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March 13, 2009

Ms. Kirsten Walli, Board Secretary
Ontario Energy Board
P.O. Box 2319
2300 Yonge Street, 27th Floor
Toronto, ON
M4P 1E4

By e-mail

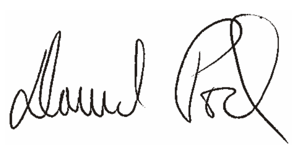
Dear Ms Walli:

Re: EB-2008-0346 Draft Measures and Assumptions for DSM Planning

As you are aware, BOMA, CCC, CME, GEC, IGUA, LIEN, LPMA, Pollution Probe and VECC cooperated in the pooling of cost eligible hours and the retention of Mr. Chris Neme of Vermont Energy Investment Inc. to comment on the Navigant draft measures and assumptions report.

Attached is the report of Mr. Neme *et al*.

Sincerely,



David Poch

Cc: all parties

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Comments on Navigant's Draft Gas Measure Characterizations

By: Chris Neme, Nick Lange and Kai Millyard

March 13, 2009

I. Introduction

VEIC was collectively retained by the Building Owners and Managers Association (BOMA), Consumers Council of Canada (CCC) Canadian Manufacturers & Exporters (CME), Green Energy Coalition (GEC), Industrial Gas Users Association (IGUA), London Property Management Association (LPMA), Low Income Energy Network (LIEN), Pollution Probe and the Vulnerable Energy Consumers Coalition (VECC) to review and prepare comments on the draft gas DSM measure assumptions developed by Navigant Consulting for the Ontario Energy Board (OEB). This document presents those comments. It begins with a brief discussion of several important policy issues that arose during our review. More detailed comments on individual measure assumptions follows.

In developing the comments, we not only reviewed what Navigant has written (and the other studies they referenced) but also held three separate conference calls with the Navigant authors to better understand what they did.

However, it should be noted that given both the extensive volume of material developed by Navigant and the relatively limited time and budget available to carefully review it, we have not conducted a detailed review of every measure analyzed and every assumption put forward by Navigant. Rather, we have focused on those measures that we expect will have the greatest potential impact on future utility DSM savings, TRC net benefits and SSM awards. In deciding which measures to address, we focused first on measures that have contributed at least $1 million to TRC net benefits for at least one of the two utilities in the past year. We also attempted to anticipate measures that, though not important in the past, may be important in the future. However, without being party to internal utility planning about future new programs, such predictions are necessarily uncertain. The measures we did not address are as follows:[1]

- #9 Radiator reflector panels
- #23 Solar pool heater
- #24 & 25 Residential Tankless water heater
- #36 Energy Star Fryer
- #37 High efficiency griddle
- #68, 69, 70 Commercial Tankless water heater
- #71 Multi-Family Clothes Washer

[1] For measures we did review, we generally did not review measure lives or market penetration/saturation estimates.

These written comments were prepared by and/or under the direction of Chris Neme. Nick Lange of VEIC and Kai Millyard of the GEC provided important support. Mr. Neme has filed regulatory testimony with the OEB on more than 15 occasions over the past 15 years. That testimony has focused on both natural gas policy questions and the DSM plans of the province's two large gas utilities: Enbridge and Union Gas. He has also served on the vast majority of the annual Audit Committees (or Evaluation and Audit Committees) of both utilities since their committees were first created in 2000.

The Table in Appendix A, reproduced from Navigant's report, includes a summary column with our high level recommendations for individual measures.

II. Over-Arching Policy Issues

1. Free Rider Rate Assumptions

Navigant appropriately notes in its summary document that it is inappropriate to develop prescriptive free rider rates for efficiency measures because free rider rates are a function of program design rather than the measure the program is promoting. We completely agree and support this conclusion.

2. Assumptions for Measures without Programs

Navigant has put forward assumptions for a number of efficiency measures that are not currently part of either gas utility's efficiency programs. We question the appropriateness of doing that. Measure costs and savings can also be significantly affected by program designs.

Consider, for example, air sealing (the first measure on Navigant's list). There are several different ways a DSM program could promote air sealing. One option would be to provide "do-it-yourself kits" of caulk and weather-stripping to consumers. Most of the air sealing that will result will be around doors, windows, outlets and other places that usually provide only very limited benefits. Another option would be to provide incentives for consumers to hire professional contractors who use a blower door to both measure air leakage and identify key leakage points, focusing primarily on leaks in the attic or basement (sealing those leaks provides greater savings than sealing those in the "neutral pressure plane" or middle of a house) and using a wider variety of materials to seal them. The savings, their useful life and costs will all be much greater under the second approach than under the first.

Thus, we suggest the Board adopt a policy that prescriptive assumptions not be put forward in the absence of a program design upon which they are based. Alternatively, if prescriptive assumptions for new measures are put forward, the measure descriptions need to be clear about the kind of program under which they are appropriate (or the way in which it is envisioned that they will be installed). Otherwise, the door will be left open for the utilities to claim savings and shareholder incentives for benefits that may not have occurred.

This issue affects measures 1, 2, 3, 8, 14, 23, 63, 64, 65, 68, 69, 70.

3. Measures that Fail Cost-Effectiveness Screening

Our preliminary analysis suggests that several of the efficiency measures for which Navigant developed assumptions fail cost-effectiveness screening as currently characterized (and with current avoided costs). We suggest the Board adopt a policy that prescriptive assumptions not be put forward for such measures. This affects measures 1, 2, 8, 14, 63, 69, 70.

4. Prescriptive Assumptions for Measures with Installation Variability

Only some kinds of measures should be considered good candidates for fully prescriptive assumptions. Others may be good candidates for quasi-prescriptive assumptions (e.g. as a function of size); still others are poor candidates for any prescriptive assumptions (except perhaps measure lives).

One key factor is variability of savings and costs. There are two key kinds of variability: (1) customer variability, and (2) installation variability. Customer variability is variability associated with differences in customer usage patterns. This variability can be reasonably addressed through use of average assumptions. As long as such assumptions are developed objectively and with good evaluation techniques, the utilities cannot easily "game the system" to claim excessive benefits. For example, once one develops a reasonable estimate of the average savings that will be produced by a more efficient residential water heater (assuming a market-wide program), there is no obvious way a utility could inappropriately alter the way they deliver a program to promote efficient water heaters to claim unrealistic savings.

Installation variability is another story. As noted above, air sealing can generate dramatically different levels of savings depending on the program design. However, even if the program design is known (e.g. even if it is professionally delivered, blower-door guided air sealing), the savings can be highly variable depending on how the measure is installed, how aggressively opportunities for sealing leaks are pursued, which buildings are targeted, etc. Similarly, savings from efficient commercial boilers will be highly variable depending on, among other things, the size of the heating load of the building. While heating loads vary for residential buildings as well, the range of variation is much smaller than for commercial buildings. Such measures should never be fully prescriptive. At best, they could be quasi-prescriptive (e.g. as a function of the volume of air leakage reduced). Navigant has appropriately proposed quasi-prescriptive savings and cost assumptions for a variety of measures (e.g. several types of commercial heating equipment). However, they have not done so for others (e.g. air sealing). The Board should adopt a policy that prohibits fully prescriptive assumptions for measures with significant installation variability.[2]

The following measures are affected by this issue: 1, 2, 3, 8, 14, 27, 38, 39, 40, 41, 42, 43, 44, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, and 67.[3]

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[2] Interestingly, Navigant appeared to agree with this principle in its summary report. On page 4 of that report it identified four key reasons why it did not propose prescriptive assumptions for some measures. The third reason had to do with what we call installation variability: "The savings or costs are highly variable and / or cannot be determined with any degree of certainty in advance (such as for building recommissioning and high efficiency new commercial construction). Such types of measures are better analyzed as 'custom' projects rather than as a single prescriptive measure, due to the large variability in the input assumptions."

[3] In most of these cases, Navigant proposed fully prescriptive savings estimates for measures which should be either quasi-prescriptive (i.e. a function of capacity, square feet of insulation, measured air leakage reduction, etc.) or custom (because savings are highly dependent on a mix of characteristics that are unique to each application). However, in a couple of cases – i.e. for pre-rinse spray nozzles and

5. Measure Lives for Custom Measures

The issue of useful lives for custom measures was not addressed by Navigant. However, it has been a key part of the utilities assumptions filings in the past. It is not clear whether this means that the Board does not intend to adopt such prescriptive assumptions. If the Board does intend to adopt prescriptive assumptions for custom measure lives, we recommend that it expand Navigant's scope of work to allow for an independent development of such assumptions. We also note that GEC strongly objected to what it considered to be a seriously flawed analysis underlying Enbridge's proposed change in measure life for industrial steam traps for 2008. That flawed assumption was subsequently adopted by the Board. We presume that the Board was in a difficult position in making that decision – more specifically, that it did not have the technical expertise necessary to pass judgment on two competing positions. However, now that it has Navigant under contract, it has the ability to obtain an objective assessment. We attach as Appendix B Enbridge's material and GECs concerns.

6. Process questions

The current process of the Board seeking advice from a consultant is a change from past practice and a number of ongoing processes that have been overseeing evaluation work and refining assumptions for a number of years. It is not entirely clear how the current process is intended to fit into existing processes or the new guidelines. For example, a number of evaluation studies are in progress and will be finalized shortly, and so may produce better values for use for 2009. How are these to be incorporated? Would the LDCs be obliged to use values in the final Navigant list for their 2010 DSM planning even if they have newer information?

Second, what is the status of the process going forward? Will the Board hire an independent third party to update prescriptive assumptions only in advance of a future multi-year plan? Will the Board seek third party advice annually to approve revisions arising from annual DSM reports and audit processes? Or does the proposed policy to require final annual results claims based only on the 'best available information' obviate the need for such a list of 'pre-approved' assumptions?

One option for managing the new information and amendments could borrow from the process used by the OPA. Its assumptions and measures list is posted on its web site, and includes a process for comments and submissions on them.[4] An even more open and transparent process that could accept comments, evaluation studies and other new information would help keep relevant information in one place and accessible by all stakeholders, whatever the process for actual review and adoption of changes.

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commercial condensing water heaters – our concern is the obverse. Specifically, Navigant proposed that savings be a function of usage that cannot be reasonably expected to be accurately measured for each participant.

[4] http://www.powerauthority.on.ca/Page.asp?PageID=122&ContentID=6247&SiteNodeID=483&BL_ExpandID=

III. Specific Measure Assumptions

What follows are comments on specific measure assumptions put forward by Navigant in its draft documents. The comments are organized according to Navigant's measure numbers. In some cases, comments on groups of common measures are presented together.

 # 10, 11, 12, 53, 54, 55 Condensing furnaces in residential and small commercial replacement, and commercial new construction 90%, 92%, 96%

1. Navigant treats the baseline here as 80% efficient furnaces. However mid efficiency furnaces have been banned in Canada as of December 31, 2009 by publication of the regulation in the Canada Gazette in December 2008. http://oee.nrcan.gc.ca/regulations/bulletin/gas-furnaces-dec08.cfm?attr=0 In addition, in 2008 the Ontario Ministry of Energy published its intention on the Environmental Bill of Rights Registry that it intends to incorporate the same requirements into Ontario's Energy Efficiency Act Regulations, effective June 1, 2009.[5] Therefore all of these measures as drafted should be deleted. There is an outside possibility that a 96% furnace may be cost-effective relative to a different baseline (not 80%), however the baseline for replacement condensing furnaces is currently roughly 93%. In the absence of filed information on this small niche situation, it should not be included in the Board's list. If either LDC wished to investigate and develop this option, they are free to do so.

 # 6, 7: Condensing furnace with ECM – residential New Construction

2. Navigant proposes a new measure not in any current program of the 2008 measures list. First, the summary table is not consistent with the substantiation sheet in that the summary suggests the base equipment is a mid-efficiency furnace, although the listed increase in gas load and substantiation sheets correctly reflect the legal minimum is 90% in new construction as a result of the Ontario Building Code. This proposed new measure then is for the gas LDCs to use DSM funds to promote furnaces where the only savings is electrical savings due to the improved furnace fan motor. Since less electric waste heat from the fan means more gas burning is needed, the measure increases space heating gas load by almost 10% in some cases.

   The new measure involves policy rules. While the OEBs guidelines supports including the value of savings of other resources in gas DSM programs, they do so only when these savings are incidental to saving gas. There is no OEB rule indicating that gas LDCs should operate DSM programs where the only beneficial result is the saving of electricity, or that they may earn shareholder incentives on programs of this type. In addition, this measure results in gas load building,

[5] Implementation of this regulation has been delayed due to the incorporation of the EEAct into the Green Energy Act.

which the LDCs already have plenty of incentive to pursue outside of the DSM portfolio. As a result the measure should be removed from the list.

 # 4 & 5: Condensing furnace with ECM – residential existing homes

3. This is exactly the same as measures 6 and 7 except that the baseline is 90% as a result of the federal ban on mid efficiency furnaces for 2010, not as a result of the Ontario Building Code. The measure should be removed from the list.

 # 47, 48, 49, 50 Condensing furnace with ECM – Small commercial New construction and replacements

4. This measure, analogous to measures 4, 5, 6 and 7, produces electric savings but increased gas consumption. It should be deleted as a load building program which OEB rules exclude from DSM funding.

 # 1, 2, 3, 8, 14 Residential building envelope retrofit measures: Air sealing, basement insulation, attic insulation, Energy Star windows, wall insulation.

5. This group of measures are all proposed by Navigant as new measures to be available for new programs.

6. The LDCs have had programs using these measures in the past. They have been phased out in recent years for a number of good reasons. The main reason is that the federal and provincial governments operate a very large residential retrofit program called ecoENERGY. This program uses Canada's home energy rating system and software to provide customized audits and incentives to homeowners that are based on measured air leakage rates before and after, and actual areas that are insulated, actual R values before and after and actual furnace efficiency in each house. The government's budgets for the program[6] exceed both gas LDCs budgets for their entire DSM portfolios, and the incentives are averaging almost $2,500 per participant. With the LDCs limited resources and a well funded residential retrofit program being operated by others the LDCs have withdrawn from this area and work in other areas. In our view this makes sense and as a result these measures should be deleted from the list.

7. A second concern is that costs and savings for measures like these are better done on a custom basis rather than a prescriptive basis, as discussed above. For example, the degree to which attic insulation saves energy is a function of the area insulated, the R values before and after, and the efficiency of the furnace in use. Most modern residential retrofit programs (like ecoENERGY, or low income

[6] The provincial budget is $112 million over 5 years and the recent Federal Budget included $300 million to extend the program for the next 2 years.

weatherization programs) consider these variables on a customized, integrated basis to produce more accurate savings estimates.

8. If prescriptive savings are to be developed for individual measures, it is critical that the average values developed represent either the average of what is likely to occur, or that the program design includes specific guidelines to ensure installations are limited to those that will produce the averages in the assumptions. In these cases no program or program design exists. A proper process for developing these values would be to develop a program design and in an iterative manner to develop the screening assumptions. Below we review the individual measures and documentation provided for whether the provided inputs are likely to be reasonable estimates.

9. We do not consider electrical savings in detail, although Navigant's estimates appear to assume that all houses have central air conditioning [CAC] and overestimate electricity savings as a result, since roughly half of Ontario houses have CAC.

10. All of the residential retrofit measures below mismodel the furnace in the HOT2000 file, inflating savings. While an 80% AFUE furnace is likely a reasonable midpoint heating efficiency, the HOT2000 run should use an "induced draft fan" furnace to simulate it. This reduces baseline consumption by 20%.

Air leakage control

11. This is an extremely difficult measure to estimate savings for in the abstract. Likely savings depend entirely on the program design. For example, if the program was a do-it-yourself program it is very likely that extremely small savings would be produced. If the program was target marketed to leaky houses and delivered as a professional service that uses a blower door during the work to identify and seal leaks, larger savings than proposed could be available on average.

12. If a dedicated program like this were to be created, savings should be quasi-prescriptive, based on a measured reduction in air leakage. Similarly, incremental costs for draftproofing are highly variable, and should be recorded as custom inputs. Over time they may be able to be converted to semi-prescriptive, tied directly to the measured air leakage reduction as well.

Basement insulation

13. We make a number of corrections and adjustments to Navigant's HOT2000 derived savings estimate:

- Furnace modelling corrected as above
- Raise basement to 2' above grade, which is average, rather than 1'

- Add 4 small windows, rather than none
- Change basement temperature to 60 degrees Fahrenheit from 66, which will be more typical for older uninsulated basements
- Correct insulation modelling from Specified R to a proper wall model with framing and drywall
- Assume 50% of basements included some semifinished wall (strap and panelling) before insulating
- Delete basement floor insulation from model, and change wood foundation to concrete
- Insulate 75% of walls, not 100%. It is very uncommon to be able to access and insulate all walls of an existing basement.

14. The resulting savings estimate is 43% higher than Navigant's at 340 m^3/y rather than 237 m^3/y.

15. Navigant lists the incremental costs at $1,645 for basement insulation (based on $2/$ft^2$), which does not include lumber or drywall. Even with these incremental costs however the measure does not pass TRC testing, either with Navigant's gas savings estimate, nor with our result. The measure should therefore be deleted in this prescriptive form. If a customized program were developed the specific basement insulation opportunities that are cost effective could be identified and incented where appropriate.

Attic insulation

16. Attic insulation savings are highly sensitive to the starting level of insulation in the attic. Navigant reports that it assumes R10 as a starting level[7], increasing it to R40. We have adjusted Navigant's HOT2000 file to correct modeling errors:

- Furnace modeling corrected as above
- R value modeling corrected from specified R to use actual construction material Codes, which can significantly change before and after R values. Navigant effectively used upgraded insulation values considerably higher than R40, and did not take into consideration the true effective R values of the ceiling when thermal bridging and insulation compression from actual construction materials and configuration are considered. We also adjusted the joist framing to 16" centres, more likely than 12".

17. The resulting savings estimate is 16% lower than Navigant at 291 m^3 rather than 348 m^3/y. However, savings are so sensitive to the base level that attic insulation programming should only be done on a custom basis. If the ecoENERGY

[7] Our Ontario *Energuide for Houses* database shows that the average R value of ceilings where insulation was recommended was R-16, not R10. This would lead to much lower savings than estimated by Navigant. For this exercise we maintain the use of Navigant's R10 of insulation.

program were not operating, savings estimates, or an approach to using customized savings estimates, should be developed along with a program design.

Energy Star Windows

18. High performance window programs have been phased out in Ontario. Enbridge sponsored a market share study a few years ago and found that roughly 80% of the market already installs high performance windows. Navigant cites a similar finding by NRCan. Therefore this technology is ready for regulation to capture the remaining market share in a minimum legal standard, not for a new resource acquisition program. In fact in 2008 the Ontario Ministry of Energy announced its intention to regulate a minimum standard for windows in January 2010 under the Energy Efficiency Act, "similar to the requirements… in the Ontario Building Code". While implementation of this regulation has been delayed due to the incorporation of the EEAct into the Green Energy Act, the government's Green Energy Act announcements make clear that it plans on using Energy Star as the basis for minimum standards.[8] Using Navigant's savings and incremental cost values this measure fails TRC testing. The measure should be dropped.

Wall insulation

19. Similar to attic insulation, the savings produced by wall insulation are highly variable, very sensitive to area insulated, and to before and after R-values. The particular increment proposed by Navigant in its draft (from R8 to R19) is an extremely unusual and expensive interval to expect as a typical wall insulation project. To start, R8 is a very unusual starting point for a wall R-value. Second, to increase it to R19, it would be necessary to demolish the inner wall covering and add wall thickness to accommodate more insulation, then rebuild the wall surface and replace all the door and window trim – a very disruptive and expensive project. In the alternative, the house could be wrapped from the outside with a significant layer of insulation and covered with siding or stucco, again an upgrade requiring tens of thousands of dollars.

20. Navigant's HOT2000 modeling used to estimate savings has been corrected as follows:

- Furnace modeling corrected as above
- R value modeling method corrected from specified R to use actual construction material Codes, which changes before and after R values (although maintaining R8 and R19 levels).

The result is a reduction in savings of over half to 197 m^3/y.

21. Navigant's proposed incremental cost is just $2.50 per ft^2, which again includes only the "insulation material and labour but not the costs of wall removal and

[8] http://www.mei.gov.on.ca/english/news/?page=news-releases&news_id=28&body=yes

reconstruction." However, even using Navigant's higher savings and low incremental costs ($2,360) the proposed measure fails the basic measure TRC screen. OEB rules prohibit programs that are not cost effective.

22. The most common wall insulation opportunity would add R-12 of insulation to an empty 2x4 frame wall, which is likely to be cost-effective. Costs and savings should be custom and expressed on a per ft^2 basis within any proposed program design.

#13 & 26: Programmable Thermostat (Residential and Low Income)

23. Navigant references three studies as the basis for its estimate that programmable thermostats generate 6% heating season savings. It is not clear whether each of these studies estimated savings as the difference between typical consumption before and after installation of a programmable thermostat. The description of at least one of them (CCHT) suggests it may have simply estimated the difference between consumption when one does night-time setback and when one doesn't. That approach would not account for (1) the percentage of customers who practice manual setback with non-programmable units (various studies suggest this is high); (2) the percentage of customers who don't program their thermostats; and (3) the percentage of customers who replace an existing programmable unit with a new programmable unit. As a result, it would overstate "real world" savings.

24. Navigant's estimate of cooling savings appears to implicitly presume that (1) *every* home does a 3 degree setback during the day; (2) no home would have practiced manual setback during the day; and (3) every home has a central A/C.[9] All three of these assumptions can lead to significant overstating of cooling savings

25. Navigant's estimate of cooling savings assumes that the average baseline SEER is 8.7 – something that hasn't been legal to sell for nearly 20 years. NRCan data for Ontario suggest that the real average is probably more like 10.7 in 2010.[10] This assumption alone leads to a nearly 20% overstating of cooling savings.

26. Navigant appears to be assuming furnace fan savings of 44 kWh. The baseline assumption for furnace electric use appears to be over 2,300 kWh – more than a factor of two more than any study of such use would suggest. For example, a

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[9] NRCan estimates that only about 2.5 million of the 4.7 million households in Ontario (i.e. 53%) have central cooling. On the phone Navigant suggested it had data to suggest that the saturation among natural gas users was more like 70%, though we haven't seen a reference for such an estimate.

[10] NRCan estimates that the average stock efficiency in Ontario in 2006 was SEER 10.3. The average stock efficiency has been increasing by about 0.1 per year. See http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/tablestrends2/res_on_27_e_3.cfm?attr=0

detailed study of furnace fan use in Wisconsin suggests an average of about 1 kWh per therm (0.35 kWh/m^3) for standard furnaces and 0.5 kWh/therm (0.17 kWh/m^3) for furnaces with efficient fans.[11] Using Navigant's assumptions of typical Ontario gas heating energy use of 2,436 m^3, that translates to 425 to 850 kWh per winter.[12] An ACEEE report suggests similar levels of furnace fan consumption.[13]

#15, 16, 28, 29, 72, 73: Faucet Aerators – Kitchen & Bathroom (Residential, Low Income and Multi-Family)

We have eight concerns that apply to all of the different faucet aerator measures. Where possible we've provided estimates of the impacts on savings that Navigant has provided. Note that there are interactive effects from making multiple corrections.

27. Navigant's savings estimate is calculated using a formula that assumes the efficiency of water heating is 57%. While it is true that the typical water heater has an energy factor of 0.57, Energy Factors are average annual efficiency values that reflect the fact that gas water heaters lose a lot of energy through stack losses in stand-by mode – however stand-by losses are not reduced by water conservation measures. A review of GAMA data suggests that a typical instantaneous recovery efficiency – which is the efficiency at which cold water is turned into hot – is more like 75% to 80% (we suggest an average of 78%). Correcting this error will reduce savings estimates by 25% to 30%.

28. Navigant's savings estimate assumes average daily faucet use of 14 gallons. That is high relative to most commonly quoted value of 10.9 (including the U.S. Environmental Protection Agency's "water sense" documents).[14] Adopting this lower water usage assumption will further lower savings by approximately 20%.

29. Navigant's savings estimate assumes an average water inlet temperature of 45 F. That is nearly 4 degrees colder than the 48.8 F average that the City of Toronto reports for its water system.[15] Revising the assumption to the actual Toronto average will reduce Navigant's estimated delta T (and therefore estimated

[11] Scott Pigg (Energy Center of Wisconsin), Electricity Use by New Furnaces: A Wisconsin Field Study, prepared for the Wisconsin Focus on Energy Program, October 2003.

[12] The same report notes that consumption if furnace fans are run continuously (rather than just when heat is needed) is substantially higher. However, under such conditions there would be no electrical savings from thermostat set-back.

[13] Sachs and Smith, Efficient Air Handlers for Gas Furnaces in Northern Climates: Electricity Savings from Efficient Air Handlers in Massachusetts, ACEEE Furnace Fans Project #4, December 2002.

[14] For example, see: (1) http://bcn.boulder.co.us/basin/local/wateruse.html; (2) http://www.h2ouse.org/tour/details/element_action_contents.cfm?elementID=1D4BABB7-8E4C-4524-98836EECCC5AEE08&actionID=11252FC5-E889-45A5-A088549C8CF50361; (3) http://www.epa.gov/watersense/docs/home_suppstat508.pdf.

[15] Personal Communication, Andrea Gonzalves, City of Toronto Works Dept, March 4, 2009.

savings) by 8.4%. Navigant also uses the 45 F inlet temperature in the characterization of measures #17-21, 30-34, 63-65, 68-70, and 74-78.

30. Navigant's savings estimate assumes that the average water temperature of water coming out of each faucet, over the course of a year, is 90 F (32 C). That assumption is based on two studies from warmer climates: one from California and the other from Seattle. That average temperature is a mix of use at high temperatures (typically 100 F (38 C)) and use at lower temperatures. One would not expect the temperature of hot water use to be appreciably different in Ontario than in warmer climates. However, the temperature of water used at low temperatures (e.g. when someone is filling a glass of drinking water) will be primarily a function of the water inlet temperature. Thus, averages across all uses from warmer climates with higher water inlet temperatures will be higher than averages across all uses in Ontario. For example, one could impute that the California study suggests inlet water temperatures there are 62 F and that 65% of all faucet use is for hot water.[16] If one assumes that the same percentage of faucet water use is "hot" in Ontario, the average annual temperature of water would be 81 F.[17] That would reduce Navigant's estimated delta T – and savings – by 20%.[18] Combined with the point above, the reduction would be 26%.[19]

31. The water savings values Navigant has computed appear accurate given the assumptions they used. However, they do not appear to come out of the formula presented in Appendix B (i.e. the formula used to generate the values was correct, but the formula written into the document is not). The correct formula should be as follows:

Savings = Fu * Ppl * 365 * Ba * Dr * ((FLBase – FLEff)/FLBase)

32. The comparisons that Navigant uses to demonstrate that its savings are in a reasonable range are misleading. First, only one of the two comparables are for a similar 0.7 GPM reduction from baseline faucets to efficient faucets. The second comparison (from Iowa) is for more than twice that reduction. Second, the values used in the two comparisons do not distinguish between kitchens (where savings are much larger) and bathrooms (where they are smaller). When the Iowa savings are adjusted down to reflect lower GPM savings per unit assumed in Ontario, the two comparables provide a range of 8 to 15 m^3 for a combination of bathroom and kitchen aerators. By comparison, the Navigant proposal produces an average of 24 m^3 (assuming half bathroom and half kitchen) – or 70% to 200% higher.

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[16] The report says that 8.6 of the 13.2 gallons (i.e. 65%) of water used per day are hot water. If the average hot water temperature is 100 F, and the average annual temperature is 90 F as Navigant suggests, then the average cold water temperature would be 71 F [(0.35 * 71) + (0.65 * 100) = 90].

[17] Note that we are not suggesting that the water inlet temperatures in California or Seattle are 75 F. We do not know what they are and cannot know without further research. However, they are almost certainly more than the 45 F estimated for Ontario. Even if they were only as high as 60 F, the impacts on Navigant's savings estimate would be a reduction of 10%.

[18] (0.35 * 48.8 F) +(0.65 * 100F) = 82 F

[19] (82 - 48.8) / (90 - 45) = 0.74

33. Navigant estimates an incremental cost of $2 for a low flow faucet aerator. That is for the hardware only. The vehicle through which measure is delivered sometimes involve installation costs too which are not addressed here. That should be made explicit.

34. Navigant assumes an average measure life of 10 years. That seems reasonable for the useful life of the physical hardware. However, if the program replaces an existing model that is on average half way through its life (i.e. it is an early retirement), then the baseline efficiency against which savings are calculated would change halfway through the measure life. That change would be a function of the likely efficiency of a new showerhead the customer would buy. Thus, we suggest an average measure life of only 5 years is more appropriate for the savings in the context of the utilities' program designs. For what it is worth, that is also more consistent with the two comparables provided.

 # 17-21, 30-34, 74-78: Low Flow Showerheads (Residential, Low Income and Multi-Family)

We have six concerns. Most cut across all of the different showerhead measures. However, some are specific to Enbridge showerhead (numbers 19-21, 31-33, and 75-77). Where possible we've provided estimates of the impacts on savings that Navigant has provided. Note that there are interactive effects from making multiple corrections.

35. As with faucet aerators, Navigant's showerhead savings estimates are calculated using a formula that assumes the efficiency of water heating is 57%. While it is true that the typical water heater has an energy factor of 0.57, Energy Factors are average annual efficiency values that reflect the fact that gas water heaters lose a lot of energy through stack losses in stand-by mode. However, standby losses are not reduced by water conservation measures. A review of GAMA data suggests that a typical instantaneous recovery efficiency – which is the efficiency at which cold water is turned into hot – is more like 75% to 80% (we suggest an average of 78%). Correcting this error will reduce savings estimates by 25% to 30%.

36. As with faucet aerators, Navigant's savings estimate assumes an average water inlet temperature of 45 F. That is nearly 4 degrees colder than the 48.8 F average that the City of Toronto reports for its water system.[20] Revising the assumption to the actual Toronto average will reduce Navigant's estimated delta T (and therefore estimated savings) by 8.4%.

37. After talking with Navigant it is clear that what the way they treated "as used flow" is appropriate. However, the explanation in footnote 6 is not as clear as it could or should be.

[20] Personal Communication, Andrea Gonzalves, City of Toronto Works Dept, March 4, 2009.

38. Navigant estimates an incremental cost of $6 for a low flow showerhead. That is for the hardware only. The vehicle through which the measure is delivered sometimes involves installation costs which are not addressed here. That should be made explicit.

39. One of the two comparable studies cited by Navigant – the U.S. Department of Energy's Federal Energy Management Program (FEMP) – is quoted as suggesting savings of 81%. That is appears mathematically impossible given the types of showerheads being discussed. There is obviously something problematic with the FEMP reference.

40. It is unclear whether Navigant's proposed savings and costs for the Enbridge showerheads are intended to be per showerhead or per household. The 76% factor for the percentage of household showers affected that Navigant uses to both water and energy savings estimates comes from a 2008 Summit Blue evaluation. As that evaluation makes clear, the 76% factor represents the impact at the household level in Enbridge's case because it was derived from survey responses to the question about the impacts of the program and Enbridge's program design delivers more than one showerhead per household.[21] Indeed, the savings estimates developed by Summit Blue in that report are presented as per household estimates.[22] This also has implications for incremental costs, as it appears as if Navigant has used a per measure incremental cost. That cost should be adjusted upward by the average number of showerheads per household that the Enbridge program installs. It is also worth noting that the utilities and their Evaluation and Audit Committees agreed in 2008 that the 76% adjustment factor would be refreshed each year with the results of a new survey, with final savings adjusted accordingly. This raises questions about the appropriateness of using the 76% value for 2010, rather than making the prescriptive savings explicitly a function of the results of new research. One solution to this concern, would be to make clear in the substantiation sheets that the 76% value is a placeholder to be modified, with related impacts on per measure or per household savings, to be made at year's end.

 # 22, 35: Pipe Insulation

41. As with faucet aerators and showerheads, savings were calculated using an average water heater annual Energy Factor of 0.57 rather than a typical recovery efficiency of 0.78. See above for more detailed discussion of this error.

42. The incremental cost shown is for the insulation itself. It does not include any installation cost. That is probably why the comparables cited all show much higher costs. This distinction should be made clear so that if the programs or

[21] Summit Blue, *Resource Savings Values in Selected Residential Prescriptive Programs*, submitted to Union Gas and Enbridge, June 23, 2008; p. 8.

[22] Ibid., p. 13.

customers (through a contractor they hire) incur installation costs, such additional costs are captured in TRC net benefits calculations.

 # 27: Low Income Weatherization

43. Specifically, it is not a measure that should have a prescriptive savings and incremental cost assumption. There are two reasons for that conclusion. First, savings and costs can be highly variable, dependent on program design, the homes targeted for treatment, structure of the contract with service providers, etc. Second, unlike measures like thermostats or furnaces or showerheads for which it is both too expensive and too cumbersome to expect to collect site-specific data that would enable more accurate savings, site-specific savings and costs should be developed and collected as part of weatherization initiatives (audits are conducted both pre- and post-retrofit). Thus, we recommend that this measure be deleted from any prescriptive list.

 # 38, 39: Air curtains – Single and Double door (Commercial)

44. The performance of air curtains is very site specific. It is affected by a large number of variables and conditions of air on either side of the air curtain[23]. Unfortunately, they are cost effective retrofit measures only under certain conditions. It is likely that the benefits of this prescriptive approach would be undermined by measures installed in the majority of situations where savings are non-existent or negative (see additional comments below). The high sensitivity of this measure's performance to site parameters strongly favors a custom approach that would assure installations only in cost-effective situations. In other words, this is not a measure for which there should be prescriptive savings estimates.

45. Navigant savings estimates are predicated on several assumptions including outside temperatures and wind speeds. They estimate that roughly 80% of heat loss through doorways without air curtains is due to wind. That assumption is in turn based on a constant average wind into the door of 10mph for the entire winter. These speeds are far too high for two main reasons. First, the speeds used are from data taken by anemometers at a 10m height. Wind speed increases considerably with height, particularly in built-up areas, and is near zero at ground level[24]. Second, Navigant's savings estimates implicitly assume the wind is always blowing in the direction into the door. That will clearly not always be the case. Indeed, if door direction is random, one would expect it to be facing prevailing winds no more than one quarter of the time. These errors grossly overstate presumed infiltration, and the resulting savings estimates.

[23] Theodoros C. Pappas Savvas A. Tassou, ASHRAE, *Numerical Investigations into the Performance of Doorway Vertical Air Curtains in Air-Conditioned Spaces*

[24] http://www.windpower.org/en/tour/wres/shear.htm

46. Navigant's analysis only considers the temperature of the inside and outside of the door. Ignored is the temperature of the air that makes up the curtain. This air is commonly heated for comfort reasons. Heated air curtains have reduced efficacy due to the effects of buoyancy and additional energy losses from the curtain itself. Once the energy associated with heating this air and the additional related losses are accounted for, the energy savings argument in favor of this measure is reduced or completely lost.

47. Also not considered are changes in facility behavior after the installation. Retail establishments in particular benefit from welcoming customers, and the buffer of comfort from an air curtain can induce them to leave their doors open longer and more frequently as a result. Vendors of such products often tout this change as part of the benefits of installing these doors. It is safe to assume that some will take advantage of this. Conversely, it is not at all likely that after the installation facilities will see the amount of open door time fall. The result being on average a net increase in open door time. Given Navigant's working baseline assumption of 1 hr of open door time daily, even modest average increases in the length of time the door is open would have dramatic impacts on energy use. Failing to account for this likely increase will overstate savings claims.

 # 40: Condensing Boilers – Existing (Commercial)

48. As there is no performance test standard for seasonal efficiency, it is impossible to reach any reliable conclusions about "average" seasonal efficiencies even in the projected seasonal efficiency of new boilers.[25] The inclusion of such estimates of seasonal efficiencies here is questionable, and the value of the resulting estimates are bound by a margin of error so broad as to be without meaning.[26] Thus, if a prescriptive savings assumption is to be put forward and used, there needs to be more discussion of the rationale behind the baseline assumption being proposed, including discussion of they key variables that affect efficiency. To justify even a quasi-prescriptive assumption, such variables need to be easily identified and routinely tracked.

49. A significant energy saving aspect of condensing boiler installations has been disregarded here. Conventional boiler systems must operate at higher loop temperatures to protect against corrosion from exhaust gases. The capability of condensing boilers to operate at lower temperatures provides greater savings than the analysis of estimated seasonal efficiency alone would indicate[27]. As an example, Navigant's sample calculation estimates average savings of 13.6%. In contrast, the very article that Navigant references found an average savings of

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[25] draft Boiler Base Case Efficiency Study, SeeLine Group Ltd Report to Union Gas Ltd, January 30th, 2009

[26] Even performance standard thermal efficiency market data for retrofit boilers sold must be bound by a margin of error (±8%) a range which is inclusive of nearly every boiler available. *(ibid.)*

[27] Estimates based on "Boiler System Efficiency", Thomas H. Durkin, ASHRAE Journal, July 2006

49% for a collection of schools in the same size range that Navigant analyzed.[28] Thus, this may be a case in which Navigant's proposed prescriptive assumption significantly understates savings in the most typical applications of the measure. The concern expressed in this point also underscores the point above – that the key variable to savings is not the efficiency rating, but rather the system configuration and operation. Again, this raises the fundamental question about whether this measure should even be quasi-prescriptive.

50. There appears to be an error in the calculation of the incremental cost. The factor used to account for the exchange rate (1.1) was applied inversely. In other words, Navigant's calculation assumes that Canadian dollar is worth more than the American dollar. While that may someday be the case, it is not today! This results in a cost estimate that is 22% low.

 # 41-43: Demand Control kitchen Ventilation– Existing (5,000, 10,000, 15,000CFM)

51. The savings associated with this measure appear to be largely a capacity of the system. Unless a case can be made to the contrary, this measure should be quasi-prescriptive, i.e. a function of CFM capacity rather than fully prescriptive.

52. The entirety of the gas savings for Navigant's analysis comes from multiplying an air-flow derived baseline heating load by (1-"the estimated average make-up air RPM factor"). At the highest level the approach seems reasonable, however, the reasonableness of their savings estimates is a function of the underlying assumptions used to compute the RPM factor. Regrettably, Navigant has not explained how this factor was estimated, or documented the basis for any of the underlying assumptions. This makes it impossible to pass judgment on the reasonableness of their proposal. It is worth noting that compared to the utilities 2008 savings estimates Navigant's are larger by 31%, 93%, and 73% for the 5,000, 10,000, and 15,000 CFM measures respectively.

53. With respect to electric savings, Navigant presents three tables which estimate the reduced runtime hours of the exhaust fan motors, but they do not indicate the basis for the new load distribution, nor do they explain why the distribution is distinctly different for each of the three cases. (For example the 5,000 CFM measure table shows the fan running at 60% RPM for 15% of the time, while the 10,000 CFM measure spends 30% of its time at 60%.) The impact of these differences is significant in two ways: 1. the weighted average fan speed may be related to Navigant's "estimated average make-up air RPM factor" and directly impacts the claimed gas savings. 2. Fan speed is a very significant, exponential factor of calculated electrical savings (for example slowing a fan from 100 to 80% speed cuts the energy consumption roughly in half) so small changes in the distribution of fan speed run time can have a very significant impact on the

[28] These savings appear to be an upper limit of savings because their baseline was an old existing boiler. New standard efficiency boiler will be more efficient.

electrical savings numbers. The outcome of Navigant's estimates result in electrical savings that are higher than the 2008 values by 87%, 35%, and 22% for the 5,000, 10,000, and 15,000 CFM measures respectively.

54. Navigant assumes motor sizes that seem appreciably larger than what we would expect. In the 5,000 CFM measure for example, Navigant assumes a 5 HP motor, but the Melink report cited elsewhere in the substantiation sheet includes several case studies that indicate that something in the range of 2 to 3 HP would be closer to the mark. This would suggest that their savings estimate is high by a factor of two.

55. Navigant's explanation for the useful life is confusing.In the measure life section Navigant mentions that in ten year's time only the calibration of the CO_2 sensor warrants concern. This is a concern because the demand for kitchen ventilation is not reflected in the CO_2 levels in the space, but rather by temperature and optical sensors above a cooking area. The reference that Navigant cites for the concern about CO_2 sensors is a document that addresses Demand Controlled Ventilation that is most commonly used in office buildings to ensure air-quality (rather than demand controlled kitchen ventilation). At a minimum Navigant needs to updates its references. However this mistaken reference coupled with the suggestion in the analysis of electric savings that the ventilation would never operate below 40-50% raises questions about whether their savings estimates are applicable to kitchen ventilation.

 # 44: Destratification Fans– New, Existing (Commercial)

56. Navigant has characterized this measure on a per fan basis, but Navigant's analysis of the estimated savings is based upon whole building heating loads. The problem with this approach is that it would only be accurate when there was only one fan per building. In the common cases where multiple fans are installed, the savings will be grossly overstated by a factor of the number of fans installed. This is problematic and could be avoided with an approach based upon each fan's area of effective influence: a square footage within which it effectively destratifies the air for a given ceiling height. Though this area would vary with the diameter of the fan, the market share of each fan type is already used by Navigant elsewhere in the analysis and could be employed here to distill a proper average value. Thus rather than the near certainty of grossly overestimating savings in the per-building approach, it would be far more accurate to base the heating loads, and the resulting savings claims upon the average area of effectiveness, for the average destratification fan.

57. It is curious that after defining this measure's efficient equipment as having a minimum diameter of 20' that Navigant chooses the lack of any destratification fans as the baseline. Incorporation of destratification fans is not at all new, rather it would be rather exceptional if they were omitted. Much more commonplace is

the usage of higher speed fans with smaller diameters and fewer airfoils. Accordingly it is common for efficient equipment marketing materials to pitch their lower speed, larger diameter destratification fans as a better and more electrically efficient alternative to traditional arrays of smaller (6') higher speed industrial fans.[29] This is reinforced by Navigant's classification of efficient technology by fan diameter: it is the size and speed of the fan that constitute the new components against which savings should be claimed. However using this more realistic baseline would dramatically reduce the gas savings to an incremental efficacy gain in destratification of the large fans over multiple small fans. This shift would also mean that electrical impacts would shift significantly in the other direction (Navigant's baseline results in an increase in electricity consumption). From this perspective, the driving force for installation of the efficient equipment becomes significantly electrical in nature, as the actual gas savings would be much reduced if not eliminated entirely. For this reason we feel that unless the application of this measure were programmatically restricted to retrofit cases where there are no existing destratification fans, that this efficiency measure is electrical in nature. Our critique is reassured by Navigant's failure to include examples of measure assumptions from other jurisdictions claiming gas savings.

58. Navigant's calculation of the electrical usage of the fans lists questionably low powers, 60 and 55 Watts for the 24 and 20 foot fans respectively, that contradicts the 1 and 2 Horsepower (roughly equivalent to 750 and 1500 Watt) listed in the incremental costs section. Our literature review indicated that a magnitude on the order of hundreds of Watts[30] was typical for a 24' fan.

59. Navigant uses heating load data taken from DOE modeling files adjusted for each building type and the Union service territories, but they do not share which parameters they used, such as building types, age, construction or size, to identify the appropriate data to use. Newer buildings with more efficient heating systems, constructed with better building standards of insulation, thermal breaks, and air-tightness would have sharply reduced heating loads than older, leaky, less thermally sound buildings. Similarly the size of the building as addressed above will significantly affect heating loads, and Navigant's analytical approach would grossly overstate savings in many circumstances. Without the details of these parameters it is difficult to identify the constraints under which Navigant's assumptions would be valid, and therefore risks programmatic application that would use these values when they may not be legitimate.

29 http://www.macro-air.com/principle/
http://www.bigassfans.com/downloads/calculators/flash.php?file=energy_analysis.swf&width=540&height=396

30 http://www.enviranorth.com/pdf-files/11-00029%20PrimeEnergy%20Indust%2007%20FINAL.pdf

 # 45, 46, 51 & 52: Energy and Heat Recovery Ventilators – New and Existing (Commercial)

60. One of the key variables for this measure is the typical hours of operation per week. Navigant developed typical weekly hours of operation for 7 different commercial building types, with estimates ranging from 60 hours per week for offices to 168 hours per week for hotels, healthcare facilities and warehouses. To develop an average savings estimate across all building types, Navigant computed a simple average of the assumed hours for each of the 7 building types. The problem with this approach is that ERVs are not equally likely to be installed in each of the building types. We would expect there to be more offices buildings than any other type. We would also expect more ERVs to be installed in offices than in any other building. If that is correct, the average hours of operation across all ERVs is likely to be significantly less than estimated by Navigant. Our assumptions on this issue could be tested by looking at utility data regarding the distribution of building types into which ERVs have been installed. This is an important enough assumption that no prescriptive measure should be put in place until it has been adequately researched.

61. Navigant's estimates of savings for new buildings are slightly lower than for existing buildings. Intuitively that makes sense, because one would expect newer buildings to have more efficient heating systems. However, the inputs Navigant presents for computing savings are the same for both building types. While Navigant notes that "New buildings and existing buildings mainly differ in the enthalpy (BTU/LBa) that is used to calculate the Specific Supply Air Conditions Volume in formula (B)," it is not clear why the specific energy content of the supply air would be different for the two situations.

 # 56-58: Infrared Heaters – New and Existing (Commercial)

62. Navigant mentions a supplemental 20% oversizing factor, but does not make clear why this is appropriate, and what data were used to support the increase. Indeed, the Agviro report upon which Navigant relies for its savings estimate recommends assuming an average of 15% over-sizing.

63. Navigant's proposed savings assumptions are, like the utilities' previous filings, separately proposed for three different size bins. However, they use the saving quasi-prescriptive assumption for each of the three, calling into question the point of having three different measures for three different size bins. However, the savings estimates proposed are an average of savings estimated for three different types of infrared heaters, one of which has much higher savings than the other two. In putting forth savings estimates, Navigant has simply assumed that each type of infrared heater would command one-third of the market. We are unaware of any basis for such an assumption. This suggests that it would be more appropriate to have different quasi-prescriptive assumptions for *different types* of

infrared heaters rather than for *different sized* heaters, as the issue of size is already addressed through the quasi-prescriptive approach.

64. The incremental costs shown in the detailed measure substantiation sheets (i.e. Appendix C) are different than those shown in Navigant's summary table (i.e. Appendix B).

#59: Gas-Fired Rooftop Unit – New (Commercial)

65. Navigant uses a purely prescriptive baseline of five, 5 ton units serving a new 10,000 ft^2 office building, and divides by 5 to get a per unit savings value, with an implied 5 ton size average for the units. This approach risks savings inaccuracy if the average tonnage of units sold does not align with their 5 ton assumption. Navigant provides no market data or source for their 5 ton per unit assumption, which would appear to increase the risk of inaccuracy. Alternatively were this measure to be characterized on a quasi-prescriptive, per ton basis, the data could be easily tracked through standard nameplate and invoice details and would provide useful programmatic feedback with much more accurate savings. This approach would be more flexible going forward as technology and market conditions may change in the future.

#60: Programmable Thermostat – Existing (Commercial)

Many of our concerns with the residential programmable thermostats also apply to this commercial characterization. Specifically our comments #23 and #24 regard overestimates of baseline behavior and pre and post thermostat programming. In addition we have the following comments specific to the commercial characterization:

66. Navigant has defined this measure on a per thermostat basis, but as we have identified elsewhere in our comments, they pair this with whole building heating loads.[31] This is very problematic because it will over-count the savings by a factor of the number of thermostats installed per building. As it is not at all uncommon for buildings to be served by multiple zones, the risk of gross overstated savings is significant. It would be far more accurate to base the savings upon the typical average area of the zone controlled by the thermostat. The measure needs far clearer definition.

67. Navigant has, for the purposes of estimating electrical cooling savings, assumed that the "space cooling to space heating ratio for residential is the same as for commercial applications." This assumption goes against several key differences between the residential and commercial sectors including significantly higher commercial cooling loads, thermal characteristics of the building, and occupied

[31] The previous listing for Union's program has treated these values as for a full building.

schedules. Accordingly, in assuming a residentially equivalent heating to cooling ratio, Navigant understates the electrical savings significantly.

 # 61, 62: Schools Hydronic Boiler – Primary and Secondary (Commercial)

68. It may be reasonable to forgo a custom approach to this measure and use a semi-prescriptive approach (e.g. a function of actual installed efficiency and capacity), but it is not clear what the rationale is for a purely prescriptive basis. If quasi-prescriptive approach similar to the method for infrared heaters were used, (i.e. defining savings and cost as a function of size) the result would be a much more accurate estimate of savings.

69. Navigant cites an Agviro report Enbridge as the source for its proposed savings estimates. However, the specifics of that report are unclear and questionable. For example, given the differences between base case combustion efficiency (i.e. 81%) and combustion efficiencies for "mid-efficiency" systems (average of 83.5%) and "high efficiency" systems (average of 86.5%), one would initially estimate the savings per average boiler to be about 6% of baseline consumption. That would lead to savings on the order of one-third of those presented. It appears that the proposed prescriptive savings assume other differences between the equipment, including some type of modulating feature for "mids" and "highs" not in the base case as well as much larger losses due to an input called "maximum supply water temperature" (though, confusingly, the temperature value is shown as the same for standard, mid-efficiency and high efficiency units).[32] We see two major problems with the report used by Navigant to develop its estimates. First, the basis for both the assumed differences between standard and higher efficiency new equipment are not documented and, at least in some cases, questionable. For example, GAMA data make clear that not all standard efficiency boilers are single stage as assumed by Agviro. Similarly, not all mid-efficiency boilers are two-stage as also implied by the Agviro analysis.[33] Second, the savings assumed to be associated with such differences need to be carefully explained, scrutinized, validated and documented before they are suitable for prescriptive savings assumptions.

70. Navigant's estimate of the incremental cost is substantially lower than those put forward by Enbridge in 2008. This is because they only present the incremental equipment costs, and ignore incremental installation costs. This leads to a significant understating of actual incremental costs.

[32] Agviro, *Secondary Schools Prescriptive Savings Analysis*, November 23, 2007, p. B-2.
[33] draft Boiler Base Case Efficiency Study, SeeLine Group Ltd Report to Union Gas Ltd, January 30th, 2009

 # 63 -65: Condensing Water Heaters (Commercial)

71. As with faucet aerators and reduced flow showerheads, Navigant's savings estimate assumes an average water inlet temperature of 45 F. That is nearly 4 degrees colder than the 48.8 F average that the City of Toronto reports for its water system.[34] Revising the assumption to the actual Toronto average will reduce Navigant's estimated delta T (and therefore estimated savings) by 4.5%.

72. Navigant provides different savings estimates for different levels of daily hot water consumption. It is unclear how a utility DSM program could reasonably estimate such usage for every participant. Nor is it clear from Navigant's work that the three usage bins for which it estimates savings represent the three most typical usage profiles of commercial water heating customers. Absent a reasonably articulated approach to estimating commercial customer usage for each prospective participant, it seems that this measure is not yet ready for a prescriptive savings assumption.

 # 66-67: Pre-rinse Spray Nozzles – Existing, 1.6 and 1.24 GPM (Commercial)

73. This measure is quasi-prescriptive, claiming savings on a per-hour of daily use basis. This is a significant factor, with the two studies cited by Navigant indicating a four-fold range of variability, and it is unclear how a program would go about determining the suitable value to input into the semi-prescriptive approach.

74. Since this measure doesn't lend itself well to a quasi-prescriptive approach, we have done some research on typical daily usage rates found in other studies. All of them are more consistent with the lower of the two studies cited by Navigant. Several different studies and reports, including one in Ontario, suggest average daily use between 0.5 and 1.5 hours.[35] We would suggest a prescriptive savings estimate be based on an average of one hour of daily use.

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[34] Personal Communication, Andrea Gonzalves, City of Toronto Works Dept, March 4, 2009.

[35] (1) CEE's program literature on this technology estimates savings assuming average usage of 1.5 hours per day (http://www.cee1.org/com/com-kit/prv-guides.pdf). (2) The Region of Waterloo, Ontario did a study of a pilot program promoting pre-rinse spray valves and found that the average usage was only about 40 minutes. Moreover, the average usage went up by almost 20% after the lower flow valves were put in place. Thus, they estimated average daily water savings of 185 litres or annual savings of 67,000 litres. http://www.allianceforwaterefficiency.org/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=980. (3) A 2005 report summarizing five separate evaluation studies (2 in California, 2 in Washington state and the Waterloo, Ontario study note above) found that the average hours of use for a pre-rinse spray valve was 0.91 hours per day. The average for the individual studies ranged from 0.52 to 1.35 daily hours of use. Usage was much higher in restaurants (1.02 hours of use per day) than in grocery stores (0.14 hours of use per day). Tso and Koeller, *Pre-Rinse Spray Valve Programs: How Are They Really Doing?* December 2005.

IV. Conclusions and Recommendations

Navigant obviously did an enormous amount of work in developed detailed savings, cost, useful life and other related characterizations for more than 75 efficiency measures. There is a lot of good work in their draft report. However, the draft report also raises a number of fundamental policy or process questions about the role of prescriptive assumptions, when they are appropriate and how the Board intends to address their development and application in the future. There are also a number of assumptions which we believe need to be amended to either correct some errors in Navigant's work or incorporate better sources for key underlying assumptions. With respect to all of these things, we make the following recommendations to the Board:

1. **Do not make free rider assumptions prescriptive**. We whole-heartedly support Navigant's suggestion to that effect.

2. **Establish a policy that there will be no prescriptive assumptions for measures for which there are not yet specific program designs proposed for their delivery**. As Navigant has itself acknowledged, savings and other key assumptions are affected by program designs (that is why they propose different assumptions for Union showerheads than for Enbridge showerheads).

3. **Establish a policy that there will be no prescriptive assumptions for measures that fail cost-effectiveness screening without a compelling case being made for exceptions** (e.g. for equity and other policy reasons, many jurisdictions do not apply the requirement that all measures pass screening to low income measures).

4. **Establish a policy that purely prescriptive assumptions for measures with high installation variability are inappropriate**. Such assumptions should be either entirely custom or quasi-prescriptive. Quasi-prescriptive is appropriate when (1) there is a key variable that truly drives savings (e.g. equipment capacity or measured leakage reductions), and (2) it is reasonable to expect routine tracking of such variables.

5. **Make clear whether the Board intends to make custom measure lives prescriptive or not**. If the Board it intends that they become prescriptive, it should solicit Navigant's independent assessment of what they should be and allow for stakeholder feedback on draft Navigant conclusions before issuing a final order on the question.

6. **Clarify how the Board expects interactions between existing audit and evaluation processes and this proceeding (including Navigant's assumptions) will take place, as well as what it expects will be the process for developing prescriptive assumptions in the future**.

7. **Instruct Navigant to address each of the assumption-specific issues raised in section III above, modifying assumptions and/or documentation of those assumptions as appropriate**. We have attached a summary table that briefly summarizes our highest level recommendation for each of the efficiency measures as an appendix to this report.

In closing, we will note that during our conversations with Navigant about their initial work there were a number of cases in which Navigant staff indicated that they would need to investigate a question we had raised and get back to us on it. While some of that information was provided, we have not yet received all the information requested so some of our comments are not fully informed with regard to thinking behind some of Navigant's work. Given the limits to our conversations thus far, the complexity of some of the issues at hand, and the difficulty sometimes associated to clearly explaining technical issues in writing, a further dialogue might narrow or resolve some of the issues raised in this report.

Appendix A: - VEIC Comment Summary

Appendix A

	Target Market		Equipment Details				Annual Resource Savings			Other			
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	VEIC COMMENT
	Residential Space Heating												
1	Residential	Existing	Air Sealing	Air infiltration reduction (6 ACH50)	Existing infiltration controls	(8 ACH50)	231	101	0	15	$1,000	8.3	DELETE
2	Residential	Existing	Basement Wall	R-1 Insulation	R-12 Insulation		237	87	0	25	$2 / ft^2	13.4	DELETE
3	Residential	Existing	Ceiling	R-40 Insulation	R-10 Insulation		348	214	0	20	$0.7 / ft^2	3.2	DELETE
4	Residential	Existing	Enhanced Furnace	ECM (continuous)	Mid-efficiency furnace	PSC motor	-183	1,387	0	15	$960	22*	DELETE
5	Residential	Existing	Enhanced Furnace	ECM (non continuous)	Mid-efficiency furnace	PSC motor	-26	324	0	15	$960	51*	DELETE
6	Residential	New	Enhanced Furnace	Furnace only (continuous)	Mid-efficiency furnace		-166	1,403	0	15	$960	18*	DELETE
7	Residential	New	Enhanced Furnace	Furnace only (non continuous)	Mid-efficiency furnace		-26	207	0	15	$960	137*	DELETE
8	Residential	Existing	Energy Star Windows	Low E, argon filled (R-3.8)	Standard windows	Double pane, standard glazing (R-2.0)	121	206	0	20	$150 / unit	28	DELETE
9	Residential	Existing	Reflector Panels		No reflector panels		143	0	0	18	$229	3.1	NOT REVIEWED
10	Residential	Existing	High Efficiency Furnace	AFUE 90	Mid-efficiency furnace	AFUE 80	268	0	0	18	$667	4.8	DELETE
11	Residential	Existing	High Efficiency Furnace	AFUE 92	Mid-efficiency furnace	AFUE 80	317	0	0	18	$1,067	6.5	DELETE
12	Residential	Existing	High Efficiency Furnace	AFUE 96	Mid-efficiency furnace	AFUE 80	407	0	0	18	$2,433	11.5	DELETE
13	Residential	Existing	Programmable Thermostat		Standard Thermostat		146	182	0	15	$25	0.3	NEEDS AMENDING
14	Residential	Existing	Wall Insulation	R-8 Insulation	R-19 Insulation		405	194	0	30	$2.5 / ft^2	11.2	DELETE
	Residential Water Heating												
15	Residential	Existing	Faucet Aerator	Kitchen, 1.5 GPM	Average existing stock	2.5 GPM	38	0	7,797	10	$2	0.1	NEEDS AMENDING
16	Residential	Existing	Faucet Aerator	Bathroom, 1.5 GPM	Average existing stock	2.2 GPM	10	0	2,004	10	$2	0.4	NEEDS AMENDING
17	Residential	Existing	Low-flow showerhead	1.5 GPM	Average existing stock	2.2 GPM	33	0	6,334	10	$6	0.4	NEEDS AMENDING
18	Residential	Existing	Low-flow showerhead Union	1.25 GPM	Average existing stock	2.2 GPM	60	0	10,570	10	$13	0.4	NEEDS AMENDING
19	Residential	Existing	Low-flow showerhead	1.25 GPM	Average existing stock	2.0 GPM	49	0	8,817	10	$13	0.5	NEEDS AMENDING
20	Residential	Existing	Low-flow showerhead	1.25 GPM	Average existing stock	2.25 GPM	62	0	10,886	10	$13	0.4	NEEDS AMENDING
21	Residential	Existing	Low-flow showerhead	1.25 GPM	Average existing stock	3.0 GPM	102	0	17,168	10	$13	0.3	NEEDS AMENDING
22	Residential	Existing	Pipe insulation for DHW outlet pipe	R-4 insulation	Uninsulated DHW outlet pipes	R-1	25	0	0	10	$2	0.2	NEEDS AMENDING

Appendix A: - VEIC Comment Summary

	Target Market		Equipment Details				Annual Resource Savings			Other			
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	VEIC COMMENT
23	Residential	New/Existing	Solar Pool Heater	Solar Heating System	Conventional Gas-fired Heating System	50% seasonal efficiency	493	-57	0	20	$1,450	5.7	NOT REVIEWED
24	Residential	Existing	Tankless Water Heater	EF = 0.82	Storage Tank Water Heater	EF=0.575	137	0	0	18	$750	10.5	NOT REVIEWED
25	Residential	New	Tankless Water Heater	EF = 0.82	Storage Tank Water Heater	EF=0.575	137	0	0	18	$750	10.5	NOT REVIEWED
	Low Income Space Heating												
26	Low Income	Existing	Programmable Thermostat		Standard manual thermostat		146	182	0	15	$25	0.3	NEEDS AMENDING
27	Low Income	Existing	Weatherization	full weatherization	No Weatherization		1,134	165	0	23	$2,284	3.9	DELETE
	Low Income Water Heating												
28	Low Income	Existing	Faucet Aerator	Kitchen, 1.5 GPM	Average existing stock	2.5 GPM	38	0	7,797	10	$2	0.1	NEEDS AMENDING
29	Low Income	Existing	Faucet Aerator	Bathroom, 1.5 GPM	Average existing stock	2.2 GPM	10	0	2,004	10	$2	0.4	NEEDS AMENDING
30	Low Income	Existing	Low-flow showerhead	1.5 GPM	Average existing stock	2.2 GPM	33	0	6,334	10	$6	0.4	NEEDS AMENDING
31	Low Income	Existing	Low-flow showerhead	1.25 GPM	Average existing stock in one of three ranges.	2.0 GPM	49	0	8,817	10	$13	0.5	NEEDS AMENDING
32	Low Income	Existing	Low-flow showerhead	1.25 GPM	Average existing stock in 1 of 3 ranges.	2.25 GPM	62	0	10,886	10	$13	0.4	NEEDS AMENDING
33	Low Income	Existing	Low-flow showerhead	1.25 GPM	Average existing stock in 1 of 3 ranges.	3.0 GPM	102	0	17,168	10	$13	0.3	NEEDS AMENDING
34	Low Income	Existing	Low-flow showerhead	1.25 GPM	Average existing stock	2.2 GPM	60	0	10,570	10	$13	0.4	NEEDS AMENDING
35	Low Income	Existing	Pipe insulation for DHW outlet pipe	R-4 insulation	Uninsulated DHW outlet pipes (R-1)		25	0	0	10	$2	0.2	NEEDS AMENDING
	Commercial Cooking												
36	Commercial	New/Existing	Energy Star Fryer	50% cooking efficiency	Standard fryer	35% cooking efficiency	1,099	0	0	12	$3,250	5.9	NOT REVIEWED
37	Commercial	New/Existing	High Efficiency Griddle	40% cooking efficiency	Standard griddle	32% cooking efficiency	503	0	0	12	$1,570	6.2	NOT REVIEWED
	Commercial Space Heating												
38	Commercial	Existing	Air Curtains	Single door	Non-air curtain doors		2,191	172	0	15	$1,650	1.5	NEEDS AMENDING
39	Commercial	Existing	Air Curtains	Double door	Non-air curtain doors		4,661	1,023	0	15	$2,500	1.1	NEEDS AMENDING
40	Commercial	Existing	Condensing Boilers	88% seasonal efficiency (est.)	Non-condensing boiler	76% estimated seasonal efficiency	0.0104 / Btu/hr	0	0	25	$12	2.3	NEEDS AMENDING
41	Commercial	Existing	Demand Control Kitchen Ventilation	5,000 CFM	Kitchen ventilation without DCKV		4,801	13,521	0	10	$10,000	4.2	NEEDS AMENDING

Appendix A: - VEIC Comment Summary

	Target Market		Equipment Details				Annual Resource Savings			Other			
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	VEIC COMMENT
42	Commercial	Existing	Demand Control Kitchen Ventilation	10,000 CFM	Kitchen ventilation without DCKV		11,486	30,901	0	10	$15,000	2.6	NEEDS AMENDING
43	Commercial	Existing	Demand Control Kitchen Ventilation	15,000 CFM	Kitchen ventilation without DCKV		18,924	49,102	0	10	$20,000	2.1	NEEDS AMENDING
44	Commercial	New / Existing	Destratification Fans		No destratification fans		6,129	-511	0	15	$7,021	2.3	NEEDS AMENDING
45	Commercial	Existing	Energy Recovery Ventilator		Ventilation without ERV		3.95 / CFM	0	0	20	$3 / cfm	1.5	NEEDS AMENDING
46	Commercial	New	Energy Recovery Ventilator		Ventilation without ERV		3.75 / CFM	0	0	20	$3 / cfm	1.6	NEEDS AMENDING
47	Commercial	Existing	Enhanced Furnace	ECM (continuous)	Standard PSC Motor		(-)2.7 kBtu/hr	20.5/kBtu/hr	0	15	$960	14*	DELETE
48	Commercial	Existing	Enhanced Furnace	ECM (non-continuous)	Standard PSC Motor		(-)0.4 / kBtu/hr	4.8 / kBtu/hr	0	15	$960	31*	DELETE
49	Commercial	New	Enhanced Furnace	ECM (continuous)	Standard PSC Motor		(-)2.5 kBtu/hr	20.8/kBtu/hr	0	15	$960	11*	DELETE
50	Commercial	New	Enhanced Furnace	ECM (non-continuous)	Standard PSC Motor		(-)0.3 / kBtu/hr	3.1 / kBtu/hr	0	15	$960	55*	DELETE
51	Commercial	Existing	Heat Recovery Ventilation	Ventilation with HRV	Ventilation without HRV		3.77/cfm	0	0	20	$3.40	1.8	NEEDS AMENDING
52	Commercial	New	Heat Recovery Ventilation	Ventilation with HRV	Ventilation without HRV		3.49/cfm	0	0	20	$3.40	2.0	NEEDS AMENDING
53	Commercial	Existing	High Efficiency Furnace	AFUE 90	Mid-efficiency furnace		3.6 / kBtu/hr	0	0	18	$6.7 / kBTu/h	3.7	DELETE
54	Commercial	Existing	High Efficiency Furnace	AFUE 92	Mid-efficiency furnace		4.2 / kBtu/hr	0	0	18	$11 / kBTu/h	5.2	DELETE
55	Commercial	Existing	High Efficiency Furnace	AFUE 96	Mid-efficiency furnace		5.4 / kBtu/hr	0	0	18	$22 / kBTu/h	8.1	DELETE
56	Commercial	New / Existing	Infrared Heaters	0 - 75,000 BTUH	Regular Unit Heater		0.015 / Btu/hr	245	0	20	$0.0154	1.6	NEEDS AMENDING
57	Commercial	New / Existing	Infrared Heaters	76,000 - 150,000 BTUH	Regular Unit Heater		0.015 / Btu/hr	559	0	20	$0.0154	1.6	NEEDS AMENDING
58	Commercial	New / Existing	Infrared Heaters	151,000 - 300,000 BTUH	Regular Unit Heater		0.015 / Btu/hr	870	0	20	$0.0154	1.6	NEEDS AMENDING
59	Commercial	New	Rooftop Unit	Two-stage rooftop unit	Single stage rooftop unit		255	0	0	15	$375	2.9	NEEDS AMENDING
60	Commercial	Existing	Programmable Thermostat		Standard thermostat		239	251	0	15	$110	0.9	NEEDS AMENDING
61	Commercial	Existing	Schools - Primary	hydronic boiler with 83%+ efficiency	hydronic boiler with 80% - 82% efficiency		10,830	0	0	25	$5,646	1.0	NEEDS AMENDING
62	Commercial	Existing	Schools - Secondary	hydronic boiler with 83%+ efficiency	hydronic boiler with 80% - 82% efficiency		43,859	0	0	25	$8,470	0.4	NEEDS AMENDING
	Commercial Water Heating												
63	Commercial	New / Existing	Condensing Gas Water Heater	95% thermal efficiency	Conventional water heater	80% efficiency, 91 gal. tank.	338	0	0	13	$2,230	13	NEEDS AMENDING

Appendix A: - VEIC Comment Summary

	Target Market		Equipment Details				Annual Resource Savings			Other			
	Sector	New / Existing	Efficient Equipment	Details of efficient equipment	Base Equipment	Details of base equipment	Natural Gas (m^3)	Electricity kWh	Water (L)	EUL	Inc. Cost ($)	Payback (Yrs)*	VEIC COMMENT
64	Commercial	New / Existing	Condensing Gas Water Heater	95% thermal efficiency	Conventional water heater	80% efficiency, 91 gal. tank.	905	0	0	13	$2,230	5.0	NEEDS AMENDING
65	Commercial	New / Existing	Condensing Gas Water Heater	95% thermal efficiency	Conventional water heater	80% efficiency, 91 gal. tank.	1,614	0	0	13	$2,230	2.8	NEEDS AMENDING
66	Commercial	Existing	Pre-Rinse Spray Nozzle	1.6 GPM	Standard pre-rinse spray nozzle	3.0 GPM	387	0	116,086	5	$41	0.2	NEEDS AMENDING
67	Commercial	Existing	Pre-Rinse Spray Nozzle	1.24 GPM	Standard pre-rinse spray nozzle	3.0 GPM	486	0	145,937	5	$60	0.3	NEEDS AMENDING
68	Commercial	New	Tankless Water Heater (100 gal/day)	84% thermal efficiency	Conventional water heater	80% efficiency, 91 gal. tank.	215	0	0	18	-$1,570	0.0	NOT REVIEWED
69	Commercial	New	Tankless Water Heater (500 gal/day)	84% thermal efficiency	Conventional water heater	80% efficiency, 91 gal. tank.	57	0	0	18	$510	18	NOT REVIEWED
70	Commercial	New	Tankless Water Heater (1000 gal/day)	84% thermal efficiency	Conventional water heater	80% efficiency, 91 gal. tank.	-142	0	0	18	$2,590	N/A	NOT REVIEWED
	Multi-Family Water Heating												
71	Multi-Family	Existing	EnergyStar Clothes Washer	MEF=1.72, WF=8.0	Conventional top-loading, vertical axis clothes washer	MEF=1.26, WF=9.5	79	201	19,814	11	$150	3.8	NOT REVIEWED
72	Multi-Family	Existing	Faucet Aerator	Kitchen, 1.5 GPM	Average existing stock	2.5 GPM	26	0	5,377	10	$2	0.2	NEEDS AMENDING
73	Multi-Family	Existing	Faucet Aerator	Bathroom, 1.5 GPM	Average existing stock	2.2 GPM	7	0	1,382	10	$2	0.5	NEEDS AMENDING
74	Multi-Family	Existing	Low-flow showerhead	1.5 GPM	Average existing stock	2.2 GPM	23	0	4,369	10	$6	0.5	NEEDS AMENDING
75	Multi-Family	Existing	Low-flow showerhead	1.25 GPM	Average stock	2.0 GPM	34	0	6,081	10	$13	0.7	NEEDS AMENDING
76	Multi-Family	Existing	Low-flow showerhead	1.25 GPM	Average stock	2.25 GPM	43	0	7,507	10	$13	0.6	NEEDS AMENDING
77	Multi-Family	Existing	Low-flow showerhead	1.25 GPM	Average stock	3.0 GPM	70	0	11,840	10	$13	0.4	NEEDS AMENDING
78	Multi-Family	Existing	Low-flow showerhead	1.25 GPM	Average existing stock	2.2 GPM	42	0	7,289	10	$6	0.6	NEEDS AMENDING
	Industrial		Steam Traps							3			NEEDS AMENDING

STEAM TRAP RESEARCH SUMMARY

Assumption	Measure Life of Steam Traps	
Recommendation	Increase Measure Life from 3 years to 13 years	
Authors	Terry Whitehead, P. Eng, EGD Manager of DSM Standards Pirapa Tharmalingam EGD Senior Load Research Analyst	Robert Griffin, P.Eng. EGD DSM Industrial Sales
Research Completed	November, 2007	

BACKGROUND

Steam traps are automatic valves that release condensed steam (*water)* from a steam system while preventing the loss of steam vapour. They also remove non-condensable gases from the steam system. Steam traps are designed to maintain steam energy efficiency for performing specific tasks such as heating a building or maintaining heat for process use. Once steam has transferred heat through a process and becomes hot water, it is removed by the trap from the steam side as condensate and returned to the boiler via condensate return lines. Alternatively, the condensate is discharged, simply wasting water and energy.

In the Settlement Agreement for the Enbridge Gas Distribution 2003 DSM Program, a steam trap measure life of 3 years was agreed on between the parties (RP-2002-0133, Ex. N1, Tab 1, Sch.1, Pg. 64).

Since the introduction of the “steam trap audit program” at Enbridge in 1998, 216 audits have been completed through third parties, providing a significant amount of data that has enabled Enbridge to statistically establish the average operating life of a steam trap.

RESEARCH DESCRIPTION

Enbridge has conducted 216 steam trap surveys (to the end of 2005) through the Industry Partners Spirax Sarco and Preston Phipps. These surveys were completed over a period of about 7 years.

The general finding in the vast majority of cases of the 216 surveys done to the end of 2005 was that the traps were quite old and poorly maintained on average.

The results of the surveys were as follows:

- 216 surveys
- 41,124 traps tested
- 16.3% of traps leaking
- 7.7% of traps blocked
- Total defect rate: 24.0%

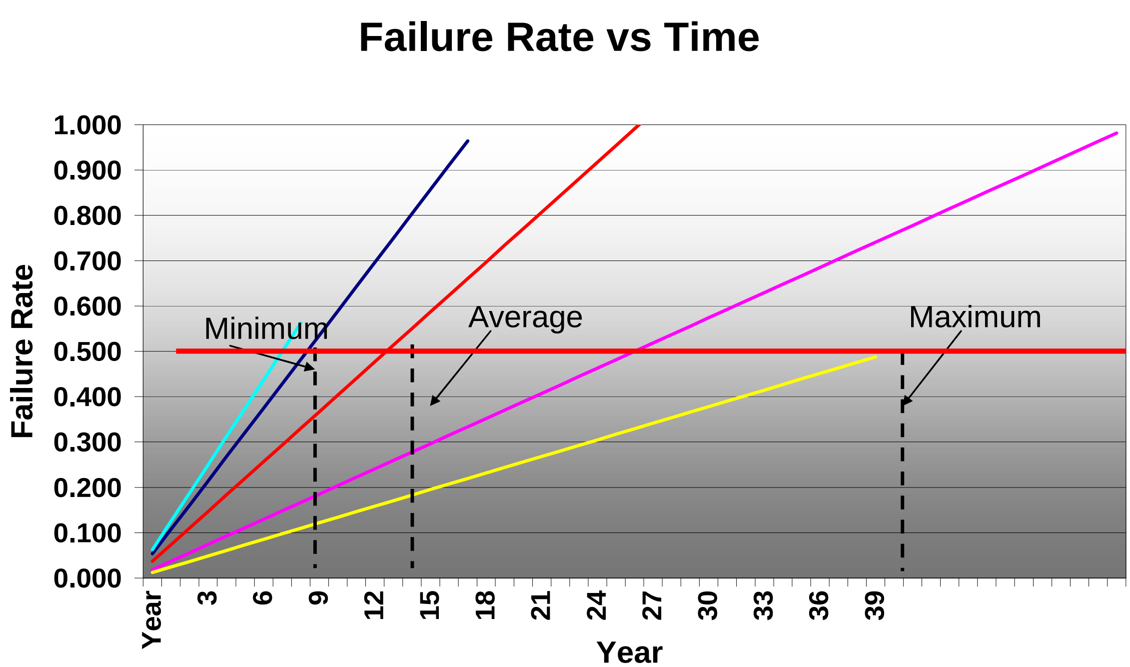
Of the 216 steam trap audits, four sites provided multiple audits over many years of inspecting the same steam traps. This information was used to develop a statistical evaluation of the life span of a steam trap. At these sites the steam traps were tagged during the first audit which allowed subsequent audits to track specific steam traps. To complete a life analysis the steam traps which were replaced or repaired during the first audit provide a base year for the equipment.

Each of the sites provided two audits of the same steam traps. The base year varied from 2001 to 2004, and the follow-up study year was either 2 years, or 4 years apart. The total number of leaking traps was separated. It was understood that the four customer sites did not repair or replace any of the steam traps between the two audit years, therefore this data provides reasonable life operation of the steam traps that were replaced in the base year.

RESULTS

Using the data it is possible to conclude the "average" years it takes for 50% of the units to fail. A linear approximation methodology was used to extrapolate average yearly failure rates of the units for each customer. Then an average yearly failure of all customers was calculated.

Some time between year 13 and 14, 50% of the sample would have failed if the linearly approximated trend were to be continued into the future. Based on the data, the minimum expected life span would be 8 years and the maximum would be 41 years. This analysis provides strong support for the "average life" of 13 years.



RECOMMENDATION

Adopt a measure life of 13 years for steam traps.

modulating features; and (3) that the savings from modulation are dramatic enough to account for the other 15% savings. However, the company has put forward no evidence to support any of these three assumptions.

15. Second, even if the issues above were resolved, there is no good rationale for an entirely prescriptive measure. Beyond differences in modulating features of boilers, savings and incremental cost at each school is a function of the size of the load being served. Thus, at most (i.e. even if one took EGD's assumptions about modulation on faith), the measure should be semi-prescriptive, with savings (and incremental cost) a function of the size of the boiler being installed (boiler capacity can be a reasonable proxy for size of load; also, boiler capacity ought to be among the most basic project elements reported and tracked in a DSM database). Indeed, this semi-prescriptive approach is being used successfully by Union for infrared heaters and condensing boilers. We are aware that Enbridge sought a simplified approach to reduce complexity and facilitate participation. The semi-prescriptive approach would achieve that end, with greater savings accuracy.

16. GEC submits no prescriptive assumption should be approved and the matter be referred, as above, back to the audit and evaluation process for resolution.

Industrial Steam Trap measure life

17. The one change EGD is proposing to make to prescriptive measure life assumptions for commercial and industrial measures is to steam traps. EGD is proposing to increase the assumed life from 3 years to 13. GEC has several concerns with this proposal. First, EGD has not filed any documentation to support its proposal. Second, and more importantly, the unfiled analysis that EGD is using for the change appears flawed in several respects.[2] To begin with, EGD's analysis is based on data from just four customer sites. As such it cannot be a statistically valid representation of EGD's customers as a whole. In addition, the company only got data on steam trap failure rates either two years or four years after the measures were installed. They then assumed that the failure rate over two years or over four years could be linearly extrapolated indefinitely into the future. Most equipment does not work that way. Failure rates of equipment are often low in early years and then rapidly increase before tailing off. In other words, they typically have something like a bell curve pattern. If Enbridge applied this approach to analyze the failure rates of refrigerators that were purchased four years ago and found that only 4% had failed during those four years, they would have assumed that the average refrigerator would last 100 years – a result that is obviously absurd.

18. GEC therefore submits the change should not be approved and the matter be referred, as above, back to the audit and evaluation process for review of all the background information and resolution.

Spillover for custom projects replacing free ridership

19. We have reviewed the submission of CME, and fully support CME's approach. Inclusion of spillover is premature, is a matter for the Board's Consultation process and

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[2] We state "appears flawed" because all we have ever seen from the Company on this issue is a two-page summary of the analysis that it performed.