted:
107,024</td></tr>
<tr><td colspan="4">OBSERVATIONS & REASON FOR AGREEMENT/ADJUSTMENT:
The savings related to natural gas consumption reduction for [redacted] dryer systems are difficult to quantify because of the complex variables involved. The performance of these dryers is subject to the type of [redacted] moisture content and is seasonally dependent on yield quality and drought conditions. The approach adopted in the project file to estimate energy savings is based on a comparison of energy intensity for the before/after BTU/lb H_2O evaporated and projecting this coefficient on future anticipated throughput of a variety of [redacted] including [redacted] While the calculation methodology included in the file is sound, a review of production data on site confirmed that [redacted] at approximately 2013 throughput levels). This automatically reduces the major component of energy</td></tr>
</table>

savings estimates in the project file. The savings calculations also are based on the expectation that the manufacturer's published fuel input of 1,359 BTU/lb of H_2O evaporated will be achieved in practice. Revised calculations by the reviewer are based on actual metered and archived production data obtained during the site survey and are appended for reference. Accordingly, a year 2013 coefficient of 1,999 BTU/lb of H_2O evaporated was calculated. This differs from the published efficiency, which would likely be based on full firing load on the dryer, whereas the actual natural gas consumption data suggests that this dryer was firing just above low fire turndown modulation for the majority of the time. Also, actual site data revealed that the base case coefficient was 2,330 BTU/lb of H_2O evaporated, compared to the 2,416 value identified in the project file. The basis of comparison in the revised calculations is between Years 2011 (old dryer) and 2013. (Year 2012 data was disregarded as it represented an anomaly due to commissioning transition and severe drought season that would have resulted in lower moisture content of crop and considerable on/off cycling of the burner due to low turndown limits). The revised coefficients were applied to Year 2013 production data, which is expected by the site to be representative in the near-future years.

FILE SUPPORTING DOCUMENTATION:
Project file includes new dryer specification data, spreadsheet based evaporation and energy calculations, new dryer process description PowerPoint presentation, and vendor quotation.

REVIEWED BY: Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.	**REFERENCE APPENDIX FOR ADJUSTMENT RATIONALE: 'Appendix I'**

6. Commercial CUSTOM PROJECT REVIEW SUMMARIES

Detailed summaries for each Industrial Custom Application project, with review comments and adjustments, are presented below

Sector: Education

UNION GAS DSM, Research and Evaluation Review of 2013 Custom Projects			
Union Gas Project Code:	CI12 - 2013-IND-0055		
Site Verification Date:	February 12, 2014		
Site Measurements:	Spot checks of pipe and fittings surface temperature with IR Temperature Gun.		
Equipment Useful Life:	20 years	**Reviewer's Technical Opinion:**	Reasonable.
Installed/Incremental Cost:	$350,001	**Reviewer's Observations:**	Supported by copies of contractor invoice progress draws.
Project Measure:	Pipe and Vessel Insulation		
Project Description:	A mechanical insulation appraisal was conducted at the site in October 2012 to quantify the potential energy savings and greenhouse gas emission reductions that could be achieved through the effective application of insulation on steam distribution system components located in various buildings across the campus. The recommendation of that appraisal report where implemented during this project work. Installed insulation on 46 sections of piping and 516 fittings.		
Commissioned Date:	February 8, 2013	**AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS**	**Decrease annual natural gas avoidance by 7,754 m³.**
GROSS ANNUAL NATURAL GAS (m³) SAVINGS PROJECTIONS			
Union Gas File: 381,402		**Reviewer Adjusted:** 373,648	
OVERALL CUMULATIVE NATURAL GAS (m³) SAVINGS PROJECTIONS			
Union Gas File: 3,508,898		**Reviewer Adjusted:** 3,437,562	
OBSERVATIONS & REASON FOR AGREEMENT/ADJUSTMENT: The installed insulation and removable covers were viewed on site and the quality of the installation was considered to be excellent. While the supporting analysis was based on sound principles, site observations prompted the reviewer to calculate an adjustment to the claimed savings, on the basis that the temperature in the *condensate lines* is in the 165 °F range vs the 230 °F process temperature that is used in the file calculations. The use of the higher temperature matches IR temperature readings taken on site for the low pressure steam component of the original calculations and that aspect warrants no adjustment. The			

calculated adjustment (applied to the condensate line piping and factoring the lower temperature) to heat losses and natural gas savings is outlined in Appendix "J" for reference.

FILE SUPPORTING DOCUMENTATION:
Project file includes detailed insulation survey and linear quantities, calculation spreadsheet analysis and summary. Installed cost is supported by itemized description of work according to contractor's Purchase order and Invoice numbers.

REVIEWED BY: Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.	**REFERENCE APPENDIX FOR ADJUSTMENT RATIONALE: 'Appendix J'**

UNION GAS
DSM, Research and Evaluation Review of 2013 Custom Projects

Union Gas Project Code:	CI17 - 2013-IND-0064		
Site Verification Date:	February 18, 2014		
Site Measurements:	Spot checks of trap inlet/outlet temperature with IR Temperature Gun.		
Equipment Useful Life:	7 years	**Reviewer's Technical Opinion:**	Reasonable.
Installed/Incremental Cost:	$3,124	**Reviewer's Observations:**	Supported by copy of contractor's invoice.
Project Measure:	Steam Trap Replacement		
Project Description:	Replace 27 failed steam traps as identified by Steam Trap Survey.		
Commissioned Date:	November 15, 2012	**AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS**	**AGREED**

GROSS ANNUAL SAVINGS PROJECTIONS

Natural Gas (m³)		**Electricity (kWh)**		**Water (L)**	
Union Gas File	**Reviewer Adjusted**	**Union Gas File**	**Reviewer Adjusted**	**Union Gas File**	**Reviewer Adjusted**
172,935	No adjustment	11,397	19,375	210,995	358,691

OVERALL CUMULATIVE NATURAL GAS (m^3) SAVINGS PROJECTIONS

Union Gas File:	**Reviewer Adjusted:**
556,851	No adjustments.

OBSERVATIONS & REASON FOR AGREEMENT/ADJUSTMENT:
Information gathered from the site visit observations prompted an *initial* adjustment of the fuel savings to 171,164 m³, based on:

- condensate return rate of 80% - 85%, vs 90% used in file
- condensate return temperature of 168 °F vs 145 °F used in file

The impact of the revised parameters noted in the above is illustrated in Appendix "K" and would have resulted in a modest downward adjustment of 1,771 m³. Other considerations that must be placed in proper perspective have led the reviewer to a balanced conclusion that no adjustment is warranted.

[redacted] Given that the projected 531lb/hr steam saving is small in comparison to total steam generation, the impact of this measure is difficult to verify by steam load trending analysis on plant data archives. As such, verification relies on an analytical approach. The performance analysis of a defective steam trap is complex and subject to differing results among equally competent technical resources in the industry. Performance calculations can vary according to assumed factors that are applied in the calculation equations. The following considerations illustrate the inexact science of estimating energy loss from a malfunctioning trap:

- determination of "leaking" vs "blowing" is subjective for each observer
- further complications from both steam and condensate flowing through the orifice of a failed trap
- imperfect orifice in a steam trap does not lend itself to normal calculation methods and other trap internals create unpredictable flow restrictions
- the degree to which a trap is oversized determines the effect that condensate volume has on the amount of steam that can simultaneously pass through the trap orifice.

The inconsistencies in savings calculations from different vendors prompted an industry bench testing study (per ASTM Performance Test Code PTC 39.1) which concluded that standard engineering calculations usually understate steam loss. Weighing the inexact nature of widely accepted calculation methods vs the modest adjustment based on site observations guides the reviewer to support the savings claim, as the calculation methodology tends to err on the conservative side.

FILE SUPPORTING DOCUMENTATION:

Project file includes steam trap survey report summary (Mentec/Yarway) and spreadsheet calculations. More detailed (Trap Failure and Verification) reports were requested and obtained on site. Installed cost is supported by summary of Labour & Material breakdown.

REVIEWED BY: Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.	**REFERENCE APPENDIX FOR AGREEMENT/ADJUSTMENT RATIONALE:** **'Appendix K'**

Sector: Retail

<table>
<tr><th colspan="4">UNION GAS
DSM, Research and Evaluation Review of 2013 Custom Projects</th></tr>
<tr><td>Union Gas Project Code:</td><td colspan="3">CI13 - 2013-COM-0162</td></tr>
<tr><td>Site Verification Date:</td><td colspan="3">February 20, 2014</td></tr>
<tr><td>Site Measurements:</td><td colspan="3">Ruler measurements of door seal gaps.</td></tr>
<tr><td>Equipment Useful Life:</td><td>15 years</td><td>Reviewer's Technical Opinion:</td><td>Reasonable.</td></tr>
<tr><td>Installed/Incremental Cost:</td><td>$297,340</td><td>Reviewer's Observations:</td><td>Supported by labour & materials Purchase Order.</td></tr>
<tr><td>Project Measure:</td><td colspan="3">Dock Door Seals</td></tr>
<tr><td>Project Description:</td><td colspan="3">Installation of [redacted] Dock Doors and dock door seals in [redacted]:
• [redacted]
Operating schedules, invoices and other miscellaneous details are on PAS sheet.</td></tr>
<tr><td>Commissioned Date:</td><td>November 15, 2012</td><td>AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS</td><td>Decrease annual natural gas avoidance by 6,840 m³.</td></tr>
<tr><th colspan="4">GROSS ANNUAL SAVINGS PROJECTIONS</th></tr>
<tr><th colspan="2">NATURAL GAS (m³)</th><th colspan="2">Electricity (kWh)</th></tr>
<tr><th>Union Gas File:</th><th>Reviewer Adjusted:</th><th>Union Gas File:</th><th>Reviewer Adjusted:</th></tr>
<tr><td>349,726</td><td>342,886</td><td>61,961</td><td>No Adjustment</td></tr>
<tr><th colspan="4"><i>OVERALL CUMULATIVE NATURAL GAS (m³) SAVINGS PROJECTIONS</i></th></tr>
<tr><th colspan="2">Union Gas File:</th><th colspan="2">Reviewer Adjusted:</th></tr>
<tr><td colspan="2">2,413,109</td><td colspan="2">2,365,913</td></tr>
</table>

OBSERVATIONS & REASON FOR AGREEMENT/ADJUSTMENT:

The calculation methodology in the project file is sound and demonstrates considerable rigor. Observations made during the site visit that prompt the reviewer to adjust the estimated annual savings, as outlined in Appendix "L" and highlighted in red, include:

- a 65 °F temperature setpoint is programmed into the BMS, instead of 67 °F and 70 °F (typo) identified in the calculations (reference: photo in Appendix).
- the heating system positioned above the dock doors is IR so an 83% efficiency was re-input instead of the 80% factor commonly assumed for unit heaters
- Truck trailer backing up to the dock is not uniform. It was observed that the integrity of the dock seals was *often* compromised by trucks backing up at an angle, still causing some air gaps to occur on the dock seals (reference: photos in Appendix.)
- The worst measured gap was ¾" vs the 1 ½" used in the original calculations.

On the basis of the foregoing points, the spreadsheet calculations were amended by the reviewer for temperature setpoint, efficiency factor and a 15% reduction factor of the energy efficient case to discount the gap sealing for doors where there were observed gaps.

<table>
<tr><td colspan="2">(As such, a weighted average approach yielded a blended average gap of 0.1225" in the spreadsheet calculations vs the 0.1" originally input to the spreadsheet files). In addition to this, a final adjustment was made to account for the colder HDD for the actual location of the facility, vs the HDD used in the file for another (warmer) region.</td></tr>
<tr><td colspan="2">FILE SUPPORTING DOCUMENTATION:
Project file includes spreadsheet analysis of infiltration calculations and summary. Installed cost is supported by a copy of the installer's invoice.</td></tr>
<tr><td>REVIEWED BY:
Byron Landry, P. Eng., CEM, CEA
Byron J. Landry & Associates, Inc.</td><td>REFERENCE APPENDIX FOR AGREEMENT/ADJUSTMENT RATIONALE:
'Appendix L'</td></tr>
</table>

UNION GAS
DSM, Research and Evaluation Review of 2013 Custom Projects

Union Gas Project Code:	CI19 - 2013-COM-0149		
Site Verification Date:	February 11, 2014		
Site Measurements:	Viewed on-line data from refrigeration system controller PLC. Spot checks of pipe temperatures on heat reclaim circuit with IR Temperature Gun.		
Equipment Useful Life:	15 years	**Reviewer's Technical Opinion:**	Reasonable.
Installed/Incremental Cost:	$14,895	**Reviewer's Observations:**	Identified as a line item in Customer's corporate cost tracking summary.
Project Measure:	Heat Transfer Improvement		
Project Description:	After engineering review, building operations found that the heat recovery systems from the coolers in these facilities were in disrepair and not functioning as intended for various reasons. The facility management group have undertaken the recommissioning of these units to capture waste heat and offset building heating.		
Commissioned Date:	February 20, 2012	**AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS**	**AGREED**

GROSS ANNUAL NATURAL GAS (m^3) SAVINGS PROJECTIONS

Union Gas File:	**Reviewer Adjusted:**
25,660	No adjustment.

OVERALL CUMULATIVE NATURAL GAS (m^3) SAVINGS PROJECTIONS

Union Gas File:	**Reviewer Adjusted:**
177,054	No adjustments.

OBSERVATIONS & REASON FOR AGREEMENT/ADJUSTMENT:

The review focused on the energy calculations outlined in the project file and site observations. (Comparative analysis of natural gas consumption history would be skewed by a number of variables such as operation of ovens and fryers located elsewhere in the facility, weather sensitivity, etc. and could not offer a reliable verification approach). The calculations are based on sound engineering principles and the stated equipment capacities were confirmed on site though engineering drawings and nameplate data. IR temperature measurements on heat reclaim pipework showed variability, indicating that it was prudent to apply a 50% diversity factor on available heat recovery in the file calculations. Also, while the heat reclaim circuit is rated at 329.8 MBH, the calculations adopt a final (conservative) 186.3 MBH heat reclaim number applied to all months, excluding June/July/Aug. In addition to the Air Preheat Coil (on the building rooftop HVAC unit), the heat reclaim system is also piped to (2) x 80 MBH Domestic Hot Water storage tanks, which have not been factored in the energy savings calculations (likely due to unpredictability of load). This additional heat sink increases the likelihood, however, that heat recovery will always be utilized. Site observations (illustrated in Appendix 'M') confirmed that the heat reclaim system was operating within control limits during the visit.

On the basis of the foregoing, the reviewer supports the savings claim without adjustment.	
FILE SUPPORTING DOCUMENTATION: Project file includes heat reclaim calculation spreadsheet analysis, matching heat sources to heat sinks. Installed cost is supported by service agency's cost records and brief description of remedial work.	
REVIEWED BY: Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.	**REFERENCE APPENDIX FOR AGREEMENT/ADJUSTMENT RATIONALE:** **'Appendix M'**

<table>
<tr><th colspan="4">UNION GAS
DSM, Research and Evaluation Review of 2013 Custom Projects</th></tr>
<tr><td>Union Gas Project Code:</td><td colspan="3">CI21 - 2013-COM-0101</td></tr>
<tr><td>Site Verification Date:</td><td colspan="3">February 6, 2014</td></tr>
<tr><td>Site Measurements:</td><td colspan="3">Spot checks of ceiling underside temperatures with IR Temperature Gun.</td></tr>
<tr><td>Equipment Useful Life:</td><td>20 years</td><td>Reviewer's Technical Opinion:</td><td>Reasonable.</td></tr>
<tr><td>Installed/Incremental Cost:</td><td>$90,800</td><td>Reviewer's Observations:</td><td>Incremental cost for incremental (R3) value confirmed in writing by installer.</td></tr>
<tr><td>Project Measure:</td><td colspan="3">Upgraded Roof Insulation</td></tr>
<tr><td>Project Description:</td><td colspan="3">This brand new facility ([redacted] sq ft) was constructed in February of 2013. As per Ontario Building Code, minimum R-Value for a warehouse is R-27; the roof constructed was R-30.</td></tr>
<tr><td>Commissioned Date:</td><td>February 7, 2013</td><td>AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS</td><td>AGREED</td></tr>
<tr><th colspan="4">GROSS ANNUAL NATURAL GAS (m^3) SAVINGS PROJECTIONS</th></tr>
<tr><td colspan="2">Union Gas File:
13,924</td><td colspan="2">Reviewer Adjusted:
No adjustments.</td></tr>
<tr><th colspan="4"><i>OVERALL CUMULATIVE NATURAL GAS (m^3) SAVINGS PROJECTIONS</i></th></tr>
<tr><td colspan="2">Union Gas File:
128,101</td><td colspan="2">Reviewer Adjusted:
No adjustments.</td></tr>
<tr><td colspan="4">OBSERVATIONS & REASON FOR AGREEMENT/ADJUSTMENT:
The project file includes a spreadsheet analysis of the roof insulation upgrade measure, which is accurately modeled according to ASHRAE calculation procedures. Viewing the roof installation and Architectural specifications enabled visual confirmation of the magnitude of the insulation measures as well as the space temperatures being maintained within the facility and underside of the roof. On this basis, the reviewer agrees with the savings analysis as presented in the project file.</td></tr>
<tr><td colspan="4">FILE SUPPORTING DOCUMENTATION:
Project file includes HDD based calculation spreadsheet analysis and summary. <i>Incremental</i> cost of roof insulation upgrade is supported by installer's e-mail message.</td></tr>
<tr><td colspan="2">REVIEWED BY:
Byron Landry, P. Eng., CEM, CEA
Byron J. Landry & Associates, Inc.</td><td colspan="2">REFERENCE APPENDIX FOR AGREEMENT RATIONALE: N/A</td></tr>
</table>

Sector: Multi – Family Residential

UNION GAS **DSM, Research and Evaluation Review of 2013 Custom Projects**			
Union Gas Project Code:	CI20 - 2013-COM-0069		
Site Verification Date:	February 14, 2014		
Site Measurements:	Spot checks of window and door interior temperatures with IR Temperature Gun.		
Equipment Useful Life:	22 years	**Reviewer's Technical Opinion:**	Reduce to 20 years in accordance with Union Gas limit.
Installed/Incremental Cost:	$168,436	**Reviewer's Observations:**	Supported by vendor's supply & install quote.
Project Measure:	Window and Door Replacement		
Project Description:	Install high efficiency windows and patio doors in 55 units. This is a 6 floor building built in 1957 with the original windows and doors still in place.		
Commissioned Date:	January 3, 2012	**AGREEMENT OR ADJUSTMENT ON ANNUAL SAVINGS PROJECTIONS**	**AGREED**
GROSS ANNUAL NATURAL GAS (m³) SAVINGS PROJECTIONS			
Union Gas File: 14,480		**Reviewer Adjusted:** 19,798	
OVERALL CUMULATIVE NATURAL GAS (m³) SAVINGS PROJECTIONS			
Union Gas File: 146,538		**Reviewer Adjusted:** 133,216	
OBSERVATIONS & REASON FOR AGREEMENT/ADJUSTMENT: The supporting analysis in the project file is heavily based on Regression and CUSUM analysis of weather (HDD) and natural gas consumption data. This type of analysis would reflect several influencing factors such as the door and window opening/closing discipline of individual tenants and the space temperature setpoints and solar gain in individual apartment units. As such, the reviewer completed heat loss calculations for glazing transmission and infiltration using the temperature bin method as a cross-check to the utility file's analysis. The results of the reviewer's independent analysis, included in Appendix "N" for reference, project a higher energy savings. This increases the confidence of the reviewer that the project file's projections are inherently conservative a subsequent positive adjustment was made by the reviewer.			
FILE SUPPORTING DOCUMENTATION: Project file includes Regression and CUSUM calculation spreadsheet analysis, dimensional data summary, window and door replacement data. Installed cost is supported by vendor and installer's quotation.			
REVIEWED BY: Byron Landry, P. Eng., CEM, CEA Byron J. Landry & Associates, Inc.		**REFERENCE APPENDIX FOR AGREEMENT/ADJUSTMENT RATIONALE:** **'Appendix N'**	

APPENDIX A: Union Gas Project Code - CI01 - 2013-IND-0455

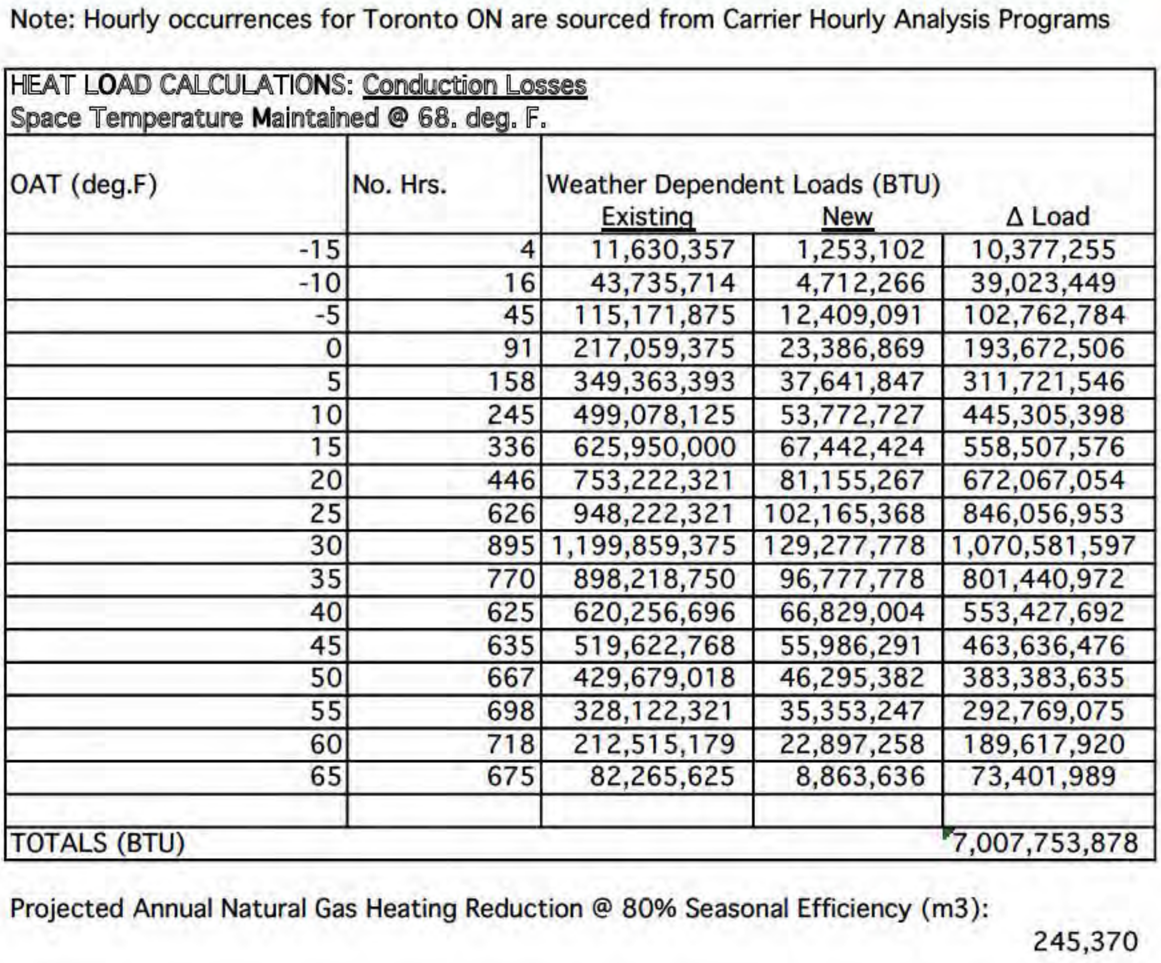
2013

HEAT LOAD CALCULATIONS
Roof Insulation Upgrade

Thermal Resistances:		
Component:	"R" Value	
Base Case Roof:		
Outside Air Film	0.17	
1.5" haydite deck	0.5	
2-ply 15 lb felt and asphalt vapour barrier	0.12	
2" fibreboard insulation (saturated with water)	0.5	R 5.6 normal
4 layers of 15 lb felt and asphalt	0.33	
Inside Air Film	0.62	
Composite Thermal Resistance	2.24	
Upgraded Roof:		
Outside Air Film	0.17	
new roof system	20.00	
Inside Air Film	0.62	
Composite Thermal Resistance	20.79	

Summary of Parameters	Area (sq.ft.)	Peak Heat Loss (BTUH) (based on -15 °F OAT)
	78000	2,925,000
	78000	315,152
Peak Heat Loss Reduction		2,609,848

Old roof (brown haydite) vs New roof contrast



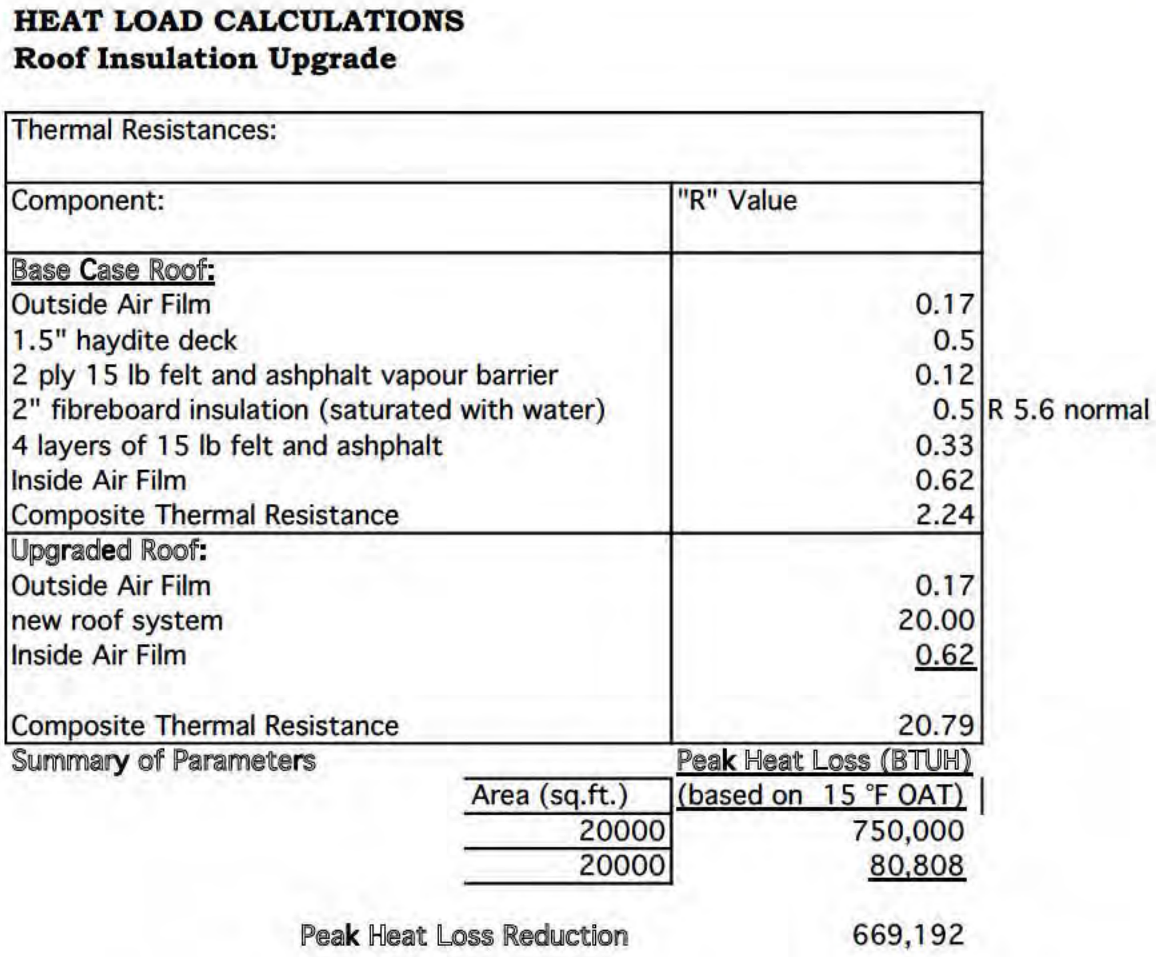
Note: Hourly occurrences for Toronto ON are sourced from Carrier Hourly Analysis Programs

HEAT LOAD CALCULATIONS: <u>Conduction Losses</u>
Space Temperature Maintained @ 68. deg. F.

OAT (deg.F)	No. Hrs.	Weather Dependent Loads (BTU) Existing	New	Δ Load
-15	4	11,630,357	1,253,102	10,377,255
-10	16	43,735,714	4,712,266	39,023,449
-5	45	115,171,875	12,409,091	102,762,784
0	91	217,059,375	23,386,869	193,672,506
5	158	349,363,393	37,641,847	311,721,546
10	245	499,078,125	53,772,727	445,305,398
15	336	625,950,000	67,442,424	558,507,576
20	446	753,222,321	81,155,267	672,067,054
25	626	948,222,321	102,165,368	846,056,953
30	895	1,199,859,375	129,277,778	1,070,581,597
35	770	898,218,750	96,777,778	801,440,972
40	625	620,256,696	66,829,004	553,427,692
45	635	519,622,768	55,986,291	463,636,476
50	667	429,679,018	46,295,382	383,383,635
55	698	328,122,321	35,353,247	292,769,075
60	718	212,515,179	22,897,258	189,617,920
65	675	82,265,625	8,863,636	73,401,989
TOTALS (BTU)				7,007,753,878

Projected Annual Natural Gas Heating Reduction @ 80% Seasonal Efficiency (m3):
245,370

2012



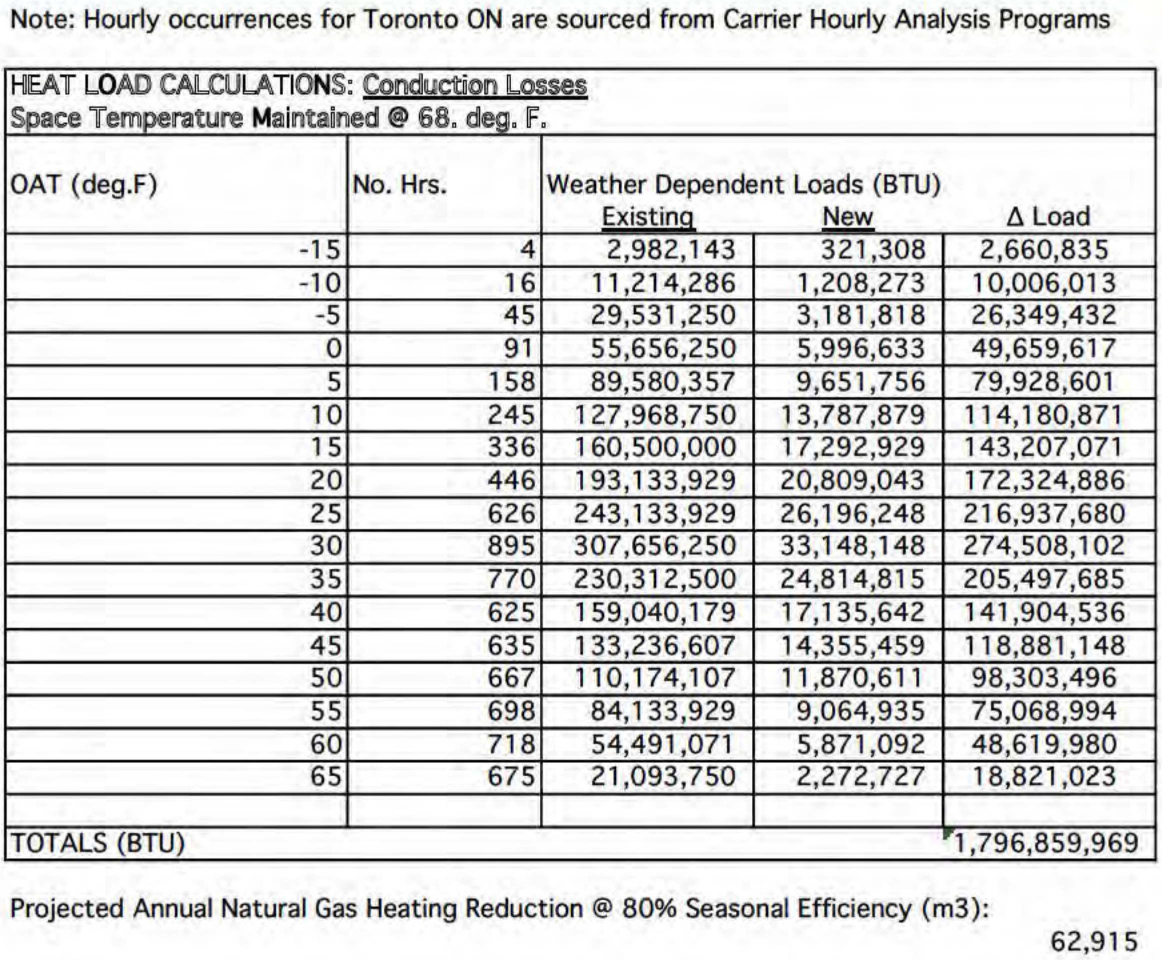
HEAT LOAD CALCULATIONS
Roof Insulation Upgrade

Thermal Resistances:

Component:	"R" Value	
Base Case Roof:		
Outside Air Film	0.17	
1.5" haydite deck	0.5	
2 ply 15 lb felt and ashphalt vapour barrier	0.12	
2" fibreboard insulation (saturated with water)	0.5	R 5.6 normal
4 layers of 15 lb felt and ashphalt	0.33	
Inside Air Film	0.62	
Composite Thermal Resistance	2.24	
Upgraded Roof:		
Outside Air Film	0.17	
new roof system	20.00	
Inside Air Film	0.62	
Composite Thermal Resistance	20.79	

Summary of Parameters

	Area (sq.ft.)	Peak Heat Loss (BTUH) (based on 15 °F OAT)
	20000	750,000
	20000	80,808
Peak Heat Loss Reduction		669,192



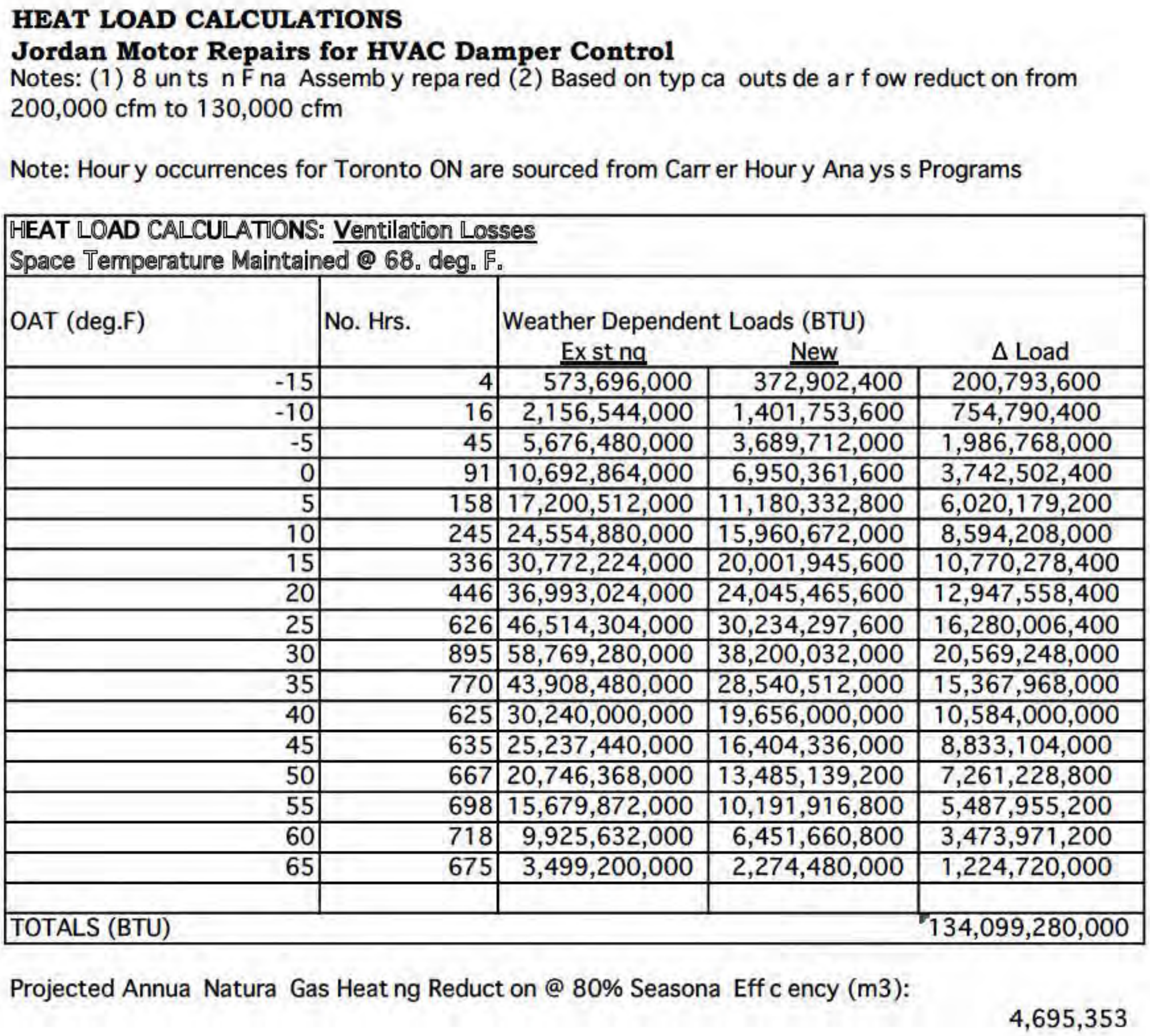
Note: Hourly occurrences for Toronto ON are sourced from Carrier Hourly Analysis Programs

HEAT LOAD CALCULATIONS: Conduction Losses
Space Temperature Maintained @ 68. deg. F.

OAT (deg.F)	No. Hrs.	Weather Dependent Loads (BTU) Existing	 New	 Δ Load
-15	4	2,982,143	321,308	2,660,835
-10	16	11,214,286	1,208,273	10,006,013
-5	45	29,531,250	3,181,818	26,349,432
0	91	55,656,250	5,996,633	49,659,617
5	158	89,580,357	9,651,756	79,928,601
10	245	127,968,750	13,787,879	114,180,871
15	336	160,500,000	17,292,929	143,207,071
20	446	193,133,929	20,809,043	172,324,886
25	626	243,133,929	26,196,248	216,937,680
30	895	307,656,250	33,148,148	274,508,102
35	770	230,312,500	24,814,815	205,497,685
40	625	159,040,179	17,135,642	141,904,536
45	635	133,236,607	14,355,459	118,881,148
50	667	110,174,107	11,870,611	98,303,496
55	698	84,133,929	9,064,935	75,068,994
60	718	54,491,071	5,871,092	48,619,980
65	675	21,093,750	2,272,727	18,821,023
TOTALS (BTU)				1,796,859,969

Projected Annual Natural Gas Heating Reduction @ 80% Seasonal Efficiency (m3):
62,915

Jordan Motors



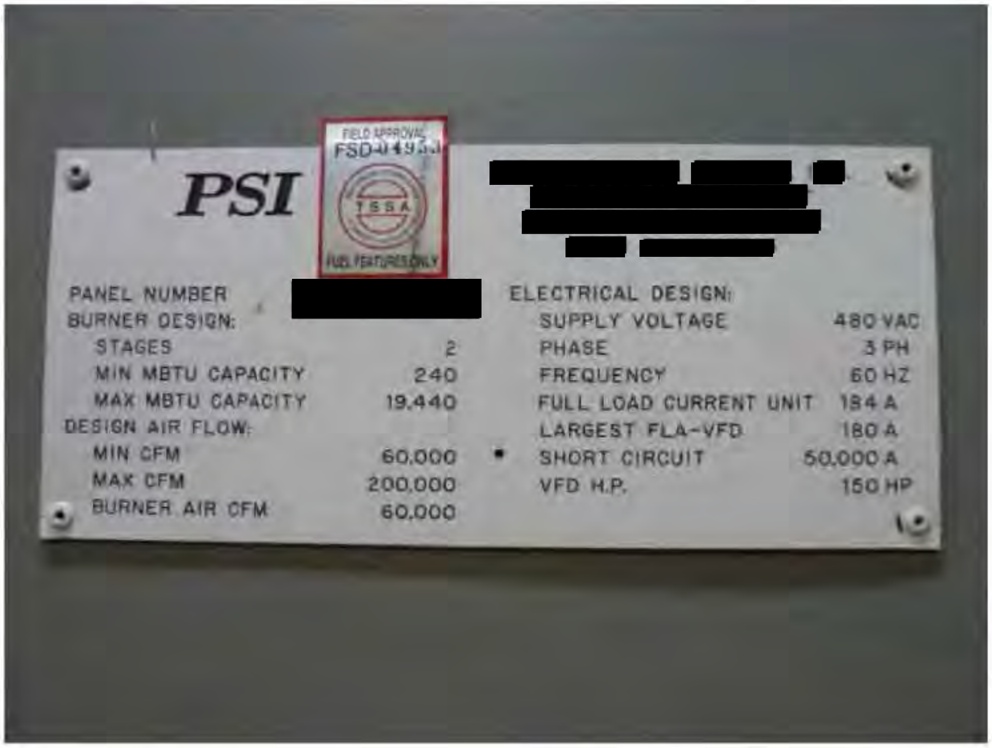
HEAT LOAD CALCULATIONS
Jordan Motor Repairs for HVAC Damper Control
Notes: (1) 8 units in Final Assembly repaired (2) Based on typical outside air flow reduction from 200,000 cfm to 130,000 cfm

Note: Hourly occurrences for Toronto ON are sourced from Carrier Hourly Analysis Programs

HEAT LOAD CALCULATIONS: Ventilation Losses
Space Temperature Maintained @ 68. deg. F.

OAT (deg.F)	No. Hrs.	Weather Dependent Loads (BTU)		
		Existing	New	Δ Load
-15	4	573,696,000	372,902,400	200,793,600
-10	16	2,156,544,000	1,401,753,600	754,790,400
-5	45	5,676,480,000	3,689,712,000	1,986,768,000
0	91	10,692,864,000	6,950,361,600	3,742,502,400
5	158	17,200,512,000	11,180,332,800	6,020,179,200
10	245	24,554,880,000	15,960,672,000	8,594,208,000
15	336	30,772,224,000	20,001,945,600	10,770,278,400
20	446	36,993,024,000	24,045,465,600	12,947,558,400
25	626	46,514,304,000	30,234,297,600	16,280,006,400
30	895	58,769,280,000	38,200,032,000	20,569,248,000
35	770	43,908,480,000	28,540,512,000	15,367,968,000
40	625	30,240,000,000	19,656,000,000	10,584,000,000
45	635	25,237,440,000	16,404,336,000	8,833,104,000
50	667	20,746,368,000	13,485,139,200	7,261,228,800
55	698	15,679,872,000	10,191,916,800	5,487,955,200
60	718	9,925,632,000	6,451,660,800	3,473,971,200
65	675	3,499,200,000	2,274,480,000	1,224,720,000
TOTALS (BTU)				134,099,280,000

Projected Annual Natural Gas Heating Reduction @ 80% Seasonal Efficiency (m3):
4,695,353



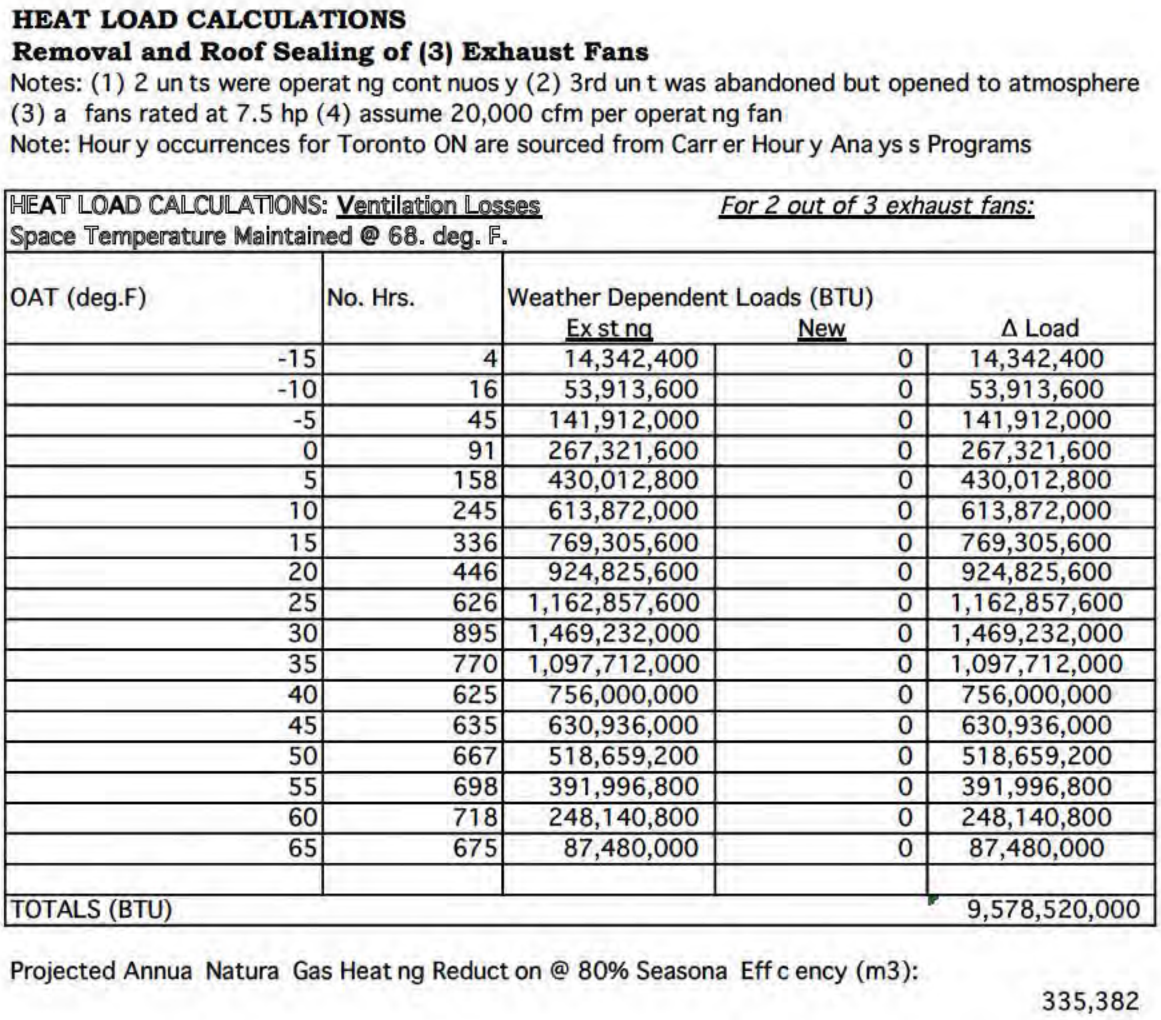
[redacted]

PANEL NUMBER [redacted]

BURNER DESIGN:	
STAGES	2
MIN MBTU CAPACITY	240
MAX MBTU CAPACITY	19,440
DESIGN AIR FLOW:	
MIN CFM	60,000
MAX CFM	200,000
BURNER AIR CFM	60,000

ELECTRICAL DESIGN:	
SUPPLY VOLTAGE	480 VAC
PHASE	3 PH
FREQUENCY	60 HZ
FULL LOAD CURRENT UNIT	184 A
LARGEST FLA-VFD	180 A
SHORT CIRCUIT	50,000 A
VFD H.P.	150 HP

Exhaust Fans



HEAT LOAD CALCULATIONS

Removal and Roof Sealing of (3) Exhaust Fans

Notes: (1) 2 units were operating continuosly (2) 3rd unit was abandoned but opened to atmosphere (3) all fans rated at 7.5 hp (4) assume 20,000 cfm per operating fan

Note: Hourly occurrences for Toronto ON are sourced from Carrier Hourly Analysis Programs

HEAT LOAD CALCULATIONS: <u>Ventilation Losses</u> Space Temperature Maintained @ 68. deg. F.		*<u>For 2 out of 3 exhaust fans:</u>*		
OAT (deg.F)	No. Hrs.	Weather Dependent Loads (BTU) <u>Existing</u>	<u>New</u>	Δ Load
-15	4	14,342,400	0	14,342,400
-10	16	53,913,600	0	53,913,600
-5	45	141,912,000	0	141,912,000
0	91	267,321,600	0	267,321,600
5	158	430,012,800	0	430,012,800
10	245	613,872,000	0	613,872,000
15	336	769,305,600	0	769,305,600
20	446	924,825,600	0	924,825,600
25	626	1,162,857,600	0	1,162,857,600
30	895	1,469,232,000	0	1,469,232,000
35	770	1,097,712,000	0	1,097,712,000
40	625	756,000,000	0	756,000,000
45	635	630,936,000	0	630,936,000
50	667	518,659,200	0	518,659,200
55	698	391,996,800	0	391,996,800
60	718	248,140,800	0	248,140,800
65	675	87,480,000	0	87,480,000
TOTALS (BTU)				9,578,520,000

Projected Annual Natural Gas Heating Reduction @ 80% Seasonal Efficiency (m3):

335,382

Roof Sealing Exhaust Fan

Calculation of Exfiltration loss of 3rd Fan open to atmosphere:
Stack effect → $cfm = 60 \times 0.67 \times A \times \sqrt{(2\,gh\,(Ti - To)/Ti)}$
where T is in °R

Area (sq.ft.)
7

HEAT LOAD CALCULATIONS: Ventilation Losses *For 3rd exhaust fan:*
Space Temperature Maintained @ 68. deg. F.

OAT (deg.F)	No. Hrs.	Weather Dependent Loads (BTU)		
		cfm exfiltration	New	Δ Load
-15	4	4,043	1,449,777	1,449,777
-10	16	3,920	5,283,066	5,283,066
-5	45	3,792	13,453,057	13,453,057
0	91	3,660	24,458,451	24,458,451
5	158	3,523	37,869,720	37,869,720
10	245	3,380	51,871,912	51,871,912
15	336	3,231	62,140,861	62,140,861
20	446	3,075	71,092,027	71,092,027
25	626	2,910	84,606,008	84,606,008
30	895	2,736	100,489,947	100,489,947
35	770	2,550	69,965,803	69,965,803
40	625	2,348	44,385,514	44,385,514
45	635	2,128	33,572,962	33,572,962
50	667	1,883	24,415,115	24,415,115
55	698	1,600	15,681,754	15,681,754
60	718	1,255	7,787,241	7,787,241
65	675	769	1,681,163	1,681,163
TOTALS (BTU)				650,204,379

Projected Annual Natural Gas Heating Reduction @ 80% Seasonal Efficiency (m3): 22,766

Exhaust Fan Opening (closed over by roof)

HEAT LOAD CALCULATIONS

Temperature setback from 70 °F to 68 °F

Notes: (1) applies plant-wide to 8 HVAC units (2) applies to occupied time frames only (ie. Weekends excluded)
(3) Based on original outside air flow as reduction efforts have already been factored in previous calculations

Note: Hourly occurrences for Toronto ON are sourced from Carrier Hourly Analysis Programs

HEAT LOAD CALCULATIONS: Space heating
Space Temperature Maintained @ 68. deg. F. instead of 70 deg. F during occupied periods

OAT (deg.F)	No. Hrs	Weather Dependent Loads (BTU)		
		Existing	New	Δ Load
-15	4	587,520,000	573,696,000	13,824,000
-10	16	2,211,840,000	2,156,544,000	55,296,000
-5	45	5,832,000,000	5,676,480,000	155,520,000
0	91	11,007,360,000	10,692,864,000	314,496,000
5	158	17,746,560,000	17,200,512,000	546,048,000
10	245	25,401,600,000	24,554,880,000	846,720,000
15	336	31,933,440,000	30,772,224,000	1,161,216,000
20	446	38,534,400,000	36,993,024,000	1,541,376,000
25	626	48,677,760,000	46,514,304,000	2,163,456,000
30	895	61,862,400,000	58,769,280,000	3,093,120,000
35	770	46,569,600,000	43,908,480,000	2,661,120,000
40	625	32,400,000,000	30,240,000,000	2,160,000,000
45	635	27,432,000,000	25,237,440,000	2,194,560,000
50	667	23,051,520,000	20,746,368,000	2,305,152,000
55	698	18,092,160,000	15,679,872,000	2,412,288,000
60	718	12,407,040,000	9,925,632,000	2,481,408,000
65	675	5,832,000,000	3,499,200,000	2,332,800,000
			TOTALS (BTU)	26,438,400,000
Occupancy factor adjustment (5 out of 7 days per week):				18,884,571,429

Projected Annual Natural Gas Heating Reduction @ 80% Seasonal Efficiency (m3): 661,224

Summary

Rationalization Of Energy Measures Summary (rough estimate)

	Annual m3 of Natural Gas Savings estimate
Year 2013 Roof Upgrades:	245,370
Year 2012 Roof Upgrades:	62,915
Jordan Fan Damper Control Repairs:	4,695,353
Temperature setback:	661,224
Shutdown of (2) Exhaust Fans:	335,382
Sealing of 3rd Exhaust Fan:	22,766
Total	6,023,011

Setback Temperature

confirmation of zone temperature setback being maintained through the BMS

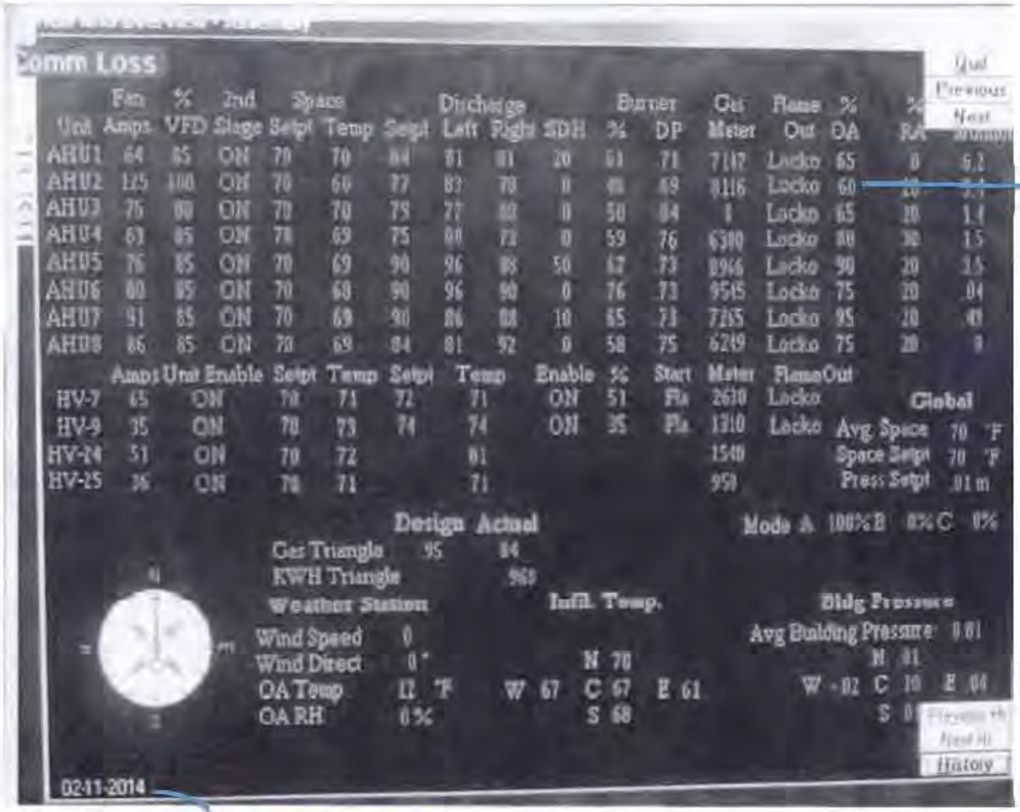
Kiser Concept Parameters

```
68    Tn        normal (occupied) Avg space Temp setpt Zone 1 (°F)
60    Tn        normal (occupied) Avg space Temp setpt Zone 2 (°F)
68    Tn        normal (occupied) Avg space Temp setpt Zone 3 (°F)
68    Tn        normal (occupied) Avg space Temp setpt Zone 4 (°F)
65    Tnb     normal Mode B (occupied) temp setpt Zone 1 (°F)
65    Tnb     normal Mode B (occupied) temp setpt Zone 2 (°F)
65    Tnb     normal Mode B (occupied) temp setpt Zone 3 (°F)
65    Tnb     normal Mode B (occupied) temp setpt Zone 4 (°F)
60    Tu        unoccupied Avg space Temp setpt        Zone 1 (°F)
60    Tu        unoccupied Avg space Temp setpt        Zone 2 (°F)
60    Tu        unoccupied Avg space Temp setpt        Zone 3 (°F)
60    Tu        unoccupied Avg space Temp setpt        Zone 4 (°F)
.01   Fpsp      Avg (File) Pressure Setpt - permanent  Zone 1 (inche
.01   Fpsp      Avg (File) Pressure Setpt - permanent  Zone 2 (inche
.01   Fpsp      Avg (File) Pressure Setpt - permanent  Zone 3 (inche
.01   Fpsp      Avg (File) Pressure Setpt - permanent  Zone 4 (inche

48    LoEcon    min oa temp for econ mode                     (°F)
.5    Htdb      Heating temp deadband
40    Lodisch   min allowable discharge temp
70    summerlim when OA > this, OAD -> 100%

30    Pgain     OA damper pressure gain (% change for .01" p change)
15    maxTSdev  max temp sensor deviation from average        (°F)
```

Click on values to change them.

VFD – Before Condition

VFD 2014 – After Condition



Unit	Fan Amps	% VFD	2nd Stage	Space Setpt	Space Temp	Discharge Setpt	Discharge Left	Discharge Right	SDH	Burner %	Burner DP	Gas Meter	Flame Out	% OA	% RA	
AHU1	64	85	ON	70	70	84	81	81	20	61	.71	7107	Locko	65	0	5.2
AHU2	125	100	ON	70	66	77	83	78	0	48	.69	8116	Locko	60	10	[illegible]
AHU3	75	80	ON	70	70	75	77	80	0	50	.84	1	Locko	65	20	1.4
AHU4	63	85	ON	70	69	75	80	72	0	59	.76	6300	Locko	80	30	1.5
AHU5	76	85	ON	70	69	90	96	88	50	67	.73	8966	Locko	90	20	1.5
AHU6	80	85	ON	70	68	90	96	90	0	76	.73	9545	Locko	75	20	.04
AHU7	91	85	ON	70	69	90	86	88	10	65	.73	7265	Locko	95	20	.40
AHU8	86	85	ON	70	69	84	81	92	0	58	75	6289	Locko	75	20	0

	Amps	Unit Enable	Setpt	Temp	Setpt	Temp	Enable	%	Start	Meter	FlameOut
HV-7	65	ON	70	71	72	71	ON	51	Fls	2610	Locko
HV-9	35	ON	70	73	74	74	ON	35	Fls	1310	Locko
HV-24	51	ON	70	72		81				1540	
HV-25	36	ON	70	71		71				950	

Global
Avg Space 70 °F
Space Setpt 70 °F
Press Setpt .01 in

Mode A 100% B 0% C 0%

	Design	Actual
Gas Triangle	95	84
KWH Triangle		969

Weather Station
Wind Speed 0
Wind Direct 0°
OA Temp 12 °F
OA RH 0 %

Infil. Temp.
N 70
W 67 C 67 E 61
S 68

Bldg Pressure
Avg Building Pressure 0.01
N .01
W -.02 C .10 E .04
S 0

02-11-2014

VFD is at 100% and at similar Δp across the burner, damper system is actually controlling to 60% outdoor air and getting feedback to the VFD.

Retrofit Case archived data

Appendix B: Union Gas Project Code - CI04 - 2013-IND-0185

[redacted] Unit Temperature Setback

[redacted]

[redacted] Unit Temperature Setback

[redacted]

[redacted] Unit Temperature Setback

[redacted]

[redacted] Unit Temperature Setback

[redacted]

Material Weekend Shut Down Set Up Plan

Material Handling

[redacted]

- ☐ Remaining Put Up Carts Collected and loaded onto trailer at dock 2
- ☐ [redacted] 3/4 Strip out Support
- ☐ [redacted] system Empty - [redacted] Support Required
- ☐ All Fork Lifts / Tuggers returned to their proper storage location.
- ☐ Hyster Rapid Charge Fork Lifts Plugged in for Weekend.
- ☐ All Trailers Released at the end of shift for Facilities P.M.'s
- 🟨 Ensure all doors are closed or sealed and all dock lights off.
- ☐ [redacted] - all stock removed for maintenance P.M.'s
- ☐ [redacted] Lift Tables Emptied
- ☐ AGC Carts are powered down at end of shift.
- ☐ Shut Off communication Televisions in Rest Areas

[redacted]:

- ☐ All buffers to be 1/2 full to allow for equipment verification.
- ☐ Support [redacted] East and West for [redacted] out.
- ☐ All Fork Lifts / Tuggers returned to their proper storage location.
- ☐ Hyster Rapid Charge Fork Lifts Plugged in for Weekend.
- ☐ All Tuggers plugged in at end of shift for battery equalization.
- ☐ All Trailers Released at the end of shift for Facilities P.M.'s
- 🟨 Ensure all doors are closed or sealed and all dock lights off.
- ☐ Shut Off communication Televisions in Rest Areas

Energy Conservation Activities:

- ☐ Process Lighting turned off - verify [redacted] and Sequence area lighting shut off.
- ☐ All fans at Sequence area and break areas are turned off
- ☐ All water coolers unplugged before end of shift.
- ☐ Planning Office Computers are shut down vs. logging off
- ☐ Planning Office Lights turned off
- 🟨 Ensure all doors are closed or sealed and all dock lights off.
- ☐ Ensure all Fork Lifts and Tuggers are powered down

APPENDIX C: Union Gas Project Code - CI07 - 2013-IND-0037

Hot Oil Temperature (Winter operation)

[redacted]

Adjusted results highlighted in red....

Savings Summary - Tabs

	Base Case Loss	HE Option Loss	Savings	
Insulation Savings Tank 201-202	782,456	198,988	583,468	OK
Insulation Savings Tank R1	32,225	8,539	23,686	OK
6" Dia Pipe	306,952	104,559	202,392	
Internal Pipe Insulation	32,420	11,835	20,585	
Total	1,154,053	323,922	830,131	

Total COSTS

Tanks Insulation		
[redacted]	[redacted]	
Pipe Insulation		
[redacted]	$ [redacted]	
less costs above included in other projects	[redacted]	
	[redacted]	(removalable covers)
	[redacted]	

From The Weather Network
Ambient Conditions [redacted]

[redacted]

				6" Diameter Pipe (Outbound Hot Oil) [redacted] 1/2" INSULATION 3EPlus v4.0 [BTU/hr/ft]	3EPlus v4.0 [BTU/Month/ft]	6" Diameter Pipe (Outbound Hot Oil) 450 Deg F Hot Oil Temp 2" INSULATION 3EPlus v4.0 [BTU/hr/ft]	3EPlus v4.0 [BTU/Month/ft]
[redacted]	[redacted]	[redacted]	Heat Loss =	[redacted]	218,120	[redacted]	73,579
Air Temperature =	[redacted]	[redacted]	Heat Loss =	[redacted]	188,575	[redacted]	63,880
Air Temperature =	[redacted]	Mar	Heat Loss =	[redacted]	254,646	[redacted]	86,381
Air Temperature =	[redacted]	Apr	Heat Loss =	[redacted]	238,403	[redacted]	81,060
Air Temperature =	[redacted]	May	Heat Loss =	[redacted]	240,844	[redacted]	82,703
Air Temperature =	[redacted]	Jun	Heat Loss =	[redacted]	224,981	[redacted]	77,739
Air Temperature =	[redacted]	Jul	Heat Loss =	[redacted]	230,507	[redacted]	80,255
Air Temperature =	[redacted]	Aug	Heat Loss =	[redacted]	230,451	[redacted]	80,440
Air Temperature =	[redacted]	Sep	Heat Loss =	[redacted]	225,686	[redacted]	78,249
Air Temperature =	[redacted]	Oct	Heat Loss =	[redacted]	243,809	[redacted]	83,680
Air Temperature =	[redacted]	Nov	Heat Loss =	[redacted]	240,117	[redacted]	81,738
Air Temperature =	[redacted]	[redacted]	Heat Loss =	[redacted]	214,448	[redacted]	72,664
Total Hours	[redacted]		Average Heat Loss =	418	229,218	143.37	78,531

Total Hours In A Year	8,760	
[redacted] Avg Estimated Storage Tank Operating Hours	6570	
Difference	2,190	183 hrs/mth

Base Case Heat Loss =	6,251,334,398	[Btu/yr]
New Project Heat Loss =	2,141,747,330	[Btu/yr]
Energy Savings =	4,109,587,068	[Btu/yr]
Natural Gas Savings =	[redacted]	[m³/yr]

177,021	[m³/yr]
60,649	[m³/yr]

Note: 183hrs were subtracted from every month in the Weather Data Chart. This was done to reflect [redacted] Average Estimated Storage Tank Annual Operating Hours

[redacted]	Outbound Oil Temperature =	450 F
	Outbound Nominal Pipe Length =	2,000 Feet
	Return Oil Temperature	356 F
	Return Nominal Pipe Length =	2,000 Feet
	Nominal Pipe Diameter =	6 Inch
	Insulation Thickness =	2 Inch
	Oil System Efficiency =	86%

KNOWNS:

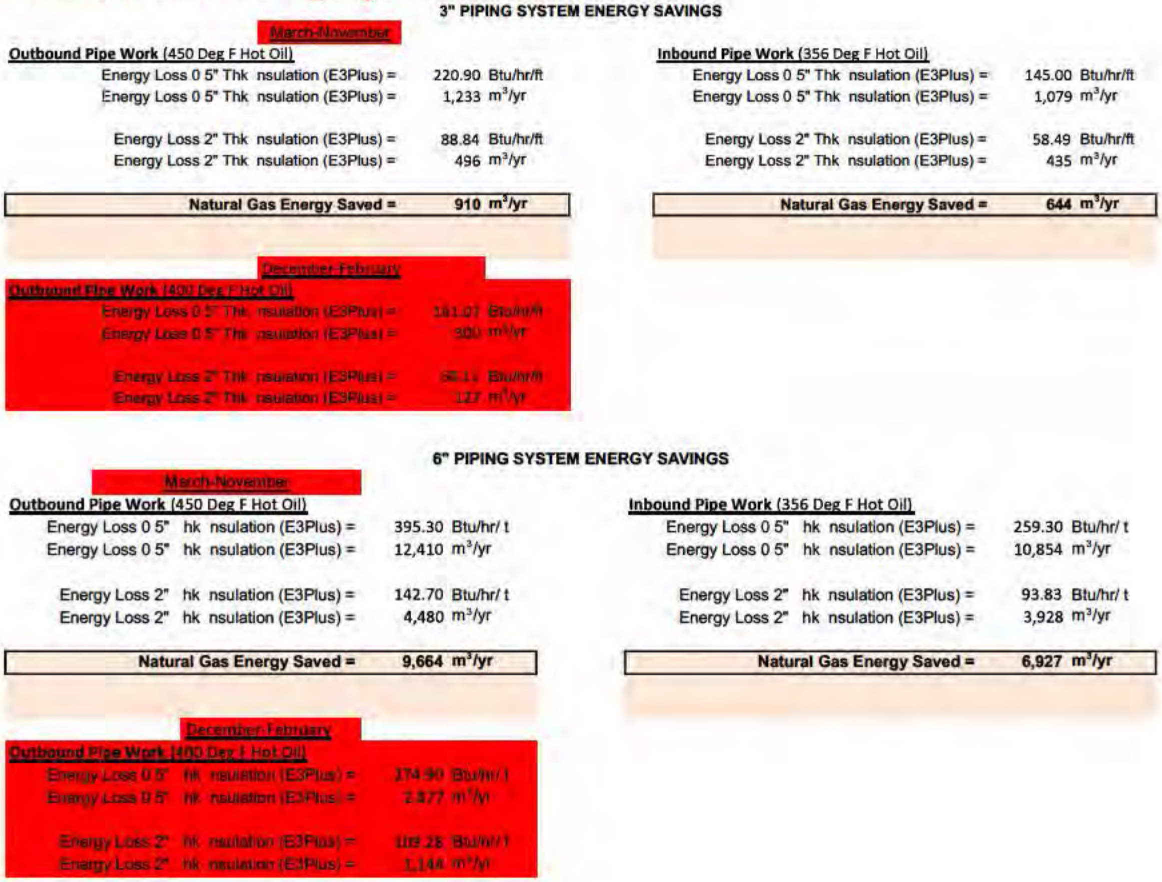
Nat Gas HHV =	1,000	Btu/ft³
1 m3 =	35.314	ft³

		6" Diameter Pipe (Hot Oil Return) 356 Deg F Hot Oil Temp 1/2" INSULATION 3EPlus v4.0 [BTU/hr/ft]	3EPlus v4.0 [BTU/Month/ft]	6" Diameter Pipe (Hot Oil Return) 356 Deg F Hot Oil Temp 2" INSULATION 3EPlus v4.0 [BTU/hr/ft]	3EPlus v4.0 [BTU/Month/ft]
Jan	Heat Loss =	[redacted]	164,020	[redacted]	62,040
Feb	Heat Loss =	[redacted]	159,029	[redacted]	53,835
Mar	Heat Loss =	[redacted]	178,742	[redacted]	60,535
Apr	Heat Loss =	[redacted]	165,960	[redacted]	56,341
May	Heat Loss =	[redacted]	166,255	[redacted]	56,961
Jun	Heat Loss =	[redacted]	154,209	[redacted]	53,170
Jul	Heat Loss =	[redacted]	157,383	[redacted]	54,568
Aug	Heat Loss =	[redacted]	157,596	[redacted]	54,875
Sep	Heat Loss =	[redacted]	155,273	[redacted]	53,716
Oct	Heat Loss =	[redacted]	169,169	[redacted]	57,947
Nov	Heat Loss =	[redacted]	190,651	[redacted]	57,034
Dec	Heat Loss =	[redacted]	180,567	[redacted]	61,142
	Average Heat Loss =	308	168,239	103.89	56,857

Base Case Heat Loss =	4,588,349,807	[Btu/yr]
New Project Heat Loss =	1,550,648,580	[Btu/yr]
Energy Savings =	3,037,701,227	[Btu/yr]
Natural Gas Savings =	[redacted]	[m³/yr]

129,930	[m³/yr]
43,910	[m³/yr]

Revised coefficients highlighted in red…



3" PIPING SYSTEM ENERGY SAVINGS

March-November

Outbound Pipe Work (450 Deg F Hot Oil)
Energy Loss 0 5" Thk nsulation (E3Plus) = 220.90 Btu/hr/ft
Energy Loss 0 5" Thk nsulation (E3Plus) = 1,233 m³/yr

Energy Loss 2" Thk nsulation (E3Plus) = 88.84 Btu/hr/ft
Energy Loss 2" Thk nsulation (E3Plus) = 496 m³/yr

Natural Gas Energy Saved = 910 m³/yr

Inbound Pipe Work (356 Deg F Hot Oil)
Energy Loss 0 5" Thk nsulation (E3Plus) = 145.00 Btu/hr/ft
Energy Loss 0 5" Thk nsulation (E3Plus) = 1,079 m³/yr

Energy Loss 2" Thk nsulation (E3Plus) = 58.49 Btu/hr/ft
Energy Loss 2" Thk nsulation (E3Plus) = 435 m³/yr

Natural Gas Energy Saved = 644 m³/yr

December-February

Outbound Pipe Work (400 Deg F Hot Oil)
Energy Loss 0 5" Thk nsulation (E3Plus) = 161.07 Btu/hr/ft
Energy Loss 0 5" Thk nsulation (E3Plus) = 300 m³/yr

Energy Loss 2" Thk nsulation (E3Plus) = 68.11 Btu/hr/ft
Energy Loss 2" Thk nsulation (E3Plus) = 127 m³/yr

6" PIPING SYSTEM ENERGY SAVINGS

March-November

Outbound Pipe Work (450 Deg F Hot Oil)
Energy Loss 0 5" hk nsulation (E3Plus) = 395.30 Btu/hr/ t
Energy Loss 0 5" hk nsulation (E3Plus) = 12,410 m³/yr

Energy Loss 2" hk nsulation (E3Plus) = 142.70 Btu/hr/ t
Energy Loss 2" hk nsulation (E3Plus) = 4,480 m³/yr

Natural Gas Energy Saved = 9,664 m³/yr

Inbound Pipe Work (356 Deg F Hot Oil)
Energy Loss 0 5" hk nsulation (E3Plus) = 259.30 Btu/hr/ t
Energy Loss 0 5" hk nsulation (E3Plus) = 10,854 m³/yr

Energy Loss 2" hk nsulation (E3Plus) = 93.83 Btu/hr/ t
Energy Loss 2" hk nsulation (E3Plus) = 3,928 m³/yr

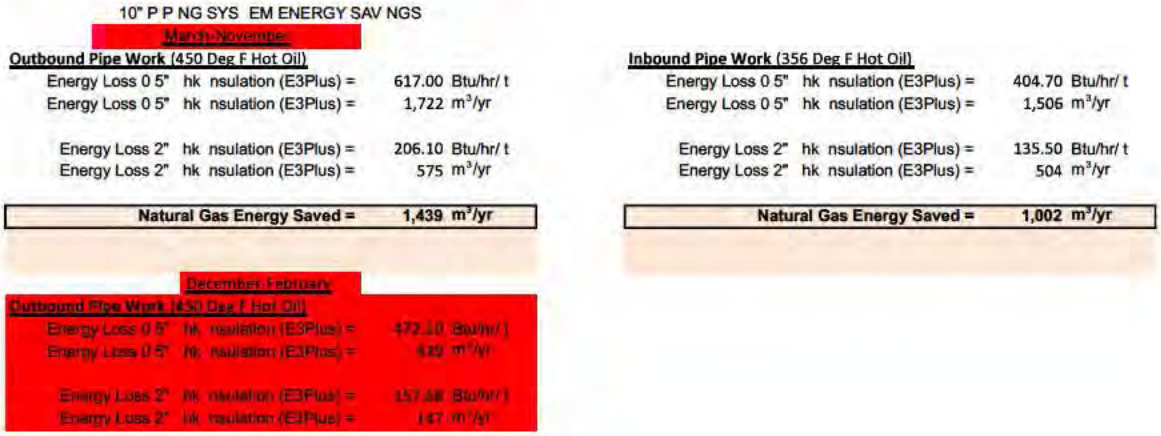
Natural Gas Energy Saved = 6,927 m³/yr

December-February

Outbound Pipe Work (400 Deg F Hot Oil)
Energy Loss 0 5" hk nsulation (E3Plus) = 274.90 Btu/hr/ t
Energy Loss 0 5" hk nsulation (E3Plus) = 2,877 m³/yr

Energy Loss 2" hk nsulation (E3Plus) = 109.28 Btu/hr/ t
Energy Loss 2" hk nsulation (E3Plus) = 1,144 m³/yr

Revised coefficients highlighted in red...



10" P P NG SYS EM ENERGY SAV NGS

March-November

Outbound Pipe Work (450 Deg F Hot Oil)

Energy Loss 0 5" hk nsulation (E3Plus) =	617.00	Btu/hr/ t
Energy Loss 0 5" hk nsulation (E3Plus) =	1,722	m^3/yr
Energy Loss 2" hk nsulation (E3Plus) =	206.10	Btu/hr/ t
Energy Loss 2" hk nsulation (E3Plus) =	575	m^3/yr
Natural Gas Energy Saved =	**1,439**	**m^3/yr**

Inbound Pipe Work (356 Deg F Hot Oil)

Energy Loss 0 5" hk nsulation (E3Plus) =	404.70	Btu/hr/ t
Energy Loss 0 5" hk nsulation (E3Plus) =	1,506	m^3/yr
Energy Loss 2" hk nsulation (E3Plus) =	135.50	Btu/hr/ t
Energy Loss 2" hk nsulation (E3Plus) =	504	m^3/yr
Natural Gas Energy Saved =	**1,002**	**m^3/yr**

December-February

Outbound Pipe Work (450 Deg F Hot Oil)

Energy Loss 0 5" hk nsulation (E3Plus) =	472.10	Btu/hr/ t
Energy Loss 0 5" hk nsulation (E3Plus) =	439	m^3/yr
Energy Loss 2" hk nsulation (E3Plus) =	157.58	Btu/hr/ t
Energy Loss 2" hk nsulation (E3Plus) =	147	m^3/yr

APPENDIX D: Union Gas Project Code - CI08 - 2013-IND-0046

[redacted]

Avg. daily Estimated Gas
[redacted] [redacted]
[redacted] [redacted]
Before [redacted] [redacted]
After [redacted] [redacted]
Diff [redacted]
[redacted]

Gas savings **472,215 m3/yr**

Data includes 2013

[redacted]

Avg. daily prod'n Estimated Gas consumption
Before
After
[redacted]

Gas savings **402,543 m3/yr**

APPENDIX E: Union Gas Project Code - CI15 - 2013-IND-0042

Enthalpy Calculations

1.) Calculate the Energy (Enthalpy) which the boiler must add to feed water to make steam
This energy is dependent on the operating pressure and the temperature of the feed water from the de aerator to the boiler

1 1) Steam Pressure			**130**	**PSIG**
1 2) Total enthalpy (Hg) of steam at	130	PSIG	1193 5	BTU/LB
1 3) Temperature of Feed-water from De-aerator			230	degrees F
1 4) Enthalpy of feed-water at	230	F	198	BTU/LB
1.5) Net Enthalpy added by boiler = (1.2) - (1.4)			**995.5**	**BTU/LB**

This figure 995.5 BTU/LB is used to calculate the amount of steam produced.

2.) Calculate the Energy which must be supplied to the De-Aerator by adding steam to the feed-water.
This is the energy required to raise the temperature of the feed-water from Mixed Condensate temperature to the de-aerator temperature.
(Use Steam Tables to determine the enthalpy difference of water at each temperature)

2 1) De-Aerator Operating Pressure	**9**	**PSIG**
2 2) De-aerator saturated water temperature at its operating pressure	230	degrees F
2 3) Enthalpy of water in the de-aerator	198	BTU/LB
2 4) Enthalpy of steam vented from the de-aerator	1158	BTU/LB
2 4) Condensate Return Rate as a % of Steam Production	70 0%	as estimated
2 5) Make-up Water Rate as a % of Steam Production	30 0%	
2 6) Average Temperature of Condensate Return Water		°F
2 7) Average Temperature of Make-up Water		°F
2 8) Average Temperature of return and make-up water (same as mixed water in the condensate return tank)	150 0	°F
2 9) Enthalpy of water in the condensate return tank at it's mixed temperature	118 0	BTU/LB
2.10) Steam Energy supplied to the De-aerator= (2.3) - (2.9)	**80.0**	**BTU/LB**

This figure 80.0 BTU/LB is used to calculate the mass flow of steam which is supplied to the de-aerator

3.) Calculate the Enthalpy of blow-down water. Using steam tables calculate the enthalpy of saturated water at the same pressure as the operating steam pressure. Blow-down rate is normally considered to be a percentage of the steam rate, however, blow-down water has only a fraction of the enthalpy of steam.

3 1 Steam pressure	130	**PSIG**
3 2 Steam Temperature	356	**°F**
3 2 Enthalpy of blow-down water from steam tables	**328**	**BTU/LB**

3.3 BLOW-DOWN LOSS CALCULATION

		TEST #1	TEST #2	TEST #3	TEST #4	TEST #5	
Boiler #3	**MBTU/HR**	124 5	125 1	128 0	122 8	125 2	**MBTU/HR**

4.) Calculate the Mass Flow of Steam Required to heat the water in the de-aerator from the mixed condensate temperature to the temperature of the feed-water.

De-Aerator Vent Rate	100	LB/HR
Vent Steam Enthalpy	**1158**	BTU/LB
Enthalpy of steam at DA pressure	**9**	PSIG from steam tables

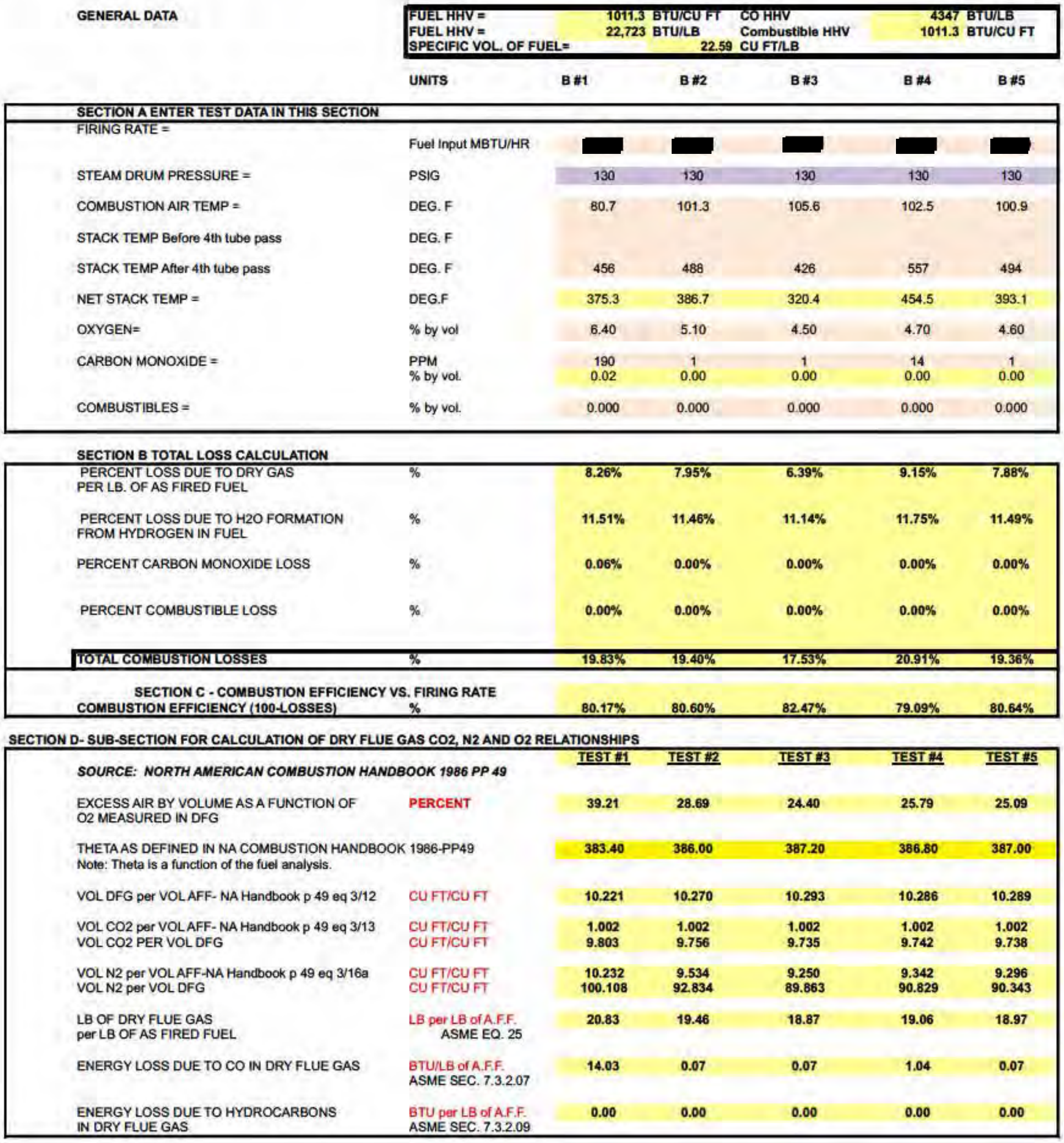
Feed-Water Flow **LB/HR**

	TEST #1	TEST #2	TEST #3	TEST #4	TEST #5	
Boiler #3	9 552	9 603	9 831	9 421	9 608	LB/HR

Steam Flow to De-Aerator **LB/HR**

	TEST #1	TEST #2	TEST #3	TEST #4	TEST #5	
Boiler #3	807	811	828	797	811	LB/HR

Boiler Combustion



GENERAL DATA

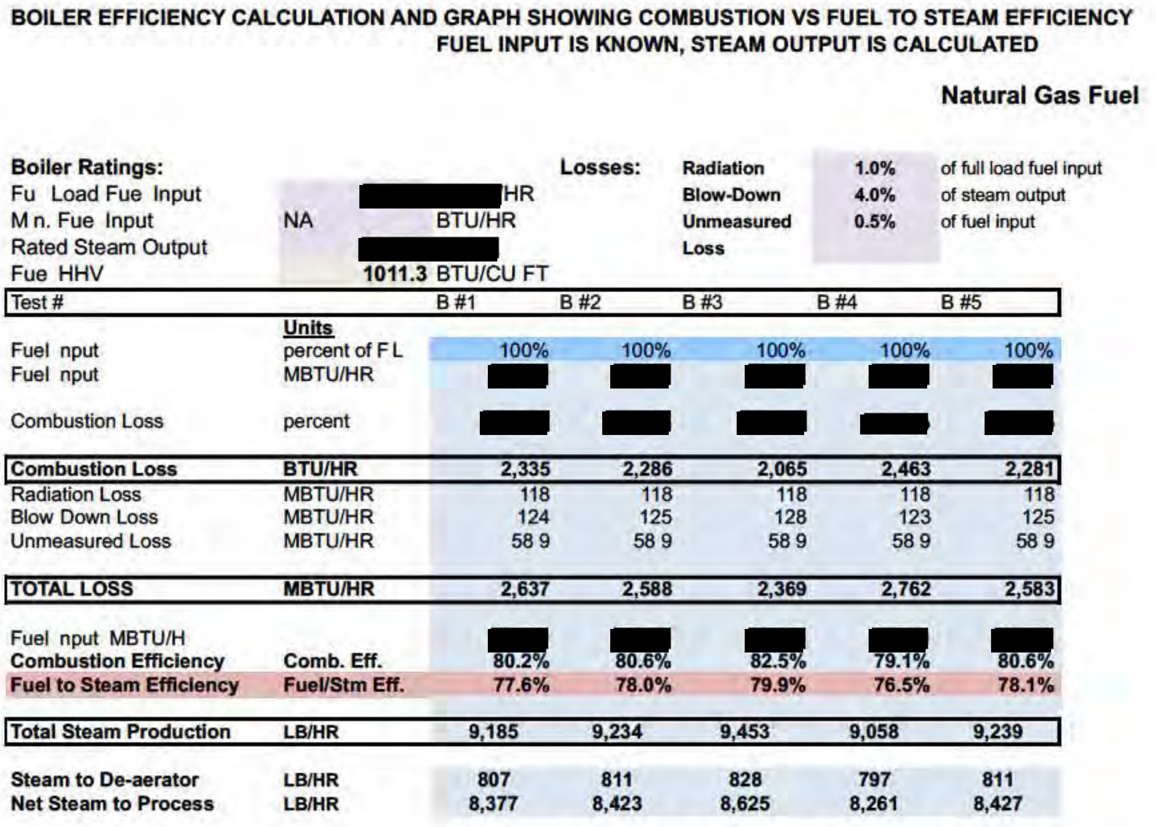
FUEL HHV =	1011.3	BTU/CU FT	CO HHV	4347	BTU/LB
FUEL HHV =	22,723	BTU/LB	Combustible HHV	1011.3	BTU/CU FT
SPECIFIC VOL. OF FUEL=	22.59	CU FT/LB			

	UNITS	B #1	B #2	B #3	B #4	B #5
SECTION A ENTER TEST DATA IN THIS SECTION						
FIRING RATE =	Fuel Input MBTU/HR	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
STEAM DRUM PRESSURE =	PSIG	130	130	130	130	130
COMBUSTION AIR TEMP =	DEG. F	80.7	101.3	105.6	102.5	100.9
STACK TEMP Before 4th tube pass	DEG. F					
STACK TEMP After 4th tube pass	DEG. F	456	488	426	557	494
NET STACK TEMP =	DEG.F	375.3	386.7	320.4	454.5	393.1
OXYGEN=	% by vol	6.40	5.10	4.50	4.70	4.60
CARBON MONOXIDE =	PPM	190	1	1	14	1
	% by vol.	0.02	0.00	0.00	0.00	0.00
COMBUSTIBLES =	% by vol.	0.000	0.000	0.000	0.000	0.000
SECTION B TOTAL LOSS CALCULATION						
PERCENT LOSS DUE TO DRY GAS PER LB. OF AS FIRED FUEL	%	8.26%	7.95%	6.39%	9.15%	7.88%
PERCENT LOSS DUE TO H2O FORMATION FROM HYDROGEN IN FUEL	%	11.51%	11.46%	11.14%	11.75%	11.49%
PERCENT CARBON MONOXIDE LOSS	%	0.06%	0.00%	0.00%	0.00%	0.00%
PERCENT COMBUSTIBLE LOSS	%	0.00%	0.00%	0.00%	0.00%	0.00%
TOTAL COMBUSTION LOSSES	%	19.83%	19.40%	17.53%	20.91%	19.36%
SECTION C - COMBUSTION EFFICIENCY VS. FIRING RATE						
COMBUSTION EFFICIENCY (100-LOSSES)	%	80.17%	80.60%	82.47%	79.09%	80.64%

SECTION D- SUB-SECTION FOR CALCULATION OF DRY FLUE GAS CO2, N2 AND O2 RELATIONSHIPS

		TEST #1	TEST #2	TEST #3	TEST #4	TEST #5
SOURCE: NORTH AMERICAN COMBUSTION HANDBOOK 1986 PP 49						
EXCESS AIR BY VOLUME AS A FUNCTION OF O2 MEASURED IN DFG	PERCENT	39.21	28.69	24.40	25.79	25.09
THETA AS DEFINED IN NA COMBUSTION HANDBOOK 1986-PP49 Note: Theta is a function of the fuel analysis.		383.40	386.00	387.20	386.80	387.00
VOL DFG per VOL AFF- NA Handbook p 49 eq 3/12	CU FT/CU FT	10.221	10.270	10.293	10.286	10.289
VOL CO2 per VOL AFF- NA Handbook p 49 eq 3/13	CU FT/CU FT	1.002	1.002	1.002	1.002	1.002
VOL CO2 PER VOL DFG	CU FT/CU FT	9.803	9.756	9.735	9.742	9.738
VOL N2 per VOL AFF-NA Handbook p 49 eq 3/16a	CU FT/CU FT	10.232	9.534	9.250	9.342	9.296
VOL N2 per VOL DFG	CU FT/CU FT	100.108	92.834	89.863	90.829	90.343
LB OF DRY FLUE GAS per LB OF AS FIRED FUEL	LB per LB of A.F.F. ASME EQ. 25	20.83	19.46	18.87	19.06	18.97
ENERGY LOSS DUE TO CO IN DRY FLUE GAS	BTU/LB of A.F.F. ASME SEC. 7.3.2.07	14.03	0.07	0.07	1.04	0.07
ENERGY LOSS DUE TO HYDROCARBONS IN DRY FLUE GAS	BTU per LB of A.F.F. ASME SEC. 7.3.2.09	0.00	0.00	0.00	0.00	0.00

Boiler Efficiency



BOILER EFFICIENCY CALCULATION AND GRAPH SHOWING COMBUSTION VS FUEL TO STEAM EFFICIENCY
FUEL INPUT IS KNOWN, STEAM OUTPUT IS CALCULATED

Natural Gas Fuel

Boiler Ratings:		
Full Load Fuel Input	[redacted]	HR
Min. Fuel Input	NA	BTU/HR
Rated Steam Output	[redacted]	
Fuel HHV	**1011.3**	BTU/CU FT

Losses:		
Radiation	**1.0%**	of full load fuel input
Blow-Down	**4.0%**	of steam output
Unmeasured Loss	**0.5%**	of fuel input

Test #		B #1	B #2	B #3	B #4	B #5
	Units					
Fuel Input	percent of F L	100%	100%	100%	100%	100%
Fuel Input	MBTU/HR	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Combustion Loss	percent	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Combustion Loss	**BTU/HR**	2,335	2,286	2,065	2,463	2,281
Radiation Loss	MBTU/HR	118	118	118	118	118
Blow Down Loss	MBTU/HR	124	125	128	123	125
Unmeasured Loss	MBTU/HR	58 9	58 9	58 9	58 9	58 9
TOTAL LOSS	**MBTU/HR**	**2,637**	**2,588**	**2,369**	**2,762**	**2,583**
Fuel Input MBTU/H		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Combustion Efficiency	**Comb. Eff.**	**80.2%**	**80.6%**	**82.5%**	**79.1%**	**80.6%**
Fuel to Steam Efficiency	**Fuel/Stm Eff.**	**77.6%**	**78.0%**	**79.9%**	**76.5%**	**78.1%**
Total Steam Production	**LB/HR**	**9,185**	**9,234**	**9,453**	**9,058**	**9,239**
Steam to De-aerator	**LB/HR**	**807**	**811**	**828**	**797**	**811**
Net Steam to Process	**LB/HR**	**8,377**	**8,423**	**8,625**	**8,261**	**8,427**

Savings Calculation

Energy Savings Calculation (Steam Leaks)

Number of Steam Leaks	Leak Rate	Steam Loss (lbs)	Steam Pressure Raised	(leaked) Steam Enthalpy	Steam System Efficiency	Heat Loss / Yr (BTU)	Heat Input
1	13.23 lbs/hr	97,161 lbs	125 psig	1,193 Btu/lbs	78%	115,913,216 Btu/yr	148,606,687 Btu/yr
3	12.50 lbs/hr	275,400 lbs	125 psig	1,193 Btu/lbs	78%	328,552,200 Btu/yr	421,220,769 Btu/yr
1	52.91 lbs/hr	388,571 lbs	125 psig	1,193 Btu/lbs	78%	463,565,251 Btu/yr	594,314,424 Btu/yr
1	500.00 lbs/hr	3,672,000 lbs	flash steam to atmosphere	956 Btu/lbs	78%	3,512,047,680 Btu/yr	4,502,625,231 Btu/yr
Total		**4,433,132 lbs**					**5,666,767,111 Btu/yr**

Conversions

1,000,000	Btu		27.92	m3	37.79 MJ/m3
1	lb		0.4536	L	
1	hp		0.7457	kW	

Heat Loss per Year (Btu)		**5,666,767,111**	Gross Estimates
Gas Loss per Year (m3)		**158,733**	
Water Loss per Year (L)		**2,010,869**	

CR Flash Steam/Process Hot Water Heat Exchanger

Enthalpy of Steam At 0 PSIG and 212 F = 1150.5 BTU/LB
Enthalpy of Water = 180.2 BTU/LB

The moisture content in steam vented from the tank will cause an increase in the fluid density and a decrease in the BTU content per LB. Assume that the mixture is:

0.2 water by weight and 0.8 Steam by weight

Enthalpy of Steam per LB of Mixture = =0.8 x 1150.5 BTU/lb = 920.4 BTU/LB
Enthlapy of Water per LB of Mixture = =0.2 x 180.2 BTU/lb = 36.04 BTU/LB
Total Enthalpy of Mixture = 956.44 BTU/LB

assumed hrs/yr: 7344

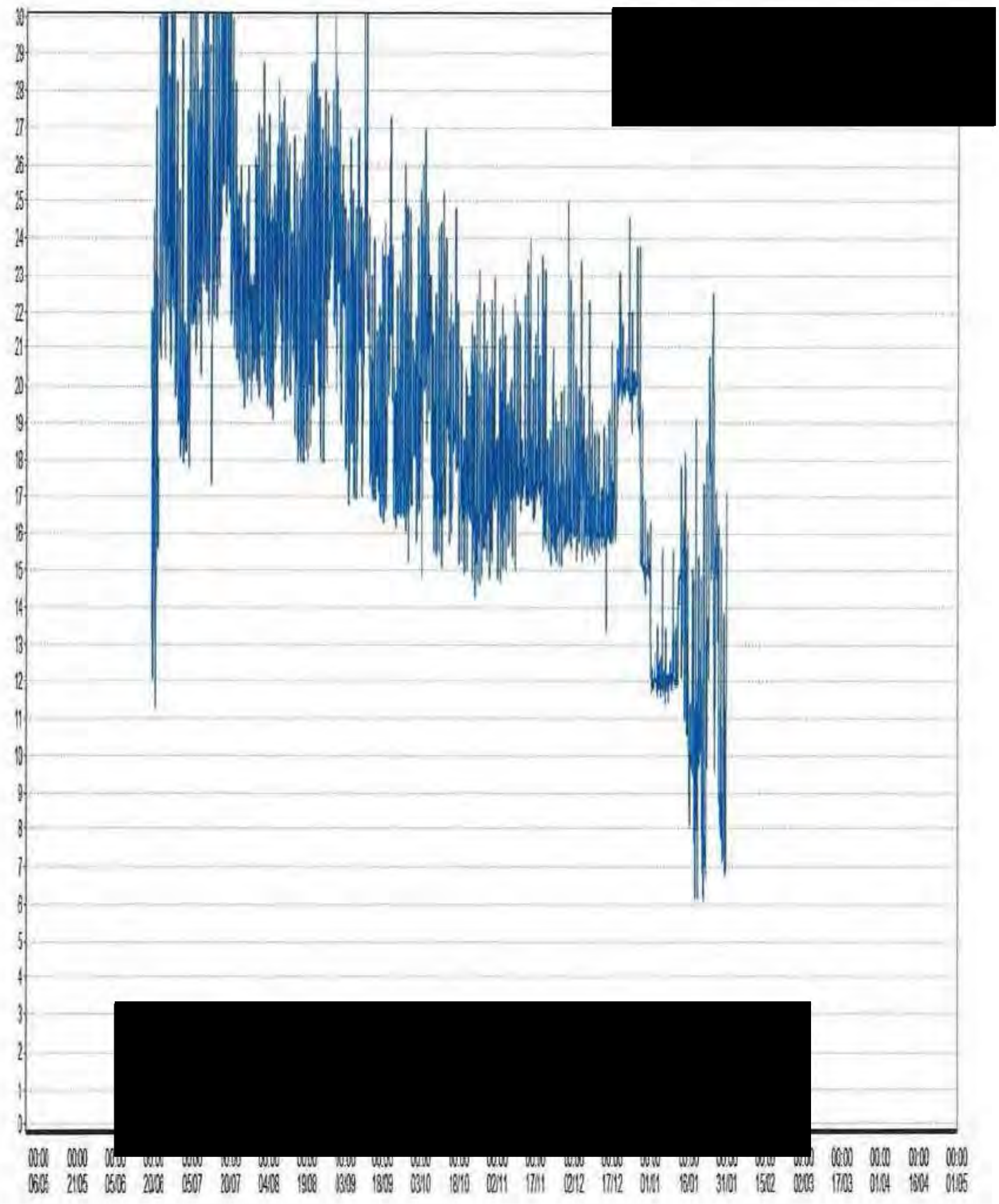
APPENDIX F: Union Gas Project Code - CI03 - 2013-IND-0267

Temperature Profiles Indicating Energy Curtain "open/close" Operation

[redacted]

Space Temperatures (average temperature downward profile)

Graph 24 hours



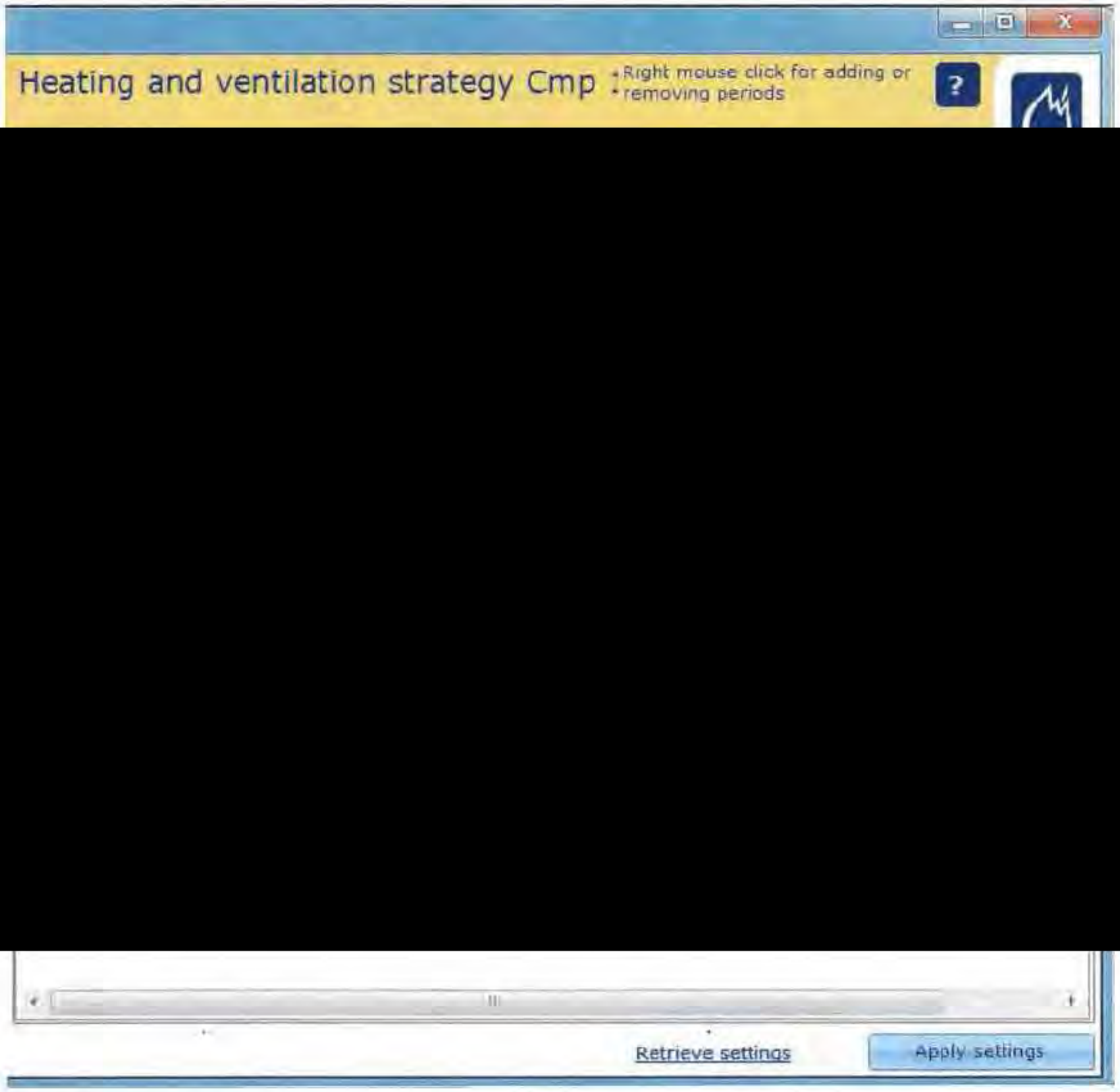
[redacted]

[redacted]

[redacted]

APPENDIX G: Union Gas Project Code - CI05 - 2013-IND-0083

Temperature and Venting Control

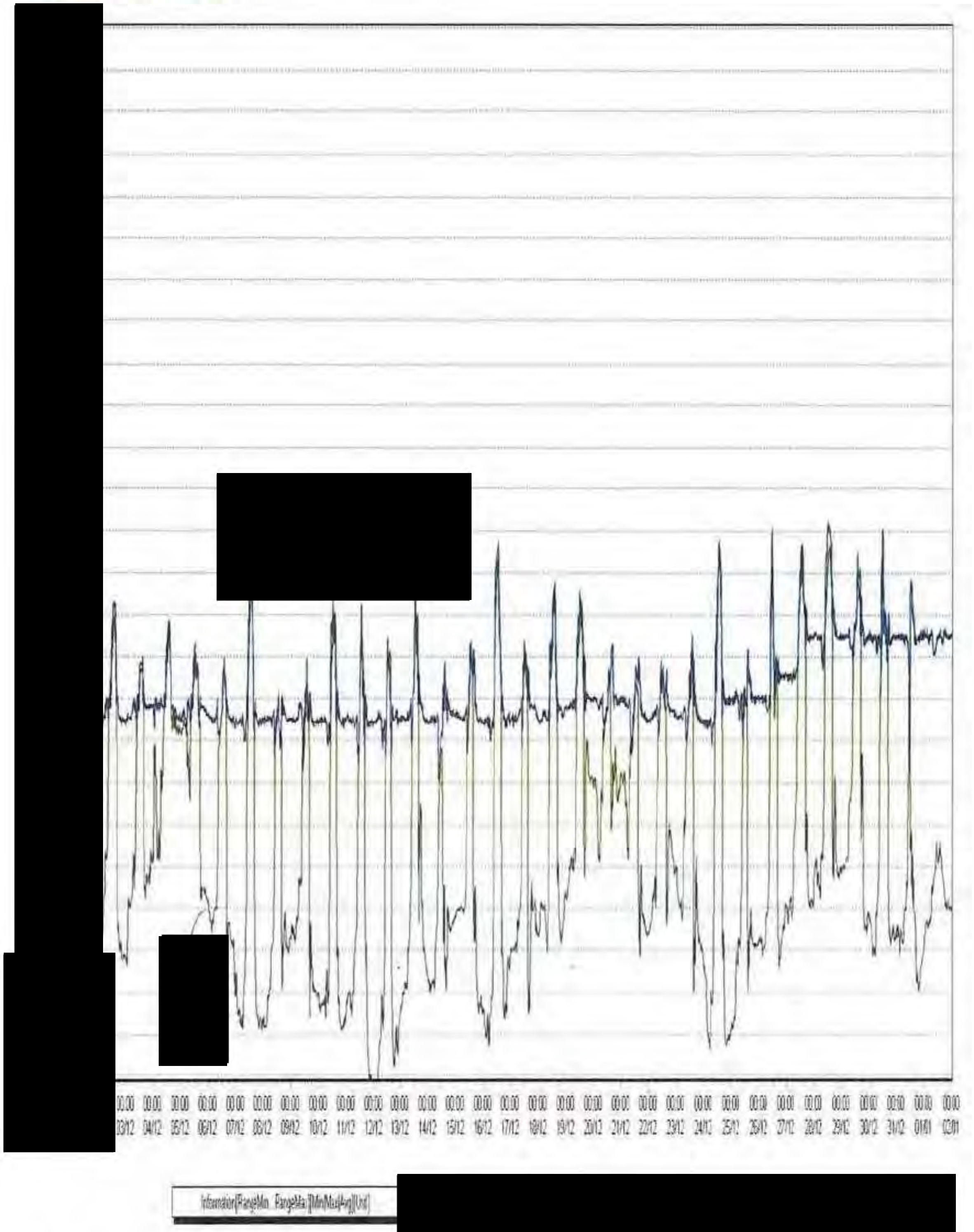


[redacted]

Appendix H: Union Gas Project Code - CI11 - 2013-IND-0177

(Note: below 18 ° during curtain closure)

Graph version inf.



[redacted]

[redacted]

[redacted]

[redacted]

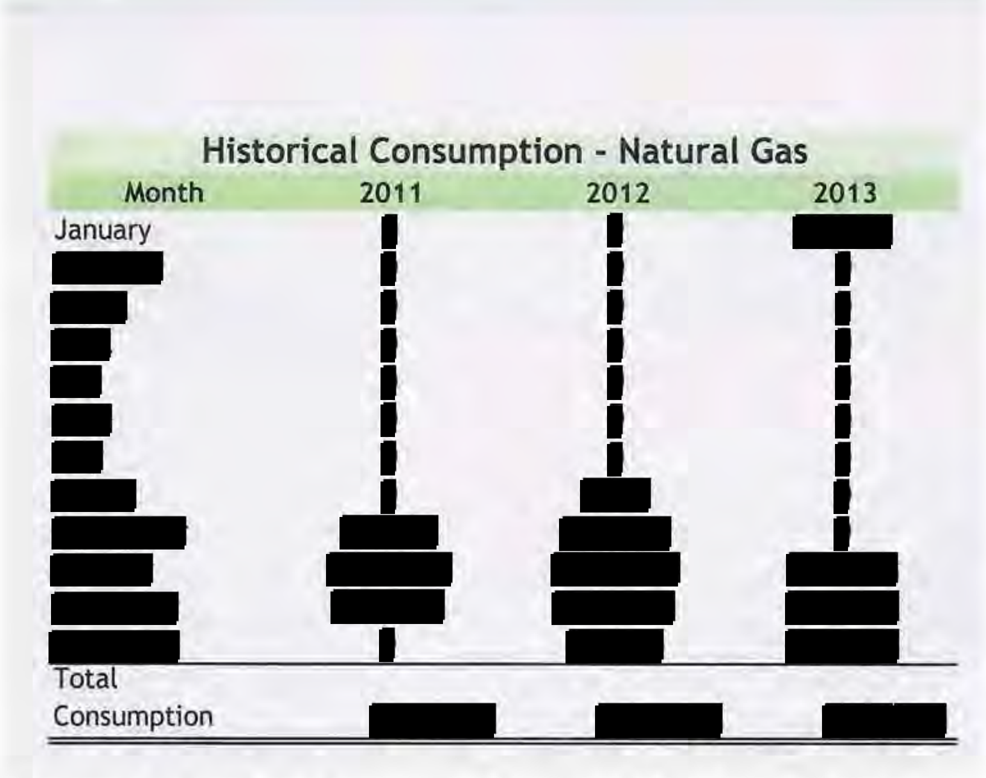
Temperature Comparison

Temperature below 20 ˚C in New Expansion

[redacted]

Concurrently above 20 ˚C in old adjacent GH (glass wall) facility

APPENDIX I: Union Gas Project Code - CI16 - 2013-COM-0026



Historical Consumption - Natural Gas

Month	2011	2012	2013
January	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
Total Consumption	[redacted]	[redacted]	[redacted]

This data was obtained from site records and extracted from the utility invoices.
It represents dedicated, metered data for the Dryer.
January 2013 data reflects a prior period adjustment, which should be added to Year 2012.

Dryer	2013 data	2012 data	2011 data
Performance Comparison ([redacted] ONLY) - Grain Dryers Dryer Operation: [redacted] Grain Moisture			
Data supplied by *customer*			
Estimated Annual Grain Drying [redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
Annual Gas Consumption Savings (m³)			11,633

i.e. [redacted] period adjustment that was actually in 2012 consumption

Note: Year 2012 data appears to be an anomaly, likely due to commissioning transition and drought season possibly causing burner to cycle on/off below turndown range with lower moisture content received.

Calculated 2013 Average Firing range:

[redacted]	BTU
[redacted]	Burner hours
[redacted]	Average MBH firing
[redacted]	Low Fire Burner Rating

[redacted]

[redacted]

APPENDIX J: Union Gas Project Code - CI12 - 2013-IND-0055

Savings Summary

Insulation Savings Project

Summary of Savings by Purchase Order

Overall Results:

Estimated Dollar Savings:	$78,335.00 per year
BTU Savings:	10,800,000,000 per year
Natural Gas Savings:	381,402 m3 per year
Carbon Dioxide Reductions:	1,640,939 lbs per year
Nitrogen Oxide Reductions:	3,312 lbs per year
Carbon Equivalent Reductions:	447,168 lbs per year
Estimated Union Gas Subsidy:	$38,140.20
Fixed Cost to Implement:	$350,000.00
Payback with Union Gas Subsidy:	3.98 years or 47.76 months

Purchase Order 582233:

Estimated Dollar Savings:	$68,201.00 per year
BTU Savings:	9,416,940,000 per year
Natural Gas Savings:	331,976 m3 per year
Carbon Dioxide Reductions:	1,527491 lbs per year
Nitrogen Oxide Reductions:	3,081 lbs per year
Carbon Equivalent Reductions:	416,260 lbs per year
Estimated Union Gas Subsidy:	$33,197.60
Fixed Cost to Implement:	$300,000.00
Payback with Union Gas Subsidy:	3.91 years or 46.92 months

Purchase Order 582491:

Estimated Dollar Savings:	$10,134.00 per year
BTU Savings:	1,383,060,000 per year
Natural Gas Savings:	49,426 m3 per year
Carbon Dioxide Reductions:	113,448 lbs per year
Nitrogen Oxide Reductions:	231 lbs per year
Carbon Equivalent Reductions:	30,908 lbs per year
Estimated Union Gas Subsidy:	$4,942.60
Fixed Cost to Implement:	$50,000.00
Payback with Union Gas Subsidy:	4.46 years or 53.52 months

Revised Savings Estimate: A+C+D= 10,404,598,170 BTU/yr

@ 78% seasonal efficiency: 13,339,228,423 BTU/yr

@ Union 10 yr weighted avg. 35,700 BTU/m³

373,648 m³/yr

REVIEWER REVISIONS:

[illegible]

BTU/yr	from savings details tab
2598945300	
1023488300	
1884101800	
916132500	
991861400	
348889100	
400227900	
744468700	removable covers
[illegible] A [illegible]	on valves, etc.
659000000	from insulation survey
363000000	
35700000	
15200000	
24200000	
14700000	
28000000	
14000000	
253000000	
690000000	
14000000	
B 2,110,800,000	piping & misc.

[illegible]

but process temperatures (based on 230 °F for condensate lines and returns) actually range from (158 to 176) °F

[illegible]

Recalculation of Condensate line loss assuming 165 °F Process temperature

Corrections to item "B" follow in items "C" and "D" as follows:

Pipe size (in.)	LF	BTUH/LF		Est. Savings	
		Bare pipe	Insulated	BTUH	BTU/yr
1/2	45	75.22	9.62	2,952	25,859,520
3/4	141	87.12	11.6	10,648	93,279,283
1	21	101.39	11.96	1,878	16,451,543
1.5	16	131.13	15.59	1,849	16,194,086
2	86	154.17	13.98	12,056	105,613,538
2.5	84	177.71	14.3	13,726	120,243,614
3	16	206.67	18.45	3,010	26,366,899
4	41	251.88	22.2	9,416	32,484,686

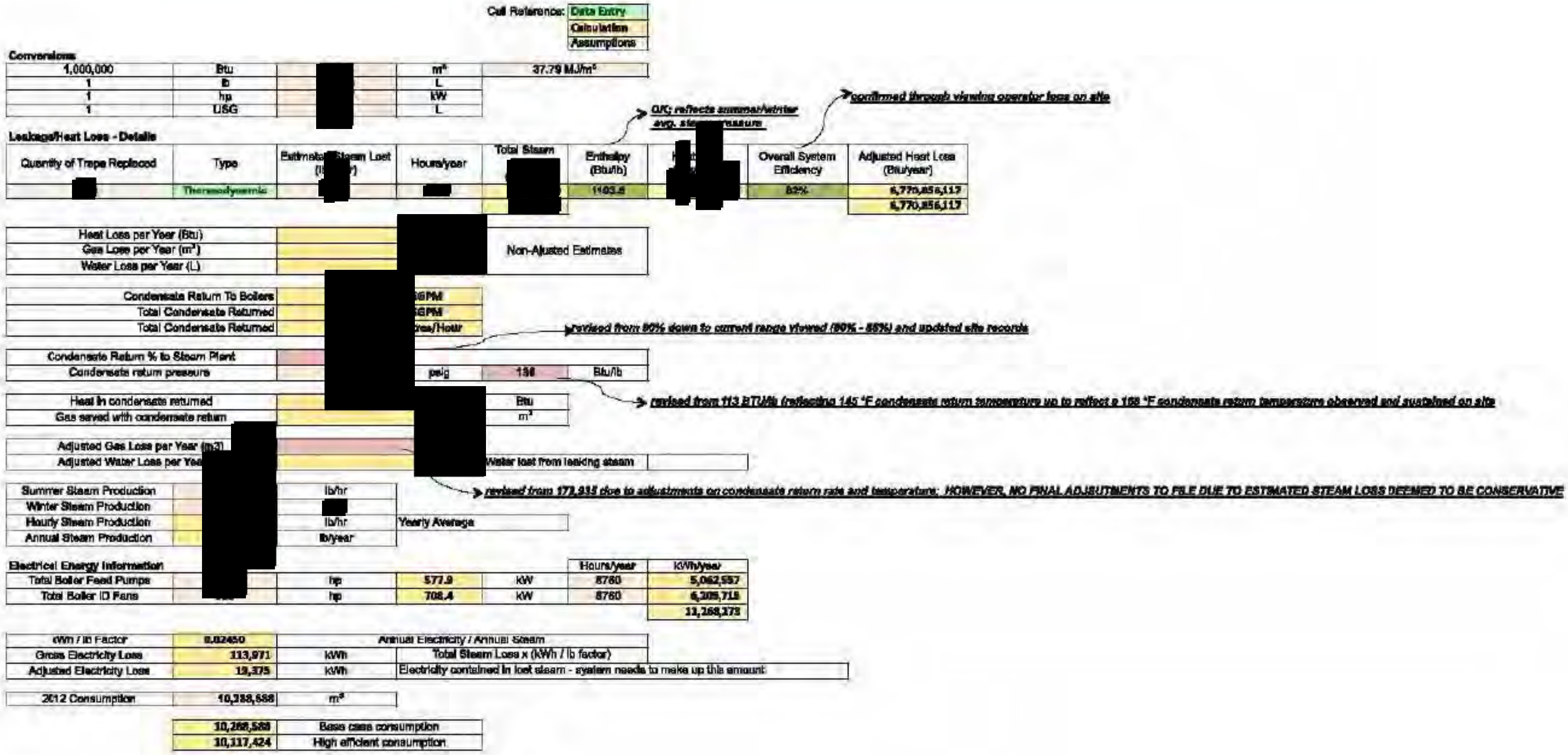
C Total 436,493,170

additional savings in file; not factored above:

	unadjusted
Breeching	19,400,000
Cond. Boxes	116,400,000
Cond. Pump	48,500,000
Steam line	43,890,000
Patch work	943,000,000
MR tank	38,800,000

D Total 1,209,990,000

APPENDIX K: Union Gas Project Code - CI17 - 2013-IND-0064



Cell Reference:
- Data Entry
- Calculation
- Assumptions

Conversions

1,000,000	Btu	[redacted]	m³	37.79 MJ/m³
1	lb	[redacted]	L	
1	hp	[redacted]	kW	
1	USG	[redacted]	L	

Leakage/Heat Loss - Details

Quantity of Traps Replaced	Type	Estimate [redacted] team Lost (l [redacted])	Hours/year	Total Steam [redacted]	Enthalpy (Btu/lb)	H [redacted]	Overall System Efficiency	Adjusted Heat Loss (Btu/year)
[redacted]	Thermodynamic	[redacted]	[redacted]	[redacted]	1103.5	[redacted]	82%	6,770,856,117
				[redacted]				6,770,856,117

O/K; reflects summer/winter avg. st [redacted] ressure

confirmed through viewing operator logs on site

Heat Loss per Year (Btu)		[redacted]	Non-Ajusted Estimates
Gas Loss per Year (m³)		[redacted]	
Water Loss per Year (L)		[redacted]	

Condensate Return To Boilers	[redacted]	GPM
Total Condensate Returned	[redacted]	GPM
Total Condensate Returned	[redacted]	tres/Hour

revised from 90% down to current range viewed (80% - 85%) and updated site records

Condensate Return % to Steam Plant	[redacted]			
Condensate return pressure	[redacted]	psig	136	Btu/lb

revised from 113 BTU/lb (reflecting 145 °F condensate return temperature up to reflect a 168 °F condensate return temperature observed and sustained on site

Heat in condensate returned	[redacted]	Btu
Gas saved with condensate return	[redacted]	m³

Adjusted Gas Loss per Year (m3)	[redacted]		
Adjusted Water Loss per Yea [redacted]		Water lost from leaking steam	

revised from 173,935 due to adjustments on condensate return rate and temperature; HOWEVER, NO FINAL ADJUSTMENTS TO FILE DUE TO ESTMATED STEAM LOSS DEEMED TO BE CONSERVATIVE

Summer Steam Production	[redacted]	lb/hr	
Winter Steam Production	[redacted]	[redacted]	
Hourly Steam Production	[redacted]	lb/hr	Yearly Average
Annual Steam Production	[redacted]	lb/year	

Electrical Energy Information

					Hours/year	KWh/year
Total Boiler Feed Pumps	[redacted]	hp	577.9	kW	8760	5,062,557
Total Boiler ID Fans	[redacted]	hp	708.4	kW	8760	6,205,715
						11,268,273

kWh / lb Factor	0.02450	Annual Electricity / Annual Steam	
Gross Electricity Loss	113,971	kWh	Total Steam Loss x (kWh / lb factor)
Adjusted Electricity Loss	13,375	kWh	Electricity contained in lost steam - system needs to make up this amount

2012 Consumption	10,238,558	m³

10,268,588	Base case consumption
10,117,424	High efficient consumption

APPENDIX L: Union Gas Project Code - CI13 - 2013-COM-0162

Dock Door Seal Observations

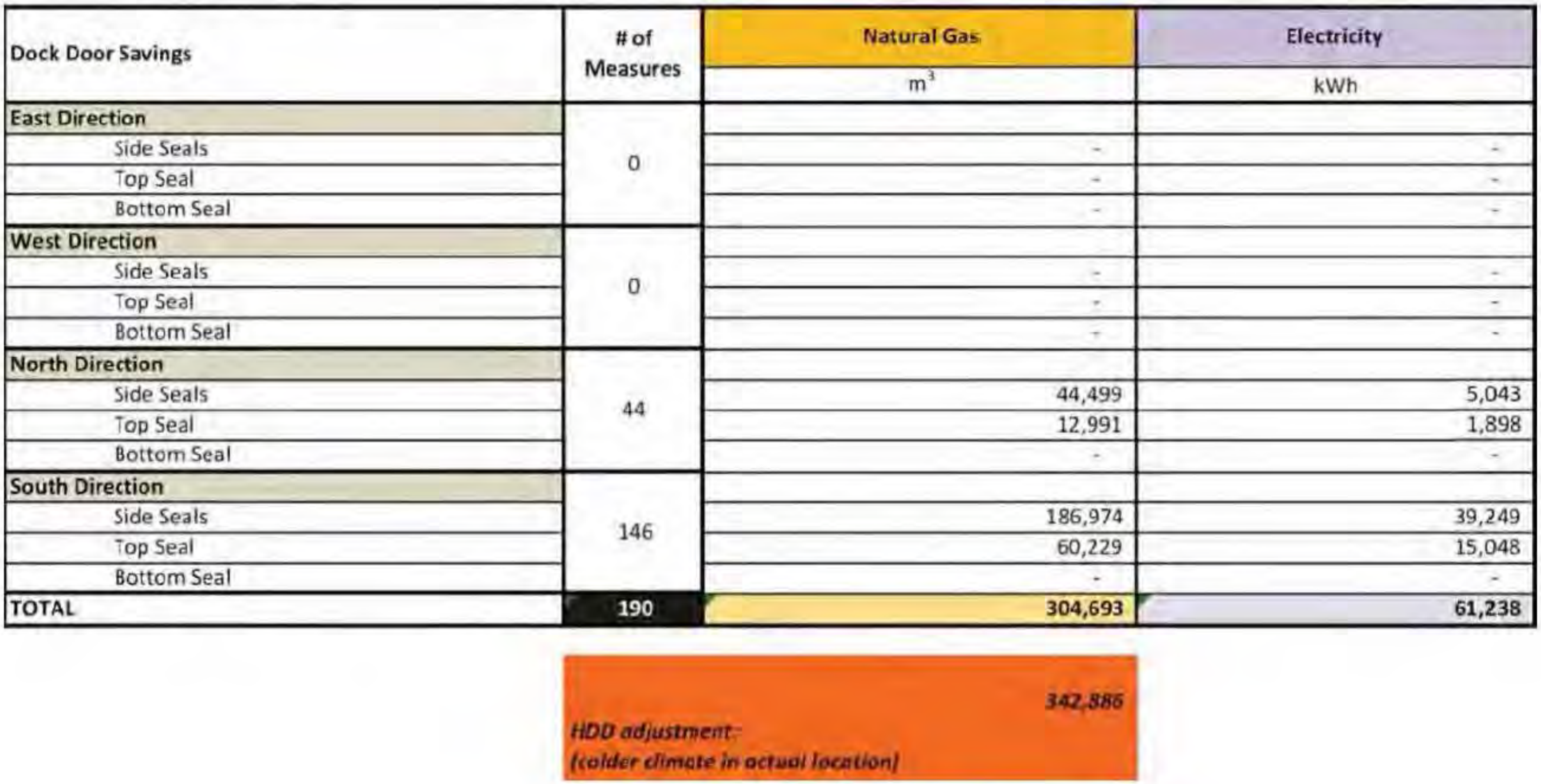
Door Dock Seal Gap (due to truck backing angle)

Example of typically sealed door

Example of top seal gap at dock

Temperature control set point

Estimated Energy Savings



Dock Door Savings	**# of Measures**	**Natural Gas**	**Electricity**
		m^3	kWh
East Direction	0		
Side Seals		-	-
Top Seal		-	-
Bottom Seal		-	-
West Direction	0		
Side Seals		-	-
Top Seal		-	-
Bottom Seal		-	-
North Direction	44		
Side Seals		44,499	5,043
Top Seal		12,991	1,898
Bottom Seal		-	-
South Direction	146		
Side Seals		186,974	39,249
Top Seal		60,229	15,048
Bottom Seal		-	-
TOTAL	**190**	**304,693**	**61,238**

342,886

HDD adjustment:
(colder climate in actual location)

North Calculations - Side

Weatherization Improvements
Estimated Energy Savings

Project Description:

NORTH - SIDE SEALS

Key Equations:

FOR SMALL OPENINGS

1) $\Delta P_w = C_w \times \rho_o \times WS^2 \times WD/ (2 \times g_c)$ (- for infiltration for exfiltration)

2) $\Delta P_t = C_t \times (\rho_o \times g / g_c) \times \Delta H_{NPL} \times [({}_{i} - {}_{o}/ {}_{i}$ (- for infiltration for exfiltration)

3) $\Delta H_{NPL} = H_o - H_{NPL}$

4) $\Delta P_m = P_o - P_i$ (- for infiltration for exfiltration)

5) $\Delta P_T = \Delta P_w \quad \Delta P_t \quad \Delta P_m$ (- for infiltration for exfiltration)

6) $Q_T = N \times 136\ 8 \times C_D \times A \times (2 \times g_c \times \Delta P_T / \rho_o\ )^n$

7) $q_h = 1\ 08 \times Q_{total} \times (\ i - \ o)$

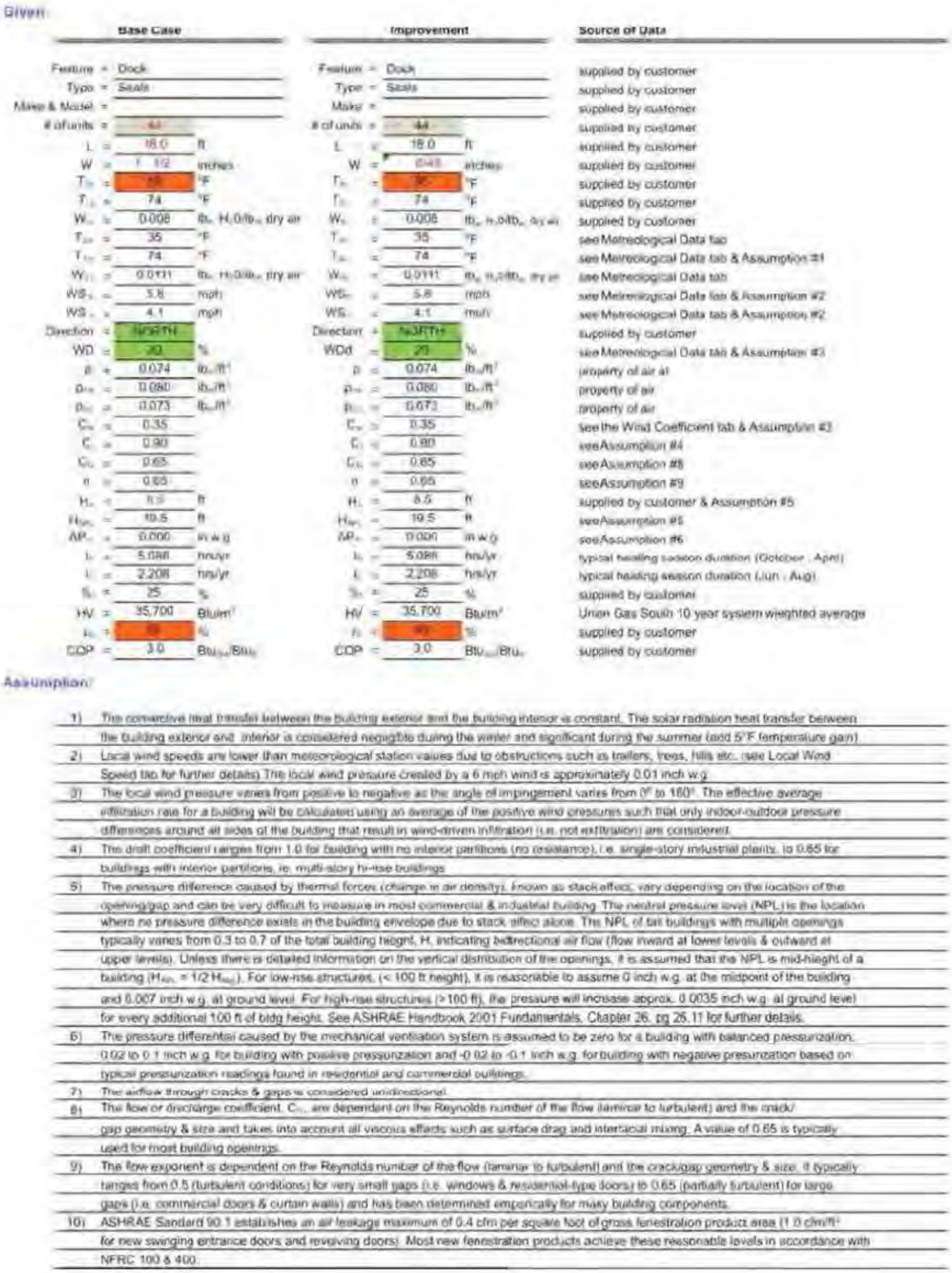
8) $q_c = [1\ 08 \times Q_{total} \times (\ i - \ o) \quad [4840 \times Q_{total} \times (Wo - Wi)$

9) $NG = (q_h \times t_h \times \%_t) / (HV \times \varepsilon_h)$

10) $E = (q_c \times t_c \times \%_t)/(COP \times 3412)$

Where

b = subscript for base case
e = subscript for energy improvement
T = subscript for total
w = subscript for wind effect
t = subscript for stack (thermal) effect
m = subscript for building pressurization effect (mechanical ventilation system)
i = subscript for inlet/entering conditions/indoor/inner surface
o = subscript for outlet/exiting conditions/outdoor/outer surface
p = subscript for perdendicular direction
d = subscript for diagonal direction
h = subscript for heating/heater
c = subscript for cooling/cooler
ΔP = Differential pressure across opening (inch w g)
C_w = Wind pressure coefficient (dimensionless)
ρ = Density of air (lb_m/ft^3)
WS = Average wind speed (mph)
WD = Wind direction frequency (%)
C_t = Draft coefficient due to thermal forces (dimensionless)
g = Local acceleration of gravity = 32 174 ft/s² @ sea level
g_c = Gravitational proportionality constant = 32 174 lb_m-ft/s_2-lb_f
ΔH_{NPL} = Vertical distance between opening and the neutral pressure level (NPL) (ft)
H_o = Height of opening above reference point (ground level (ft)
H_{NPL} = Height of neutral pressure level (NPL) above reference point (ground level) (ft)
T = Temperature (°R) = 459 7 + Temperature (°F)
L = Length of crack/gap of building envelope component (door window etc) (ft)
W = Width of crack/gap (inches)
A = Area of building envelope component (door window etc) (ft^2)
Q = Infiltration air flowrate (cfm)
C_D = Discharge or flow coefficient for opening (dimensionless)
n = Flow exponent between 0 5 (turbulent) to 1 0 (laminar) and typically considered 0 65 for buildings
W = Humidity (lb_m H_2O/lb_m dry air)
q = Heat transfer rate (Btu/hr)
t = Annual hours in heating or cooling mode (hrs/days)
$\%_t$ = Percentage of time in operating mode (%)
HV = Heating value of natural gas (Btu/m^3)
ε_h = Heating system efficiency (%)
NG = Natural gas consumption (m^3/yr)
COP = Coeffiienct of Performace (Btu_{out}/Btu_{n})
E = electricty consumption (kWh/yr)



Given

	Base Case			Improvement		Source of Data
Feature =	Dock		Feature =	Dock		supplied by customer
Type =	Seals		Type =	Seals		supplied by customer
Make & Model =			Make =			supplied by customer
# of units =	44		# of units =	44		supplied by customer
L =	18.0	ft	L =	18.0	ft	supplied by customer
W =	1 1/2	inches	W =	[illegible]	inches	supplied by customer
T =	[illegible]	°F	T =	[illegible]	°F	supplied by customer
T =	74	°F	T =	74	°F	supplied by customer
W =	0.008	lb H₂O/lb dry air	W =	0.008	lb H₂O/lb dry air	supplied by customer
T =	35	°F	T =	35	°F	see Metreological Data tab
T =	74	°F	T =	74	°F	see Metreological Data tab & Assumption #1
W =	0.0111	lb H₂O/lb dry air	W =	0.0111	lb H₂O/lb dry air	see Metreological Data tab
WS =	5.8	mph	WS =	5.8	mph	see Metreological Data tab & Assumption #2
WS =	4.1	mph	WS =	4.1	mph	see Metreological Data tab & Assumption #2
Direction =	NORTH		Direction =	NORTH		supplied by customer
WD =	20	%	WDd =	20	%	see Metreological Data tab & Assumption #3
ρ =	0.074	lb/ft³	ρ =	0.074	lb/ft³	property of air at
ρ =	0.080	lb/ft³	ρ =	0.080	lb/ft³	property of air
ρ =	0.073	lb/ft³	ρ =	0.073	lb/ft³	property of air
C =	0.35		C =	0.35		see the Wind Coefficient tab & Assumption #3
C =	0.90		C =	0.80		see Assumption #4
C =	0.65		C =	0.65		see Assumption #8
n =	0.65		n =	0.65		see Assumption #9
H =	8.5	ft	H =	8.5	ft	supplied by customer & Assumption #5
H =	19.5	ft	H =	19.5	ft	see Assumption #5
ΔP =	0.000	in w.g	ΔP =	0.000	in w.g	see Assumption #6
t =	5,088	hrs/yr	t =	5,088	hrs/yr	typical heating season duration (October - April)
t =	2,208	hrs/yr	t =	2,208	hrs/yr	typical heating season duration (Jun - Aug)
% =	25	%	% =	25	%	supplied by customer
HV =	35,700	Btu/m³	HV =	35,700	Btu/m³	Union Gas South 10 year system weighted average
η =	[illegible]	%	η =	[illegible]	%	supplied by customer
COP =	3.0	Btu/Btu	COP =	3.0	Btu/Btu	supplied by customer

Assumption

1) The convective heat transfer between the building exterior and the building interior is constant. The solar radiation heat transfer between the building exterior and interior is considered negligible during the winter and significant during the summer (add 5°F temperature gain)

2) Local wind speeds are lower than meteorological station values due to obstructions such as trailers, trees, hills etc. (see Local Wind Speed tab for further details) The local wind pressure created by a 6 mph wind is approximately 0.01 inch w.g

3) The local wind pressure varies from positive to negative as the angle of impingement varies from 0° to 180°. The effective average infiltration rate for a building will be calculated using an average of the positive wind pressures such that only indoor-outdoor pressure differences around all sides of the building that result in wind-driven infiltration (i.e. not exfiltration) are considered.

4) The draft coefficient ranges from 1.0 for building with no interior partitions (no resistance), i.e. single-story industrial plants, to 0.65 for buildings with interior partitions, ie. multi-story hi-rise buildings

5) The pressure difference caused by thermal forces (change in air density), known as stack effect, vary depending on the location of the opening/gap and can be very difficult to measure in most commercial & industrial building. The neutral pressure level (NPL) is the location where no pressure difference exists in the building envelope due to stack effect alone. The NPL of tall buildings with multiple openings typically varies from 0.3 to 0.7 of the total building height, H, indicating bidirectional air flow (flow inward at lower levels & outward at upper levels). Unless there is detailed information on the vertical distribution of the openings, it is assumed that the NPL is mid-hieght of a building (H_{NPL} = 1/2 H_{bldg}). For low-rise structures, (< 100 ft height), it is reasonable to assume 0 inch w.g. at the midpoint of the building and 0.007 inch w.g. at ground level. For high-rise structures (> 100 ft), the pressure will increase approx. 0.0035 inch w.g. at ground level for every additional 100 ft of bldg height. See ASHRAE Handbook 2001 Fundamentals, Chapter 26, pg 26.11 for further details.

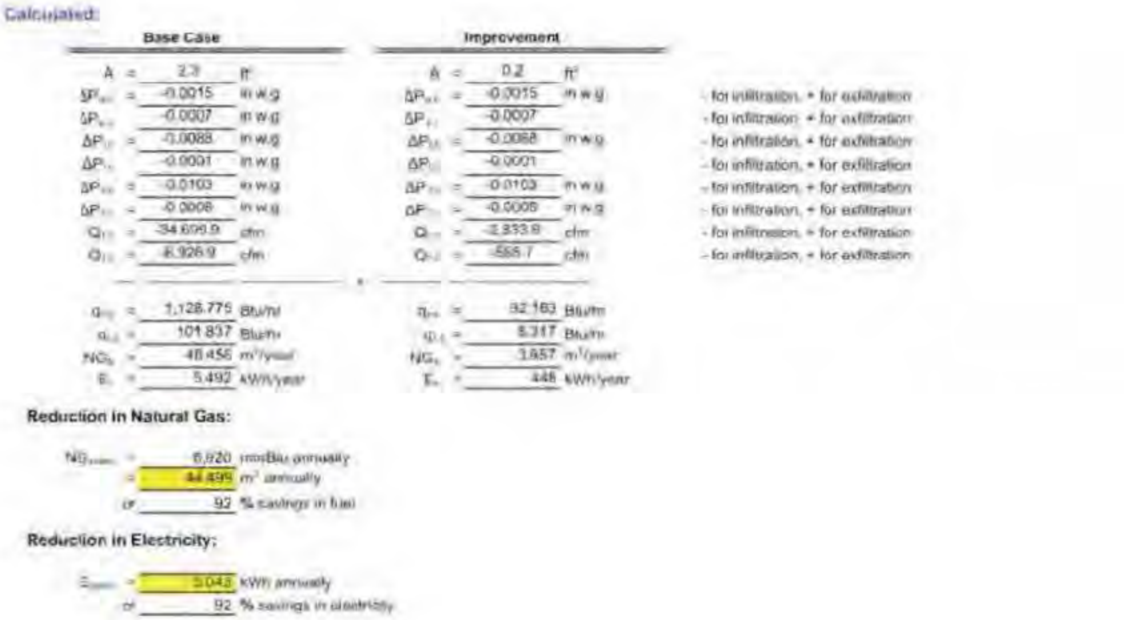
6) The pressure differential caused by the mechanical ventilation system is assumed to be zero for a building with balanced pressurization; 0.02 to 0.1 inch w.g. for building with positive pressurization and -0.02 to -0.1 inch w.g. for building with negative presurization based on typical pressurization readings found in residential and commercial buildings.

7) The airflow through cracks & gaps is considered unidirectional.

8) The flow or discharge coefficient, C, are dependent on the Reynolds number of the flow (laminar to turbulent) and the crack/gap geometry & size and takes into account all viscous effects such as surface drag and interfacial mixing. A value of 0.65 is typically used for most building openings.

9) The flow exponent is dependent on the Reynolds number of the flow (laminar to turbulent) and the crack/gap geometry & size. It typically ranges from 0.5 (turbulent conditions) for very small gaps (i.e. windows & residential-type doors) to 0.65 (partially turbulent) for large gaps (i.e. commercial doors & curtain walls) and has been determined emperically for many building components.

10) ASHRAE Sandard 90.1 establishes an air leakage maximum of 0.4 cfm per square foot of gross fenestration product area (1.0 cfm/ft² for new swinging entrance doors and revolving doors). Most new fenestration products achieve these reasonable levels in accordance with NFRC 100 & 400.



Calculated:

Base Case			Improvement			
A =	2.3	ft²	A =	0.2	ft²	
ΔP =	-0.0015	in w.g	ΔP =	-0.0015	in w.g	- for infiltration, + for exfiltration
ΔP	-0.0007	in w.g	ΔP	-0.0007		- for infiltration, + for exfiltration
ΔP =	-0.0088	in w.g	ΔP =	-0.0068	in w.g	- for infiltration, + for exfiltration
ΔP	-0.0001	in w.g	ΔP	-0.0001		- for infiltration, + for exfiltration
ΔP =	-0.0103	in w.g	ΔP =	-0.0103	in w.g	- for infiltration, + for exfiltration
ΔP =	-0.0008	in w.g	ΔP =	-0.0008	in w.g	- for infiltration, + for exfiltration
Q =	-34,699.9	cfm	Q =	-2,333.8	cfm	- for infiltration, + for exfiltration
Q =	-6,926.9	cfm	Q =	-566.7	cfm	- for infiltration, + for exfiltration
q =	1,128,775	Btu/hr	q =	92,163	Btu/hr	
q =	101,837	Btu/hr	q =	8,317	Btu/hr	
NG =	48,456	m³/year	NG =	3,957	m³/year	
E =	5,492	kWh/year	E =	446	kWh/year	

Reduction in Natural Gas:

NG = 6,920 mmBtu annually
= 44,499 m³ annually
or 92 % savings in fuel

Reduction in Electricity:

E = 5,046 kWh annually
or 92 % savings in electricity

North Calculations - Top

Weatherization Improvements

Estimated Energy Savings

Project Description:

NORTH - TOP SEALS

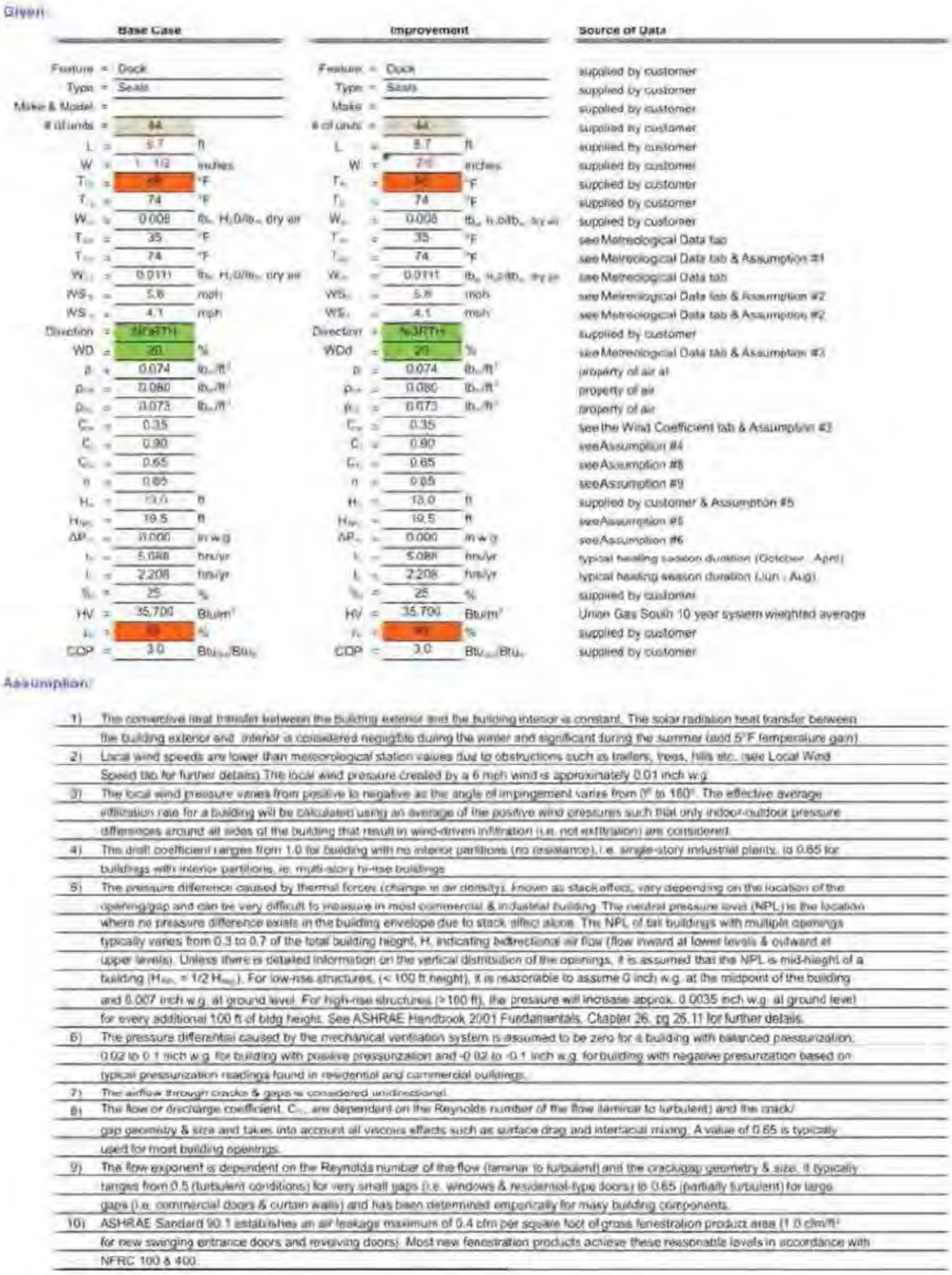
Key Equations:

FOR SMALL OPENINGS

1) $\Delta P_w = C_w \times \rho_o \times WS^2 \times WD / (2 \times g_c)$ (- for infiltration for exfiltration)
2) $\Delta P_t = C_t \times (\rho_o \times g / g_c) \times \Delta H_{NPL} \times [({}_i - {}_o / {}_i$ (- for infiltration for exfiltration)
3) $\Delta H_{NPL} = H_o - H_{NPL}$
4) $\Delta P_m = P_o - P_i$ (- for infiltration for exfiltration)
5) $\Delta P_T = \Delta P_w \quad \Delta P_t \quad \Delta P_m$ (- for infiltration for exfiltration)
6) $Q_T = N \times 136\ 8 \times C_D \times A \times (2 \times g_c \times \Delta P_T / \rho_o)^n$
7) $q_h = 1\ 08 \times Q_{total} \times (\ i - \ o)$
8) $q_c = [1\ 08 \times Q_{total} \times (\ i - \ o) \quad [4840 \times Q_{total} \times (Wo - Wi)$
9) $NG = (q_h \times t_h \times \%_t) / (HV \times \varepsilon_h)$
10) $E = (q_c \times t_c \times \%_t)/(COP \times 3412)$

Where

b = subscript for base case
e = subscript for energy improvement
T = subscript for total
w = subscript for wind effect
t = subscript for stack (thermal) effect
m = subscript for building pressurization effect (mechanical ventilation system)
i = subscript for inlet/entering conditions/indoor/inner surface
o = subscript for outlet/exiting conditions/outdoor/outer surface
p = subscript for perdendicular direction
d = subscript for diagonal direction
h = subscript for heating/heater
c = subscript for cooling/cooler
ΔP = Differential pressure across opening (inch w g)
C_w = Wind pressure coefficient (dimensionless)
ρ = Density of air (lb_m/ft^3)
WS = Average wind speed (mph)
WD = Wind direction frequency (%)
C_t = Draft coefficient due to thermal forces (dimensionless)
g = Local acceleration of gravity = 32 174 ft/s² @ sea level
g_c = Gravitational proportionality constant = 32 174 lb_m-ft/s_2-lb_f
ΔH_{NPL} = Vertical distance between opening and the neutral pressure level (NPL) (ft)
H_o = Height of opening above reference point (ground level (ft)
H_{NPL} = Height of neutral pressure level (NPL) above reference point (ground level) (ft)
T = Temperature (°R) = 459 7 + Temperature (°F)
L = Length of crack/gap of building envelope component (door window etc) (ft)
W = Width of crack/gap (inches)
A = Area of building envelope component (door window etc) (ft^2)
Q = nfiltration air flowrate (cfm)
C_D = Discharge or flow coefficient for opening (dimensionless)
n = Flow exponent between 0 5 (turbulent) to 1 0 (laminar) and typically considered 0 65 for buildings
W = Humidity (lb_m H_2O/lb_m dry air)
q = Heat transfer rate (Btu/hr)
t = Annual hours in heating or cooling mode (hrs/days)
$\%_t$ = Percentage of time in operating mode (%)
HV = Heating value of natural gas (Btu/m^3)
ε_h = Heating system efficiency (%)
NG = Natural gas consumption (m^3/yr)
COP = Coeffiienct of Performace (Btu_{out}/Btu_{in})
E = electricty consumption (kWh/yr)

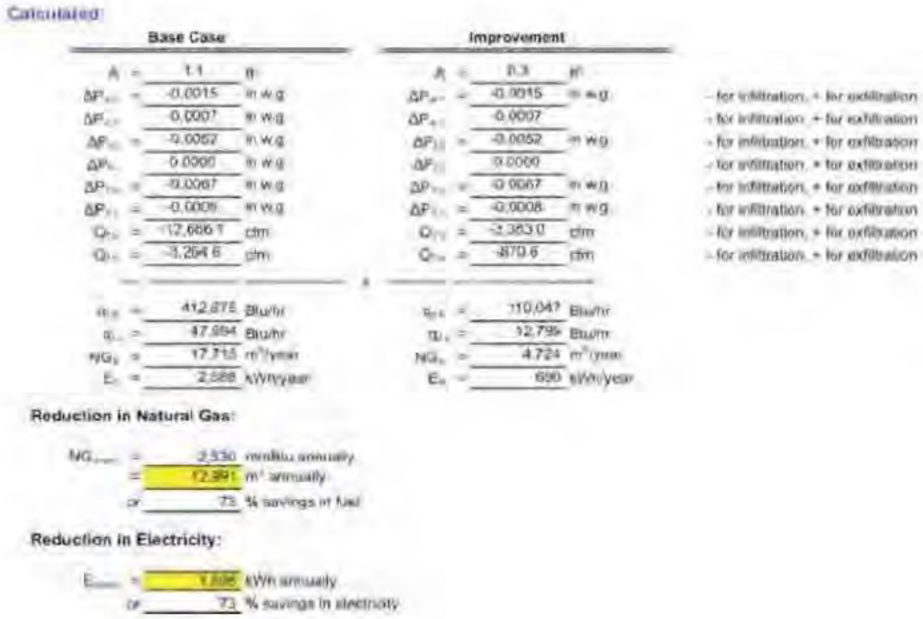


Given:

Base Case			Improvement			Source of Data
Feature =	Dock		Feature =	Dock		supplied by customer
Type =	Seals		Type =	Seals		supplied by customer
Make & Model =			Make =			supplied by customer
# of units =	44		# of units =	44		supplied by customer
L =	5.7	ft	L =	5.7	ft	supplied by customer
W =	1 1/2	inches	W =	7/8	inches	supplied by customer
T =	[illegible]	°F	T =	[illegible]	°F	supplied by customer
T =	74	°F	T =	74	°F	supplied by customer
W =	0.008	lb H$_2$O/lb dry air	W =	0.008	lb H$_2$O/lb dry air	supplied by customer
T =	35	°F	T =	35	°F	see Metreological Data tab
T =	74	°F	T =	74	°F	see Metreological Data tab & Assumption #1
W =	0.0111	lb H$_2$O/lb dry air	W =	0.0111	lb H$_2$O/lb dry air	see Metreological Data tab
WS =	5.8	mph	WS =	5.8	mph	see Metreological Data tab & Assumption #2
WS =	4.1	mph	WS =	4.1	mph	see Metreological Data tab & Assumption #2
Direction =	NORTH		Direction =	NORTH		supplied by customer
WD =	20	%	WDd =	20	%	see Metreological Data tab & Assumption #3
ρ =	0.074	lb/ft^3	ρ =	0.074	lb/ft^3	property of air at
ρ =	0.080	lb/ft^3	ρ =	0.080	lb/ft^3	property of air
ρ =	0.073	lb/ft^3	ρ =	0.073	lb/ft^3	property of air
C =	0.35		C =	0.35		see the Wind Coefficient tab & Assumption #3
C =	0.90		C =	0.90		see Assumption #4
C =	0.65		C =	0.65		see Assumption #8
n =	0.65		n =	0.65		see Assumption #9
H =	13.0	ft	H =	13.0	ft	supplied by customer & Assumption #5
H =	19.5	ft	H =	19.5	ft	see Assumption #5
ΔP =	0.000	in w.g.	ΔP =	0.000	in w.g.	see Assumption #6
t =	5,088	hrs/yr	t =	5,088	hrs/yr	typical heating season duration (October - April)
t =	2,208	hrs/yr	t =	2,208	hrs/yr	typical heating season duration (Jun - Aug)
% =	25	%	% =	25	%	supplied by customer
HV =	35,700	Btu/m^3	HV =	35,700	Btu/m^3	Union Gas South 10 year system wieghted average
η =	[illegible]	%	η =	[illegible]	%	supplied by customer
COP =	3.0	Btu/Btu	COP =	3.0	Btu/Btu	supplied by customer

Assumption:

1) The convective heat transfer between the building exterior and the building interior is constant. The solar radiation heat transfer between the building exterior and interior is considered negigible during the winter and significant during the summer (add 5°F temperature gain).
2) Local wind speeds are lower than meteorological station values due to obstructions such as trailers, trees, hills etc. (see Local Wind Speed tab for further details) The local wind pressure created by a 6 mph wind is approximately 0.01 inch w.g.
3) The local wind pressure varies from positive to negative as the angle of impingement varies from 0° to 180°. The effective average infiltration rate for a building will be calculated using an average of the positive wind pressures such that only indoor-outdoor pressure differences around all sides of the building that result in wind-driven infiltration (i.e. not exfiltration) are considered.
4) The draft coefficient ranges from 1.0 for building with no interior partitions (no resistance), i.e. single-story industrial plants, to 0.65 for buildings with interior partitions, ie. multi-story hi-rise buildings.
5) The pressure difference caused by thermal forces (change in air density), known as stack effect, vary depending on the location of the opening/gap and can be very difficult to measure in most commercial & industrial building. The neutral pressure level (NPL) is the location where no pressure difference exists in the building envelope due to stack effect alone. The NPL of tall buildings with multiple openings typically varies from 0.3 to 0.7 of the total building hiegnt, H, indicating bidirectional air flow (flow inward at lower levels & outward at upper levels). Unless there is detailed information on the vertical distribution of the openings, it is assumed that the NPL is mid-hieght of a building (H_{NPL} = 1/2 H). For low-rise structures, (< 100 ft height), it is reasonable to assume 0 inch w.g. at the midpoint of the building and 0.007 inch w.g. at ground level. For high-rise structures (> 100 ft), the pressure will increase approx. 0.0035 inch w.g. at ground level for every additional 100 ft of bldg height. See ASHRAE Handbook 2001 Fundamentals, Chapter 26, pg 26.11 for further details.
6) The pressure differential caused by the mechanical ventilation system is assumed to be zero for a building with balanced pressurization; 0.02 to 0.1 inch w.g. for building with positive pressurization and -0.02 to -0.1 inch w.g. for building with negative presurization based on typical pressurization readings found in residential and commercial buildings.
7) The airflow through cracks & gaps is considered unidirectional.
8) The flow or discharge coefficient, C, are dependent on the Reynolds number of the flow (laminar to turbulent) and the crack/gap geometry & size and takes into account all viscous effects such as surface drag and interfacial mixing. A value of 0.65 is typically used for most building openings.
9) The flow exponent is dependent on the Reynolds number of the flow (laminar to turbulent) and the crack/gap geometry & size. It typically ranges from 0.5 (turbulent conditions) for very small gaps (i.e. windows & residential-type doors) to 0.65 (partially turbulent) for large gaps (i.e. commercial doors & curtain walls) and has been determined emperically for many building components.
10) ASHRAE Sandard 90.1 establishes an air leakage maximum of 0.4 cfm per square foot of gross fenestration product area (1.0 cfm/ft^2 for new swinging entrance doors and revolving doors). Most new fenestration products achieve these reasonable levels in accordance with NFRC 100 & 400.



Calculated:

	Base Case			**Improvement**				
A	=	1.1	ft²	A	=	0.3	ft²	
ΔP	=	-0.0015	in w.g	ΔP	=	-0.0015	in w.g	- for infiltration, + for exfiltration
ΔP		0.0007	in w.g	ΔP		0.0007		- for infiltration, + for exfiltration
ΔP	=	-0.0052	in w.g	ΔP	=	-0.0052	in w.g	- for infiltration, + for exfiltration
ΔP		0.0000	in w.g	ΔP		0.0000		- for infiltration, + for exfiltration
ΔP	=	-0.0067	in w.g	ΔP	=	-0.0067	in w.g	- for infiltration, + for exfiltration
ΔP	=	-0.0008	in w.g	ΔP	=	-0.0008	in w.g	- for infiltration, + for exfiltration
Q	=	-12,666.1	cfm	Q	=	-3,383.0	cfm	- for infiltration, + for exfiltration
Q	=	-3,264.6	cfm	Q	=	-870.6	cfm	- for infiltration, + for exfiltration
q	=	412,875	Btu/hr	q	=	110,047	Btu/hr	
q	=	47,984	Btu/hr	q	=	12,795	Btu/hr	
NG	=	17,715	m³/year	NG	=	4,724	m³/year	
E	=	2,588	kWh/year	E	=	690	kWh/year	

Reduction in Natural Gas:

NG = 2,530 mmBtu annually
= 12,991 m³ annually
or 73 % savings in fuel

Reduction in Electricity:

E = 1,898 kWh annually
or 73 % savings in electricity

South Calculations - Sides

Weatherization Improvements

Estimated Energy Savings

Project Description:

SOUTH - SIDE SEALS

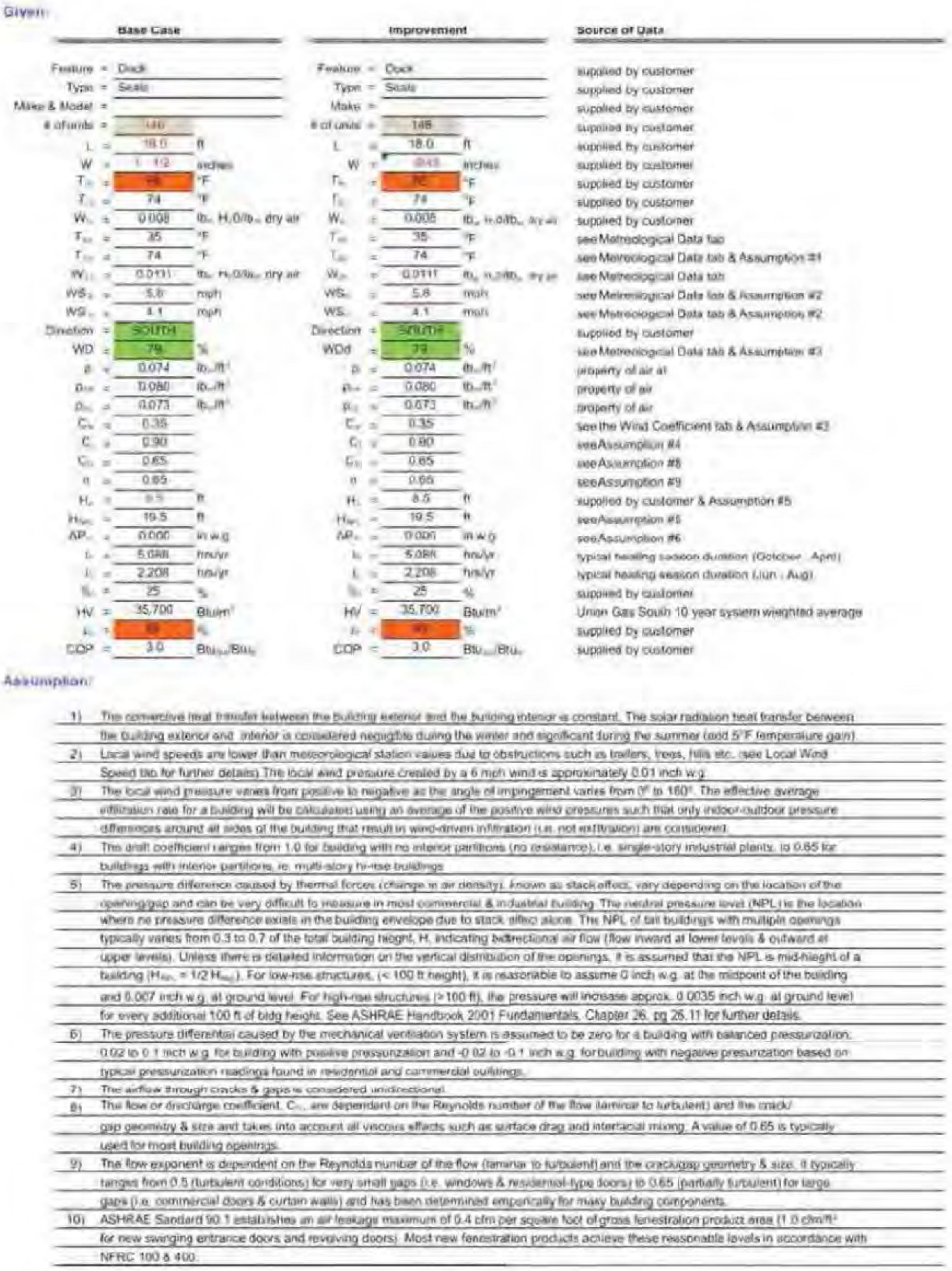
Key Equations:

FOR SMALL OPENINGS

1) $\Delta P_w = C_w \text{ x } \rho_o \text{ x } WS^2 \text{ x } WD/ (2 \text{ x } g_c)$ (- for infiltration for exfiltration)
2) $\Delta P_t = C_t \text{ x } (\rho_o \text{ x } g / g_c) \text{ x } \Delta H_{NPL} \text{ x } [(\ _i - \ _o/ \ _i$ (- for infiltration for exfiltration)
3) $\Delta H_{NPL} = H_o - H_{NPL}$
4) $\Delta P_m = P_o - P_i$ (- for infiltration for exfiltration)
5) $\Delta P_T = \Delta P_w \quad \Delta P_t \quad \Delta P_m$ (- for infiltration for exfiltration)
6) $Q_T = N \text{ x } 136\ 8 \text{ x } C_D \text{ x } A \text{ x } (2 \text{ x } g_c \text{ x } \Delta P_T / \rho_o)^n$
7) $q_h = 1\ 08 \text{ x } Q_{total} \text{ x } (\ i - \ o)$
8) $q_c = [1\ 08 \text{ x } Q_{total} \text{ x } (\ i - \ o) \quad [4840 \text{ x } Q_{total} \text{ x } (Wo - Wi)$
9) $NG = (q_h \text{ x } t_h \text{ x } \%_t) / (HV \text{ x } \varepsilon_h)$
10) $E = (q_c \text{ x } t_c \text{ x } \%_t)/(COP \text{ x } 3412)$

Where

b = subscript for base case
e = subscript for energy improvement
T = subscript for total
w = subscript for wind effect
t = subscript for stack (thermal) effect
m = subscript for building pressurization effect (mechanical ventilation system)
i = subscript for inlet/entering conditions/indoor/inner surface
o = subscript for outlet/exiting conditions/outdoor/outer surface
p = subscript for perdendicular direction
d = subscript for diagonal direction
h = subscript for heating/heater
c = subscript for cooling/cooler
ΔP = Differential pressure across opening (inch w g)
C_w = Wind pressure coefficient (dimensionless)
ρ = Density of air (lb_m/ft^3)
WS = Average wind speed (mph)
WD = Wind direction frequency (%)
C_t = Draft coefficient due to thermal forces (dimensionless)
g = Local acceleration of gravity = 32 174 ft/s² @ sea level
g_c = Gravitational proportionality constant = 32 174 lb_m-ft/s_2-lb_f
ΔH_{NPL} = Vertical distance between opening and the neutral pressure level (NPL) (ft)
H_o = Height of opening above reference point (ground level (ft)
H_{NPL} = Height of neutral pressure level (NPL) above reference point (ground level) (ft)
T = Temperature (°R) = 459 7 + Temperature (°F)
L = Length of crack/gap of building envelope component (door window etc) (ft)
W = Width of crack/gap (inches)
A = Area of building envelope component (door window etc) (ft^2)
Q = nfiltration air flowrate (cfm)
C_D = Discharge or flow coefficient for opening (dimensionless)
n = Flow exponent between 0 5 (turbulent) to 1 0 (laminar) and typically considered 0 65 for buildings
W = Humidity (lb_m H_2O/lb_m dry air)
q = Heat transfer rate (Btu/hr)
t = Annual hours in heating or cooling mode (hrs/days)
$\%_t$ = Percentage of time in operating mode (%)
HV = Heating value of natural gas (Btu/m³)
ε_h = Heating system efficiency (%)
NG = Natural gas consumption (m³/yr)
COP = Coeffiienct of Performace (Btu_{out}/Btu_{in})
E = electricty consumption (kWh/yr)



Given:

	Base Case			Improvement		Source of Data
Feature =	Dock		Feature =	Dock		supplied by customer
Type =	Seals		Type =	Seals		supplied by customer
Make & Model =			Make =			supplied by customer
# of units =	[illegible]		# of units =	148		supplied by customer
L =	18.0	ft	L =	18.0	ft	supplied by customer
W =	1 1/2	inches	W =	[illegible]	inches	supplied by customer
T =	[illegible]	°F	T =	[illegible]	°F	supplied by customer
T =	74	°F	T =	74	°F	supplied by customer
W =	0.008	lb H₂O/lb dry air	W =	0.008	lb H₂O/lb dry air	supplied by customer
T =	35	°F	T =	35	°F	see Metreological Data tab
T =	74	°F	T =	74	°F	see Metreological Data tab & Assumption #1
W =	0.0111	lb H₂O/lb dry air	W =	0.0111	lb H₂O/lb dry air	see Metreological Data tab
WS =	5.8	mph	WS =	5.8	mph	see Metreological Data tab & Assumption #2
WS =	4.1	mph	WS =	4.1	mph	see Metreological Data tab & Assumption #2
Direction =	SOUTH		Direction =	SOUTH		supplied by customer
WD =	79	%	WDd =	79	%	see Metreological Data tab & Assumption #3
ρ =	0.074	lb/ft³	ρ =	0.074	lb/ft³	property of air at
ρ =	0.080	lb/ft³	ρ =	0.080	lb/ft³	property of air
ρ =	0.073	lb/ft³	ρ =	0.073	lb/ft³	property of air
C =	0.35		C =	0.35		see the Wind Coefficient tab & Assumption #3
C =	0.90		C =	0.90		see Assumption #4
C =	0.65		C =	0.65		see Assumption #8
n =	0.65		n =	0.65		see Assumption #9
H =	8.5	ft	H =	8.5	ft	supplied by customer & Assumption #5
H =	19.5	ft	H =	19.5	ft	see Assumption #5
ΔP =	0.000	in w.g	ΔP =	0.006	in w.g	see Assumption #6
t =	5,088	hrs/yr	t =	5,088	hrs/yr	typical heating season duration (October - April)
t =	2,208	hrs/yr	t =	2,208	hrs/yr	typical heating season duration (Jun - Aug)
% =	25	%	% =	25	%	supplied by customer
HV =	35,700	Btu/m³	HV =	35,700	Btu/m³	Union Gas South 10 year system wieghted average
η =	[illegible]	%	η =	[illegible]	%	supplied by customer
COP =	3.0	Btu/Btu	COP =	3.0	Btu/Btu	supplied by customer

Assumption:

1) The convective heat transfer between the building exterior and the building interior is constant. The solar radiation heat transfer between the building exterior and interior is considered negigible during the winter and significant during the summer (add 5°F temperature gain).

2) Local wind speeds are lower than meteorological station values due to obstructions such as trailers, trees, hills etc. (see Local Wind Speed tab for further details) The local wind pressure created by a 6 mph wind is approximately 0.01 inch w.g.

3) The local wind pressure varies from positive to negative as the angle of impingement varies from 0° to 180°. The effective average infiltration rate for a building will be calculated using an average of the positive wind pressures such that only indoor-outdoor pressure differences around all sides of the building that result in wind-driven infiltration (i.e. not exfiltration) are considered.

4) The draft coefficient ranges from 1.0 for building with no interior partitions (no resistance), i.e. single-story industrial plants, to 0.65 for buildings with interior partitions, ie. multi-story hi-rise buildings.

5) The pressure difference caused by thermal forces (change in air density), known as stack effect, vary depending on the location of the opening/gap and can be very difficult to measure in most commercial & industrial building. The neutral pressure level (NPL) is the location where no pressure difference exists in the building envelope due to stack effect alone. The NPL of tall buildings with multiple openings typically varies from 0.3 to 0.7 of the total building hieght, H, indicating bidirectional air flow (flow inward at lower levels & outward at upper levels). Unless there is detailed information on the vertical distribution of the openings, it is assumed that the NPL is mid-hieght of a building (H = 1/2 H). For low-rise structures, (< 100 ft height), it is reasonable to assume 0 inch w.g. at the midpoint of the building and 0.007 inch w.g. at ground level. For high-rise structures (>100 ft), the pressure will increase approx. 0.0035 inch w.g. at ground level for every additional 100 ft of bldg height. See ASHRAE Handbook 2001 Fundamentals, Chapter 26, pg 26.11 for further details.

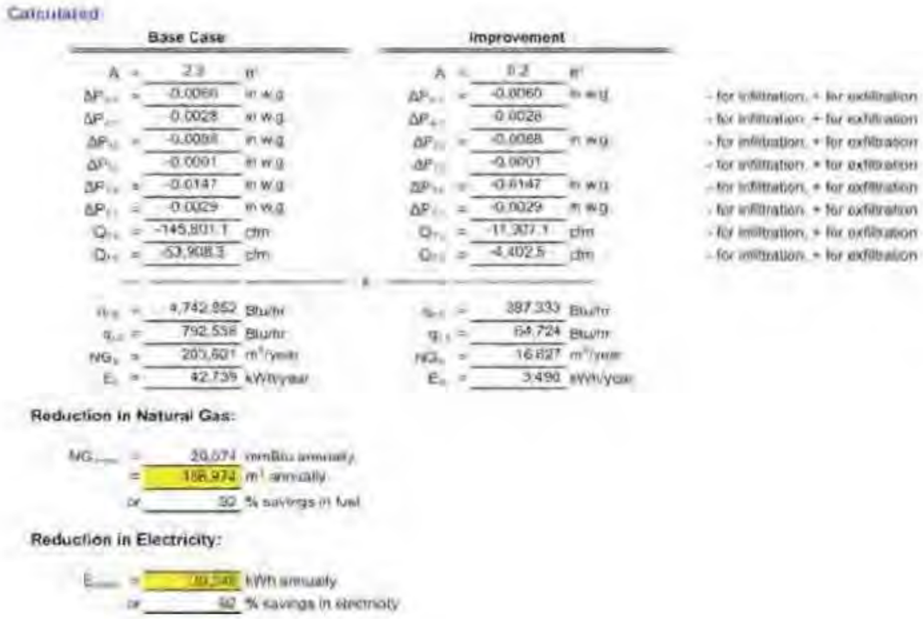
6) The pressure differential caused by the mechanical ventilation system is assumed to be zero for a building with balanced pressurization; 0.02 to 0.1 inch w.g. for building with positive pressurization and -0.02 to -0.1 inch w.g. for building with negative presurization based on typical pressurization readings found in residential and commercial buildings.

7) The airflow through cracks & gaps is considered unidirectional.

8) The flow or discharge coefficient, C, are dependent on the Reynolds number of the flow (laminar to turbulent) and the crack/gap geometry & size and takes into account all viscous effects such as surface drag and interfacial mixing. A value of 0.65 is typically used for most building openings.

9) The flow exponent is dependent on the Reynolds number of the flow (laminar to turbulent) and the crack/gap geometry & size. It typically ranges from 0.5 (turbulent conditions) for very small gaps (i.e. windows & residential-type doors) to 0.65 (partially turbulent) for large gaps (i.e. commercial doors & curtain walls) and has been determined emperically for many building components.

10) ASHRAE Sandard 90.1 establishes an air leakage maximum of 0.4 cfm per square foot of gross fenestration product area (1.0 cfm/ft² for new swinging entrance doors and revolving doors). Most new fenestration products achieve these reasonable levels in accordance with NFRC 100 & 400.



Calculated

Base Case			Improvement			
A =	2.3	ft²	A =	0.2	ft²	
ΔP =	-0.0066	in w.g	ΔP =	-0.0060	in w.g	- for infiltration, + for exfiltration
ΔP	-0.0028	in w.g	ΔP	-0.0028		- for infiltration, + for exfiltration
ΔP =	-0.0088	in w.g	ΔP =	-0.0088	in w.g	- for infiltration, + for exfiltration
ΔP	-0.0001	in w.g	ΔP	-0.0001		- for infiltration, + for exfiltration
ΔP =	-0.0147	in w.g	ΔP =	-0.0147	in w.g	- for infiltration, + for exfiltration
ΔP =	-0.0029	in w.g	ΔP =	-0.0029	in w.g	- for infiltration, + for exfiltration
Q =	-145,801.1	cfm	Q =	-11,307.1	cfm	- for infiltration, + for exfiltration
Q =	-53,908.3	cfm	Q =	-4,402.5	cfm	- for infiltration, + for exfiltration
q =	4,742,852	Btu/hr	q =	387,333	Btu/hr	
q =	792,538	Btu/hr	q =	64,724	Btu/hr	
NG =	205,601	m³/year	NG =	16,827	m³/year	
E =	42,739	kWh/year	E =	3,490	kWh/year	

Reduction in Natural Gas:

NG = 20,674 mmBtu annually
= 188,974 m³ annually
or 92 % savings in fuel

Reduction in Electricity:

E = 39,249 kWh annually
or 92 % savings in electricity

South Calculations - Top

Weatherization Improvements

Estimated Energy Savings

Project Description:

SOUTH - TOP SEALS

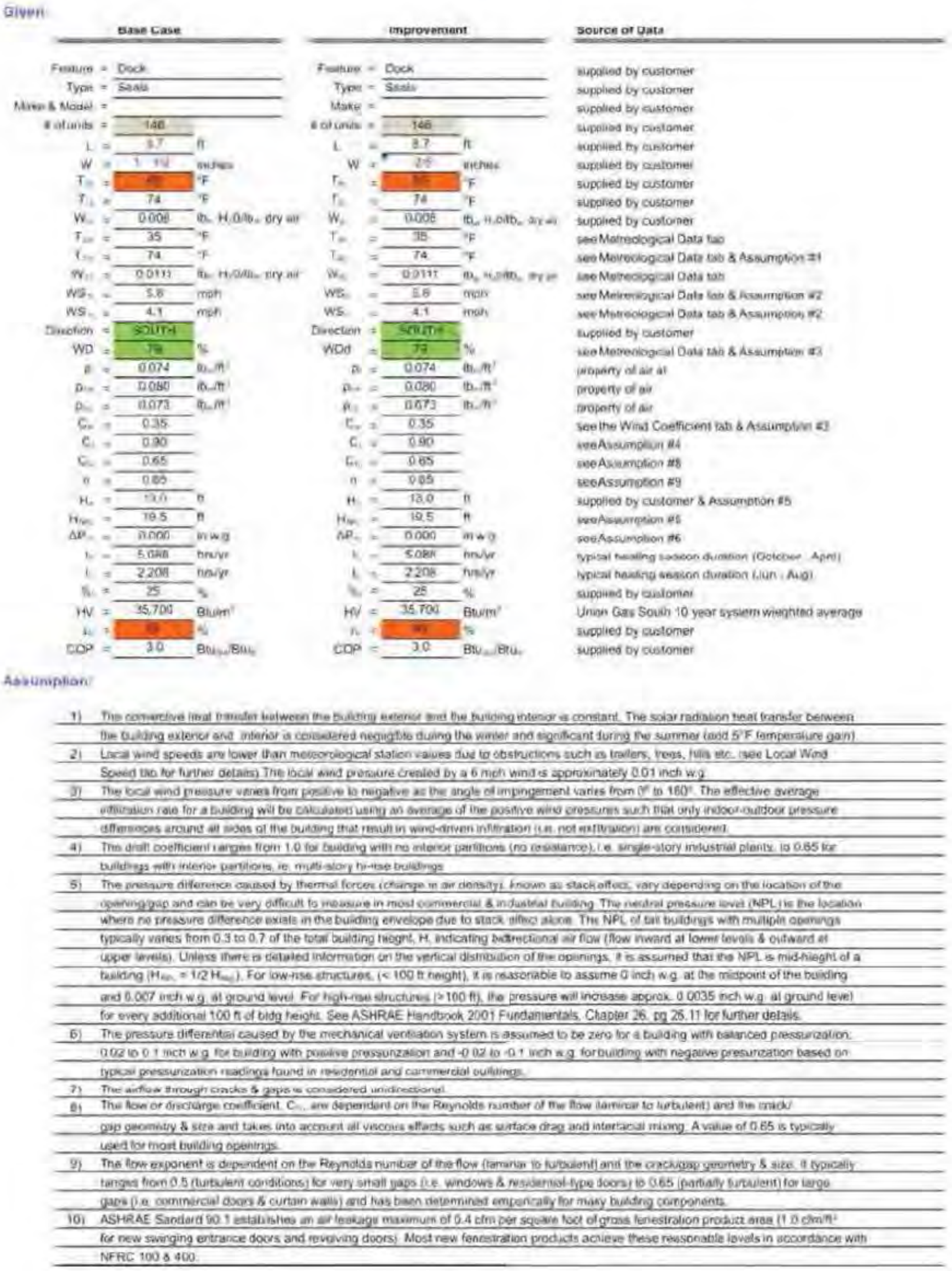
Key Equations:

FOR SMALL OPENINGS

1) $\Delta P_w = C_w$ x ρ_o x WS^2 x WD/ (2 x g_c) (- for infiltration for exfiltration)
2) $\Delta P_t = C_t$ x (ρ_o x g / g_c) x ΔH_{NPL} x [($_i$ - $_o$/ $_i$ (- for infiltration for exfiltration)
3) $\Delta H_{NPL} = H_o - H_{NPL}$
4) $\Delta P_m = P_o - P_i$ (- for infiltration for exfiltration)
5) $\Delta P_T = \Delta P_w \quad \Delta P_t \quad \Delta P_m$ (- for infiltration for exfiltration)
6) Q_T = N x 136 8 x C_D x A x (2 x g_c x ΔP_T / ρ_o)^n
7) q_h = 1 08 x Q_{total} x (i - o)
8) q_c = [1 08 x Q_{total} x (i - o) [4840 x Q_{total} x (Wo - Wi)
9) NG = (q_h x t_h x $\%_t$) / (HV x ε_h)
10) E = (q_c x t_c x $\%_t$)/(COP x 3412)

Where

b = subscript for base case
e = subscript for energy improvement
T = subscript for total
w = subscript for wind effect
t = subscript for stack (thermal) effect
m = subscript for building pressurization effect (mechanical ventilation system)
i = subscript for inlet/entering conditions/indoor/inner surface
o = subscript for outlet/exiting conditions/outdoor/outer surface
p = subscript for perdendicular direction
d = subscript for diagonal direction
h = subscript for heating/heater
c = subscript for cooling/cooler
ΔP = Differential pressure across opening (inch w g)
C_w = Wind pressure coefficient (dimensionless)
ρ = Density of air (lb_m/ft^3)
WS = Average wind speed (mph)
WD = Wind direction frequency (%)
C_t = Draft coefficient due to thermal forces (dimensionless)
g = Local acceleration of gravity = 32 174 ft/s^2 @ sea level
g_c = Gravitational proportionality constant = 32 174 lb_m-ft/s_2-lb_f
ΔH_{NPL} = Vertical distance between opening and the neutral pressure level (NPL) (ft)
H_o = Height of opening above reference point (ground level (ft)
H_{NPL} = Height of neutral pressure level (NPL) above reference point (ground level) (ft)
T = Temperature (°R) = 459 7 + Temperature (°F)
L = Length of crack/gap of building envelope component (door window etc) (ft)
W = Width of crack/gap (inches)
A = Area of building envelope component (door window etc) (ft^2)
Q = Infiltration air flowrate (cfm)
C_D = Discharge or flow coefficient for opening (dimensionless)
n = Flow exponent between 0 5 (turbulent) to 1 0 (laminar) and typically considered 0 65 for buildings
W = Humidity (lb_m H_2O/lb_m dry air)
q = Heat transfer rate (Btu/hr)
t = Annual hours in heating or cooling mode (hrs/days)
$\%_t$ = Percentage of time in operating mode (%)
HV = Heating value of natural gas (Btu/m^3)
ε_h = Heating system efficiency (%)
NG = Natural gas consumption (m^3/yr)
COP = Coeffiienct of Performace (Btu_{out}/Btu_{in})
E = electricty consumption (kWh/yr)



Given

Base Case			Improvement			Source of Data
Feature =	Dock		Feature =	Dock		supplied by customer
Type =	Seals		Type =	Seals		supplied by customer
Make & Model =			Make =			supplied by customer
# of units =	146		# of units =	146		supplied by customer
L =	8.7	ft	L =	8.7	ft	supplied by customer
W =	1 1/2	inches	W =	2.5	inches	supplied by customer
T =	[illegible]	°F	T =	[illegible]	°F	supplied by customer
T =	74	°F	T =	74	°F	supplied by customer
W =	0.008	lb H₂O/lb dry air	W =	0.008	lb H₂O/lb dry air	supplied by customer
T =	35	°F	T =	35	°F	see Metreological Data tab
T =	74	°F	T =	74	°F	see Metreological Data tab & Assumption #1
W =	0.0111	lb H₂O/lb dry air	W =	0.0111	lb H₂O/lb dry air	see Metreological Data tab
WS =	5.8	mph	WS =	5.8	mph	see Metreological Data tab & Assumption #2
WS =	4.1	mph	WS =	4.1	mph	see Metreological Data tab & Assumption #2
Direction =	SOUTH		Direction =	SOUTH		supplied by customer
WD =	79	%	WDd =	73	%	see Metreological Data tab & Assumption #3
ρ =	0.074	lb/ft³	ρ =	0.074	lb/ft³	property of air at
ρ =	0.080	lb/ft³	ρ =	0.080	lb/ft³	property of air
ρ =	0.073	lb/ft³	ρ =	0.073	lb/ft³	property of air
C =	0.35		C =	0.35		see the Wind Coefficient tab & Assumption #3
C =	0.90		C =	0.90		see Assumption #4
C =	0.65		C =	0.65		see Assumption #8
n =	0.65		n =	0.65		see Assumption #9
H =	13.0	ft	H =	13.0	ft	supplied by customer & Assumption #5
H =	19.5	ft	H =	19.5	ft	see Assumption #5
ΔP =	0.000	in w.g	ΔP =	0.000	in w.g	see Assumption #6
t =	5,088	hrs/yr	t =	5,088	hrs/yr	typical heating season duration (October - April)
t =	2,208	hrs/yr	t =	2,208	hrs/yr	typical heating season duration (Jun - Aug)
% =	25	%	% =	25	%	supplied by customer
HV =	35,700	Btu/m³	HV =	35,700	Btu/m³	Union Gas South 10 year system wieghted average
η =	[illegible]	%	η =	[illegible]	%	supplied by customer
COP =	3.0	Btu/Btu	COP =	3.0	Btu/Btu	supplied by customer

Assumption:

1) The convective heat transfer between the building exterior and the building interior is constant. The solar radiation heat transfer between the building exterior and interior is considered negligible during the winter and significant during the summer (add 5°F temperature gain).

2) Local wind speeds are lower than meteorological station values due to obstructions such as trailers, trees, hills etc. (see Local Wind Speed tab for further details) The local wind pressure created by a 6 mph wind is approximately 0.01 inch w.g.

3) The local wind pressure varies from positive to negative as the angle of impingement varies from 0° to 180°. The effective average infiltration rate for a building will be calculated using an average of the positive wind pressures such that only indoor-outdoor pressure differences around all sides of the building that result in wind-driven infiltration (i.e. not exfiltration) are considered.

4) The draft coefficient ranges from 1.0 for building with no interior partitions (no resistance), i.e. single-story industrial plants, to 0.65 for buildings with interior partitions, ie. multi-story hi-rise buildings.

5) The pressure difference caused by thermal forces (change in air density), known as stack effect, vary depending on the location of the opening/gap and can be very difficult to measure in most commercial & industrial building. The neutral pressure level (NPL) is the location where no pressure difference exists in the building envelope due to stack effect alone. The NPL of tall buildings with multiple openings typically varies from 0.3 to 0.7 of the total building hieght, H, indicating bidirectional air flow (flow inward at lower levels & outward at upper levels). Unless there is detailed information on the vertical distribution of the openings, it is assumed that the NPL is mid-hieght of a building (H = 1/2 H). For low-rise structures, (< 100 ft height), it is reasonable to assume 0 inch w.g. at the midpoint of the building and 0.007 inch w.g. at ground level. For high-rise structures (>100 ft), the pressure will increase approx. 0.0035 inch w.g. at ground level for every additional 100 ft of bldg height. See ASHRAE Handbook 2001 Fundamentals, Chapter 26, pg 26.11 for further details.

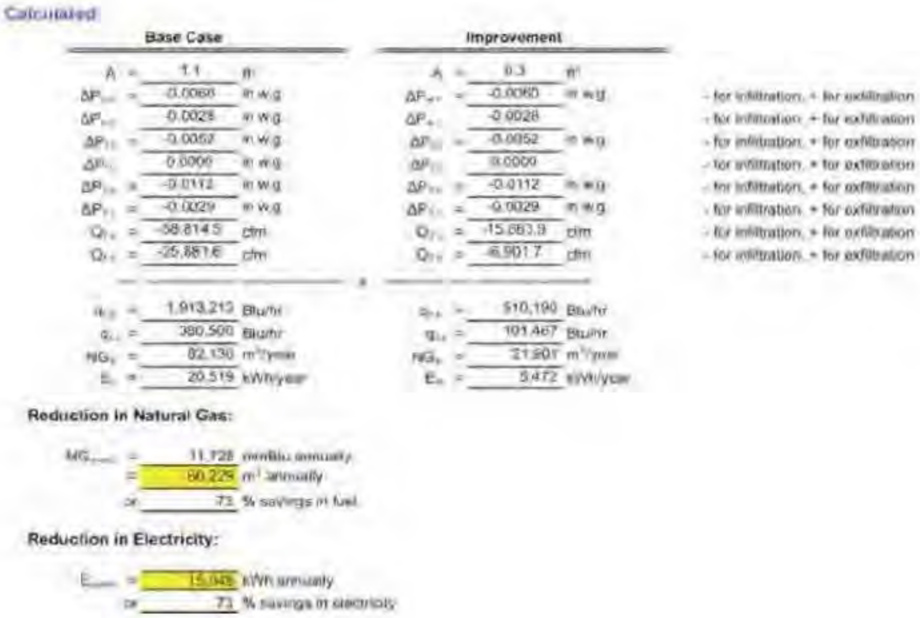
6) The pressure differential caused by the mechanical ventilation system is assumed to be zero for a building with balanced pressurization; 0.02 to 0.1 inch w.g. for building with positive pressurization and -0.02 to -0.1 inch w.g. for building with negative presurization based on typical pressurization readings found in residential and commercial buildings.

7) The airflow through cracks & gaps is considered unidirectional.

8) The flow or discharge coefficient, C, are dependent on the Reynolds number of the flow (laminar to turbulent) and the crack/gap geometry & size and takes into account all viscous effects such as surface drag and interfacial mixing. A value of 0.65 is typically used for most building openings.

9) The flow exponent is dependent on the Reynolds number of the flow (laminar to turbulent) and the crack/gap geometry & size. It typically ranges from 0.5 (turbulent conditions) for very small gaps (i.e. windows & residential-type doors) to 0.65 (partially turbulent) for large gaps (i.e. commercial doors & curtain walls) and has been determined emperically for many building components.

10) ASHRAE Sandard 90.1 establishes an air leakage maximum of 0.4 cfm per square foot of gross fenestration product area (1.0 cfm/ft² for new swinging entrance doors and revolving doors). Most new fenestration products achieve these reasonable levels in accordance with NFRC 100 & 400.



Calculated

Base Case				Improvement				
A	=	1.1	ft²	A	=	0.3	ft²	
ΔP	=	-0.0068	in w.g	ΔP	=	-0.0060	in w.g	- for infiltration, + for exfiltration
ΔP		-0.0028	in w.g	ΔP		-0.0028		- for infiltration, + for exfiltration
ΔP	=	-0.0052	in w.g	ΔP	=	-0.0052	in w.g	- for infiltration, + for exfiltration
ΔP		0.0000	in w.g	ΔP		0.0000		- for infiltration, + for exfiltration
ΔP	=	-0.0112	in w.g	ΔP	=	-0.0112	in w.g	- for infiltration, + for exfiltration
ΔP	=	-0.0029	in w.g	ΔP	=	-0.0029	in w.g	- for infiltration, + for exfiltration
Q	=	-58,814.5	cfm	Q	=	-15,883.9	cfm	- for infiltration, + for exfiltration
Q	=	-25,881.6	cfm	Q	=	-6,901.7	cfm	- for infiltration, + for exfiltration
q	=	1,913,213	Btu/hr	q	=	510,190	Btu/hr	
q	=	380,500	Btu/hr	q	=	101,467	Btu/hr	
NG	=	82,130	m³/year	NG	=	21,901	m³/year	
E	=	20,519	kWh/year	E	=	5,472	kWh/year	

Reduction in Natural Gas:

NG = 11,728 mmBtu annually
= 60,229 m³ annually
or 73 % savings in fuel

Reduction in Electricity:

E = 15,046 kWh annually
or 73 % savings in electricity

Random sample observations of door dock seals.

jpg photo	gap (% of door LF)	Average:
...299	25%	14%
...300	25%	
...301	20%	
...302	10%	
...303	10%	
...304	25%	
...305	0%	
...307	0%	
...308	0%	
...309	0%	
...310	0%	
...311	15%	
...312	25%	
...313	25%	
...314	0%	
...315	0%	
...316	50%	
...317	15%	
...318	25%	
...319	25%	
...320	15%	
...321	0%	
...322	25%	
...323	0%	
...324	25%	
...327	10%	
...328	25%	
...329	0%	
...330	25%	
...331	0%	
...332	0%	
...333	5%	
...334	20%	
...335	25%	
...336	25%	

APPENDIX M: Union Gas Project Code - CI19 - 2013-COM-0149

Heat reclaim circuits are 'ON' and operating within control limits.

[redacted]

```
02-11-14                                                    14:08:28
Press 'Log In/Out' to Log On    ANLG SENS CTRL

ANALOG SENSOR NAME:
[redacted]

Control Val: [redacted]mmand:        OFF
      Input1              : 141.4
      Input2              : 109.2

Combination Method        : AVERAGE

Out In                    : 120.0
Out Out                   : 140.0

Press enter for a list of actions.
```

```
02-11-14                       [redacted]    OAT: 15
Press 'Log In/Out' to Log On
TEST ENH +15        49.8 [ 55.0]      [redacted]
                    CAP    0%
     S1  S2  S3
     --  --  --

RACK B COND         182.4 [105.0]

Controlled By: Discharge     Status: Split
F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12
-- -- -- -- -- -- -- -- -- --  --  --

Sensor Ctrl        Value   Cmd
[redacted]         133.7   OFF
                    78.9   OFF
                      ON    ON
                    56.6   OFF
                     OFF   OFF

Press enter for a list of actions.
```

Appendix N: Union Gas Project Code - CI20 - 2013-COM-0069

HEAT LOAD CALCULATIONS
Window Replacement

Thermal Resistances:

Component:	"R" Value
Existing Glazing:	
Outside Air Film	0.17
Glazing	0.61
Inside Air Film	0.62
Composite Thermal Resistance	1.40
Upgraded Glazing:	
Outside Air Film	0.17
Glazing	1.16
Inside Air Film	0.62
Composite Thermal Resistance	1.95

Summary of Parameters

Surface	U Factor	Area (sq.ft.)	Peak Heat Loss (BTUH) (based on -15 °F OAT)
Existing Glazing	1.639	4426	275,016
New Glazing	0.862	4426	197,456

Peak Heat Loss Reduction 77,560

Grand Total Projected Annual Natural Gas Heating Reduction @ 65% Seasonal Efficiency (m3): 19,798

Note: Hourly occurrences for London ON are sourced from Carrier Hourly Analysis Programs

HEAT LOAD CALCULATIONS: **Conduction Losses**
Space Temperature Maintained @ 72 deg. F.

OAT (deg.F)	No. Hrs.	Weather Dependent Loads (BTU)		
		Existing	New	Δ Load
15	3	825,048	592,368	232,680
10	15	3,888,157	2,791,620	1,096,537
5	48	11,683,439	8,388,478	3,294,960
0	91	20,711,550	14,870,484	5,841,066
5	172	36,428,557	26,154,985	10,273,573
10	257	50,369,024	36,163,965	14,205,059
15	339	61,082,004	43,855,673	17,226,331
20	466	76,599,861	54,997,188	21,602,674
25	671	99,691,723	71,576,688	28,115,034
30	898	119,224,182	85,600,608	33,623,574
35	707	82,691,308	59,370,726	23,320,582
40	590	59,681,635	42,850,235	16,831,400
45	594	50,697,779	36,400,004	14,297,775
50	657	45,690,591	32,804,942	12,885,649
55	678	36,434,880	26,159,524	10,275,356
60	735	27,880,933	20,017,960	7,862,974
65	719	15,909,834	11,422,947	4,486,887
70	554	3,502,503	2,514,728	987,775
TOTALS (BTU)				226,459,885

Projected Annual Natural Gas Heating Reduction @ 65% Seasonal Efficiency (m3):
9,759

Infiltration Calculation

South and West facing prevailing wind: 0.6
Average wind velocity (@ 14.9 km/hr) 9.3 mph in the winter months: 144
Note: based on eWeather System data for London ON
Infiltration rate (cfm/LF): Existing 0.78
Infiltration rate (cfm/LF): New 0.32
Note: based on Carrier published data at 10 mph wind velocity

Linear ft. in South facing direction 77.45
Linear ft. in West facing direction 1768.4
Total 1845.85

OAT	No. Hrs.	Existing Heat Loss (Btu)	New Heat Loss (Btu)	Δ Infiltration Load (Btu)
15	3	405,840	166,499	239,342
10	15	1,912,581	784,649	1,127,932
5	48	5,747,073	2,357,774	3,389,300
0	91	10,187,993	4,179,690	6,008,304
5	172	17,919,175	7,351,456	10,567,719
10	257	24,776,478	10,164,709	14,611,769
15	339	30,046,184	12,326,639	17,719,544
20	466	37,679,404	15,458,217	22,221,187
25	671	49,038,270	20,118,265	28,920,005
30	898	58,646,269	24,060,008	34,586,261
35	707	40,675,781	16,687,500	23,988,281
40	590	29,357,343	12,044,038	17,313,305
45	594	24,938,193	10,231,053	14,707,139
50	657	22,475,161	9,220,579	13,254,582
55	678	17,922,285	7,352,732	10,569,553
60	735	13,714,606	5,626,505	8,088,101
65	719	7,826,033	3,210,680	4,615,353
70	554	1,722,878	706,822	1,016,056
			TOTAL	232,943,735

Projected Annual Natural Gas Heating Reduction @ 65% Seasonal Efficiency (m3):
10,039

Appendix P: 2013 Evaluation of Distribution Contract Custom Projects

2013 Evaluation of Distribution Contract Custom Projects

For

Union Gas
50 Keil Drive North
PO Box 2001
Chatham, Ontario, Canada
N7M 5M1

April 29, 2014

Performed By

Diamond Engineering Company
3723 W. Hamilton Road S
Fort Wayne, IN 46814

This report is confidential and contains sensitive information about the operations of Union Gas's customers. It is intended for use only by Union Gas and the reviewer of the program.

Table of Contents

Introduction

Union Gas has been undertaking Demand Side Management initiatives to encourage the efficient use of natural gas. In the industrial markets, custom projects represent a significant portion of the DSM savings. A sampling plan randomly selects an appropriate number of sites that are to be audited by an independent third party. The primary objectives of the report on this audit are:

- To review the original customer application and supporting documentation with respect to savings estimates.

- To conduct site visits (if instructive) and verify the system was installed and operational. To verify equipment costs with the customers.

- To discuss the project with service representatives and customers, and determine operating practices.

- To collect operating data and design information.

- To review the information and make an estimate of the rate of annual gas volume savings, and where appropriate, make an estimate of the rate of water and electrical savings. Savings estimates are Diamond Engineering's best attempt to determine, with the information provided, what the actual savings rate is, without any factors of safety.

- Project Costs are solely the representations of the customers interviewed. This review does not constitute a financial audit.

Summary

Twenty-three projects were reviewed. Customers invested $ 14,463,468 in these projects. These projects resulted in an annual natural gas savings of between 103,493,280 and 106,181,280 m^3. Using a 0.00188 metric ton CO_2 / m^3 gas consumed conversion factor, CO_2 emission reduction from these seventeen projects was between 194,600 and 199,600 metric tons per year.

While this audit process consists of both a Boolean and numeric analysis of project applications and results, there are other factors that, when considered with the supporting information and data, either add to or detract from the auditor's confidence in the conclusions presented. It must be reported that during every site visit, the customers welcomed the auditor and willingly took the time necessary to explain the project and its results. In several instances, a customer was not initially able to provide sufficient information to verify critical savings elements but provided the information at a later date.

This year, the lower than verified savings calculations for natural gas on the project applications indicate Union Gas personnel and their customers were conservative when estimating savings. This pattern is typical because while it is a common practice to apply factors of safety when performing engineering calculations, no such factors are applied by Diamond Engineering in the preparation of this report.

Union Gas Representatives and Project Managers were always welcomed by the customers, viewed as partners and considered valuable resources.

It would be desirable to encourage all Customers to provide internal verification procedures to estimate the exact savings achieved from their projects, however, it is important to note most end users perform only enough analysis to justify a course of action. In other words, if the companies required payback period is one year, the investment of additional resources to accurately calculate whether the project pays back in six or three months is a an academic exercise and has no commercial value to the customer.

As with any such body of work, the quality of the supporting material for each project varies significantly. Diamond Engineering personnel have used what is in their judgment the best available information to arrive at the savings estimates.

Summary (continued)

Other Considerations

Energy Intensity – Whenever possible, this analysis will describe energy efficiency improvement(s) in light of *Energy Intensity* reductions. If no such conclusion is provided, in general, there was insufficient data provided or the it required analysis falls outside the describe scope of the analysis. For the purposes of this analysis, Energy Intensity is defined as *Gross Energy Consumed* per consistent unit produced or processed.

Gross Energy Consumed – Unless otherwise noted, *Gross Energy Consumed* is assumed to be the energy value at the facilities boundary. Generation and Distribution losses are not accounted for in the analysis.

HHV – Unless otherwise noted, All values are expressed in terms of the *Higher Heating Value* of any given fuel. The quantity of fuel saved is expressed in terms of a volume under standard pressure and temperature. The Higher Heating Value (HHV) for a standard cubic foot of natural gas is assumed to be 1020 British Thermal Units (BTU).

Period of Savings – Unless otherwise stated, When describing the impact of a project or action on energy consumption, it is assumed the benefit has accrued for a period of one year.

Rational Process Operator – Unless evidence is uncovered to the contrary, it is assume the person / people responsible for various decisions as to the operation, maintenance, and investment in the process or apparatus follow sound business principles. Unless otherwise noted, this analysis does not seek to understand why decision(s) are made, only the decision(s) impact on energy consumption.

Honest Process Operator – Unless evidence is uncovered to the contrary, it is assume the person / people disclosing information do so without any intentional misrepresentation, however, it is not assumed the information is accurate.

While the execution of each project was verified, this was not a financial audit – project costs are as represented by the customers interviewed.

Summary (continued)

Natural Gas Savings	**Estimated Annual Natural Gas Saved (Normal Cubic Meters) from Application**	**Estimated Annual Natural Gas Saved (Normal Cubic Meters) Auditor's Calculations (Maximum)**	**Estimated Annual Natural Gas Saved (Normal Cubic Meters) Auditor's Calculations (Minimum)**	**Estimated Annual Natural Gas Saved (Normal Cubic Meters) Auditor's Calculations (Mean Average)**
1. 2013-IND-0348	10,480,821	11,640,000	11,640,000	11,640,000
2. 2013-IND-0469	7,753,349	6,940,000	6,940,000	6,940,000
3. 2013-IND-0120	4,299,973	4,507,000	3,687,000	4,097,000
4. 2013-IND-0121	1,760,727	1,846,000	1,510,000	1,678,000
5. 2013-IND-0416	1,276,692	1,309,000	1,185,000	1,247,000
6. 2013-IND-0074	2,208,231	2,427,000	1,985,000	2,206,000
7. 2013-IND-0240	1,610,769	2,127,000	1,741,000	1,934,000
8. 2013-IND-0229	1,447,273	1,707,000	1,707,000	1,707,000
9. 2013-IND-0542	200,977	98,580	98,580	98,580
10. 2013-IND-0123	888,303	1,543,000	1,263,000	1,403,000
11. 2013-IND-0101	4,861,000	4,708,000	4,708,000	4,708,000
12. 2013-IND-0273	1,740,129	1,239,000	1,239,000	1,239,000
13. 2013-IND-0124	18,099,008	32,310,000	32,310,000	32,310,000
14. 2013-IND-0157	4,218,598	3,148,000	2,848,000	2,998,000
15. 2013-IND-0205	2,287,034	2,324,000	2,324,000	2,324,000
16. 2013-IND-0117	2,504,565	2,085,000	2,085,000	2,085,000
17. 2013-IND-0159	208,366	233,000	233,000	233,000
18. 2013-IND-230	232,616	236,500	236,500	236,500
19. 2013-IND-0450	9,790,690	9,870,000	9,870,000	9,870,000
20. 2013-IND-0451	6,527,127	6,580,000	6,580,000	6,580,000
21. 2013-IND-0179	9,572,937	8,464,000	8,464,000	8,464,000
22. 2013-IND-0072	636,068	579,400	579,400	579,400
23. 2013-IND-0204	206,166	259,800	259,800	259,800
Totals	**92,811,419**	***103,493,280***	***106,181,280***	***104,837,280***

Electrical Savings	**Estimated Annual Electrical (kWh) from Application**	**Estimated Annual Electrical (kWh) Auditor's Calculations (Minimum)**	**Estimated Annual Electrical (kWh) Auditor's Calculations (Maximum)**
6. 2013-IND-0074	132,533	123,700	137,400
Totals	**132,533**	**123,700**	**137,400**

Summary (continued)

Water Savings	Estimated Annual Water (liters) from Application	Estimated Annual Water (liters) Auditor's Calculations (Maximum)	Estimated Annual Water (liters) Auditor's Calculations (Minimum)
3. 2013-IND-0120	42,928,653	47,210,000	38,630,000
4. 2013-IND-0121	17,578,166	19,330,000	15,810,000
5. 2013-IND-0416	12,603,446	12,920,000	11,690,000
6. 2013-IND-0074	24,786,831	28,190,000	23,070,000
7. 2013-IND-0240	30,595,619	33,470,000	27,390,000
8. 2013-IND-0229	1,018,372,894	826,500,000	826,500,000
10. 2013-IND-0123	4,184,570	3,076,000	3,760,000
12. 2013-IND-0273	11,166,337		
13. 2013-IND-0124	108,562,869	108,600,000	108,600,000
14. 2013-IND-0157	26,779,404	19,440,000	17,580,000
Totals	***1,297,558,789***	***1,098,736,000***	***1,073,030,000***

Summary (continued)

Project Costs	Estimated Project Costs from Application	Estimated Project Costs confirmed during site visits
1. 2013-IND-0348	$ 1,188,280	$ 1,188,280
2. 2013-IND-0469	1,268,833	272,833
3. 2013-IND-0120	178,191	178,191
4. 2013-IND-0121	155,021	155,021
5. 2013-IND-0416	702,644	702,644
6. 2013-IND-0074	21,250	21,250
7. 2013-IND-0240	17,709	17,709
8. 2013-IND-0229	133,469	133,469
9. 2013-IND-0542	19,542	19,542
10. 2013-IND-0123	66,475	66,475
11. 2013-IND-0101	1,232,775	1,232,775
12. 2013-IND-0273	48,373	30,073
13. 2013-IND-0124	4,000,000	4,000,000
14. 2013-IND-0157	35,281	35,281
15. 2013-IND-0205	552,405	552,405
16. 2013-IND-0117	2,160,899	2,160,899
17. 2013-IND-0159	1,907,390	1,907,390
18. 2013-IND-230	57,025	57,025
19. 2013-IND-0450	564,798	564,798
20. 2013-IND-0451	376,532	376,532
21. 2013-IND-0179	583,058	583,058
22. 2013-IND-0072	39,681	39,681
23. 2013-IND-0204	168,137	168,137
Totals	$ 15,477,768	$ 14,463,468

Summary (continued)

Equipment Life	Estimated Project Life in Years from Application	Estimated Project Life in Years confirmed during site visits
1. 2013-IND-0348	30	30
2. 2013-IND-0469	20	30
3. 2013-IND-0120	20	20
4. 2013-IND-0121	20	20
5. 2013-IND-0416	20	20
6. 2013-IND-0074	20	20
7. 2013-IND-0240	20	20
8. 2013-IND-0229	25	30
9. 2013-IND-0542	20	20
10. 2013-IND-0123	7	7
11. 2013-IND-0101	20	30
12. 2013-IND-0273	20	20
13. 2013-IND-0124	20	20
14. 2013-IND-0157	20	20
15. 2013-IND-0205	20	20
16. 2013-IND-0117	14	17
17. 2013-IND-0159	20	20
18. 2013-IND-230	20	20
19. 2013-IND-0450	20	20
20. 2013-IND-0451	20	20
21. 2013-IND-0179	20	20
22. 2013-IND-0072	20	20
23. 2013-IND-0204	20	20

Summary (continued)

The results of this review can also be reported in terms of CO_2 emission avoided. For a conversion, the US Department of Energy's Energy Information Agency has calculated an average value of 117.08 Pounds of CO_2 emitted per mmBTU of natural gas consumed. This value converts to 0.00188 Metric tonnes per m3 of gas (Assuming a HHV of 1000 BTU/Ft3) Using this factor, the accounts examined in the review process saved the following:

CO2 Emissions Avoided	**Annual Estimated metric tons of CO2 emissions avoided per Application values**	**Annual Estimated metric tons of CO2 emissions avoided per Auditor's Calculations (Maximum)**	**Annual Estimated metric tons of CO2 emissions avoided per Auditor's Calculations (Minimum)**
1. 2013-IND-0348	19,704	21,883	21,883
2. 2013-IND-0469	14,576	13,047	13,047
3. 2013-IND-0120	8,084	8,473	6,932
4. 2013-IND-0121	3,310	3,470	2,839
5. 2013-IND-0416	2,400	2,461	2,228
6. 2013-IND-0074	4,151	4,563	3,732
7. 2013-IND-0240	3,028	3,999	3,273
8. 2013-IND-0229	2,721	3,209	3,209
9. 2013-IND-0542	378	185	185
10. 2013-IND-0123	1,670	2,901	2,374
11. 2013-IND-0101	9,139	8,851	8,851
12. 2013-IND-0273	3,271	2,329	2,329
13. 2013-IND-0124	34,026	60,743	60,743
14. 2013-IND-0157	7,931	5,918	5,354
15. 2013-IND-0205	4,300	4,369	4,369
16. 2013-IND-0117	4,709	3,920	3,920
17. 2013-IND-0159	392	438	438
18. 2013-IND-230	437	445	445
19. 2013-IND-0450	18,406	18,556	18,556
20. 2013-IND-0451	12,271	12,370	12,370
21. 2013-IND-0179	17,997	15,912	15,912
22. 2013-IND-0072	1,196	1,089	1,089
23. 2013-IND-0204	388	488	488
Totals	**174,500***	***199,600****	***194,600****

*rounded to 4 significant digits

Project: 2013-IND-0348

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0348

[redacted]

Project: 2013-IND-0348

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0348

[redacted]

Project: 2013-IND-0469

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0469

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0469

[redacted]

Project: 2013-IND-0469

[redacted]

Project: 2013-IND-0120

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0120

[redacted]

Project: 2013-IND-0120

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0120

[redacted]

Project: 2013-IND-0120

[redacted]

Project: 2013-IND-0120

[redacted]

Project: 2013-IND-0120

[redacted]

Project: 2013-IND-0121

[redacted]

Project: 2013-IND-0121

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0121

[redacted]

Project: 2013-IND-0121

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0121

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0121

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0121

[redacted]

Project: 2013-IND-0416

[redacted]

Project: 2013-IND-0416

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0416

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0416

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0416

[redacted]

Project: 2013-IND-0416

[redacted]

Project: 2013-IND-0416

[redacted]

Project: 2013-IND-0074

[redacted]

Project: 2013-IND-0074

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0074

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0074

[redacted]

Project: 2013-IND-0074

[redacted]

Project: 2013-IND-0074

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0074

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0240

[redacted]

Project: 2013-IND-0240

[redacted]

Project: 2013-IND-0240

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0240

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0240

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0240

[redacted]

Project: 2013-IND-0229

[redacted]

Project: 2013-IND-0229

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0229

[redacted]

Project: 2013-IND-0229

[redacted]

Project: 2013-IND-0542

[redacted]

Project: 2013-IND-0542

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0123

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0123

[redacted]

Project: 2013-IND-0123

[redacted]

Project: 2013-IND-0123

[redacted]

Project: 2013-IND-0123

[redacted]

Project: 2013-IND-0101

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0101

[redacted]

Project: 2013-IND-0101

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0273

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0273

[redacted]

Project: 2013-IND-0273

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0124

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0124

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0124

[redacted]

Project: 2013-IND-0124

[redacted]

Project: 2013-IND-0157

[redacted]

Project: 2013-IND-0157

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0157

[redacted]

Project: 2013-IND-0157

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0157

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0157

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0205

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0205

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0205

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0205

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0205

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0117

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0117

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0117

[redacted]

Project: 2013-IND-0117

[redacted]

Project: 2013-IND-0117

[redacted]

Project: 2013-IND-0159

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0159

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0159

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0159

[redacted]

Project: 2013-IND-0230

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0230

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0230

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0450

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0450

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0450

[redacted]

Project: 2013-IND-0450

[redacted]

Project: 2013-IND-0451

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0451

[redacted]

Project: 2013-IND-0451

[redacted]

Project: 2013-IND-0451

[redacted]

Project: 2013-IND-0179

[redacted]

Project: 2013-IND-0179

[redacted]

Project: 2013-IND-0179

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0179

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0072

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0072

[redacted]

Project: 2013-IND-0072

[redacted]

Project: 2013-IND-0072

[redacted]

Project: 2013-IND-0204

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0204

[redacted]

This report is confidential and contains sensitive information about the operations of Union s customers. It is intended for use only by Union Gas and the reviewer of the program.

Project: 2013-IND-0204

[redacted]

Project: 2013-IND-0204

[redacted]

Filed: 2014-12-01
EB-2014-0273
Exhibit B
Tab 2

EVERGREEN
ECONOMICS

Independent Audit of 2013 DSM Program Results

Final Report

Submitted by Evergreen Economics

October 2, 2014

Table of Contents

Executive Summary

We have audited the Annual Report, DSM Shareholder Incentive, Lost Revenue Adjustment Mechanism (LRAM) and Demand Side Management Variance Account (DSMVA) of Union Gas Limited for the calendar year ended December 31, 2013. The Annual Report and the calculations of DSM Shareholder Incentive, LRAM, and DSMVA are the responsibility of the company's management. Our responsibility is to express an opinion on these amounts based on our audit.

We conducted our audit in accordance with the rules and principles set down by the Ontario Energy Board in the DSM Guidelines for Natural Gas Utilities (EB-2008-0346). Details of the steps taken in this audit process are set forth in the Audit Report that follows, and this opinion is subject to the details and explanations therein described.

In our opinion, and subject to the qualifications set forth above, the following figures are calculated correctly using reasonable assumptions, based on data that has been gathered and recorded using reasonable methods and accurate in all material respects, and following the rules and principles set down by the Ontario Energy Board that are applicable to the 2013 DSM programs of Union Gas Limited:

DSM Shareholder Incentive Amount Recoverable - $7,784,373

LRAM Amount Recoverable - $1,138,136

DSMVA Amount Recoverable - $1,197,648

1 Introduction

Evergreen Economics – along with SBW Consulting, Inc. and PWP, Inc. – were contracted by Union Gas Limited (Union Gas) to conduct an audit of the Union Gas 2013 DSM Annual Report. The primary objective of the audit is to provide DSM stakeholders (i.e., the Ontario Energy Board, intervener consultative members, and Union Gas) with an independent opinion on whether the DSMVA, LRAM, and utility DSM Shareholder Incentive calculations are appropriate and have been calculated correctly.

The following programs were included in the Union Gas 2013 Annual Report and reviewed as part of this audit:

- Residential Program
    - Energy Savings Kit Offering
    - Home Reno Rebate Offering
- Commercial/Industrial Program
    - Prescriptive and Quasi-Prescriptive Offering
    - Custom Offering
- Low-Income Program
    - Affordable Housing Conservation Offering
    - Helping Homes Conserve Offering
- Large Volume Program
- Market Transformation Program

Table 1 and Table 2 show the 2013 claimed savings values for each of the Union Gas programs.

A separate contractor selected the sample of custom projects used in the verification process. Based on the final audited savings numbers, the relative precisions levels achieved for the various custom project sample groups are as follows:

Large Volume T2/R100: 90/6.9
Large Volume T1: 90/7.8
Commercial/Industrial: 90/10.8
Low Income: 90/7.7

Additional detail is available in the sampling memo included in the final version of the Union Gas Annual Report.

Table 1: 2013 Union Gas Annual Program Savings

Program	Offering	Units	Original Annual Gas Savings (m^3)	Audited Annual Gas Savings (m^3)	Percent Change
Residential	Energy Savings Kit	43,078	2,859,018	2,859,018	0
Residential	Home Reno Rebate	207	303,672	303,672	0
Com/Ind	Prescriptive	6,558	14,207,995	14,207,995	0
Com/Ind	Custom	498	40,618,369	37,625,436	-7%
Low-Income	Helping Homes Conserve	4,658	1,618,601	1,618,601	0
Low-Income	Affordable Housing Conservation	7,645	964,489	933,333	-3%
Large Volume	Rate T1	333	12,434,596	10,488,841	-16%
Large Volume	Rate T2	90	99,411,691	91,908,922	-8%
Large Volume	Rate 100	61	21,655,093	20,020,746	-8%
Total		**63,128**	**194,073,523**	**179,966,564**	**-7%**

Table 2: 2013 Union Gas Cumulative Program Savings

Program	Offering	Units	Original Cumulative Gas Savings (m^3)	Audited Cumulative Gas Savings (m^3)	Percent Change
Residential	Energy Savings Kit	43,078	29,652,362	29,652,362	0%
Residential	Home Reno Rebate	207	6,073,437	6,073,437	0%
Com/Ind	Prescriptive	6,558	272,204,417	272,204,417	0%
Com/Ind	Custom	498	716,216,135	612,844,734	-14%
Low-Income	Helping Homes Conserve	4,658	40,236,650	40,236,650	0%
Low-Income	Affordable Housing Conservation	7,645	15,871,922	15,267,883	-4%
Large Volume	Rate T1	333	242,129,594	180,388,329	-25%
Large Volume	Rate T2	90	1,513,815,530	1,356,721,466	-10%
Large Volume	Rate 100	61	343,044,036	307,445,127	-10%
Total		**63,128**	**3,179,244,083**	**2,820,834,405**	**-11%**

The remainder of this report details the audit methods used, the results of our audit, and the recommendations for adjustments to the 2013 savings numbers along with recommendations for future evaluations.

Audit Principles

A detailed list of tasks required for the audit were included in the original project RFP, and are repeated here verbatim for reference:

- Consider and respond to stakeholder comments on Union Gas Limited's Annual DSM Report for 2013, including those of the Audit Committee.
- Review Union Gas Limited's 2013 procedures for tracking program participants and determine whether they lead to accurate counts, particularly for programs that do not provide customer rebates.
- Determine whether Union Gas Limited's reported values for participation, measure lives and gas savings are appropriate for calculation of LRAM and DSM Shareholder Incentive. This shall include assessing: (1) whether values are adequately documented by program records, evaluation studies and other relevant data; (2) where applicable, whether assumptions regarding measure lives and gas savings are in line with assumptions filed to the Board for calculation of the DSM Shareholder Incentive; and (3) the reasonableness of measure lives and savings for the calculation of LRAM and DSM Shareholder Incentive. The Auditor will be provided with a set of prescriptive measure assumptions, some of which have been reviewed and approved by the TEC. TEC- approved assumptions will be rebuttably presumed to be correct unless the Auditor has compelling information to the contrary.
- Review measures that are considered advancements (sometimes called "early retirement" measures) rather than purchases at times of natural equipment replacement to ensure measure lives and gas savings are treated appropriately.
- Review and verify the accuracy of all calculations leading up to the proposed DSMVA, LRAM, and DSM Shareholder Incentive amounts and verify that the calculations are consistent with the Board-approved prescribed methodology.
- In accordance with OEB direction, Union Gas Limited, in consultation with their Audit Committee have retained independent third party engineering consultants to undertake a detailed review of the savings estimates for Custom Project Savings Verification (CPSV) for custom projects. The Audit Committee has made provision for the Auditor to work with the selected firm to enable the review of both the draft and final reports and an opportunity to discuss individual projects, any findings and adjustment factors recommended throughout the firm's review The Auditor will be expected to provide its independent opinion on all claimed results, including those that come out of the CPSV process. This will include its opinion on the reliability and reasonableness of the error ratio (and/or realization rate) from the CPSV reports when applied to a larger population of custom projects. Any recommendations to change realization rates from those recommended by the CPSV will be explained and substantiated by relevant research/documentation.
- The auditor will also review all verification studies conducted in support of the DSM Annual Report and ensure the conclusions are sound and that the results have been appropriately incorporated into the calculation of the DSM Shareholder Incentive.

- Identify any assumptions underlying Union Gas Limited's DSM program design that should be modified prospectively, based on the auditor's experience, the results of the audit, and knowledge of other studies or data.
- Identify future evaluation research opportunities to enhance the assumptions used to calculate the DSM Shareholder Incentive and LRAM.
- Work with the AC and Union Gas Limited to resolve any relevant issues prior to completion of the audit.
- Identify any other matters considered by the Auditor to be relevant to an assessment of Union Gas Limited's DSMVA, LRAM and DSM Shareholder Incentive claims.

The principles guiding Evergreen's audit methods focused on several different layers of review of the DSM results. These principles are the same ones that the Evergreen team has applied successfully to previous audits of the Union Gas programs, and can be summarized as follows:

1. **Reviewed savings calculations for accuracy.** A preliminary review was completed to verify the basic savings calculations have been done correctly and that there are no basic calculation errors (e.g., incorrect cell references and/or application of free ridership adjustments) included in the final 2013 savings claims. Additionally, we reviewed the calculations of the DSMVA, LRAM, and DSM Shareholder Incentive to ensure that they are error-free.
2. **Reviewed calculations for consistency with stated objectives.** The next level of review was verifying that any factors that had been determined through earlier agreements with the OEB have been applied correctly. This may include fixed values for free ridership, per unit savings values, or the types of measures that are eligible to be included in the final savings calculations. We reviewed the appropriate filings and decisions from the OEB applying to the 2013 Union Gas savings claim at the start of the audit.
3. **Reviewed savings claims and related savings components for appropriate documentation.** This level of review involved reviewing supporting evaluation and research used for the 2013 DSM Annual Report. Even though the values may have been approved at a general level with the OEB and applied correctly in the calculations, there may be better information available that would support revising the values used. The analysis methods and results was compared to best practices in other regions to make sure that the Union Gas evaluation methods are conforming to standard practice observed elsewhere.
4. **Reviewed overall processes used to determine annual savings.** This included a review of participation tracking and other over-arching decisions made by Union Gas regarding the amount of evaluation research, requirements for documentation required of contractors, the timing of evaluation research in relation to publication of the Annual Report, and similar management decisions.

To follow our audit principles and cover the various requirements listed in the RFP, we conducted the following activities during the course of the audit.

- Reviewed Union's Audit Tool to verify program participant counts were accurate
- Reviewed third party surveys instruments and survey results that examined the installation and retention of measures in the ESK and HWC programs
- Reviewed Union's Audit Tool and supporting documentation for Prescriptive and Quasi-Prescriptive Measures to ensure that all algorithms and prescriptive values were used correctly to calculate the savings and were consistent with program documentation filed with the OEB
- Reviewed deep savings measure savings values and calculations for accuracy
- Reviewed Scorecard values and calculations for accuracy
- Reviewed third party verification studies that examined a sample of custom projects for Large Volume, Commercial/Industrial, and Low Income customers.
- Reviewed and verified that the LRAM claimed savings values are accurate, consistent with the Settlement agreement, and based on the best available information at the time of the audit.
- Considered and addressed issues raised by the stakeholders during the audit process, including those of the Audit Committee.

The majority of the audit was dedicated to reviewing the savings estimates for the various custom programs. To audit the custom savings, we first reviewed the draft Custom Project Savings Verification (CPSV) reports for each custom program, which are discussed in more detail below. Along with reviewing the CPSV reports, we also reviewed the individual project files for each project included in the custom verification sample. After this review, we had several conference calls with the verifiers to discuss the individual project calculations and to ask detailed technical questions about the customer site and impact analysis. Based on these conversations, the verifiers sometimes made modifications to the savings calculations prior to finalizing their CPSV reports. Once the CPSV reports were finalized, a separate set of conference calls was conducted that included members of the Audit Committee to review the same sample of custom projects. During these calls, the Audit Committee also posed questions for consideration, and at times this involved the audit team contacting the verifier to obtain additional information. A table listing the various calls and participants is included as Attachment 1 of this report.

Based on the results of all these conference calls, along with our review of secondary sources and our team's experience with similar projects, the audit team has made adjustment to the custom savings estimates where appropriate. These adjustments and our rationale for making these changes are included in this audit report.

2 Audit Findings

This section presents the findings of the Independent Auditor regarding the Union Gas 2013 DSM Report.

Note that the nature of the audit process is by definition somewhat negative, as the process is designed to identify areas where the program implementation and evaluation went *wrong* and not to focus on areas where things went *right*. Despite the comments and recommendations presented in this report, in general it appears that Union Gas has robust DSM programs that are being implemented effectively. Given the nature of the audit process, the discussion below necessarily focuses on those areas where we believe there is room for improvement and (in some cases) where savings should be adjusted for program year 2013.

Overarching Findings

The following are general observations and recommendations that apply to multiple programs.

Evaluation Resources

The audit team worked with Union Gas to determine how much was spent annually on program evaluation, and the approximate spending amounts for 2013 are shown in Table 3. Additional evaluation funds are spent as part of Union's portfolio budget that address issues such as free ridership and input assumptions reviews. Union reports that they spent $102,981 on these portfolio-level evaluation activities in 2013.

As shown in Table 3, Union Gas spends approximately 2% of the total implementation budgets to annual program evaluation (excluding the portfolio-level evaluation costs). For the Commercial Industrial and Large Volume Custom Programs, spending on program evaluation ranges from approximately 1-2% of implementation budgets even though these two programs account for the vast majority of savings. Given the size of these programs and the issues listed below, more resources should be devoted to evaluation.

A typical rule of thumb for evaluating DSM programs is that evaluation spending should equal 3-5% of the program implementation budgets. An increase in evaluation research would help address the specific issues we list below, including conducting an annual free ridership study for custom projects, documenting baseline conditions (including maintenance policies), developing program logic and metrics of progress for the market transformation program, and updating baseline conditions for ESKs and other programs where needed.

Table 3: 2013 Union Gas Program-Specific Evaluation Spending[1]

Program	Total Spending (excluding EM&V)	EM&V Spending	% of total
Residential	$ 3,311,807	$ 60,550	1.8%
Comm/Ind	$ 12,459,416	$ 106,249	0.9%
Low Income	$ 7,822,935	$ 369,394	4.7%
Large Volume	$ 4,706,908	$ 108,595	2.3%
Optimum Home	$ 944,661	$ -	0.0%
Total	**$ 29,245,727**	**$ 644,788**	**2.2%**

Evaluation Objectives

In the review of the Commercial/Industrial custom projects, there are several comments in the CPSV report where the verifier appears to be seeking to confirm the original savings values in the project application. Once the verifiers found enough savings to confirm the original savings amount from the Union project application, it appeared that the verifier more or less stopped looking for savings.

This is in contrast to the preferred approach and evaluation best practice, which is to develop an independent estimate of savings and then compare it to the original *ex ante* value.

Audit Process

The audit process was originally scheduled to begin in April, following the completion of the CPSV reports and Union's draft Annual Report. A draft audit report was then supposed to be completed in May and a final report produced by June 30.

The actual audit process involved several rounds of review of the three custom program verifications. An initial round of reviews was done between the verifiers, auditor, and Union Gas to finalize the evaluation reports. Once completed, a second round of reviews covering the same custom projects was conducted with the auditor, Union Gas, and the Audit Committee. Union Gas and the Audit Committee only being available one day a week for team conference calls during parts of the review process further slowed the second review phase. A schedule of these meetings is included as Attachment 1 of this report. The result has been an audit process that has extended several months beyond the original deadline and has deviated far from the work that was originally proposed and budgeted. If

---

[1] The spending amounts shown here reflect what Union Gas spent on evaluating the 2013 programs, and differs from the spending amounts shown in the Annual Report, which reflect evaluation spending that occurred during the calendar year 2013.

this process is to be followed in future years, it should be explicitly laid out at the beginning of the audit process.

An additional issue is determining the role of the auditor in making adjustments to savings. The Terms of Reference included in the audit RFP (and subsequently the contract the auditor signed with Union Gas) states: “Any recommendations to change realization rates from those recommended by the CPSV will be explained and substantiated by relevant research/documentation.”

Despite this language, during the course of this project the Audit Committee directed the auditor to make additional adjustments to savings in those cases where the savings are not adequately documented or evaluated by Union. In these cases, the rationale provided is that the burden of proof for justifying savings lies with Union Gas (not the auditor) and therefore it is appropriate to make punitive reductions in savings in instances where the savings are not properly supported. Furthermore, it is allowable that these punitive adjustments be set at an arbitrary level (e.g., 50%, 25%, etc.) and do not need to be justified with supporting research or documentation. This instruction is in direct contrast to the terms that were established for this contract and is therefore untenable. One cannot be required to defend savings adjustments while at the same time make punitive adjustments that are by definition arbitrary in nature.

To resolve this issue, we have identified areas where savings are not adequately supported by Union, but have stopped short of making punitive savings adjustments that are not supported by additional analysis. Projects in this category include the steam leak repairs and pipe insulation projects in the custom verification samples, where Union did not document existing baseline maintenance practices. The one exception to this is a project involving a natural gas leak where we have set the savings value to zero, as we believe this to be an accurate and appropriate value and therefore not an arbitrary adjustment.

Future audits need to make clear what types of adjustments are expected during the audit process. Making punitive and arbitrary adjustments as recommended by the Audit Committee goes against fundamental evaluation principles. If these types of adjustments are expected during the audit phase, then this expectation needs to be made clear at the very beginning of the project at the RFP and contracting stages.

Free Ridership

The free ridership issue was subject to a significant amount of discussion with the Audit Committee during the verification process. Key issues discussed included:

1. Age of the free ridership report
2. Treatment of behavioral and O&M projects
3. Making additional free ridership adjustments

Each of these issues is discussed below.

Age of Free Ridership Report

The free ridership adjustments used by Union Gas for 2013 come from a Summit Blue study published in 2008 that relies on survey responses from participants from 2006 and 2007.[2] This report uses a small sample of Union Gas custom program participants (n=52) to conduct a self-reported free ridership analysis. Union Gas uses the free ridership rate of 54 percent from this study to calculate net savings for its 2013 custom projects (Large Volume and Commercial/Industrial). While this sample was large enough to achieve a 90/10 relative precision for all custom projects, it was not large enough to achieve 90/10 precision for the individual custom programs, or for individual measure types within programs.

The current free ridership report is undoubtedly outdated, as markets, participant characteristics, technologies, and eligible custom technologies have all evolved since the original study was completed. We strongly recommend that an updated custom free ridership study be completed immediately for use in the evaluation of the 2014 custom programs. As has been discussed in past audits, we believe that free ridership values should be updated annually to reflect changes that occur year-to-year in market conditions, technology, program design, and participant makeup.

We understand that the Ontario Technical Evaluation Committee (TEC) has initiated a custom program free ridership study that Union plans to use in the future, but the study is currently delayed and appears unlikely that it will be completed in time for use with the 2014 program evaluations. Rather than wait for the TEC study, we urge Union to begin work on its own free ridership study immediately based on 2014 participants so the results will be available for use in the 2014 DSM Annual Report.

Behavioral and Maintenance Projects

A significant amount of the verification discussions centered on participants that installed measures that may be considered as routine maintenance or measures that involve changes in behavior. These include measures such as steam trap tests, steam leak repairs, thermostat setbacks, and pipe insulation.

Union Gas asserted that examples of maintenance and behavioral projects were included in the original Summit Blue free ridership study and therefore the current free ridership is valid for these projects in 2013. Upon review of the Summit Blue study, it is not clear that these types of projects were included in the sample (this level of detail is not provided in the report). Regardless of whether or not they are included, the overall sample size of 52 respondents (covering 77 projects) is so small that any subsets of O&M or behavioral measures is unlikely to be statistically significant.

---

[2] See *Custom Projects Attribution Study* prepared by Summit Blue for Union Gas and Enbridge (October 31, 2008).

In discussions with Union Gas on individual projects, Union staff also asserted that their Account Managers and Project Managers had been actively involved with the participants and had a significant amount of influence in getting these projects completed (i.e., these projects should not be considered free riders). In order to support the energy savings claims, however, these interactions between Union and its customers for specific projects need to be documented. Copies of emails and notes from customer meetings that document Union's work with these customers on a specific project should be kept in the project file. Union should also document the customer's standard maintenance practices and these should be confirmed through an independent verification.

Including appropriate documentation of customer baseline conditions was a recommendation from the previous audit (covering program year 2012) and was something that Union agreed to begin doing for future program years. This is particularly important for maintenance measures like steam leak repairs that have a greater potential for high free ridership, and this measure was specifically listed as an example in the agreement language. In conversations with Union during the audit process, they acknowledged that they had agreed to begin documenting baseline conditions but did not have sufficient time to begin this process for the 2013 program year.

The question remains as to what free ridership rate should be used for these projects for program year 2013. With the current Union Gas free ridership rate, more than half of the participating behavioral and maintenance projects are assumed to be free riders. Navigant recently completed a review of free ridership and spillover research for the TEC that examined different free ridership rates for custom programs in other jurisdictions. This study found that custom program net-of-free ridership ratios ranged from approximately 0.20 to 1.00, with the median appearing to be about 0.70 (i.e., free ridership equal to a maximum of 30 percent).[3] For custom programs in other jurisdictions, the net-of-free ridership estimates vary significantly due to the different program designs, marketing strategies, utility type, customer segment, free ridership estimation methods, and program maturity.

Given the wide range of free ridership values for other custom programs, the already significant free ridership adjustment that is being applied to these measures, and absent additional information on baseline conditions, we do not have any basis for making additional adjustments to the free ridership rate already applied to these projects.

Additional Free Ridership Adjustments

A considerable amount of discussion during the audit process focused on whether individual projects in the custom project samples should be considered free riders and, as a consequence, their savings be set to zero. In general, going through the sample of evaluated

---

[3] See *Custom Free Ridership and Participant Spillover Jurisdictional Review* prepared by Navigant Consulting for the Subcommittee of the Ontario Technical Evaluation Committee (May 29, 2013).

projects and removing savings for those projects that might be considered free riders would result in an over-correction for free ridership, as a free ridership adjustment is already being applied to the entire sample of projects. Since the free ridership adjustment is being applied to the entire group, no additional project-level adjustment is needed.

The exception to this is with measures that are obviously free riders in *every* situation. These include projects that are obvious safety issues or involve a deterioration or malfunction of equipment that would have undoubtedly been addressed as routine maintenance without any assistance from Union. Specific examples discussed among the 2013 custom projects include gas leaks and large steam leaks that posed obvious safety and performance problems.[4] In these cases where projects are obvious free riders, Union should not be providing incentives and should not be allowed to claim savings. In discussing these projects, Union asserts that these projects would not have been completed without Union's assistance, but there is no documentation provided to support this claim. As discussed above, appropriate documentation of existing customer maintenance practices will help resolve this issue.

EULs

With the EUL values for some of the custom projects, there were cases where the verifier changed the EUL value from the value that has been originally approved for custom projects by the OEB. This was done in some cases where the verifier judged that a longer EUL was 'reasonable' in a particular situation. The assumed EULs are generally around 20 years for custom projects, and given this long time frame there is a significant amount of uncertainty extending measure lives beyond this point. There are any number of reasons why a project may stop producing savings prior to this, including improved technologies, changes in market demand, poor maintenance, facility remodels, and/or calamities (e.g., fire, floods). Given the range of factors that can influence the EUL over this timeframe, EULs are typically estimated through a persistence study that utilizes a robust sample of projects and determines the length of time before 50 percent of the equipment in the sample is no longer producing savings. Absent any of type of rigorous persistence study, we do not recommend changing the EULs for custom projects from the original agreed upon *ex ante* values.

During our discussions with Union Gas regarding EULs on specific projects, anecdotal evidence was offered up as evidence that the EULs should be longer than originally claimed (e.g., this particular customer takes good care of their equipment, they are planning on keeping the equipment as long as possible, etc.). This type of anecdotal information is not sufficient to justify a longer EUL and in the audit we have revised the EULs where appropriate back down to the original 20-year value. While we understand that the Terms

---

[4] No adjustments for large steam leaks were made as part of this audit, but very large steam leaks that pose an obvious safety and/or performance issue were discussed as projects that should not be receiving incentives through the program in the future.

of Reference allows for the verifier to provide their own EUL estimates, any such adjustments need to be appropriately supported with documentation that goes beyond simple conversations with the customer.

For three of the custom projects included in the Commercial/Industrial sample, the EUL was calculated as the weighted average from several component parts that have distinct EULs. For these three projects, the weighted average was calculated using the component costs as the weighting variable. We recommend instead that the average be calculated using the savings attributable to each project component as the weight. We have noted where we have made this adjustment to EULs in the custom project summary spreadsheet that accompanies this report.

Incremental Costs

For the custom projects, there were instances where the new measures will likely increase the incremental costs of the project over the expected equipment life. In these cases, the changes to incremental costs over the entire period need to be included in the TRC calculations. It does not appear that changes to incremental costs in future project years were accounted for in some custom projects, and these have been noted in the detailed custom project tables included in this report.

Treatment of Measure Costs in the TRC calculations

In the Audit Tool, currently a free ridership rate adjustment is applied to the incremental measure costs for some direct install projects and giveaways such as the residential Energy Savings Kits and the direct install components of the low income multifamily programs. Since the program is paying 100 percent of the measure costs, we recommend that these should be treated as program costs rather than incentive costs in the TRC calculation for future program years. As such, the costs associated with the measures should not be reduced by the free ridership amount – the full cost of the measure should be included in the TRC calculation as a program administration cost for the free ridership component.

We understand that this recommendation is in contrast to method currently approved by the OEB for calculating the TRC. The rebate and direct install costs associated with free riders have typically been considered transfer payments and therefore are neutral in the TRC calculation (i.e., incremental rebate costs associated with free riders are excluded from the TRC calculation). However, as an equity concern there is reason for not treating equally the customers bearing the costs and receiving the benefits in this situation. In this case, the cost of the free riders is being borne by the rest of the ratepayers funding the program, and by including these costs in the TRC calculation it provides an automatic incentive to the program to minimize free ridership.

The recommended treatment of free ridership costs (both rebates and direct install costs) is the approach currently being used in California in their calculation of the TRC test.[5] We recommend that this approach be considered for future years, particularly for direct install program components.

Overarching Recommendations

The following are recommendations based on the overarching issues discussed above.

Recommendation #1: Increase annual evaluation spending to 3-5% of the program implementation budget. This will allow for (at a minimum) additional baseline research, an annual free ridership study for custom projects, and a full process and impact evaluation of the market transformation program as recommended below.

Recommendation #2: Strive for accuracy in verifying savings and develop a thorough and independent estimate of project impacts, rather than merely confirming whether or not the initial savings estimates are reasonable or conservative.

Recommendation #3: Structure the audit process so that only one round of reviews is conducted of the custom projects. Meetings for these reviews should be given higher priority by Union Gas and the Audit Committee members so that more days are available for meetings and consequently the timeline for the audit process can be compressed. If a similar evaluation and audit process is to be followed in 2015, the timeline in the evaluation and audit RFPs should be adjusted accordingly.

Recommendation #4: If the auditor is expected to make punitive adjustments to savings in those cases where Union does not adequately support their impact estimates, this needs to be made explicitly clear in the RFP and contracting phase of the project.

Recommendation #5: Conduct a new custom free ridership study every year (beginning in 2014) using a sample from the current year's custom participants.

Recommendation #6: The annual custom free ridership study should have separate and robust samples for behavioral and maintenance-related projects.

Recommendation #7: Interactions between Union Gas and customers need to be documented in the project file as they occur if they are to be used as support for claiming projects are not free riders.

Recommendation #8: Savings from projects that are obvious safety hazards (e.g., gas leaks or very large steam leaks) or are otherwise obviously free riders should not be eligible for Union Gas incentives. Discussions as to whether other broad classes of maintenance or behavioral projects (e.g., steam traps tests and repairs, pipe insulation)

---

[5] For additional detail on how free ridership costs are handled in the TRC calculation in California, see http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/Cost-effectiveness.htm.

should be eligible for the program should be determined at the policy level prior to the beginning of the program year.

Recommendation #9: If a free ridership rate is being applied, savings from individual projects that appear to be free riders should not be zeroed out in the custom impact analysis sample as the free ridership has already been accounted for in the adjustment factor. Note that this does not apply to obvious safety and performance issues as discussed in Recommendation #8.

Recommendation #10: Do not revise EULs for individual custom projects from the values established in the original program filing documents.

Recommendation #11: Use measure component savings (rather than costs) to calculate an average EUL for a project.

Recommendation #12: Ensure that projects that will likely affect incremental costs in future years have these costs correctly incorporated into the cost effectiveness calculations for the program.

Recommendation #13: In future program years, do not apply a free ridership adjustment to the incremental costs used in the TRC calculation for direct install or giveaway measures. Treating costs this way in the TRC provides an additional incentive to minimize free ridership in the program.

Additional issues and recommendations by specific program area are presented below.

Residential Programs

The Audit Team reviewed the Audit Tool provided by Union Gas and found that all savings values and calculations were implemented properly. The Audit activities completed included:

- Reviewing the summary tables in the Audit Tool to ensure consistency with the values reported in the Draft DSM 2013 Annual Report.
- Reviewing the data and formulas in the Audit Tool to ensure no computational errors.
- Reviewing the per-unit savings values noted in the Audit Tool to ensure consistency with the values presented in the Draft DSM 2013 Annual Report.

During the course of the audit, there was discussion of how the baseline was determined for the ESK that were distributed to households. In some cases, the ESKs were distributed to homes that Union Gas believed had not received kits since 2007 (referred to as “ESK Replacements” in Union Gas’ tracking system). Upon review, Union realized that they had not been tracking this properly and consequently removed all savings for the ESK Replacements from their 2013 claim.

In the case where the ESKs are given away door-to-door (rather than installed by contractors), Union targets customers in cities and neighborhoods that they believe are likely not to have any existing ESK measures already in place. From conversations with Union, it appears that adjustments are made to correct for some households that may have participated previously and the savings associated with these households are removed from the final savings totals for this program. We have also confirmed that the costs associated with these customers are correctly included in the TRC calculation.

Given that these kits comprise a significant amount of savings for the residential sector and given the inaccuracy in assumptions with the ESK Replacements, a study should be done to confirm or update the baseline assumptions for both the ESK direct installs and giveaways. While Union has suggested that they can accurately track which homes have received an ESK in the past and avoid distributing additional ESKs to these homes, we believe that an independent study confirming the baseline would still be beneficial given the errors that occurred in 2013. It is also possible that households in targeted areas may receive some of these measures through channels outside the Union Gas program. Given these issues, having an independent verification of baseline installations in these homes will improve the accuracy of the ESK savings estimates. This study should be done using a representative sample of the target market for both programs with a large enough sample so that results can be extrapolated with confidence to the population (we suggest a target of 90/10 relative precision).

Residential Recommendations

Recommendation #14: Conduct an on-site survey to a sample of homes to determine a more accurate and current baseline assumptions for the ESKs.

Recommendation #15: All of the ESK costs should be included in the TRC calculation for this program, even for those households that are removed from the final savings calculations due to removal of units or previous program participation.

Market Transformation

The Optimum Home Program targets the top fifty builders in Union’s franchise based on the previous year’s housing starts. This has been modified so that all interested builders have the opportunity to benefit from the program through the program-sponsored workshop. After two years (2012 and 13), with almost $1 million spent in 2013, only 12 homes have been built and tested through the program, and there is no mention of the intended or anticipated level of participation to indicate a transformed market. Since this is a market transformation with a longer time horizon than a typical rebate program, Union does expect greater benefits as the program matures.

While there is limited detail on the size of the target market and the theory by which the Optimum Home program plans to transform the residential new construction market, the material in Chapter 7 of the 2013 Audit Report does provide the basis for some findings and recommendations.

Encouraging multiple individual labels for these homes will cause significant home buyer confusion – even more so if Union Gas is planning to drive customer demand with advertising etc. (which, incidentally, has generally proven prohibitively expensive for other program and seems like it would make no sense until more builders are involved and qualifying homes available).

Since the Ontario Building Code is set to change in 2017, the program requirements will presumably change to again be 20% more efficient than the new code, and both the overall level of efficiency and likely specific code requirements should be available now or in the near future.

The Annual Report notes, "In building their discovery homes, participating builders are finding that the tighter building envelope of a high performance home necessitates other changes in home design."

The section of the report describing Marketing and Implementation of the Optimum Homes program mentions Builders and the OHBA, but there is no mention of the role of subcontractors, who play a crucial role in either supporting or inhibiting the proper use of efficient home designs.

Market Transformation Program Recommendations

Recommendations #16: Require 10% of homes or at least 3 new homes (whichever is less) to be built to program specifications. Additionally, require a specific commitment from participating builders to build x number or x percent of qualifying homes in the next 2 years.

Recommendation #17: Set participation goals (both builders and numbers of homes) in terms of the percentage of new homes built in Union Gas territory. As part of a market/process evaluation the size and composition of the market should be investigated to determine whether program goals are attainable and likely to be reached in a given timeframe. An important part of this investigation will be determining the relative roles of production and custom builders, both in the market and in the program.

Recommendation #18: Establish a Union Gas Optimum Home label or certification that builders can display on new homes. Since the standard is 20% more efficient than the Ontario Building Code, the qualifying standard can automatically change as the code requirements change. A process evaluation should help determine how home buyers, lenders and real estate agents perceive the program, including the value of a standard certification relative to builder-specific labels. Note that this process has already been established for Energy Star Canada.

Recommendation #19: It is acceptable to have the builder be responsible for the testing **if** they use an approved tester (such as the Certified Energy Evaluators currently used by the program) who should be subject to qualification and spot-checking by Union Gas or its contractors. Since it seems that program qualification is based on the results of model runs

(HOT2000), there also must be a formal inspection/Quality Assurance process to verify that homes are built as designed. A thorough impact and process evaluation should be conducted to confirm that homes are built as designed, that testing is thorough and accurate, and that there is a process for identifying and addressing problems.

Recommendation #20: There should be an indication of what the plans are to support attainment of "above code" efficiencies as the codes themselves improve. Whenever possible, the Optimum Home program/Union Gas should promote a set of building techniques that will prepare builders to both meet and exceed the next round of the code.

Recommendation #21: If homes are built with good insulation and minimum air infiltration, there will probably need to be some sort of mechanical ventilation to ensure acceptable indoor air quality. The Oregon code, for example, has requirements for this so that builders cannot simply put in a bathroom fan. Either way, a minimum number of air changes per hour should be part of the program requirements. Note that this is also a requirement for the current Energy Star Canada label.

Recommendation #22: The outreach efforts for the program need to include working with subcontractors rather than with builders alone. Especially for higher volume builders, subcontractors may handle most of the critical construction and installation tasks; builders themselves basically never do HVAC or duct work (as, for example, in the FortisBC new homes program, where HVAC contractors are doing the heat pump installations more often than the builders). A process evaluation should investigate the extent to which subcontractors are responsible for key aspects of constructing a qualifying home and how they are being trained in the techniques needed for compliance.

Recommendation #23: Conduct a formal evaluation of the market transformation that includes development of the program theory and logic model. Using the program theory and logic model, key metrics of program progress can be developed and tracked that will help ensure that the program activities are helping to achieve the long term market transformation goals.

Low Income Custom Projects

To conduct our review of the Low Income Custom Projects, we reviewed the Custom Project Savings Verification (CPSV) reports prepared by Michaels Energy for the evaluation sample of low income projects. We first conducted an initial review of the draft CPSV reports and compiled a list of questions for clarification and requested any additional information needed for the audit. A call was held with Union and Michaels Energy staff to review and resolve these initial questions based on the draft CPSV reports. This call was also used to provide input to Michaels Energy to inform the finalization of the CPSV reports.

Once all questions were resolved and supplemental information was received, we conducted secondary in-depth reviews of the final CPSV reports for each project. The CPSV reports were reviewed for baseline assumptions, operating hours, savings calculations, and

EUL for each measure. A number of questions and recommendations were compiled based on this in-depth review, and a series of calls were held with Union and Audit Committee members to discuss these issues. Based on the feedback from these calls we developed a set of recommendations and specific adjustments to project savings and EULs where necessary.

The rationales for adjustments made to savings based on our review are described below by project. No adjustments were made to EULs for the Low Income Custom projects reviewed.

Specific project adjustments include the following:

- **2013-COM-0271.** The measure installed in this project was a controls system that only affects the operation of hot water valves. Savings for this project were calculated using regressions of billing data against weather data (i.e., heating-degree days) from the baseline and post-installation periods. However, the baseline data reflect hot water valves that were malfunctioning due to improper installations. These valve malfunctions were not discovered until the building owner and the controls vendor investigated the poor performance of the heating system following project implementation. After valve repairs were conducted, the system began operating correctly. The verified savings credited to the project include the effects of the repaired valves, which were not identified in the project application, were not incentivized by Union Gas, and no recorded evidence of Union Gas's participation in the valve repairs was provided. The verifier's reference to continued involvement by Union Gas does not constitute appropriate documentation. While the valve-related savings may have come about as an unintended consequence of the project, they were not part of the incentivized project, and should not be included in the savings totals that are extrapolated to the entire population of Low Income projects. As the verification calculations do not discriminate between the controls and valve savings, the most equitable approach to reduce the claimed savings is to divide the savings evenly between the two.
- **2013-COM-0240**. The claimed savings values for insulation were adjusted downward to reflect a decrease in insulation performance over the life of the measure. The adjusted savings also take into account the jacketing material type (e.g., metal or plastic) of new insulation, which is likely to be more resistant to mechanical or moisture damage than baseline materials. Savings has been reduced by 25% to account for these effects.
- **2013-COM-0016.** See above rationale for 2013-COM-0240.

Pipe insulation savings were claimed for two of the Low Income Custom in addition to several projects in the other custom programs. For each of these projects, annual energy savings calculations were based on the difference between heat loss rates of the pre-project insulation effectiveness and those of the newly installed insulation. The annual savings were then assumed to persist throughout the effective useful life of the projects. Inherent in this approach is the assumption that, in the absence of the project, the insulation would have lost its effectiveness at a steady rate throughout its life. In actuality, the rate of degradation of the insulation's effectiveness would slow over time, as less insulating ability is available to lose. This result is that the difference between the heat loss rate of the installed insulation and that which would have occurred had the old insulation been left in place (i.e. the baseline) is reduced each year. To account for this degradation, savings has been reduced by 25 percent for all pipe insulation projects.

Table 4 below summarizes the application, verified, and audited savings and EUL values by project for the Low Income Custom program.

Table 4: Summary of Adjustments to Savings and EUL - Low Income Custom Projects

Project ID	Project Description	Savings (Cubic Meters/year)			EUL		
		Application	Verified	Audit	Application	Verified	Audit
2013-COM-0014	High Efficiency Building	30,199	20,757	20,757	20	18	18
2013-COM-0013	High Efficiency Building	34,267	28,720	28,720	17	17	17
2013-COM-0271	Temperature Controls	23,117	40,855	20,428	15	15	15
2013-COM-0218	Windows and doors	17,748	17,935	17,935	20	15	15
2013-COM-0239	Windows	9,375	5,995	5,995	20	20	20
2013-COM-0172	Windows	7,690	5,998	5,998	20	20	20
2013-COM-0130	ERV	7,239	9,665	9,665	15	15	15
2013-COM-0240	Pipe Insulation	5,403	12,739	9,554	20	20	20
2013-COM-0128	Windows	4,604	4,614	4,614	20	13	13
2013-COM-0016	Pipe Insulation	2,541	1,464	1,098	20	20	20
2013-COM-0263	Windows	654	673	673	20	20	20
Totals		142,837	149,415	125,437			
Percent of Application Savings			105%	88%			

Table 5: Summary of Adjustments to Cumulative Savings and Incremental Cost - Low Income Custom Projects

		Cumulative Savings (Cubic Meters/year)			Incremental Cost		
Project ID	**Project Description**	**Application**	**Verified**	**Audit**	**Application**	**Verified**	**Audit**
2013-COM-0014	High Efficiency Building	573,781	356,031	354,945	$240,000	$258,200	$258,200
2013-COM-0013	High Efficiency Building	553,412	457,139	463,828	$240,000	$254,000	$254,000
2013-COM-0271	Temperature Controls	329,417	582,190	291,099	$68,100	$71,100	$71,100
2013-COM-0218	Windows and doors	250,829	255,822	255,574	$350,641	$350,641	$350,641
2013-COM-0239	Windows	178,125	113,900	113,905	$386,303	$386,303	$386,303
2013-COM-0172	Windows	146,110	113,958	113,962	$19,500	$148,500	$148,500
2013-COM-0130	ERV	103,156	137,732	137,726	$9,720	$9,720	$9,720
2013-COM-0240	Pipe Insulation	102,657	242,047	181,526	$48,000	$48,000	$48,000
2013-COM-0128	Windows	87,476	87,662	56,983	$91,955	$91,955	$91,955
2013-COM-0016	Pipe Insulation	48,279	27,819	20,862	$121,050	$121,050	$121,050
2013-COM-0263	Windows	12,426	3,052	12,787	$33,869	$7,951	$7,951
Totals		2,385,668	2,377,352	2,003,197	$1,609,138	$1,747,420	$1,747,420
Percent of Application Value			100%	84%		109%	109%

Commercial/Industrial Custom Projects

A similar process was used for our review of the Commercial/Industrial Custom Projects. For this program, we reviewed CPSV reports prepared by Byron Landry & Associates in two phases. We first conducted an initial review of the draft CPSV reports and compiled a list of questions for clarification and requested any additional information needed for the audit. A call was held with Union and Byron Landry to review and resolve these initial questions based on the draft CPSV reports. This call was also used to provide input to Byron Landry as he produced the final CPSV reports for this program.

Once all questions were resolved and supplemental information was received, we conducted secondary in-depth reviews of the final CPSV reports for each project. The CPSV reports were reviewed for baseline assumptions, operating hours, savings calculations, and EUL for each measure. A number of questions and recommendations were compiled based on this in-depth review, and a series of calls were held with Union and Audit Committee members to discuss these issues. Based on the feedback from these calls we developed a set of recommendations and specific adjustments to project savings and EULs where necessary.

The rationales for adjustments made to savings and EULs based on our review are described below by project. In some cases, the audit reflects returning to the default EUL value of 20 years for custom projects. Other specific adjustments include the following:

- **2013-IND-0196.** This project involved a gas leak, which for safety reasons would require immediate repair. Therefore, this project should be considered part of a routine maintenance procedure that is required regardless of program incentives and therefore no savings should be awarded. Consequently, we have revised the savings to zero for this project.
- **2013-IND-0037.** The claimed savings values for insulation were adjusted downward to reflect a decrease in insulation performance over the life of the measure. The adjusted savings also take into account the jacketing material type (e.g., metal or plastic) of new insulation, which is likely to be more resistant to mechanical or moisture damage than baseline materials. Savings were reduced by 25% to account for these effects.
- **2013-IND-0055.** See above rationale for 2013-IND-0037.
- **2013-IND-0185.** The audit EUL takes into account behavioral measures such as dock door closures and makeup air filter maintenance that have 5-year lives, while a 1-day/week temperature setback of 3 degrees Celsius is assumed to have 20-year life. Since the setback accounts for only one-third of savings and all other measures have a 5-year life, the savings-weighted average yields a 10-year life.
- **2013-IND-0177.** Taking into account energy savings, the weighted average life of the components incentivized through Union yields a 15-year EUL for this project.

Two additional issues were brought up by the Audit Committee during the review and were investigated by the audit team. The first involved the green house expansion projects, where concern was raised as to whether an appropriate new construction baseline was assumed. We reviewed these projects and are satisfied that a new construction baseline was used in the model assumptions, and not an existing baseline. This applies to the greenhouse expansion projects in the Commercial/Industrial program as well as the greenhouse expansion project in the Large Volume custom program.

The second issue was related to project 2013-IND-0457 involving the replacement of two existing asphalt plants with a new asphalt plant. Concerns were raised about whether an appropriate baseline was used in the savings calculation. In the evaluated savings, the energy intensity associated with the old asphalt plants was compared with the energy intensity of the new equipment. There was not a significant change in the type or amount of asphalt produced that would automatically make using the existing equipment baseline inappropriate.

In the case of asphalt plants, the appropriate baseline is a little more difficult to determine. While these are referred to as asphalt 'plants', they are really large process structures that can be purchased and installed much a like a piece of equipment, as opposed to what might be traditionally considered a new plant that involves constructing a new building and installing new equipment inside. As such, there is no building code to use for asphalt plants to establish a new construction baseline. There also appears to be an active used asphalt plant equipment market, which further clouds the issue, as a 'new' asphalt plant installation might very well involve installing a used piece of equipment.

We considered these factors and also consulted with an additional engineering evaluation firm to get a second opinion on this particular project. Based on our review, we believe that the project baseline was determined appropriately and are not recommending any changes. We also examined the incremental costs for this project and it appears that the full equipment costs of the new asphalt plant were correctly used for the cost effectiveness calculations.

Table 6 below summarizes the application, verified, and audited savings and EUL values by project for the Commercial/Industrial program.

Table 6: Summary of Adjustments to Savings and EUL - Commercial/Industrial Custom Projects

Project ID	Project Description	Savings (Cubic Meters/year)			EUL		
		Application	Verified	Audit	Application	Verified	Audit
2013-COM-0101	New construction warehouse with roof insulation (R-30) exceeding code (R-27)	13,924	13,924	13,924	20	20	20
2013-IND-0196	Gas leak repairs	24,260	24,260	0	20	20	N/A
2013-IND-0045	Starch dryer steam preheater	651,488	651,488	0	20	19	N/A
2013-IND-0457	Newly constructed asphalt plant to replace 2 nearby aging plants	544,277	544,277	544,277	20	20	20
2013-IND-0256	5.1 acre expansion to an existing 4.6 acre greenhouse.	321,899	321,899	321,899	16	15	15
2013-IND-0186	Line speed improvements	1,112,600	1,112,600	1,112,600	20	20	20
2013-IND-0013	"B" deodorizer project	2,864,979	2,864,979	2,864,979	20	20	20
2013-IND-0455	HVAC improvement	5,927,716	5,927,716	5,927,716	18	18	18
2013-IND-0267	Greenhouse expansion (22.5 acres)	3,085,122	3,085,122	3,085,122	14	18	14
2013-IND-0185	HVAC improvement - space heating	1,741,055	1,741,055	1,741,055	20	20	10
2013-IND-0083	New greenhouse - multiple measures	1,531,967	1,531,967	1,531,967	20	20	20
2013-IND-0037	Tank & hot oil pipe insulation	889,373	830,131	667,000	20	20	20
2013-IND-0046	Spray dryer steam coil preheat	472,215	402,543	402,543	20	20	20
2013-IND-0177	5.2 acre expansion to an existing 4.6 acre greenhouse.	567,304	567,304	567,304	15	18	15
2013-IND-0055	Pipe & vessel insulation	381,402	373,648	286,100	20	20	20
2013-COM-0162	Dock door seals	349,726	342,886	342,886	15	15	15

Project ID	Project Description	Savings (Cubic Meters/year)			EUL		
		Application	Verified	Audit	Application	Verified	Audit
2013-IND-0042	Steam leak repairs	178,289	158,733	158,733	20	19.5	20
2013-COM-0026	Grain dryer replacement	79,769	11,633	11,633	20	20	20
2013-IND-0064	Steam trap replacement	172,935	172,935	172,935	7	7	7
2013-COM-0149	Heat transfer improvement	25,660	25,660	25,660	15	15	15
2013-COM-0069	Window & door replacements	14,480	14,480	14,480	22	20	20
Totals		20,950,440	20,719,240	19,792,813			
Percent of Application Savings			99%	94%			

Table 7: Summary of Adjustments to Cumulative Savings and Incremental Cost - Commercial/Industrial Custom Projects

		Cumulative Gas Savings (Cubic meters)			Incremental Cost		
Project ID	**Project Description**	**Application**	**Verified**	**Audit**	**Application**	**Verified**	**Audit**
2013-COM-0101	New construction warehouse with roof insulation (R-30) exceeding code (R-27)	128,101	128,101	128,101	$90,800	$90,800	$90,800
2013-IND-0196	Gas leak repairs	223,192	223,192	0	$3,000	$3,000	$3,000
2013-IND-0045	Starch dryer steam preheater	5,993,690	5,694,005	0	$95,169	$95,169	$95,169
2013-IND-0457	Newly constructed asphalt plant to replace 2 nearby aging plants	5,007,348	5,007,348	5,007,348	$3,200,000	$3,200,000	$3,200,000
2013-IND-0256	5.1 acre expansion to an existing 4.6 acre greenhouse.	2,369,177	2,221,034	2,221,103	$342,070	$342,070	$342,070
2013-IND-0186	Line speed improvements	10,235,920	10,235,920	10,235,920	$9,291,257	$9,291,257	$9,291,257
2013-IND-0013	"B" deodorizer project	26,357,807	26,357,807	26,357,807	$2,874,132	$2,874,132	$2,874,132
2013-IND-0455	HVAC improvement	49,081,488	49,081,488	49,081,488	$497,200	$497,200	$497,200
2013-IND-0267	Greenhouse expansion (22.5 acres)	19,868,186	25,544,810	19,868,186	$3,844,283	$3,844,283	$3,844,283
2013-IND-0185	HVAC improvement - space heating	16,017,706	16,017,706	8,008,853	$83,870	$83,870	$83,870
2013-IND-0083	New greenhouse - multiple measures	14,094,096	14,094,096	14,094,096	$1,188,285	$1,188,285	$1,188,285
2013-IND-0037	Tank & hot oil pipe	8,182,232	7,637,205	6,136,400	$790,008	$790,008	$790,008

		Cumulative Gas Savings (Cubic meters)			**Incremental Cost**		
Project ID	**Project Description**	**Application**	**Verified**	**Audit**	**Application**	**Verified**	**Audit**
	insulation						
2013-IND-0046	Spray dryer steam coil preheat	4,344,378	3,703,396	3,703,396	$95,131	$95,131	$95,131
2013-IND-0177	5.2 acre expansion to an existing 4.6 acre greenhouse.	3,914,398	4,697,277	3,914,398	$339,980	$339,980	$339,980
2013-IND-0055	Pipe & vessel insulation	3,508,898	3,437,562	2,632,120	$350,001	$350,001	$350,001
2013-COM-0162	Dock door seals	2,413,109	2,365,913	2,365,913	$297,340	$297,340	$297,340
2013-IND-0042	Steam leak repairs	1,640,259	1,423,835	1,460,344	$8,793	$8,793	$8,793
2013-COM-0026	Grain dryer replacement	733,875	107,024	107,024	$58,560	$58,560	$58,560
2013-IND-0064	Steam trap replacement	556,851	556,851	556,851	$3,124	$3,124	$3,124
2013-COM-0149	Heat transfer improvement	177,054	177,054	177,054	$14,895	$14,895	$14,895
2013-COM-0069	Window & door replacements	146,538	133,216	133,216	$168,436	$168,436	$168,436
Totals Percent of Application Value		174,994,302	178,844,840 102%	156,189,618 89%	$23,636,334	$23,636,334 100%	$23,636,334 100%

Large Volume Custom Projects

The Large Volume Custom Projects provided the vast majority of Union's 2013 savings (see Table 1) and therefore received the most attention from the audit team. Our review process followed the same process used for the other custom programs. First, we reviewed CPSV reports prepared by Diamond Engineering in two phases. We first conducted an initial review of the draft CPSV reports and compiled a list of questions for clarification and requested any additional information needed for the audit. A call was held with Union and Diamond Engineering staff to review and resolve these initial questions based on the draft CPSV reports. This call was also used to provide input to Diamond Engineering so they could finalize the CPSV reports.

Once all the initial questions were resolved, we conducted secondary in-depth reviews of the final CPSV reports for each project. The CPSV reports were reviewed for baseline assumptions, operating hours, savings calculations, and EUL for each measure. A number of questions and recommendations were compiled based on this in-depth review, and a series of calls were held with Union and Audit Committee members to discuss these issues. Based on the feedback from these calls we developed a set of recommendations and specific adjustments to project savings and EULs where necessary.

The rationales for adjustments made to savings and EULs based on the auditor's review are described below by project.

- **2013-IND-0348.** Coke oven gas (COG) impurities such as tars and naphthalene can be expected to accrete within the new pipeline at the same rate as the previously installed pipe. Consequently, this reduces COG capacity to the same capacity as the baseline equipment over the measure's life and results in an adjusted average savings equal to 50 percent of verified first-year savings.
- **2013-IND-0123.** The verifier assumed blowing losses equal to 50 percent for leaking traps. The adjusted savings assumes a more realistic estimate of 20 percent. Additionally, the repair of blocked traps is unlikely to have an affect on steam consumption, although properly operating traps have functional steam losses. The adjusted savings takes this into account and assumes blocked traps will have an increased steam consumption of 1.5 lbs/hour following repair.

  2013-IND-0101. The base case should reflect conditions absent the efficiency measure in question (i.e. no HRSG) and the adjusted savings accounts for this. The absence of a HRSG indicates the absence of steam-driven chillers so the baseline assumption of an existing boiler powering steam-driven chillers is not tenable. Moreover, chillers were not installed at the time of verification. Regarding project measure life, a reasonable estimate for HRSG that is not in continuous use is 20 years. This is also the default value for custom projects. Insufficient evidence was presented in the CPSV report to justify a longer EUL.
- **2013-IND-0450.** The claimed savings values for insulation were adjusted downward to reflect a decrease in insulation performance over the life of the measure. The adjusted savings also take into account the jacketing material type

(e.g., metal or plastic) of new insulation, which is likely to be more resistant to mechanical or moisture damage than baseline materials. Savings has been reduced by 25% to account for these effects.

- **2013-IND-0451.** See above rationale for 2013-IND-0450.
- **2013-IND-0179.** See above rationale for 2013-IND-0450.
- **2013-IND-0072.** See above rationale for 2013-IND-0450.
- **2013-IND-0204.** See above rationale for 2013-IND-0450.
- **2013-IND-0117.**The verified project EUL is based on a weighted average of three components new greenhouse components with heating controls having an EUL of 10 years, and both structure and heating system having EULs of 30 years. The adjusted EUL modifies the structure and heating system EUL to 20 years, which yields a weighted average EUL equal to 14 years. Additionally, although the Virtual Grower software used to calculate savings did not provide savings by component, total project life should be based on an energy-savings-weighted average rather than component cost weights.

There is an additional issue regarding costs for project IND-0101 that involved the installation of a heat recovery steam generator (HRSG) on a gas turbine generator (genset). The HRSG generates steam from waste heat in the combustion products downstream of the genset turbine. Savings were calculated assuming the steam generated by the HRSG would offset steam generated by an existing boiler. In the project review, it was stated that the customer had subsequently decided to replace existing electric chillers with steam-turbine-driven chillers to take advantage of steam produced by the HRSG. Additional savings were claimed for boiler-generated steam that would have been required to drive the chillers; however, in the absence of the project (i.e., if no HRSG was installed), the turbine chillers would not be viable and consequently the savings were reduced during the audit.

This consideration was discussed with the verifier and in that conversation it was realized that consideration of the HRSG as a stand-alone project was not viable in that it would be a necessary part of the genset to allow sufficient economical hours of operation each year to make the genset a viable project. This means that the cost of the project commensurate with the claimed savings needs to also include the cost of the genset. Savings from the turbine-driven chillers could also be included if the cost of those chillers were added to that package. Neither the cost of the genset nor that of the chillers is currently included in the project calculations. The cost effectiveness of the project will be significantly reduced by these additional costs.

Table 8 below summarizes the application, verified, and audited savings and EUL values by project for the Large Volume program.

Table 8: Summary of Adjustments to Savings and EUL - Large Volume Projects

		Savings (Cubic Meters/year)			EUL		
Project ID	Project Description	Application	Verified	Audit	Application	Verified	Audit
2013-IND-0348	Coke oven gas pipe replacement	10,480,821	11,640,000	5,820,000	30	30	30
2013-IND-0469	Coke oven gas burners installed in an existing boiler	7,753,349	6,940,000	6,940,000	20	30	20
2013-IND-0120	Steam leak repairs	4,299,973	4,097,000	4,097,000	20	20	20
2013-IND-0121	Steam leak repairs	1,760,727	1,678,000	1,678,000	20	20	20
2013-IND-0416	Steam leak repairs	1,276,692	1,247,000	1,247,000	20	20	20
2013-IND-0074	Steam leak repairs	2,208,231	2,206,000	2,206,000	20	20	20
2013-IND-0240	Steam leak repairs	1,610,769	1,934,000	1,934,000	20	20	20
2013-IND-0229	Heat recovery from equipment cooling to boiler feed water	1,477,273	1,707,000	1,707,000	25	30	25
2013-IND-0542	Burner metering equipment upgrades on heat treating furnace	200,977	98,580	98,580	20	20	20
2013-IND-0123	Steam trap repairs	888,303	1,403,000	1,116,000	7	7	7
2013-IND-0101	Install heat recovery steam generator (HRSG) on an existing gas turbine generator to offset boiler-generated steam usage; savings claimed for proposed replacement of electric chillers with turbo-chillers which provide for more annual hours of use	4,861,000	4,708,000	3,405,000	20	30	20
2013-IND-0273	Condensate heat recovery	1,740,129	1,239,000	1,239,000	20	20	20
2013-IND-0124	Re-commission existing 3rd reaction tower previously bypassed due to worn out screens	18,099,008	32,310,000	32,310,000	20	20	20

Project ID	Project Description	Savings (Cubic Meters/year)			EUL		
		Application	Verified	Audit	Application	Verified	Audit
2013-IND-0157	Shut down AHUs, including steam lines, in abandoned portion of plant	4,218,598	2,998,000	2,998,000	20	20	20
2013-IND-0205	Implementation of more precise product trimming equipment	2,287,034	2,324,000	2,324,000	20	20	20
2013-IND-0117	Greenhouse expansion with efficient materials and heating equipment	2,504,565	2,085,000	2,085,000	14	17	14
2013-IND-0159	Replacement of steam-heated AHUs with indirect gas-fired units	208,366	233,000	233,000	20	20	20
2013-IND-0230	Turbine inlet fogging	232,616	236,500	236,500	20	20	20
2013-IND-0450	Replacement of pipe insulation	9,790,690	9,870,000	7,343,000	20	20	20
2013-IND-0451	Replacement of pipe insulation	6,527,127	6,580,000	4,895,000	20	20	20
2013-IND-0179	Replacement of pipe insulation	9,572,937	8,464,000	7,180,000	20	20	20
2013-IND-0072	Replacement of pipe insulation	636,068	579,400	477,000	20	20	20
2013-IND-0204	Replacement of pipe insulation	206,166	259,800	155,000	20	20	20
Totals		92,841,419	104,837,280	91,724,080			
Percent of Application Savings			113%	99%			

Table 9: Summary of Adjustments to Cumulative Savings and Incremental Cost - Large Volume Projects

		Cumulative Gas Savings (Cubic meters)			Incremental Cost		
Project ID	**Project Description**	**Application**	**Verified**	**Audit**	**Application**	**Verified**	**Audit**
2013-IND-0348	Coke oven gas pipe replacement	144,635,330	160,632,000	80,316,000	$1,188,280	$1,188,280	$1,188,280
2013-IND-0469	Coke oven gas burners installed in an existing boiler	71,330,811	95,772,000	63,848,000	$1,268,833	$272,833	$272,833
2013-IND-0120	Steam leak repairs	39,559,752	37,692,400	37,692,400	$178,191	$178,191	$178,191
2013-IND-0121	Steam leak repairs	16,198,688	15,437,600	15,437,600	$155,021	$155,021	$155,021
2013-IND-0416	Steam leak repairs	11,745,566	11,472,400	11,472,400	$702,644	$702,644	$702,644
2013-IND-0074	Steam leak repairs	20,315,725	20,295,200	20,295,200	$21,250	$21,250	$21,250
2013-IND-0240	Steam leak repairs	14,819,075	17,792,800	17,792,800	$17,709	$17,709	$17,709
2013-IND-0229	Heat recovery from equipment cooling to boiler feed water	16,988,640	23,556,600	19,630,500	$133,469	$133,469	$133,469
2013-IND-0542	Burner metering equipment upgrades on heat treating furnace	1,848,988	906,936	906,936	$19,542	$19,542	$19,542
2013-IND-0123	Steam trap repairs	2,860,336	4,517,660	3,593,520	$66,475	$66,475	$66,475
2013-IND-0101	Install heat recovery steam generator (HRSG) on an existing gas turbine generator to offset boiler-generated steam usage; savings claimed for proposed replacement of electric chillers with turbo-chillers which provide for more annual hours of use	44,721,200	64,970,400	31,326,000	$1,232,775	$1,232,775	$1,232,775
2013-IND-0273	Condensate heat recovery	16,009,187	11,398,800	11,398,800	$48,373	$30,073	$30,073

		Cumulative Gas Savings (Cubic meters)			Incremental Cost		
Project ID	**Project Description**	**Application**	**Verified**	**Audit**	**Application**	**Verified**	**Audit**
2013-IND-0124	Re-commission existing 3rd reaction tower previously bypassed due to worn out screens	166,510,874	297,252,000	297,252,000	$4,000,000	$4,000,000	$4,000,000
2013-IND-0157	Shut down AHUs, including steam lines, in abandoned portion of plant	38,811,102	27,581,600	27,581,600	$35,281	$35,281	$35,281
2013-IND-0205	Implementation of more precise product trimming equipment	21,040,713	21,380,800	21,380,800	$552,405	$552,405	$552,405
2013-IND-0117	Greenhouse expansion with efficient materials and heating equipment	16,129,399	16,304,700	13,427,400	$2,160,899	$2,160,899	$2,160,899
2013-IND-0159	Replacement of steam-heated AHUs with indirect gas-fired units	1,916,967	2,143,600	2,143,600	$1,907,390	$1,907,390	$1,907,390
2013-IND-0230	Turbine inlet fogging	2,140,067	2,175,800	2,175,800	$57,025	$57,025	$57,025
2013-IND-0450	Replacement of pipe insulation	90,074,348	90,804,000	67,555,600	$564,798	$564,798	$564,798
2013-IND-0451	Replacement of pipe insulation	60,049,568	60,536,000	45,034,000	$376,532	$376,532	$376,532
2013-IND-0179	Replacement of pipe insulation	88,071,020	77,868,800	66,056,000	$583,058	$583,058	$583,058
2013-IND-0072	Replacement of pipe insulation	5,851,826	5,330,480	4,388,400	$39,681	$39,681	$39,681
2013-IND-0204	Replacement of pipe insulation	1,896,727	2,390,160	1,426,000	$168,137	$168,137	$168,137
Totals		893,525,908	1,068,212,736	862,131,356	$15,477,768	$14,463,468	$14,463,468
Percent of Application Value			120%	96%		93%	93%

3 Summary of Recommendations

This chapter presents a summary of the audit recommendations on the 2013 Union Gas Annual Report.

Overarching Recommendations

Recommendation #1: Increase annual evaluation spending to 3-5% of the program implementation budget. This will allow for (at a minimum) additional baseline research, an annual free ridership study for custom projects, and a full process and impact evaluation of the market transformation program as recommended below.

Recommendation #2: Strive for accuracy in verifying savings and develop a thorough and independent estimate of project impacts, rather than merely confirming whether or not the initial savings estimates are reasonable or conservative.

Recommendation #3: Structure the audit process so that only one round of reviews is conducted of the custom projects. Meetings for these reviews should be given higher priority by Union Gas and the Audit Committee members so that more days are available for meetings and consequently the timeline for the audit process can be compressed. If a similar evaluation and audit process is to be followed in 2015, the timeline in the evaluation and audit RFPs should be adjusted accordingly.

Recommendation #4: If the auditor is expected to make punitive adjustments to savings in those cases where Union does not adequately support their impact estimates, this needs to be made explicitly clear in the RFP and contracting phase of the project.

Recommendation #5: Conduct a new custom free ridership study every year (beginning in 2014) using a sample from the current year's custom participants.

Recommendation #6: The annual custom free ridership study should have separate and robust samples for behavioral and maintenance-related projects.

Recommendation #7: Interactions between Union Gas and customers need to be documented in the project file as they occur if they are to be used as support for claiming projects are not free riders.

Recommendation #8: Savings from projects that are obvious safety hazards (e.g., gas leaks or very large steam leaks) or are otherwise obviously free riders should not be eligible for Union Gas incentives. Discussions as to whether other broad classes of maintenance or behavioral projects (e.g., steam traps tests and repairs, pipe insulation) should be eligible for the program should be determined at the policy level prior to the beginning of the program year.

Recommendation #9: If a free ridership rate is being applied, savings from individual projects that appear to be free riders should not be zeroed out in the custom impact analysis sample as the free ridership has already been accounted for in the adjustment factor. Note that this does not apply to obvious safety and performance issues as discussed in Recommendation #8.

Recommendation #10: Do not revise EULs for individual custom projects from the values established in the original program filing documents.

Recommendation #11: Use measure component savings (rather than costs) to calculate an average EUL for a project.

Recommendation #12: Ensure that projects that will likely affect incremental costs in future years have these costs correctly incorporated into the cost effectiveness calculations for the program.

Recommendation #13: In future program years, do not apply a free ridership adjustment to the incremental costs used in the TRC calculation for direct install or giveaway measures. Treating costs this way in the TRC provides an additional incentive to minimize free ridership in the program.

Residential Programs

Recommendation #14: Conduct an on-site survey to a sample of homes to determine a more accurate and current baseline assumptions for the ESKs.

Recommendation #15: All of the ESK costs should be included in the TRC calculation for this program, even for those households that are removed from the final savings calculations due to removal of units or previous program participation.

Market Transformation Program

Recommendations #16: Require 10% of homes or at least 3 new homes (whichever is less) to be built to program specifications. Additionally, require a specific commitment from participating builders to build x number or x percent of qualifying homes in the next 2 years.

Recommendation #17: Set participation goals (both builders and numbers of homes) in terms of the percentage of new homes built in Union Gas territory. As part of a market/process evaluation the size and composition of the market should be investigated to determine whether program goals are attainable and likely to be reached in a given timeframe. An important part of this investigation will be determining the relative roles of production and custom builders, both in the market and in the program.

Recommendation #18: Establish a Union Gas Optimum Home label or certification that builders can display on new homes. Since the standard is 20% more efficient than the Ontario Building Code, the qualifying standard can automatically change as the code requirements change. A process evaluation should help determine how home buyers, lenders and real estate agents perceive the program, including the value of a standard certification relative to builder-specific labels. Note that this process has already been established for Energy Star Canada.

Recommendation #19: It is acceptable to have the builder be responsible for the testing **if** they use an approved tester (such as the Certified Energy Evaluators currently used by the program) who should be subject to qualification and spot-checking by Union Gas or its contractors. Since it seems that program qualification is based on the results of model runs (HOT2000), there also must be a formal inspection/Quality Assurance process to verify that homes are built as designed. A thorough impact and process evaluation should be conducted to confirm that homes are built as designed, that testing is thorough and accurate, and that there is a process for identifying and addressing problems.

Recommendation #20: There should be an indication of what the plans are to support attainment of "above code" efficiencies as the codes themselves improve. Whenever possible, the Optimum Home program/Union Gas should promote a set of building techniques that will prepare builders to both meet and exceed the next round of the code.

Recommendation #21: If homes are built with good insulation and minimum air infiltration, there will probably need to be some sort of mechanical ventilation to ensure acceptable indoor air quality. The Oregon code, for example, has requirements for this so that builders cannot simply put in a bathroom fan. Either way, a minimum number of air changes per hour should be part of the program requirements. Note that this is also a requirement for the current Energy Star Canada label.

Recommendation #22: The outreach efforts for the program need to include working with subcontractors rather than with builders alone. Especially for higher volume builders, subcontractors may handle most of the critical construction and installation tasks; builders themselves basically never do HVAC or duct work (as, for example, in the FortisBC new homes program, where HVAC contractors are doing the heat pump installations more often than the builders). A process evaluation should investigate the extent to which subcontractors are responsible for key aspects of constructing a qualifying home and how they are being trained in the techniques needed for compliance.

Recommendation #23: Conduct a formal evaluation of the market transformation that includes development of the program theory and logic model. Using the program theory and logic model, key metrics of program progress can be developed and tracked that will help ensure that the program activities are helping to achieve the long term market transformation goals.

4 Audit LRAM, DSMVA, and DSM Shareholder Incentive Amount Recoverable

We have audited the Annual Report, DSM Shareholder Incentive, Lost Revenue Adjustment Mechanism (LRAM) and Demand Side Management Variance Account (DSMVA) of Union Gas Limited for the calendar year ended December 31, 2013. The Annual Report and the calculations of DSM Shareholder Incentive, LRAM, and DSMVA are the responsibility of the company's management. Our responsibility is to express an opinion on these amounts based on our audit.

We conducted our audit in accordance with the rules and principles set down by the Ontario Energy Board in the DSM Guidelines for Natural Gas Utilities (EB-2008-0346). Details of the steps taken in this audit process are set forth in the Audit Report that follows, and this opinion is subject to the details and explanations therein described.

In our opinion, and subject to the qualifications set forth above, the following figures are calculated correctly using reasonable assumptions, based on data that has been gathered and recorded using reasonable methods and accurate in all material respects, and following the rules and principles set down by the Ontario Energy Board that are applicable to the 2013 DSM programs of Union Gas Limited:

DSM Shareholder Incentive Amount Recoverable:	$7,784,373
LRAM Amount Recoverable:	$1,138,136
DSMVA Amount Recoverable:	$1,197,648

Attachment 1

The table below shows the dates and attendees of the meetings held during the 2013 audit process.

Table 10: Meetings During the 2013 DSM Audit

Date	Meeting Topic	Attendees			
		Audit Committee	Auditor	Verifier	Union
2/7/14	Union 2013 Audit RFP	●			●
2/28/14	Review of Auditor Proposals	●			●
3/18/14	Audit Kickoff Meeting	●	●		●
3/18/14	CPSV: Large Volume Report		●	●	●
3/25/14	CPSV: Commercial/Industrial Report		●	●	●
4/3/14	CPSV: Low Income Report		●	●	●
4/7/14	CPSV: Large Volume Report		●	●	●
4/28/14	CPSV: Commercial/Industrial Report		●	●	●
5/28/14	Questions on Annual Report	●	●	●	●
6/13/14	CPSV: Large Volume Projects	●	●		●
6/18/14	CPSV: Large Volume Projects	●	●		●
7/2/14	CPSV: Commercial/Industrial Report	●	●		●
7/9/14	Questions on Annual Report	●	●		●
7/23/14	CPSV: Low Income and Questions on Report	●	●		●
8/14/14	Draft Audit Memo	●	●		●
9/3/14	Draft Audit Report	●	●	☐	●
9/23/14	Final Audit Report	●			●
9/29/14	Final Audit Report	●	●		●

Audit Committee
Summary Results and Responses to the Audit of Union's 2013 DSM Annual Report

November 4, 2014

The purpose of this document is to outline the process followed for the Audit of the 2013 DSM Annual Report, summarize the Audit Committee (AC) resolutions to Audit recommendations, and recalculate the corresponding impacts to the 2013 DSM savings claims. In addition, this report documents additional audit issues and/or recommendations brought forward by the AC and resolution of those items.

Selection of AC members

The AC was comprised of three Consultative representatives and two Union Gas representatives (Tina Nicholson and Eric Buan).

The Consultative elected three AC members by electronic voting concluding November 6, 2013, to represent the group through the Audit process. These representatives are:

- Kai Millyard – Green Energy Coalition
- Julie Girvan – Consumers Council of Canada
- Vince DeRose – Canadian Manufacturers and Exporters

Selection of Auditor and Terms of Reference

As part of the Stakeholder Engagement Terms of Reference (ToR), the audit process included the issuance and maintenance of an ongoing Request for Qualifications (RFQ) by Union to qualify audit firms to a preapproved bidders list. Union's AC reached consensus on a pre-approved bidders list from the RFQ of seven audit firms.

As outlined in the ToR, Union issued a Request for Proposal (RFP) to the pre-approved list for the purpose of conducting the Annual DSM Audit. Both the RFQ and RFP were developed in conjunction with Union and Enbridge's ACs to standardize the audit process between the two utilities. The standardized RFP scope of work was extended to include a provision that allowed the Auditor to work with the Custom Project Savings Verification firm to enable the review of both the draft and final verification reports and an opportunity to discuss individual projects, any findings and adjustment factors recommended throughout the firm's review. While the AC strives for consensus, the ToR also appointed the intervenor members of the AC to ultimately select the successful proponent in the absence of consensus.

Six responses to the Audit RFP were reviewed by the AC. The AC selected Evergreen Economics as the Auditor of the 2013 Annual Report. Evergreen was commissioned to undertake the Audit. The Request for Proposal is attached as Appendix A.

Information Exchange

The Consultative, including the members of the AC and Evergreen, reviewed the Draft 2013 DSM Annual Report circulated by Union Gas on May 13, 2014.

Other than comments from members of the AC, no additional comments were received from members of the Consultative.

Evergreen presented the AC with the 2013 Draft Final Audit report on September 18, 2014 for review. Nine joint meetings with the AC, Evergreen, and Union were held between May 28, 2014 and September 29, 2014 to initiate the audit process, review the Draft 2013 Annual DSM Report, the Draft Audit Report, and the Draft Final Audit Report. The 2013 Audit of Union's DSM Annual Report was complete following Evergreen's submission of its Final Auditor's Report dated October 2, 2014.

Auditor’s Recommended Changes to Cumulative Gas Savings, Utility DSM Incentive and LRAM Claim

Evergreen Economics conducted the audit in accordance with the rules and principles set down by the Ontario Energy Board in the DSM Guidelines for Natural Gas Utilities (EB-2008-0346) and in accordance to the contents of the 2012-2014 Union Gas Settlement Agreement (EB-2011-0327) and the 2013-2014 DSM Plan for Large Volume (EB-2012-0337). The Auditor’s Final Report presents their opinion subject to the qualifications set forth above, that “the following figures are calculated correctly using reasonable assumptions, based on data that has been gathered and recorded using reasonable methods and accurate in all material respects, and following the rules and principles set down by the Ontario Energy Board that are applicable to the 2013 DSM programs of Union Gas Ltd:

DSM Shareholder Incentive Amount Recoverable: $7,784,373

LRAM Amount Recoverable: $1,138,136

DSMVA Amount Recoverable: $1,197,648

Audit findings and recommendations led to a decrease of 364 million net cumulative m3, $2.110M in DSM Shareholder incentive and $0.065M in LRAM claim from what was reported in Union’s Pre-Audit Annual Report.

Overarching Recommendations

Recommendation #1

Increase annual evaluation spending to 3-5% of the program implementation budget. This will allow for (at a minimum) additional baseline research, an annual free ridership study for custom projects, and a full process and impact evaluation of the market transformation program as recommended below.

Resolution:

The AC agrees with the Auditor that a Budget in the range of 3-5% is appropriate for Union's future Evaluation Budget.

Recommendation #2

Strive for accuracy in verifying savings and develop a thorough and independent estimate of project impacts, rather than merely confirming whether or not the initial savings estimates are reasonable or conservative.

Resolution:

The AC accepts the Auditor’s recommendation. Union will refer this recommendation to the TEC for consideration in the 2014 CPSV Terms of Reference (ToR).

Recommendation #3

Structure the audit process so that only one round of reviews is conducted of the custom projects. Meetings for these reviews should be given higher priority by Union Gas and the Audit Committee members so that more days are available for meetings and consequently the timeline for the audit process can be compressed. If a similar evaluation and audit process is to be followed in 2015, the timeline in the evaluation and audit RFPs should be adjusted accordingly.

Resolution:

The AC agrees that Union will refer the Auditor's recommendation to the 2014 Union/Enbridge Joint AC for discussion and/or clarification of Auditor expectations in the 2014 Auditor RFP. Union will also ensure to clearly communicate expectations as part of the audit kick-off process. The AC does not accept the Auditor's recommendation that one round of reviews of custom projects is necessarily sufficient to adequately satisfy the audit requirements.

Recommendation #4

If the auditor is expected to make punitive adjustments to savings in those cases where Union does not adequately support their impact estimates, this needs to be made explicitly clear in the RFP and contracting phase of the project.

Resolution:

The AC agrees with the Auditor that the Auditor RFP should make Auditor expectations explicitly clear. Union will refer this recommendation to the Joint Union/Enbridge AC for discussion and/or clarification in the 2014 Auditor RFP.

Recommendation #5

Conduct a new custom free ridership study every year (beginning in 2014) using a sample from the current year's custom participants.

Resolution:

The AC agrees that monitoring and adjusting Net-to-Gross (NTG) ratios, including free ridership and spillover, for custom projects is an important input to estimating savings for custom projects. A number of the details about how this should be done may be resolved by the parties following the study being planned by the TEC. Subject to the outcome of that study, and a review of the cost-effectiveness of regular NTG studies, the AC agrees that annual studies are preferable due to the large contribution of custom projects to total savings.

Given the current initiated TEC endorsed Net-to-Gross study, the AC agrees that it is not reasonable to conduct a Net-to-Gross (NTG) study for use in the 2014 audit.

Recommendation #6

The annual custom free ridership study should have separate and robust samples for behavioral and maintenance-related projects.

Resolution:

The AC agrees to interpret the Auditor's recommendation as recommending separate and robust samples for behavioral and maintenance-related projects included in a free ridership study and not about the frequency of free ridership studies.

The AC agrees that when sampling for free ridership surveys, customized questions dealing properly with the difference between baseline and free ridership issues should be posed for behavioural and maintenance projects (see #8 below). The topic will be referred to the TEC for further discussion.

Recommendation #7

Interactions between Union Gas and customers need to be documented in the project file as they occur if they are to be used as support for claiming projects are not free riders.

Resolution:

The AC accepts the Auditor's recommendation. Union will continue to refine the custom project documentation included in project files.

Recommendation #8

Savings from projects that are obvious safety hazards (e.g., gas leaks or very large steam leaks) or are otherwise obviously free riders should not be eligible for Union Gas incentives. Discussions as to whether other broad classes of maintenance or behavioral projects (e.g., steam traps tests and repairs, pipe insulation) should be eligible for the program should be determined at the policy level prior to the beginning of the program year.

Resolution:

The AC accepts the Auditor's recommendation in principle that savings from projects that are obvious safety hazards should not be eligible for incentives. The AC also agrees that if classes of projects are to be made ineligible that this policy should be established in advance.

The AC agrees that in the future Union will not claim projects involving fixing gas leaks for DSM savings.

There are classes of projects, generally O&M projects (e.g. cleaning heat exchangers, fixing steam leaks or steam traps) for which there might be an increased potential of overlap between the concepts of baseline and free ridership. The AC does not propose to prohibit savings from these projects, but rather clearly delineate how baseline and free ridership should be treated. In last year's report the parties agreed that

> *Where the conservation measure is of a behavioural or maintenance nature, the information about the customer's current practises (prior to participation in the program) must be collected.*

Free ridership should then be evaluated by a separate set of questions in free ridership surveys to ensure that there is no overlap between the concepts of baseline (the customer's current practices prior to participation in the program) and free ridership. Adjusting the baseline to reflect customer's current practice would require re-evaluation of existing free ridership to prevent overlap between the two concepts. Union will refer this to the TEC for discussion in the context of the net to gross work currently being done. Recommendation #6 above provides for identifying this subset of projects so that customized survey questions can be asked.

Recommendation #9

If a free ridership rate is being applied, savings from individual projects that appear to be free riders should not be zeroed out in the custom impact analysis sample as the free ridership has already been accounted for in the adjustment factor. Note that this does not apply to obvious safety and performance issues as discussed in Recommendation #8.

Resolution:

The AC agrees to interpret the Auditor's recommendation as referring to the concept that Union should not apply project-specific free ridership rates to individual custom projects since a portfolio-level free ridership rate has already been applied; application of a project-specific free ridership rate would be a double adjustment. Note that this does not apply to obvious safety and performance issues as discussed in Recommendation #8.

The AC accepts the Auditor's recommendation.

Recommendation #10

Do not revise EULs for individual custom projects from the values established in the original program filing documents.

Resolution:

The custom project effective useful lives by measure filed in the joint submission Union Gas and Enbridge Gas Distribution New and Updated DSM Measures (EB-2013-0430) are a guide. "Where site specific information or a relevant prescriptive Equipment Useful Life (EUL) is available to support an alternate EUL value for a specific custom project Union will use the alternate value for that custom project."

The AC agrees that Union will refer the Auditor's recommendation to the TEC for consideration in the 2014 CPSV Terms of Reference.

Recommendation #11

Use measure component savings (rather than costs) to calculate an average EUL for a project.

Resolution:

The AC accepts the Auditor's recommendation and agrees that Union will refer the Auditor's recommendation to the TEC for consideration in establishing the 2014 CPSV ToR.

Recommendation #12

Ensure that projects that will likely affect incremental costs in future years have these costs correctly incorporated into the cost effectiveness calculations for the program.

Resolution:

The AC accepts the Auditor's recommendation and agrees that Union will refer the Auditor's recommendation to the TEC for consideration in establishing the 2014 CPSV ToR.

Recommendation #13

In future program years, do not apply a free ridership adjustment to the incremental costs used in the TRC calculation for direct install or giveaway measures. Treating costs this way in the TRC provides an additional incentive to minimize free ridership in the program

Resolution:

The AC does not accept the Auditor's recommendation. Union calculates TRC consistent with the methodology outlined in *Demand Side Management Guidelines for Natural Gas Utilities* EB-2008-0346, which indicates that "equipment costs associated with free riders are excluded from the TRC test" (Section 5.1.1 Net Equipment Costs, p.13) but "all program costs associated with free riders should be included in the TRC analysis (Section 5.1.2 Program Costs, p.15).

Residential Program Recommendations

Recommendation #14

Conduct an on-site survey to a sample of homes to determine a more accurate and current baseline assumptions for the ESKs.

Resolution:

The AC does not accept the Auditor's recommendation.

Union confirms that ESK savings are only counted for households that have not previously received an ESK. As such, the AC agrees that it is redundant to conduct an on-site survey to a sample of homes to determine more accurate and current baseline assumptions for the ESKs.

Recommendation #15

All of the ESK costs should be included in the TRC calculation for this program, even for those households that are removed from the final savings calculations due to removal of units or previous program participation.

Resolution:

The AC accepts the Auditor's recommendation and agrees with the Auditor's finding that Union already correctly includes in the TRC calculation costs associated with households that are removed from final savings calculations.

Market Transformation Program Recommendations

Recommendation #16

Require 10% of homes or at least 3 new homes (whichever is less) to be built to program specifications. Additionally, require a specific commitment from participating builders to build x number or x percent of qualifying homes in the next 2 years.

Resolution:

The AC does not accept the Auditor's recommendation for the purposes of the Optimum Home program agreed upon in Union's Settlement Agreement (EB-2011-0327). The AC agrees that this audit recommendation is a forward-looking program design recommendation to be considered when planning the 2015 Optimum Home program.

Recommendation #17

Set participation goals (both builders and numbers of homes) in terms of the percentage of new homes built in Union Gas territory. As part of a market/process evaluation the size and composition of the market should be investigated to determine whether program goals are attainable and likely to be reached in a given timeframe. An important part of this investigation will be determining the relative roles of production and custom builders, both in the market and in the program.

Resolution:

The AC does not accept the Auditor's recommendation for the purposes of the Optimum Home program agreed upon in Union's Settlement Agreement (EB-2011-0327). The AC agrees that this audit recommendation is a forward-looking program design recommendation to be considered when planning the 2015 Optimum Home program.

Recommendation #18

Establish a Union Gas Optimum Home label or certification that builders can display on new homes. Since the standard is 20% more efficient than the Ontario Building Code, the qualifying standard can automatically change as the code requirements change. A process evaluation should help determine how home buyers, lenders and real estate agents perceive the program, including the value of a standard certification relative to builder-specific labels. Note that this process has already been established for Energy Star Canada.

Resolution:

The AC does not accept the Auditor's recommendation for the purposes of the Optimum Home program agreed upon in Union's Settlement Agreement (EB-2011-0327). The AC agrees that this audit recommendation is a forward-looking program design recommendation to be considered when planning the 2015 Optimum Home program.

Recommendation #19

It is acceptable to have the builder be responsible for the testing <u>**if**</u> they use an approved tester (such as the Certified Energy Evaluators currently used by the program) who should be subject to qualification and spot-checking by Union Gas or its contractors. Since it seems that program qualification is based on the results of model runs (HOT2000), there also must be a formal inspection/Quality Assurance process to verify that homes are built as designed. A thorough impact and process evaluation should be conducted to confirm that homes are built as designed, that testing is thorough and accurate, and that there is a process for identifying and addressing problems.

Resolution:

The AC accepts the Auditor's recommendation. Union confirms that approved testers and an inspection/Quality Assurance process are already in use. Union also confirms that its quality assurance process ensures that homes are built as designed, that testing is thorough and accurate, and that there is a process for identifying and addressing problems.

Recommendation #20

There should be an indication of what the plans are to support attainment of “above code” efficiencies as the codes themselves improve. Whenever possible, the Optimum Home program/Union Gas should promote a set of building techniques that will prepare builders to both meet and exceed the next round of the code.

Resolution:

The AC does not accept the Auditor’s recommendation for the purposes of the Optimum Home program agreed upon in Union’s Settlement Agreement (EB-2011-0327). The AC agrees that this audit recommendation is a forward-looking program design recommendation to be considered when planning the 2015 Optimum Home program.

Recommendation #21

If homes are built with good insulation and minimum air infiltration, there will probably need to be some sort of mechanical ventilation to ensure acceptable indoor air quality. The Oregon code, for example, has requirements for this so that builders cannot simply put in a bathroom fan. Either way, a minimum number of air changes per hour should be part of the program requirements. Note that this is also a requirement for the current Energy Star Canada label.

Resolution:

The AC does not accept the Auditor’s recommendation for the purposes of the Optimum Home program agreed upon in Union’s Settlement Agreement (EB-2011-0327). The AC agrees that this audit recommendation is a forward-looking program design recommendation to be considered when planning the 2015 Optimum Home program.

Recommendation #22

The outreach efforts for the program need to include working with subcontractors rather than with builders alone. Especially for higher volume builders, subcontractors may handle most of the critical construction and installation tasks; builders themselves basically never do HVAC or duct work (as, for example, in the FortisBC new homes program, where HVAC contractors are doing the heat pump installations more often than the builders). A process evaluation should investigate the extent to which subcontractors are responsible for key aspects of constructing a qualifying home and how they are being trained in the techniques needed for compliance.

Resolution:

The AC does not accept the Auditor’s recommendation for the purposes of the Optimum Home program agreed upon in Union’s Settlement Agreement (EB-2011-0327). The AC agrees that this audit recommendation is a forward-looking program design recommendation to be considered when planning the 2015 Optimum Home program.

Recommendation #23

Conduct a formal evaluation of the market transformation that includes development of the program theory and logic model. Using the program theory and logic model, key metrics of program progress can be developed and tracked that will help ensure that the program activities are helping to achieve the long term market transformation goals.

Resolution:

The AC does not accept the Auditor's recommendation for the purposes of the Optimum Home program agreed upon in Union's Settlement Agreement (EB-2011-0327). The AC agrees that this audit recommendation is a forward-looking program design and evaluation planning recommendation to be considered when planning the 2015 Optimum Home program.

Low Income Custom Projects

Specific Project Recommended Adjustments

Recommendation #24

2013-COM-0271. The measure installed in this project was a controls system that only affects the operation of hot water valves. Savings for this project were calculated using regressions of billing data against weather data (i.e., heating-degree days) from the baseline and post-installation periods. However, the baseline data reflect hot water valves that were malfunctioning due to improper installations. These valve malfunctions were not discovered until the building owner and the controls vendor investigated the poor performance of the heating system following project implementation. After valve repairs were conducted, the system began operating correctly. The verified savings credited to the project include the effects of the repaired valves, which were not identified in the project application, were not incentivized by Union Gas, and no recorded evidence of Union Gas's participation in the valve repairs was provided. The verifier's reference to continued involvement by Union Gas does not constitute appropriate documentation. While the valve-related savings may have come about as an unintended consequence of the project, they were not part of the incentivized project, and should not be included in the savings totals that are extrapolated to the entire population of Low Income projects. As the verification calculations do not discriminate between the controls and valve savings, the most equitable approach to reduce the claimed savings is to divide the savings evenly between the two.

Resolution:

The AC accepts, for 2013 only, the Auditor's recommendation for the purpose of reaching consensus although Union disagrees with the Auditor's interpretation of the project. The Audit adjustment decreased the cumulative natural gas savings for this project by a total of 291,091 m3 from the verified value.

Recommendation #25

2013-COM-0240 and 2013-COM-0016. The claimed savings values for insulation were adjusted downward to reflect a decrease in insulation performance over the life of the measure. The adjusted savings also take into account the jacketing material type (e.g., metal or plastic) of new insulation, which is likely to be more resistant to mechanical or moisture damage than baseline materials. Savings has been reduced by 25% to account for these effects.

Resolution:

The AC accepts, for 2013 only, the Auditor's recommendation for the purpose of reaching consensus although Union disagrees with the Auditor's findings.

The Audit adjustment decreased the cumulative natural gas savings for two audited projects by a total of 67,478 m3 from the verified value. The combined impacts of Recommendations #25, #27 and #33, which all reflect a downward adjustment to claimed savings from insulation, are a decrease of 54,843,165 net cumulative m3 from the verified savings and a decrease of approximately $460,000 to the total DSM shareholder incentive earned.

Commercial/Industrial Custom Projects

Specific Project Recommended Adjustments

Recommendation #26

2013-IND-0196.

This project involved a gas leak, which for safety reasons would require immediate repair. Therefore, this project should be considered part of a routine maintenance procedure that is required regardless of program incentives and therefore no savings should be awarded. Consequently, we have revised the savings to zero for this project.

Resolution:

The AC accepts the Auditor's recommendation but Union disagrees with the characterization of this project as a safety issue whose repair would be considered part of a routine maintenance procedure. The gas piping leaks at this facility were located on the roof, which emitted gas directly to the outdoor environment, and therefore did not pose a safety hazard.

The AC agrees that in the future Union will not claim projects involving fixing gas leaks for DSM savings.

The Audit adjustment decreased the cumulative natural gas savings for this project by a total of 223,192 m3 from the verified value.

Recommendation #27

2013-IND-0037 and 2013-IND-0055. The claimed savings values for insulation were adjusted downward to reflect a decrease in insulation performance over the life of the measure. The adjusted savings also take into account the jacketing material type (e.g., metal or plastic) of new insulation, which is likely to be more resistant to mechanical or moisture damage than baseline materials. Savings were reduced by 25% to account for these effects.

Resolution:

The AC accepts, for 2013 only, the Auditor's recommendation for the purpose of reaching consensus although Union disagrees with the Auditor's findings.

The Audit adjustment decreased the cumulative natural gas savings for two audited projects by a total of 2,306,247 m3 from the verified value. The combined impacts of Recommendations #25, #27 and #33, which all reflect a downward adjustment to claimed savings from insulation, are a decrease of 54,843,165 net cumulative m3 from the verified savings and a decrease of approximately $460,000 to the total DSM shareholder incentive earned.

Recommendation #28

2013-IND-0185. The audit EUL takes into account behavioral measures such as dock door closures and makeup air filter maintenance that have 5-year lives, while a 1-day/week temperature setback of 3 degrees Celsius is assumed to have 20-year life. Since the setback accounts for only one-third of savings and all other measures have a 5-year life, the savings-weighted average yields a 10-year life.

Resolution:

The AC accepts the Auditor's recommendation that multi-measure claims should use a savings-weighted average EUL. The Audit adjustment decreased the cumulative natural gas savings for this project by a total of 8,008,853 m3 from the verified value.

Recommendation #29

2013-IND-0177. Taking into account energy savings, the weighted average life of the components incentivized through Union yields a 15-year EUL for this project.

Resolution:

The AC accepts the Auditor's recommendation.

The Audit adjustment decreased the cumulative natural gas savings for this project by a total of 782,879 m3 from the verified value.

Large Volume Custom Projects

Specific Project Recommended Adjustments

Recommendation #30

2013-IND-0348. Coke oven gas (COG) impurities such as tars and naphthalene can be expected to accrete within the new pipeline at the same rate as the previously installed pipe. Consequently, this reduces COG capacity to the same capacity as the baseline equipment over the measure's life and results in an adjusted average savings equal to 50 percent of verified first-year savings.

Resolution:

The AC accepts, for 2013 only, the Auditor's recommendation for the purpose of reaching consensus. The Audit adjustment decreased the cumulative natural gas savings for this project by a total of 80,316,000 m3 from the verified value.

Recommendation #31

2013-IND-0123. The verifier assumed blowing losses equal to 50 percent for leaking traps. The adjusted savings assumes a more realistic estimate of 20 percent. Additionally, the repair of blocked traps is unlikely to have an effect on steam consumption, although properly operating traps have functional steam losses. The adjusted savings takes this into account and assumes blocked traps will have an increased steam consumption of 1.5 lbs/hour following repair.

Resolution:

Union accepts, for 2013 only, the Auditor's recommendation for the purpose of reaching consensus. The Audit adjustment decreased the cumulative natural gas savings for this project by a total of 924,140 m3 from the verified value.

Recommendation #32

2013-IND-0101. The base case should reflect conditions absent the efficiency measure in question (i.e. no HRSG) and the adjusted savings accounts for this. The absence of a HRSG indicates the absence of steam-driven chillers so the baseline assumption of an existing boiler powering steam-driven chillers is not tenable. Moreover, chillers were not installed at the time of verification. Regarding project measure life, a reasonable estimate for HRSG that is not in continuous use is 20 years. This is also the default value for custom projects. Insufficient evidence was presented in the CPSV report to justify a longer EUL.

Resolution:

The AC accepts, for 2013 only, the Auditor's recommendation for the purpose of reaching consensus although Union disagrees with the Auditor's interpretation of the project.

The Audit adjustment to gas savings decreased the cumulative natural gas savings for this audited project by a total of 11,987,600 m3 from the verified value.

In principle, Union disagrees with the Auditor's recommendation that custom project EULs should not be revised from the values established in the original program filing documents (discussed in Recommendation # 10). For this project, Union understands that the adjustment to EUL may result from insufficient evidence provided, on the part of the verifier, to support the change in EUL. As a result, Union accepts the adjustment to EUL for this project.

The Audit adjustment to EUL decreased the cumulative natural gas savings for this project by a total of 21,656,800 m3 from the verified value.

Recommendation #33

2013-IND-0450, 2013-IND-0451, 2013-IND-0179, 2013-IND-0072 and 2013-IND-0204. The claimed savings values for insulation were adjusted downward to reflect a decrease in insulation performance over the life of the measure. The adjusted savings also take into account the jacketing material type (e.g., metal or plastic) of new insulation, which is likely to be more resistant to mechanical or moisture damage than baseline materials. Savings has been reduced by 25% to account for these effects.

Resolution:

The AC accepts, for 2013 only, the Auditor's recommendation for the purpose of reaching consensus although Union disagrees with the Auditor's findings.

The Audit adjustment decreased the cumulative natural gas savings for five audited projects by a total of 52,469,440 m3 from the verified value. The combined impacts of Recommendations #25, #27 and #33, which all reflect a downward adjustment to claimed savings from insulation, are a decrease of 54,843,165 net cumulative m3 from the verified savings and a decrease of approximately $460,000 to the total DSM shareholder incentive earned.

Recommendation #34

2013-IND-0117. The verified project EUL is based on a weighted average of three components new greenhouse components with heating controls having an EUL of 10 years, and both structure and heating system having EULs of 30 years. The adjusted EUL modifies the structure and heating system EUL to 20 years, which yields a weighted average EUL equal to 14 years. Additionally, although the Virtual Grower software used to calculate savings did not provide savings by component, total project life should be based on an energy-savings-weighted average rather than component cost weights.

Resolution:

Union notes that this project was not based on a cost-weighted average EUL. Both the Large Volume custom project Verifier and Union employed a savings-weighted approach to determine EULs.

The AC accepts, for 2013 only, the Auditor's recommendation for the purpose of reaching consensus although Union disagrees with the Auditor's revision of the EUL for the reasons discussed in recommendation #10.

The Audit adjustment would decrease the cumulative natural gas savings for this audited project by a total of 2,877,300 m3 from the verified value.

Impacts of Audit Recommendations

Claimed Cumulative m3 savings

Recommendations that adjusted cumulative m3 savings had the following impact to values claimed in Union's pre-audit Annual Report.

Table 1 – Impact of Audit Recommendations on 2013 Cumulative Gas Savings (m3)

Scorecard	Union Pre-Audit Annual Report	Audit Findings	Difference
Resource Acquisition	1,029,760,592	920,774,950	-108,985,642
Large Volume (Rate T1, T2/ R100)	2,098,989,160	1,844,554,922	-254,434,238
Low Income	56,108,532	55,504,533	-603,999
Market Transformation	NA	NA	NA
Total	**3,184,858,284**	**2,820,834,405**	**-364,023,879**

Claimed DSM Incentive Amounts

Recommendations that resulted in adjustments to cumulative m3 savings had the following impact on the Utility DSM incentive values claimed in Union's pre-audit Annual Report.

Table 2– Impact of Audit Recommendations on 2013 DSM Utility Incentives

Scorecard	Union Pre-Audit Annual Report	Audit Findings	Difference
Resource Acquisition	$4,806,937	$3,143,206	-$1,663,731
Large Volume (Rate T1, T2/ R100)	$1,808,765	$1,362,407	-$446,358
Low Income	$2,728,501	$2,728,501	$0
Market Transformation	$550,259	$550,259	$0
Total	**$9,894,462**	**$7,784,373**	**-$2,110,089**

Claimed LRAM Amounts

Recommendations that adjusted cumulative m3 savings had the following impact on the Utility LRAM values claimed in Union's pre-audit Annual Report.

Table 3 – Impact of Audit Recommendations on 2013 LRAM Claim

Rate Class	Union Pre-Audit Annual Report	Audit Findings	Difference
South			
M1 Residential	$98,284	$86,465	-$11,819
M1 Commercial	$70,999	$70,144	-$855
M1 Industrial	$3,094	$3,094	$0
M2 Commercial	$263,581	$255,814	-$7,767
M2 Industrial	$52,341	$49,340	-$3,001
M4 Industrial	$58,463	$54,541	-$3,922
M5 Industrial	$284,675	$263,985	-$20,690
M7 Industrial	$6,072	$5,625	-$447
T1 Industrial	$5,718	$4,817	-$901

Rate Class	Union Pre-Audit Annual Report	Audit Findings	Difference
T2 Industrial	$6,003	$5,550	-$453
South Total	**$849,231**	**$799,374**	**-$49,857**
01 Residential	$43,687	$36,254	-$7,433
01 Commercial	$63,837	$63,710	-$127
10 Commercial	$161,766	$157,644	-$4,122
10 Industrial	$37,723	$37,530	-$193
20 Industrial	$21,202	$19,640	-$1,562
100 Industrial	$25,941	$23,983	-$1,958
North Total	**$354,156**	**$338,761**	**-$15,395**
Total	**$1,203,387**	**$1,138,136**	**-$65,251**

Union Gas Limited

Request for Proposal

Independent Audit of 2013 DSM Program Results

BACKGROUND

Union Gas Limited has been delivering Demand Side Management (DSM) initiatives since 1997 to its broad customer base. DSM activities include planning, developing, implementing and evaluating energy efficiency initiatives for residential, commercial, industrial and low income markets. Union Gas Limited's DSM activities are regulated by the Ontario Energy Board (OEB/Board) and adhere to the requirements as laid out in the newly implemented EB-2008-0346 DSM Guidelines for Natural Gas Utilities.

The OEB DSM Guidelines include two financial mechanisms: the Demand Side Management Variance Account (DSMVA) and the Lost Revenue Adjustment Mechanism (LRAM), with a provision for a DSM Shareholder Incentive.

The Guidelines establish an annual cap for the 2012 DSM Shareholder Incentive at $9.45M to be escalated for inflation in subsequent years. This cap was later increased by the Board to $10.45M to reflect the increased budget for the utilities' Low Income programs. In the new Guidelines, the DSM Shareholder Incentive is no longer based on TRC, but on scorecards with a focus on lifetime cumulative cubic meters of natural gas savings.

Program results are presented in a detailed Annual Report which is then subject to a third party audit. The 2013 DSM Annual Report contains a review of DSM program results and will be provided to the auditor.

As part of the new framework, the utilities worked with intervenor (active participants before the OEB) stakeholder groups to develop a "Joint Terms of Reference on Stakeholder Engagement for DSM Activities by Enbridge Gas Distribution Inc and Union Gas Limited" (hereto referred to as ToR) for the 2012-2014 Plan period.[1]

In accordance with the ToR, each utility will have an Audit Committee (AC). Comprised of three intervenor representatives and a utility representative, the goal of the AC is to ensure that there is, each year, an effective and thorough audit of the utility's DSM results.

---

[1] www.ontarioenergyboard.ca

OBJECTIVE

The primary objective of the audit is to provide an independent opinion to DSM stakeholders (i.e. the OEB, Intervenor consultative members, and the utility), that serves to determine if the DSMVA, LRAM and utility DSM Shareholder Incentive calculations are appropriate.

The auditor should include in their final report or subsequent memo an independent professional opinion in the following form, with or without qualifications:

We have audited the Annual Report, DSM Shareholder Incentive, Lost Revenue Adjustment Mechanism (LRAM) and Demand Side Management Variance Account (DSMVA) of Union Gas Limited for the calendar year ended December 31, 2013. The Annual Report and the calculations of DSM Shareholder Incentive, LRAM, and DSMVA are the responsibility of the company's management. Our responsibility is to express an opinion on these amounts based on our audit.

We conducted our audit in accordance with the rules and principles set down by the Ontario Energy Board in the DSM Guidelines for Natural Gas Utilities (EB-2008-0346). Details of the steps taken in this audit process are set forth in the Audit Report that follows, and this opinion is subject to the details and explanations therein described.

In our opinion, and subject to the qualifications set forth above, the following figures are calculated correctly using reasonable assumptions, based on data that has been gathered and recorded using reasonable methods and accurate in all material respects, and following the rules and principles set down by the Ontario Energy Board that are applicable to the 2013 DSM programs of Union Gas Limited:

DSM Shareholder Incentive Amount Recoverable - $x,xxx,xxx
LRAM Amount Recoverable - $x,xxx,xxx
DSMVA Amount Recoverable - $xxx,xxx

REPORTING STRUCTURE

2013 Union Gas Limited AC members are: Julie Girvan representing Consumers Council of Canada, Vince DeRose representing CME (Canadian Manufacturers and Exporters), Kai Millyard representing Green Energy Coalition, Tina Nicholson representing Union Gas Limited.

The AC members, together with the utility representative, endeavor to reach consensus on both a bidders list for the auditor RFP and selection of the winning bid. In the event consensus is not possible, the utility has responsibility for final selection of the firms on the bidders list and the non-utility AC members make the final decision on the selection of the auditor from among those submitting bids. In practice, consensus on both has been the norm.

The following excerpts from the ToR outline the primary function of the AC with respect to the Audit itself:

- "The auditor will receive guidance and direction from the AC (e.g., on the scope of work, draft work plans, and draft work products). However, the Auditor's report and effort will be independent of utility or intervenor control or influence."[2]
- The AC will make recommendations based on the Audit Report regarding the utility's claims regarding DSM results and DSMVA, LRAM, and utility DSM Shareholder incentives through the AC Report submitted to the Board.

The AC will also help to ensure that the process enables the utility to file the Final Auditor's Report and recommended DSMVA, LRAM and DSM Shareholder Incentive claims by June 30th as required by the Board's Directive and in keeping with the Guidelines.

While the AC will provide guidance and direction throughout the audit process, "The utility will administer the audit contract and hold the auditor accountable to the terms of the contract."[3]

The initial start-up meeting with the Auditor will be held with all members of the AC to ensure a consistent understanding among all parties of the scope and expectations of the independent audit. Additional meetings between all Committee members and the Auditor will be arranged for group discussion and progress reporting. Meetings will be held at Company offices or through conference calls as appropriate.

---

[2] Joint ToR on Stakeholder Engagement for DSM Activities by Enbridge Gas Distribution Inc. and Union Gas Limited, November 4, 2012, page 15 of 21.

[3] Ibid, page 15 of 21.

SCOPE AND REQUIREMENTS

The Auditor shall, at a minimum:

- provide an audit opinion on the DSMVA, LRAM and DSM Shareholder Incentive amounts proposed by the natural gas utility and any amendment thereto;
- identify any input assumptions that either warrant further research or that should be updated with new best available information;
- audit the reasonableness of Custom Project Savings Verification (CPSV) reports produced by independent 3rd-party engineering firms and, if necessary and appropriate, proposing modifications to custom C&I project savings realization rates;
- audit the reasonableness of any other work (e.g. studies of installation rates and/or persistence of installation of measures) that has been undertaken to inform utility savings estimates; and
- recommend any forward-looking evaluation work to be considered.[4]

The Auditor selected for this task will be expected to exercise his/her expert judgment to determine the elements of the audit, and to set the approach and process that will be followed in the audit in order to meet the regulatory requirements as stated above.

The deliverable will be a written report outlining the principles of the audit, the methodology followed, and the findings and recommendations of the audit, including an opinion in the form set forth above.

The following list outlines activities that are expected to be carried out for the purpose of this audit. The Auditor is encouraged to propose other tasks that they believe would be helpful in reaching the study objective.

Audit Activities

1. Consider and respond to stakeholder comments on Union Gas Limited’s Annual DSM Report for 2013, including those of the AC.
2. Review Union Gas Limited’s 2013 procedures for tracking program participants and determine whether they lead to accurate counts, particularly for programs that do not provide customer rebates.

---

[4] Ibid, page 17 of 21.Modified to reflect recent updates in requirements that have evolved.

3. Determine whether Union Gas Limited's reported values for participation, measure lives and gas savings are appropriate for calculation of LRAM and DSM Shareholder Incentive. This shall include assessing: (1) whether values are adequately documented by program records, evaluation studies and other relevant data; (2) where applicable, whether assumptions regarding measure lives and gas savings are in line with assumptions filed to the Board for calculation of the DSM Shareholder Incentive; and (3) the reasonableness of measure lives and savings for the calculation of LRAM and DSM Shareholder Incentive. The Auditor will be provided with a set of prescriptive measure assumptions, some of which have been reviewed and approved by the TEC. TEC-approved assumptions will be rebuttably presumed to be correct unless the Auditor has compelling information to the contrary.
4. Review measures that are considered advancements (sometimes called "early retirement" measures) rather than purchases at times of natural equipment replacement to ensure measure lives and gas savings are treated appropriately.
5. Review and verify the accuracy of all calculations leading up to the proposed DSMVA, LRAM, and DSM Shareholder Incentive amounts and verify that the calculations are consistent with the Board-approved prescribed methodology.
6. In accordance with OEB direction, Union Gas Limited, in consultation with their AC have retained independent third party engineering consultants to undertake a detailed review of the savings estimates for Custom Project Savings Verification (CPSV) for custom projects. The AC has made provision for the Auditor to work with the selected firm to enable the review of both the draft and final reports and an opportunity to discuss individual projects, any findings and adjustment factors recommended throughout the firm's review The Auditor will be expected to provide its independent opinion on all claimed results, including those that come out of the CPSV process. This will include its opinion on the reliability and reasonableness of the error ratio (and/or realization rate) from the CPSV reports when applied to a larger population of custom projects. Any recommendations to change realization rates from those recommended by the CPSV will be explained and substantiated by relevant research/documentation.
7. Any recommendations to change realization rates from those recommended by the CPSV will be explained and substantiated by relevant research/documentation.
8. The auditor will also review all verification studies conducted in support of the DSM Annual Report and ensure the conclusions are sound and that the results have been appropriately incorporated into the calculation of the DSM Shareholder Incentive.
9. Identify any assumptions underlying Union Gas Limited's DSM program design that should be modified prospectively, based on the auditor's experience, the results of the audit, and knowledge of other studies or data.

10. Identify future evaluation research opportunities to enhance the assumptions used to calculate the DSM Shareholder Incentive and LRAM.
11. Work with the AC and Union Gas Limited to resolve any relevant issues prior to completion of the audit.
12. Identify any other matters considered by the Auditor to be relevant to an assessment of Union Gas Limited's DSMVA, LRAM and DSM Shareholder Incentive claims.

Audit Resources

To assist the Auditor in conducting the audit, all relevant Union Gas Limited documentation will be made available to the Auditor for review. Union Gas Limited is committed to providing the necessary data and tools the Auditor deems reasonably necessary in order to meet the ultimate goal of the audit.

SCHEDULE

Following the Board Directive of December 2004, the independent audit of DSM results is to be completed and a recommendation filed with the Board by the last day of the sixth month after the financial year end.

Due to the importance to meet these Board imposed deadlines, the Auditor will be contractually bound to meet the deadlines outlined in their proposal. If due to the Auditor's negligence, the Auditor has not provided the AC with the deliverables, 10% of the amount payable to the Auditor may be deducted for each week beyond the deliverable dates specified herein that the Auditor has not provided the AC with the deliverables.

Audit Schedule	
Activity	**Due**
RFP Dissemination	February 10, 2014
Questions of Clarification	February 14, 2014
Proposals Due	February 21, 2014 – 3:00 PM E.S.T.
Contract Awarded	March 4, 2014
Auditor Work Plan	Week of March 10, 2014
Launch Meeting	Week of March 10, 2014
CPSV Draft Reports	Week of March 10, 2014
CPSV Final Reports	Week of March 28, 2014
DSM Annual Report sent to Auditor	April 1, 2014
AC & Consultative Comments on Annual Report	April 11, 2014
Draft Audit Report	On or before May 16, 2014
Response from AC	On or before May 23, 2014
Final Draft Audit Report	On or before May 30, 2014
Final Audit Report	On or before June 6, 2014

SELECTION CRITERIA

Proposals will be evaluated on the following criteria listed in approximate order of importance:

Qualifications & Experience of Project Team

Experience in Ontario and knowledge of the DSM regulatory framework for natural gas utilities;

Demonstrated ability to work with (and be viewed as credible and objective by) a variety of different types of stakeholders, including utilities, environmental groups, consumer groups and industry;

Experience to include both market transformation and resource acquisition programs for all market sectors   (residential, commercial, industrial, and low-income);

Qualification and experience of key project personnel in evaluation of natural gas utility DSM programs;

Relevant engineering experience (preference for a PEng), particularly in understanding Commercial and Industrial Custom Projects.

Approach

Quality, depth and clarity of writing in the proposal and work plan;

Logical presentation of a reasonable, clear, and comprehensive approach and method; and supporting rationale for approach including description of quantitative and qualitative assessments that will be conducted.

Cost and Administration

Reasonableness of cost proposal including allocation of dollars per task and team member;

Ability to work in Eastern Standard Time (E.S.T.) regular business hours.

MANDATORY PROPOSAL REQUIREMENTS

The proposal must include the following elements:

- A clear disclosure of any potential conflict of interest,
- A description of the methodology and approach to be used in the audit,
- A list of proposed tasks,
- Suitable information for the AC to determine the qualifications of individuals and their roles in the project:
  - Breadth of expertise in impact evaluations of gas DSM
  - Experience in developing deemed savings and/or review of year end savings calculations
  - Identify exact nature of historic experience with DSM in Ontario
  - Identify and describe technical expertise that the firm would bring to the role for the review of the CPSV
  - Focus on examples of experience in the past 5 years
- Confirmation that the proponent will be able to meet the Union Gas Limited contractor insurance and WSIB requirements.
- Confirmation of ability to meet timelines or specific reasons why a deviation from the schedule is required.

The cost proposal must include:

- Breakout of costs by task and roles,
- Assumptions regarding the number of meetings at the Union Gas Limited offices and the associated costs, and
- Hourly rates for additional related work such as appearing as an expert witness at the OEB.

Proposals are due no later than 3:00pm EST February 21, 2014. Proposals must be submitted in electronic format via email.

Questions of clarification should be directed to the utility representatives at the coordinates indicated below. Responses to questions of clarification will be circulated to all respondents.

Proposals must be sent to the attention of all stakeholders listed in Appendix A.

APPENDIX A – AUDIT CONTACTS

Union Gas Limited **Representatives**

Valerie Bennett - vbennett@uniongas.com
Tina Nicholson - tnicholson@uniongas.com

Intervenor Representatives:

Julie Girvan - jgirvan@uniserve.com
Vince DeRose - vderose@blg.com
Kai Millyard - kai@web.ca