# VECC INTERROGATORY #1

## INTERROGATORY

Reference Exhibit A, Tab 1, Schedule 3, Page 3, paragraph 7.

Preamble:" In September of 2009 Enbridge submitted a proposal for a pilot project to field test and evaluate different solar thermal collector types and storage technologies in different configurations. In January of 2010, NRCan announced that Enbridge was one of 19 successful proponents from a field of 178 applicants"

a) Provide a copy of the Application to NRCan, or alternatively a complete description of the project and multi year budget/financial proposal.

## RESPONSE

Please find attached a copy of the proposal sent to NRCan.

Witnesses: P. Hoey
A. Mandyam

**Residential Solar Space Heating Project Proposal**

**CONFIDENTIAL**

**Section 1 - General Information and Applicant's Attestations**

| | |
|---|---|
| 1. Project Title | **Residential Solar Space Heating Project** |
| 2. Project applicant(s) -legal names of company(ies) | **Enbridge Gas Distribution Inc.**<br>**500 Consumers' Road**<br>**North York, Ontario M2J 1P8**<br>**PO Box 650**<br>**Scarborough, Ontario M1K 5E3** |
| 3. Project partners (legal names of companies, utilities, provincial agencies) | **To be added during trial period** |

| | |
|---|---|
| 4. Project Start Date: (year/month/day)<br>**February 12th, 2009** | 5. Project Completion Date: (year/month/day)<br>**March 31st, 2014** |

6. Project Location and Province /Territory
**Toronto, Ontario**

7 Project Technology
**Solar Thermal Energy and Storage of Solar Thermal Energy**

8. Project Summary

The Residential Solar Space Heating Project is designed to address the issue of using solar thermal energy to provide space heating in dwellings. Through the innovative use of storage, solar thermal energy can extend its usability to provide for a higher degree of space heating in dwellings. The project will provide the basis for transforming current solar thermal technology applications into higher order integrated heating systems which reduce the reliance of fossil fuels and achieve a significant reductions of emissions. The project will use different types of solar collectors to verify and validate the efficiency and applicability of them as well it will use different storage technologies to enhance the overall energy displacement of the combinations. Lastly it will integrate these technologies with existing systems.

9. Expected Benefits

The expected benefits of the Residential Solar Space Heating Project is to take different types of current state of the art technology for solar thermal collection and integrated it with different types of storage to achieve a marked reduction in fossil fuel use and reduce costs on the full build out of such systems. The project is expected to reduce Carbon Dioxide Emissions by 20,000 tonnes over the life of the systems installed and reduce energy usage by 400,000 GJ for the target sample of 200 dwellings, homes and small commercial installations in units or multi-residential buildings.

10. Total Project Cost
**$8,477,000**

| |
|---|
| 11. Funding amount Requested from the CEF Fund<br>**$4,239,000** |
| 12. Has this proposal been submitted to other funding organizations? (Y/**N**), if Y, please list their names and contact information)<br>**No**<br><br>*As part of its due diligence process, NRCan would like to contact these other potential funders. If you do not want NRCan to contact these organizations, please provide your reasoning below.* |

**Attestations**

By submitting this proposal, the project applicant attests that:

- It is acting on behalf of all partners and collaborators and has received written permission from them to do so.
- It is legally registered or incorporated in Canada.
- Barring unforeseen events that could reduce their capacity, the applicant and participating partners and collaborators have, and will retain over the lifetime of the CEF project, the technical and personnel capacity to undertake and complete the project, and that they have contingency plans in place to minimize, as far as possible, the impact of any such unforeseen events.
- All funding (cash and in-kind) identified by the applicant and its partners and collaborators in the proposal is expected to be available for commitment at the time of the signing of the Contribution Agreement by duly authorized representatives of the project applicant and its partners and collaborators.
- It agrees with the terms and conditions of the CEF program as well as the process described in the Applicants' Guide provided to Applicants.
- Any proprietary or confidential information provided as part of the submission, by any party, is provided with the approval of that party. Federal reviewers are bound by the requirements of the Access to Information Act and the Privacy Act regarding the treatment of confidential information.
- It understands and acknowledges that should the project be accepted for co-funding from the Clean Energy Fund, no liability and no commitment or obligation exists on the part of NRCan to make a financial contribution to the project until a written contribution agreement is signed by both parties, and, furthermore, that any costs or expenses incurred or paid by the applicant prior to the execution of a written contribution agreement by both parties are the sole responsibility of the applicant, and no liability exists on the part of NRCan.
- It understands and acknowledges that NRCan officials will not entertain any request by project proponents to review or revisit NRCan's project approval decisions.
- It understands and acknowledges that NRCan reserves the right to alter or cancel the currently envisaged process at its sole discretion.

The individual signing below attests that he / she has the authority to sign a legally binding contribution agreement between NRCan and the project proponent.

| Please sign below to confirm these attestations: | |
|---|---|
| Name of Duly Authorized Officer for Applicant: | Date: SEPT. 14/09 |

Arunas J. Pleckaitis
Title:
Vice President, Business Development & Customer Strategy

## Section 2 Project Details

### Project Description and Relevance

The Residential Solar Space Heating Project will help Canada achieve its goal of reducing greenhouse gas emissions by 20 percent by 2020 from 2006 levels. The project is expected to reduce both GHG emissions by 50% and energy usage by 50%.

Enbridge Gas Distribution Inc. is undertaking this project to expand the use of solar thermal technology from its current applications for water heating and extend the range of applicability of these solar thermal installations to include space heating and thus reduce the use of fossil fuels and GHG emissions. The second reason is to increase the potential for thermal storage applications in both new buildings and retrofits to existing buildings thus marrying the daytime production of solar energy with the varying need for thermal energy during the course of a day, week, or year. The integration of the two aspects of the project will allow for future energy storage from other renewable sources of energy and further the development of solar collection technology for application in the Canadian environment.

Enbridge will be the lead investor, program and technology manager. The involvement of various suppliers will be managed by Enbridge and they will not at this point be investors in the project. Enbridge is currently working with a Canadian solar panel manufacturer (Enerworks) for a solar water heating program, but as Enbridge would like to test three distinct solar panel / collection technologies for this project a partnership or investor role with any one supplier may introduce bias into the project and not permit the best technology to be chosen at the end of the project. With respect to the storage aspects of the project, Enbridge through its experience as Canada's largest natural gas distribution utility has ample experience in managing, constructing and operating projections and complex distribution systems, and as such has the in house capability to design and implement thermal storage solutions through various contractors, and again to preserve neutrality with suppliers, wish not at this stage to constrain our choices in vendors.

The specific objectives of the project are to do the following:

- Investigate the best type of solar thermal collectors for a space heating application to determine an economic and technology winner for future use in wide scale deployment.
- Investigate the best type of thermal storage for short, medium and long term applications to determine an economic and technology winner for future use in wide scale deployment.
- Investigate the best methods for the installation of thermal storage in locations remote of the collection arrays. This will include locations that are either remote or integral with the foundation of the building, depending on whether it is a retrofit or new construction.
- Determine the best integration platform, methods and operations protocols for the two features of the project (solar thermal collection and thermal storage) which will provide the highest reduction in fossil fuels, GHG and cost.
- Investigate the ability to provide these systems as retrofits to both air and existing hot water heated buildings, primarily residential and then as progress permits for small multi-residential or commercial applications.
- Investigate the ability to incorporate geothermal technologies into the information learned from the first phases of the project to increase the duration effectiveness of the storage technologies.
- Investigate the ability to use thermally activated cooling to increase system applicability and efficiency in summer periods to displace electricity currently used for cooling.

The alignment of this project with the objectives of the CEF is clear. The project is designed promote green technology, in this project solar thermal, to displace fossil fuels, which reduces energy consumption and greenhouse gas emissions.

The project will demonstrate the integration of intermittent renewable and clean energy into the "built"

environment. As a utility Enbridge Gas Distribution would be able to use this fundamentals developed in this project to transform its position as the largest natural gas distributor in Canada to the largest clean and green energy distributor thus achieving the end result of integrating renewable energy into our operations. The goal of integration into housing, buildings, etc. would be achieved through low impact project work, which would be equally applicable to new construction and retrofit markets. Enbridge believes that this project means virtually every criteria set out by NRCan for the CEF.

The urgency of completing this project work within the next five years is extremely compelling. With the proposed legislation with respect to atmospheric carbon dioxide emission abatement both within Canada and North America, the fuel that has been the historical green fuel of choice and a significant cost and growth driver for the housing sector is being placed into a position where it is becoming increasingly under threat. With most legislation coming into force in the next decade, the plans for a transition to even cleaner fuels that natural gas must be made.

While the ultimate costs of compliance with new GHG legislation are not fully clear, we do know that there will be costs and with a significant stock of existing housing and all new housing subject to these costs, there is a large potential to redirect expenditures to achieve the goals of GHG reductions through technological innovation and changes in current practices. This project has the potential to significantly transform the way thermal energy is derived for residential use in Canada, keep costs down for homeowners and provide the ability to use natural gas for other purposes, such as chemicals, exports, power generation, and the extraction of higher value hydrocarbons.

The risk of not funding this project is multifold. The expansion of existing solar applications will be hindered, in that, the focus will remain on single end uses such as residential solar water heating, and an expansion into heating will be slowed. The development of alternatives to standard heating technologies will be delayed and with the renewable of the current heating equipment stock that is currently taking place will only result in slight efficiency improvements (age / code related only), thus maintaining the almost the current level of consumption of fossil fuels. The integration of storage in the project will assist with the increased applicability of intermittent renewables which will further reduce the risks of this application of solar thermal technology.

On the macro level, this project will also result permanent reductions in fossil fuel use and increase price certainty for Canadian homeowners with respect to their energy bills. When the storage integration potential is fully exploited, the cost of such systems will be lowered so much so that they will be cost competitive with conventional systems. If the full potential of integrating cooling is achieved, substantial reductions electrical infrastructure (distribution, transmission and generation) could be achieve further improving cost dynamics, all of which will need improvements or upgrades in the ten year time horizon.

This project builds upon work that has taken place on the introduction and installation of flat panel solar thermal collectors used to heat water for domestic purposes and the long standing rental water heater program that found its roots within Enbridge Gas Distribution.

The installation program for solar thermal water heaters was launched in April 2009 by Bullfrog, Enerworks and Enbridge (http://www.thestar.com/Business/article/626571) after testing and validation of the product by the partners. The result of this testing were ample to indicate that homeowners could reduce their natural gas consumption for water heating by up to 70% depending on their time and usage patterns. This work is immediately transferable to the solar collector portion of this project, but it is specific to one type and brand of solar collector. This project would use the methods and process to assist in the installation of other types of collectors to demonstrate.

The municipal requirements and code requirements for panel installation are now fully know, but the requirements for storage and integration of other elements of the project (cooling and geothermal) will need to be tailored to meet our requirements.

Overall, Enbridge has learned what the key elements will require to get this project operational and we

have the resources that will be required to develop this project fully.

As discussed earlier, the objective of this project is to reduce energy consumption and GHG emission. Our target is 50% of the overall household energy demand for thermal heating applications. In the final phase of our project, we believe we can also reduce emissions from electrical generation through the displacement of electricity used for cooling during the summer with solar absorption systems. The primary GHG emission from natural gas combustion is carbon dioxide. The other emissions related to the combustion of natural gas are oxides of nitrogen, carbon monoxide, methane, solid particles, oxides of sulfur, and volatile organic compounds in varying degrees. While natural gas rates very well with respect to the emissions of these by products of combustion relative to other fuels such as oil or coal, some by-products still remain and further abatement of them through this project would create welcome benefits. The reductions oxides of nitrogen, methane and carbon dioxide are directly proportional to the reduction natural gas used. Their reduction also improves local, particularly urban, air quality.

### 2.1.1 Partners and Collaborators

| Organization | Type of contribution to the project |
|---|---|
| Enbridge Gas Distribution Inc. | Financial (both cash and in-kind), technical. Enbridge Gas Distribution will be responsible for the overall management, planning, execution, monitoring and evaluation of the program. Enbridge as outlined above and below will provide or contract for the technical support for all aspects of the project. |
| Home and property owners | Financial (in-kind). Home and property owners will provide sites to conduct the demonstrations on and will provide on-going access to their property for the purposes of monitoring, testing, upgrading and operating the project. They will also pay for a portion of the cost of heating their property using existing technology the project will pay the part of the installation and part of the incremental costs. |
| Property development firms / home builders | Financial (in-kind). Developers will provide technical information about their developments and the structural, electrical, HVAC and plumbing information to permit the installation of collectors and storage, and heating/cooling units. They will also provide marketing assistance, information dissemination and sites through their new developments. |
| Equipment vendors | Technical. They will provide detailed information on their products and how best to use them, their performance and pricing. They will be chosen via an RFP method and will provide the equipment needed for the project and any support required by the project managers. |
| Contractors | Technical. They will provides the services, labour, know how, and balance of plant equipment require to install and service equipment where Enbridge does not have the ability to do so or wishes to provide further opportunity for collaboration. |
| Consultants | Technical. They will provides the services, design, know how, and technical information where Enbridge does not have the ability to do so or wished to provide further opportunity for collaboration. |
| Other levels of Government | Technical. Governments will provide the required guidelines for installation and code requirements, and building permit approvals. |

## 2.2 Project Methodology and Risk Mitigation

### 2.2.1 Project Team

**Team Member**: Paolo Baragetti

**Organization: Enbridge Gas Distribution Inc.**

**Role in project: Project Manager**

**Expertise and experience**: Mr. Baragetti is a skilled engineer and manager from the high technology sector is and experienced in new product development and project management. Mr. Baragetti has over 15 years experience in the implementation of programs and commercialization of projects. Mr. Baragetti is the overall program lead. He was responsible for the partnership and development of Bullfrog, EnerWorks solar project at Enbridge.

**Team Member**: Felix Ovis

**Organization: Enbridge Gas Distribution Inc.**

**Role in project: Program Manager**

**Expertise and experience**: Mr. Ovis is an experienced engineer, technical program manager and has over 10 years of experience in the management and research of technology. Mr. Ovis will manage the technical aspects of this program. Mr. Ovis was responsible for the technical development work for the Bullfrog, EnerWorks, solar water heating project at Enbridge.

**Team Member**: Jay Jayaraman

**Organization: Enbridge Gas Distribution Inc.**

**Role in project: Program Management**

**Expertise and experience**: Mr. Jayaraman is a seasoned veteran of the solar industry having been active in the initial development of the technology in Canada almost 30 years ago, having served as a Vice-President of a solar engineering and manufacturing firm. Mr. Jayaraman is a graduate level engineer, project manager and has 20 years of utility experience. Mr. Jayaraman will be responsible for the development work for this project.

**Team Member**: Ada Leung

**Organization: Enbridge Gas Distribution Inc.**

**Role in project: Research Engineer**

**Expertise and experience**: Ms. Leung is an engineer who is experienced in the evaluation technical aspects of project. She has over five years of experience in the energy industry and will be evaluating technologies and integration work.

**Team Member**: Owen Schneider

**Organization: Enbridge Gas Distribution Inc.**

**Role in project: Finance, Contracts**

**Expertise and experience**: Mr. Schneider is an MBA and is an experienced Senior Financial Manager with extensive experience in technical feasibility analysis, contract management and project evaluation. Mr. Schneider has been active for over 15 years in the fabrication, energy and chemical industries and has been involved with a number of large energy projects.

**Team Member**: John Tideman

**Organization: Enbridge Gas Distribution Inc.**

**Role in project: Marketing, Channel Management**

**Expertise and experience**: Mr. Tideman is an MBA and is an experience sales and marketing manager with extensive work in the HVAC and developer market area. He has over 15 years experience and has worked internationally.

**Team Member**: Andrew Yang

**Organization: Enbridge Gas Distribution Inc.**

**Role in project: Program Manager**

**Expertise and experience**: Mr. Yang is an experienced engineer, technical program manager and has over 10 years of experience in the management and research of technology. Mr. Yang will manage the technical aspects of this program. Mr. Yang was responsible for the technical development work for the Bullfrog, EnerWorks, solar water heating project at Enbridge.

**Team Member**: Patrick Hoey

**Organization: Enbridge Gas Distribution Inc.**

**Role in project: Director**

**Expertise and experience**: Mr. Hoey is an experience executive with extensive work in Policy, Regulatory and Economic management. He has over 25 years experience and has worked in utility management for two decades. He was instrumental in the solar water heating project at Enbridge and has overall responsibility for the development of green and carbon neutral projects.

### 2.2.2 Project Statement of Work

**Phase 1 – Project Design and Development**

The project design phase will encompass the following activities:

- Literature review – A comprehensive review of all literature available both domestically and internationally with respect to solar home heating, collection technologies, storage technologies and integration. A report on the findings will be issued.

- Calculation of thermal requirements – The calculation of the thermal requirements of typical homes and small business for annual use both for space heating, water heating, and cooling.

- Calculation of thermal storage requirements – Based on the needs calculations done above, a determination of what amount and level of storage is required for achieving the goals of daily, weekly, and seasonal storage. This will be based on tank, tube and block storage.

- Calculation of thermal output – To calculate the amount of heat (temperature, consistency, etc.) from each technology based on generic performance measures, for flat panels, evacuated tubes and microCSP.

- System Pre-liminary Design – This phase is integrates the results of the prior steps and determines what the system design should be. It is the first determination point in the project work for a decision on what is feasible.

- Equipment Specification Review – This item will identify all of the potential suppliers and the specifications of their equipment. This will determine which equipment will be suitable for the project. The system design models will be updated with the actual parameters of the equipment under consideration.

- Data protocols, monitoring and storage design – This stage will develop the data to be collected, monitored and the storage requirements therefore. The initial data dictionaries will be developed for this stage. A design report will be issued after this stage.

- Partner Identification – This stage will involve the development of criteria for partners, a market scan of who is available and the creation of a target list of potential partners for this project from the academic, business, builders, interest groups, municipal, and other organizations. This item will also include seeking interest in sites for the project from these potential participants.

- Consultant Selection for Phase 2 – This step will develop a list of consultants who can carry out work that is planned for phase 2. The list will include those consultants assisting in phase 1, but will be expanded and permit for future work when required.

- Site Pre-screening and site data collection – A list of potential sited based on internal data and data collected from partners will be used to develop the first band of usable sites. This list will include the data requirements developed above. It is anticipated site visits will determine if they are suitable and what characteristics are common for usable sites.

- Developer (Home) Review – As portion of the installations will be targeted for new homes, it is anticipated that some progressive developers would like to be part of the test sample, thus a review will be conducted of potential partner developers and the market interest in such homes. As well this will serve as a test bed for potential communities of solar homes and other

technological aspect that would apply when they are incorporated into new builds.

- Contract Development – This item encompasses the development of the contracts between the site hosts and Enbridge, suppliers and Enbridge and the release of data (security and confidentiality agreements).

- Code Review – The local and provincial building codes will be reviewed and changes as required will be incorporated into the sub-designs as well development of the projects to ensure they are code compliant.

- Permit Review – With the sample of sites, potential partners, and equipment specifications and code requirements, the applicable permits standards for each area will be reviewed and design modifications incorporated into each of the sub projects. It is hoped the permitting process can be standardized for each installation type.

- Development of RFP for equipment and contracting – This step involves the development of a request for proposals for the equipment and contracting required to install the pieces of the project at sites. At this step a report will be completed to outline the design phase of the project.

The project development phase will encompass the following activities:

- Site final selection – This activity will encompass the requirements from the design phase and use them to screen out any sites that will not meet the criteria developed above or be too difficult to fully permit or that would otherwise require an environmental assessment (either Federal or Provincial - Ontario). A list of chosen sites will be made available to other participants and to the public where consent is given and a generic location (at the neighbourhood level) where not.

- RFP for equipment – The RFP process for equipment will be undertaken to ensure compliance with company policies and ensure each potential vendor identified above is able to compete fairly for the business of this project. The RFP will be based on a points system which will incorporate delivery, performance, warranty and price specifications.

- RFP for contractors and any additional consultants – The RFP process for installation contractors and consultants will be undertaken to ensure compliance with company policies and ensure each party is able to compete fairly for the business of this project. The RFP will be based on a points system which will incorporate speed, performance, work processes and price specifications.

- Permits obtained – This step will be the include getting all required permits for the installation including HVAC and plumbing.

- Contract negotiations – The negotiations with suppliers will attempt to get the pricing we need for this project to be successful and ensure the specifications are met. The goal is to get suppliers who can continue to provide equipment in the longer term and who will be able to reduce pricing to make future installations fully feasible. As well suppliers of installations will be chosen to ensure that they can become longer term business partners and be installers of choice for future wider scale deployment.

- Integration of existing site equipment and data logging equipment – A key part of this project will be the ability to integrate the solar equipment into the existing HVAC system seamlessly and to ensure any new installations are not technically challenging. It will be a key part of the installation contract to facilitate this. It is expected that this item can deselect some sites with technically complex existing systems.

- Site specific design requirements – While site selection is a key factor in the project, some sites,

which are attractive for many reasons, will have more difficult installations. They will need to have more extensive modifications, but should still be within the parameters of the contracts, permits and prior design work.

- Data reporting parameters and report design – This element will provide the external data as noted in the Phase 4 information below. The data design conducted above will be matched to reporting parameters, costs, and data storage and flow abilities. The reports will provide gross information on performance, refined data and in some cases real time data. At this point the final design and development report will be release, as the project's development and approaches will be fully documented.

**Phase 2 – Project Implementation**

- Equipment procurement – The procurement process will essentially be the execution of the negotiated contracts. The upfront work doing the design stage will therefore have paid off through a low issue purchase stage.

- Civil Construction Works (for storage, any reinforcements, code specific requirements) – This element will involve the any work related to the construction of the storage equipment and reinforcing or other installation specific work for the thermal equipment. It will ensure the installation of the other equipment will go as planned and minimize the time required for any specialized solar installation contractors.

- Thermal equipment Installation – This phase is the installation of the solar thermal equipment and any HVAC related equipment. This will involve only the equipment that generates and transfers heat. It is anticipated that from all of the prior design and development work, civil work and feedback that it will be an almost mechanical or routine type of job.

- Monitoring equipment installation – The installation of the monitoring and reporting equipment will be the final installation activity and will generally be add on equipment that is used to collect and distribute for analysis the key parameters of the installation. It is anticipated that the data may be logged in some applications and that some will be real time via an IP type solution, if the host permits the use of their infrastructure.

- Commissioning – Once all of the equipment, storage, collection, monitoring is in place the commissioning process can begin. This stage will include the first operating of system, moving it from an install to steady state operation. Again, planning will ensure that this goes smoothly. A report on the progress of Phase 2 will be made once this is complete.

- Testing Phase – As the project moves from commissioning, the initial testing will occur. It is expected that any issues with operations and data acquisition will be found in this activity and that any operating parameters can be tested and initial results noted. Testing will give the first real world view of the equipment.

- Monitoring / Data Acquisition – The key part of this project will be the monitoring and data generation of the installed equipment. The data will be compared to the expected performance of the installations and will undergo quality testing to ensure it is valid.

- Revisions to any systems requiring updates based on initial design changes post installation – Through the initial data analysis, any anomalies will be investigated and it will be determined if any parts of the design, installation, equipment or monitoring functions are deficient. This will service a way to update and correct any problems observed in the testing and monitoring activities. Repairs or reconfigurations will be designed and deployed to ensure a long run stability and suitability of the project test units and sites.

- Release to long term steady state operation – Once all of the above steps of Phase two are completed, the projects which meet all of the design and testing conditions and are producing reasonable and measurable results without error will be release into steady state long term operations. A report on this sum of activities will be produced to highlight the beginning of the testing phase and share the outcomes of the work.

**Phase 3 – Project Analysis and Reporting**

- Data logging – This element will be the long term capture and retention of the data produced by the installations. The population of the database and the safe keeping of data, along with the capture elements are encompassed here.

- Data Analysis – The analysis of data will be the management the raw data that was captured in the above stage and processing of it into the values can be used to disseminate to end users of this information, including academia, hosts, and other interested parties. This stage will also look for faults in the long term in equipment, data transmission, results and other environmental variables.

- Data reporting – The key result of this project is to provide data in user friendly reports that allows evaluations to take place. The material that is created here will flow to the following elements for further work. Monthly data summaries will be generated.

- Corrective actions measures – The data analysis stage may reveal information that proves that there are long term faults in the equipment, controls or data transmission and logging activities. This step will seek to remedy any issues in the long term phase that were not evident in the design, development, installation, commission or testing phases.

- Implementation of corrective actions – This step will be the implementation of any remedies developed for long term issues as noted above.

- Efficiency Reporting – The first efficiency reports will be made available when the data from the project is fully validated. These calculations will highlight the technology as selected and the installations. This item will include the first of a series of monthly reports which will provide the data for analysis by others.

- System Utilization Reports – They are a subset of the efficiency reports and will highlight how much energy is being produced and how systems are working.

- Calculation of Economic, Energy and Emissions Savings – This subset report element will report on the economic, energy usage and environmental / emissions for the project for the major technology types to provide context as to what the various types of systems performance levels are from a broad measure, as opposed to just energy related parameters.

- Reporting on general category winners – The main and clear objective of this project is to report why type of solar collection equipment works best with which type of storage technology. This report provides a detailed analysis of the work of the project and the winners of the technology based on performance, as determined by energy and emission savings and finally economics. The report will capture the future developments and will determine where modifications of equipment and future designs should target efforts.

**Phase 4 – Project Knowledge Transfer and Dissemination**

**(Please see below in section 2.3.4 – Information Dissemination for details on this Phase)**

- Report on Literature Review
- Call for demonstration locations via marketing channels and/or media
- Report on technologies and locations pre-selected, codes, standards
- Report on expected system performance based on specifications, data monitoring and reporting protocols
- Press Release and initial site selections – added information if more sites required
- Report on Selected locations and participants with equipment choices
- Installation and Monitoring Report
- Monthly Data Summary Report (multiple reports)
- Annual Detailed Performance Reporting (multiple reports)
- Final Performance and Project Report with conclusions and performance winners – future recommendations, media release, technical paper and conference presentations (as required)
- Continued Monitoring as required.

### 2.2.3 Project Milestones, Outputs and Budget

See Table A1 – Below

See Table A2 – Below

| Activities | Year | Principal Milestones | Completion date | Outputs - identify whether interim (I) or final (F) |
|---|---|---|---|---|
| Reporting | | | | Progress reports as specified in contribution agreement |
| **Phase 1 – Project Design and Development** | | | | |
| **Project Design** | **2009-2010** | | | |
| Literature review | | Pre-liminary Design Criteria | November 30, 2009 | Draft Report |
| Calculation of thermal requirements | | | | |
| Calculation of thermal storage requirements | | | | |
| Calculation of thermal output | | | | |
| System Pre-liminary Design | | | | |
| Equipment Specification Review | | | | |
| Data protocols, monitoring and storage design | | System Design Complete | July 15, 2010 | Interim Report |
| Partner Identification | | | | |
| Consultant Selection | | | | |
| Site Pre-screening and site data collection | | | | |
| Developer (Home) Review | | | | |
| Contract Development | | | | |
| Code Review | | | | |
| Permit Review | | | | |
| Development of RFP for equipment and contracting | | Contracts Complete | September 30, 2010 | Interim Report |
| **Project Development** | **2010-2011** | | | |
| Site final selection | | Sites Selected | November 30, 2010 | Final Site List |
| RFP for equipment | | | | |
| RFP for contractors and additional consultants | | | | |
| Permits obtained | | | | |
| Contract negotiations – suppliers | | | | |
| Integration of existing site equipment and data logging equipment | | | | |
| Site specific design requirements | | | | |
| Data reporting parameters and report design | | Site and Equipment Planning Complete | January 31, 2011 | Final Report on Design and Development |
| **Phase 2 – Project Implementation** | | | | |
| Equipment procurement | **2011** | | March 31, 2011 | Interim Report |
| Civil Construction Works (for storage, any reinforcements, code specific requirements) | | | | |
| Thermal equipment Installation | | | | |
| Monitoring equipment installation | | | | |
| Commissioning | | Equipment Commissioning | June 30, 2011 | Interim Report |
| Testing Phase | | | | |
| Monitoring / Data Acquisition | | | | |
| Revisions to any systems requiring updates based on initial design changes post installation | | | | |
| Release to long term steady state operation | | Release to Test Phase | August 31, 2011 | Final Report |
| **Phase 3 – Project Analysis and Reporting** | | | | |
| Data logging | **2011-2014** | | | |
| Data Analysis | | | | |
| Data reporting | | | | |
| Corrective actions measures | | | | |
| Implementation of corrective actions | | | | |
| Efficiency Reporting | | Data Reporting | September 30, 2011 | Interim Report |
| System Utilization Reports | | | | |
| Calculation of Economic, Energy and Emissions Savings | | | | |
| Reporting on general category winners | | Data Analysis and Draft Report Completion | January 31, 2014 | Draft Report |
| **Phase 4 – Project Knowledge Transfer and Dissemination** | | | | |
| Report on Literature Review | **2009-2014** | | November 30, 2009 | Final Report |
| Call for demonstration locations via marketing channels and/or media | | | | |
| Report on technologies and locations pre-selected, codes, standards | | | | |
| Report on expected system performance based on specifications, data monitoring and reporting protocols | | | July 15, 2010 | Interim Report |
| Press Release and initial site selections – added information if more sites required | | | November 30, 2010 | Media Release |
| Report on Selected locations and participants with equipment choices | | | December 31, 2010 | Interim Report |
| Installation and Monitoring Report | | | September 30, 2011 | Interim Report |
| Monthly Data Summary Report (multiple reports) | | | Monthly | Interim Report |
| Annual Detailed Performance Reporting (multiple reports) | | | Yearly | Interim Report |
| Draft Paper on Report of Results | | | January 31, 2014 | Draft Report |
| Final Performance and Project Report with conclusions and performance winners – future recommendations, media release, technical paper and conference presentations (as required) | | Project Completion | March 28, 2014 | Final Report on Project |
| Continued Monitoring as required. | **2014+** | | Annual Report | As Requested Data |

| Activities | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| COST TYPE (in Dollars) | Time Period | Salaries & Benefits | Overhead Expenses | Professional, Scientific, Contracting, Consulting | Data collection, processing, analysis | Licenses and permit fees | Legal | Travel | Equipment | Total |
| **Phase 1 – Project Design and Development** | | | | | | | | | | |
| **Project Design** | **2009-2010** | | | | | | | | | |
| Literature review | | 1,600 | 240 | - | - | - | - | - | - | 1,840 |
| Calculation of thermal requirements | | 2,400 | 360 | - | - | - | - | - | - | 2,760 |
| Calculation of thermal storage requirements | | 2,400 | 360 | 10,000 | - | - | - | - | - | 12,760 |
| Calculation of thermal output | | 3,600 | 540 | - | - | - | - | - | - | 4,140 |
| System Pre-liminary Design | | 8,000 | 1,200 | 25,000 | - | - | - | - | - | 34,200 |
| Equipment Specification Review | | 4,000 | 600 | 5,000 | - | - | - | - | - | 9,600 |
| Data protocols, monitoring and storage design | | 8,000 | 1,200 | 20,000 | 5,000 | - | - | - | - | 34,200 |
| Partner Identification | | 8,000 | 1,200 | - | - | - | - | - | - | 9,200 |
| Consultant Selection For Next Phase | | 2,400 | 360 | - | - | - | - | 500 | - | 3,260 |
| Site Pre-screening and site data collection | | 16,000 | 2,400 | - | - | - | - | 5,000 | - | 23,400 |
| Developer (Home) Review | | 8,000 | 1,200 | - | - | - | - | - | - | 9,200 |
| Contract Development | | 20,000 | 3,000 | 6,250 | - | - | 25,000 | - | - | 54,250 |
| Code Review | | 8,000 | 1,200 | 1,000 | - | - | 2,500 | - | - | 12,700 |
| Permit Review | | 8,000 | 1,200 | 1,000 | - | - | 2,500 | - | - | 12,700 |
| Development of RFP for equipment and contracting | | 8,000 | 1,200 | 10,000 | - | - | 20,000 | - | - | 39,200 |
| **Project Development** | | | | | | | | | | |
| Site final selection | | 14,400 | 2,160 | 20,000 | 1,000 | - | 5,000 | 2,000 | - | 44,560 |
| RFP for equipment | | 14,400 | 2,160 | 5,000 | - | - | 25,000 | - | - | 46,560 |
| RFP for contractors and additional consultants | | 14,400 | 2,160 | 5,000 | - | - | 25,000 | - | - | 46,560 |
| Permits obtained | | 14,400 | 2,160 | 15,000 | - | 22,500 | 10,000 | 250 | - | 64,310 |
| Contract negotiations – suppliers | | 12,500 | 1,875 | - | - | - | 15,000 | - | - | 29,375 |
| Integration of existing site equipment and data logging equipment | | 8,000 | 1,200 | 5,000 | 35,000 | - | - | - | - | 49,200 |
| Site specific design requirements | | 12,500 | 1,875 | - | - | - | - | - | - | 14,375 |
| Data reporting parameters and report design | | 12,500 | 1,875 | - | 25,000 | - | - | - | - | 39,375 |
| **Total Phase 1 - Costs** | | **211,500** | **31,725** | **128,250** | **66,000** | **22,500** | **130,000** | **7,750** | **-** | **597,725** |

| Phase 2 - Project Implementation | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| COST TYPE (in Dollars) | Time Period | Salaries & Benefits | Overhead Expenses | Professional, Scientific, Contracting, Consulting | Data collection, processing, analysis | Licenses and permit fees | Legal | Travel | Equipment | Total |
| Equipment procurement | | 40,000 | 6,000 | 50,000 | - | - | - | 5,000 | 2,500,000 | 2,601,000 |
| Civil Construction Works (for storage, any reinforcements, code specific requirements) | | 40,000 | 6,000 | 50,000 | - | - | - | 5,000 | 3,000,000 | 3,101,000 |
| Thermal equipment Installation | | 40,000 | 6,000 | 15,000 | - | - | - | 2,000 | 480,000 | 543,000 |
| Monitoring equipment installation | | 40,000 | 6,000 | 15,000 | - | - | - | 2,000 | 480,000 | 543,000 |
| Commissioning | | 50,000 | 7,500 | 25,000 | - | - | - | 2,000 | - | 84,500 |
| Testing Phase | | 50,000 | 7,500 | - | 12,500 | - | - | 5,000 | - | 75,000 |
| Monitoring / Data Acquisition | | 25,000 | 3,750 | - | 50,000 | - | - | 2,000 | 50,000 | 130,750 |
| Revisions to any systems requiring updates based on initial design changes post installation | | 12,000 | 1,800 | - | 12,500 | - | - | - | - | 26,300 |
| Release to long term steady state operation | | 2,000 | 300 | - | - | - | - | - | - | 2,300 |
| **Total Phase 2 - Costs** | | **299,000** | **44,850** | **155,000** | **75,000** | **-** | **-** | **23,000** | **6,510,000** | **7,106,850** |

| Phase 3 – Project Analysis and Reporting | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| COST TYPE (in Dollars) | Time Period | Salaries & Benefits | Overhead Expenses | Professional, Scientific, Contracting, Consulting | Data collection, processing, analysis | Licenses and permit fees | Legal | Travel | Equipment | Total |
| Data logging | | 4,000 | 600 | - | 5,000 | - | - | - | - | 9,600 |
| Data Analysis | | 10,000 | 1,500 | - | 20,000 | - | - | - | - | 31,500 |
| Data reporting | | 5,000 | 750 | - | - | - | - | - | - | 5,750 |
| Corrective actions measures | | 15,000 | 2,250 | 25,000 | - | - | - | - | - | 42,250 |
| Implementation of corrective actions | | 20,000 | 3,000 | 25,000 | - | - | 5,000 | 2,500 | 100,000 | 155,500 |
| Efficiency Reporting | | 24,000 | 3,600 | 10,000 | 5,000 | - | - | - | - | 42,600 |
| System Utilization Reports | | 24,000 | 3,600 | 5,000 | 15,000 | - | - | - | - | 47,600 |
| Calculation of Economic, Energy and Emissions Savings | | 36,000 | 5,400 | 15,000 | - | - | - | - | - | 56,400 |
| Reporting on general category winners | | 20,000 | 3,000 | 25,000 | - | - | - | 2,500 | - | 50,500 |
| **Total Phase 3 - Costs** | | **158,000** | **23,700** | **105,000** | **45,000** | **-** | **5,000** | **5,000** | **100,000** | **441,700** |

| Phase 4 – Project Knowledge Transfer and Dissemination | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| COST TYPE (in Dollars) | Time Period | Salaries & Benefits | Overhead Expenses | Professional, Scientific, Contracting, Consulting | Data collection, processing, analysis | Licenses and permit fees | Legal | Travel | Equipment | Total |
| Report on Literature Review | | - | - | - | - | - | - | - | - | - |
| Call for demonstration locations via marketing channels and/or media | | 5,000 | 750 | 15,000 | - | - | - | 2,500 | 2,000 | 25,250 |
| Report on technologies and locations pre-selected, codes, standards | | - | - | - | - | - | - | - | - | - |
| Report on expected system performance based on specifications, data monitoring and reporting protocols | | - | - | - | - | - | - | - | - | - |
| Press Release and initial site selections – added information if more sites required | | 500 | 75 | 500 | - | - | - | - | - | 1,075 |
| Report on Selected locations and participants with equipment choices | | 1,000 | 150 | 1,000 | - | - | - | - | - | 2,150 |
| Installation and Monitoring Report | | 3,200 | 480 | 2,000 | 2,000 | - | - | - | - | 7,680 |
| Monthly Data Summary Report (multiple reports) | | 23,040 | 3,456 | 2,500 | 2,000 | - | - | - | - | 30,996 |
| Annual Detailed Performance Reporting (multiple reports) | | 12,000 | 1,800 | 5,000 | 5,000 | - | - | - | - | 23,800 |
| Draft Paper on Report of Results | | 25,000 | 3,750 | 5,000 | 10,000 | - | - | 1,500 | - | 45,250 |
| Final Performance and Project Report with conclusions and performance winners – future recommendations, media release, technical paper and conference presentations (as required) | | 50,000 | 7,500 | 2,500 | 10,000 | 2,000 | 2,000 | 3,000 | - | 77,000 |
| Continued Monitoring as required. | | 25,000 | 3,750 | 2,500 | 75,000 | 10,000 | - | 1,500 | - | 117,750 |
| **Total Phase 4 - Costs** | | **144,740** | **21,711** | **36,000** | **104,000** | **12,000** | **2,000** | **8,500** | **2,000** | **330,951** |

| COST TYPE (in Dollars) | Time Period | Salaries & Benefits | Overhead Expenses | Professional, Scientific, Contracting, Consulting | Data collection, processing, analysis | Licenses and permit fees | Legal | Travel | Equipment | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **SUMMARY** | | | | | | | | | | |
| **Total Phase 1** | | **211,500** | **31,725** | **128,250** | **66,000** | **22,500** | **130,000** | **7,750** | **-** | **597,725** |
| **Total Phase 2** | | **299,000** | **44,850** | **155,000** | **75,000** | **-** | **-** | **23,000** | **6,510,000** | **7,106,850** |
| **Total Phase 3** | | **158,000** | **23,700** | **105,000** | **45,000** | **-** | **5,000** | **5,000** | **100,000** | **441,700** |
| **Total Phase 4** | | **144,740** | **21,711** | **36,000** | **104,000** | **12,000** | **2,000** | **8,500** | **2,000** | **330,951** |
| **Total Project Amount** | | **813,240** | **121,986** | **424,250** | **290,000** | **34,500** | **137,000** | **44,250** | **6,612,000** | **8,477,226** |

### 2.2.4 Summary of Project Funding Sources and Contributors

| **TABLE 1: TOTAL FROM APPLICANT** | | | | |
|---|---|---|---|---|
| | Fiscal Year (April 1-March 31) | Cash (1000$) | In-kind (1000$) | Total (1000$) |
| Enbridge | 2009-10 * | **19** | **154** | **173** |
| Enbridge | 2010-11 | **840** | **179** | **1,019** |
| Enbridge | 2011-12 | **2,414** | **290** | **2,704** |
| Enbridge | 2012-13 | **16** | **73** | **88** |
| Enbridge | 2013-14 | **15** | **239** | **254** |
| **TOTAL APPLICANT (CASH + IN-KIND)** | | **3,303** | **935** | **4,239** |

| **TABLE 2: TOTAL FROM PRIVATE SECTOR[1] AND ACADEMIC SECTOR** | | | | |
|---|---|---|---|---|
| Names of Contributors | Fiscal Year (April 1-March 31) | Cash (1000$) | In-kind (1000$) | Total (1000$) |
| **TOTAL PRIVATE AND ACADEMIC (CASH + IN-KIND)** | | **TBD** | **TBD** | **TBD** |

| **TABLE 3: TOTAL FROM FEDERAL[2] GOVERNMENT ( if applicable NOT CEF funding)** | | | | |
|---|---|---|---|---|
| Names of Contributing Departments or Agencies | Fiscal Year (April 1-March 31) | Cash (1000$) | In-kind (1000$) | Total (1000$) |
| **TOTAL FEDERAL GOVERNMENT[2] (CASH + IN-KIND)** | | **Nil** | **Nil** | **Nil** |

[1] Other than applicant (if applicable). Include any funding from Sustainable Development Technology Canada in this box.
[2] Other than Clean Energy Fund

| TABLE 4: TOTAL FROM PROVINCIAL / TERRITORIAL / MUNICIPAL GOVERNMENTS | | | | |
|---|---|---|---|---|
| Names of Contributing Governments | Fiscal Year (April 1-March 31) | Cash (1000$) | In-kind (1000$) | Total (1000$) |
| **TOTAL PROVINCIAL / TERRITORIAL / MUNICIPAL GOVERNMENT (CASH + IN-KIND)** | | **Nil** | **Nil** | **Nil** |

| TABLE 5: TOTAL REQUESTED FROM CLEAN ENERGY FUND | |
|---|---|
| Fiscal Year (April 1 - March 31) | Amount (1000$) |
| 2009-10 * | **173** |
| 2010-11 | **1,019** |
| 2011-12 | **2,704** |
| 2012-13 | **88** |
| 2013-14 | **254** |
| **TOTAL CLEAN ENERGY FUND** | **4,239** |

| TABLE 6: SUMMARY OF PROJECT FUNDING | | | | |
|---|---|---|---|---|
| **Funding Source** | **Total Cash (1000$)** | **Total In-Kind (1000$)** | **Total Cash + In-Kind (1000$)** | **Percentage of project total** |
| Applicant | **$3,303** | **$935** | **$4,239** | **50%** |
| Private Sector and Academic | **TBD** | **TBD** | **TBD** | **0%** |
| Federal Government (other than Clean Energy Fund) | **Nil** | **Nil** | **Nil** | **0%** |
| Provincial / Territorial / Municipal Governments | **Nil** | **Nil** | **Nil** | **0%** |
| Clean Energy Fund | **4,239** | **Nil** | **$4,239** | **50%** |
| **TOTAL PROJECT** | **$7,542** | **$935** | **$8,477** | **100%** |

### 2.2.5 Financial Structure and Business Case for Funding Assistance

The business case for this project is derived from the calculation of the total costs of using conventional equipment versus the costs of conducting this project and the resultant savings of using the solar technology. The development of systems that are most efficient and provide the benefits expect require more investment than just the standard equipment and even more investment to get the technology to a point where it is widely commercially available in large numbers once the industry has matured. The project team anticipates that the storage, thermal collection and control systems will decrease in price and by the 2020 time frame could see cost reductions of 30-50%. If the project achieves greater thermal (75%) savings, the benefits could exceed those projected in the business case, thus the research objectives for this project would be met and would provide a cost competitive, relative to today's paradigm, system that would clearly and demonstrably meet NRCan's goals for the CEF.

On the most basic level, the project will cost approximately $8.5 million. Of this $6.6 million is equipment (thermal collection, storage, monitoring and installation) and $1.9 million of labour and services used to develop and design the project and conduct monitoring. Conventional heating equipment for a home would be approximately $5,500 on average or $1.1 million for the project. This leaves a funding gap in this project of approximately $4.2 million. If the participants present value of the projected savings in fuel costs and emissions are factored in, the project would see benefits of approximately $2.9 million, which would leave $4.2 million in costs that would need to be recovered from sources other than the participants.

The above narrative is the basis of the calculations in the table below for the request from the Clean Energy Fund for approximately $4.2 million in fund for this project. We have conducted an additional calculation to determine what the societal benefits, in terms of labour, services and capital multipliers are. These multipliers are broad measures of the impact on the economy as a whole of expenditures on these general elements of the economy. The multiplier values are calculated by Statistics Canada and in this analysis have been applied to 50% of the capital and labour /services expended by the project. The result of this calculation is that approximately $6.6 million in "spin-off" benefits could be generated by investment in this project. This would leave the Government of Canada with a net new benefit to Canadian of $2.3 million dollars when compared to not investing in this project using the narrow definition of capital and labour expenditures, which excludes the societal benefits and fuel / emission savings of conducting this project.

**Project Benefits**

| No. | Item | Per Unit | Project | Calculation or Source |
|---|---|---|---|---|
| | Project Costs | | | |
| a. | Capital | $ 33,060 | $ 6,612,000 | Table A2 |
| b. | Labour / Services | $ 9,326 | $ 1,865,226 | Table A2 |
| c. | Total Costs | $ 42,386 | $ 8,477,226 | a plus b |
| | Participant Costs | | | |
| d. | Conventional Equipment | $ 5,500 | $ 1,100,000 | Estimate |
| | Incremental Costs and Benefits | | | |
| e. | Incremental Project Cost | $ 36,886 | $ 7,377,226 | c less d |
| f. | Fuel Savings | $ 14,282 | $ 2,856,307 | Calculated |
| g. | Emissions Costs | $ 1,393 | $ 278,626 | Calculated |
| h. | Net Incremental Costs | $ 21,211 | $ 4,242,292 | e less ( f plus g ) |
| i. | **Funding Request** | **$ 21,193** | **$ 4,238,613** | c times 50% |
| j. | Societal Mulitplier Benefits | $ 32,814 | 6,562,869 | Calculated |
| k. | Net Benefit to Canada | $ 11,621 | $ 2,324,256 | j less i |

The project will be funded out of capital provided by Enbridge Gas Distribution. Enbridge Gas Distribution is Canada's largest natural gas distributor with 1.9 million customers, and assets of $6.2 Billion, and is a wholly owned subsidiary of Enbridge Inc. which is the owner and operator of the world's longest crude oil and liquids pipeline system. It is anticipated that cash for this project will be from operating and investment capital budgets. Enbridge Gas Distribution and Enbridge Inc. have sufficient cash reserves, credit facilities and the ability to raise equity to fund this project. Enbridge Inc. and Enbridge Gas Distribution's financial information is available at www.sedar.com with full public disclosure of our financial condition on a quarterly basis. Enbridge Inc. is traded on the Toronto and New York Stock Exchanges under the symbol ENB.

The budgets for this project have been approved for 2009. The financial commitment for the upcoming fiscal year, January 1, 2010 to December 31, 2010, are only partially approved and are pending the result of the completion of the literature review and initial in house engineering work. Future budgets will be dependent on the results of the design phase of the project which is consistent with the stage gated approach we have adopted for all of our development work, including this project.

The financial risks of this project are relatively low. The majority of the costs will be related to investment in assets, with known costs around operations and engineering work. The only area of potential variability on the trouble shooting work for system revisions based on the work being done during the commissioning phase. Enbridge anticipates that contingencies within the time plan, costs and stage gated approach, with peer review, will ensure that mitigation will not upset the project plan.

Enbridge believes that the funding requested from the CEF is well within the program limits and should not unduly tax the fund and its resources. Enbridge's partners will provide in-kind contributions in the form of sites, continued operating support, and the adaptation of their facilities. We anticipate that they will also provide funding for data access and continued public relations support. The final site list has not yet been established and Enbridge will require in the selection process that partners contribute the above resources and will provide additional support over and above the minimum outlined above. It is anticipated that any additional contributions will expand project elements (such as cooling, size or type of storage, etc.). This in-kind or co-funding will be finalized in the contracting portion of project's design phase.

Support for this project from governmental agencies is very strong, as the Federal, Ontario and Saskatchewan governments are offering programs which already support a portion of the scope of this project, namely solar water heating. This project adds to the government supported activities by introducing thermal storage and potentially adding solar cooling.

### 2.2.6 Risks and Risk Mitigation Strategy

This project carries with it three main areas of risk. Those are technical, business and other risks. Outlined below is our view of these risks, their frequency, manageability and the specific mitigants that will be employed to manage this project in a manner that is consistent with Enbridge's risk management procedures and policies.

As an overall strategy the phased project approach (stage gate) is being employed to ensure that no one element or phase of the project can proceed without a proper and complete conclusion to a prior element. This management technique ensures that decision to move forward have a basis in reality and that the project must achieve measured and practical results. The addition of reporting to external parties and peer review add robustness to the process. This approach is consistent with current process management methods within Enbridge.

The other risks that this project faces involve those with external party reviews, such as building codes, permits and other requirements from external stakeholders. Environmental permitting will not be required for this scale of project as they are not subject to federal or provincial environmental assessments and our ability to choose sites will ensure that this is not a concern.

The issue of building codes and permits will be a concern in the retrofit aspect of this project. The need to get approvals for the work with the HVAC, plumbing and electrical system of a building are key elements of the installation plan. As we anticipate that a limited number of initially selected sites would be problematic, and thus the reserve test sites may need to be utilized. This ability to cycle through a pool and develop further select criteria is part of the design of this project. We do anticipate using the work and information from our involvement in the solar water heating project with Bullfrog Power to assist on the collector installations. The area where we will have to work with our consultants, local, regional and national standards groups will be on the storage units, but we believe permitting will not be an issue.

The technical risks of this project can be classified into three major categories which correspond to the technologies being tested, those being, panels, storage and integration. Below we will address each area.

Solar panels under test in this project will be from three major families: Flat panel, evacuated tube and lastly concentrated solar. Flat panel thermal solar collectors are the oldest and most time tested units in the market. Enbridge as discussed is a prime participant in a project to install EnerWorks panels for solar thermal water heating. These panels have been tested and reviewed by Enbridge and as such we believe little to no residual risk is posed by using flat panel type units in this project.

Evacuated tube collectors are a newer technology, but are in full mass production throughout the world. Enbridge anticipates that they will provide better efficiency, installation ease, insulation, roof wear, etc., but they may have some longevity issues in later years around tube seals. As the tubes are able to be replaced individually, the long term risk around them is lowered. We believe that they may prove to be more suited to the space heating application than the flat panels. We look forward to managing them as part of this project.

Micro Concentrating Solar Panel (Micro CSP) collectors will be tested. They present the largest technological push on the collector side of the project. CSP collectors are normally used in large scale solar thermal projects used for the generation of electricity or distillation of sea water. As a class of solar panel, they operate at higher temperatures than the other two technologies. They can also be married to frensel lenses, but usually are configured as troughs. This technology, particularly in the intended Micro CSP, has few active projects in Canada. This will be the area of the largest potential gain in information, but it will also be the largest area of risk. We plan on using the available technology in this area and intend to get a manufacturer as a project participant to minimize our risk of deployment and maintenance over the long term.

Storage is the next major area of technical risk. The project will use three major storage concepts and attempt to provide for individual storage systems that will be able to do daily storage and progress to seasonal storage. The risk are that the storage systems will be costly and thus and economically challenging for wide spread implementation. The other risk is that they will not be technically possible in the retrofit market, in that their installation would be too costly and require too much room. As well the technical issues around the capacity of storage, both time and volume are key variables that will be addressed in this project. Materials, insulation and the fluids will be key elements thereof as well. The design phase and site selection will be key to addressing the risks, but only the project and the test elements will provide sufficient data to determine the best (from a cost and total energy provision) fit with the collection technology and uses.

The integration of systems is normally the most complex area of any project that marries multiple types of technology. This area the largest area of unknown technical risk, as it will require the project to adapt control systems to function with existing equipment which may be difficult to manage electronically or within the desired parameters. Risk management in this area can be accomplished through the use of active control systems for the solar and storage equipment which will be optimized to work with the passive systems used in most residential and small commercial system. As the intent to this project is to work with retrofit system for approximately half of the projects, this is a key area. With the ability to select

The business risk of this project is largely captured in the following areas: energy commodity costs, equipment pricing, operating expenses and project management.

As Enbridge is an experience manager of energy infrastructure projects and has the talent to manage this type of activity, we believe that the risk to the project would be minimal from our actions. We will only employ contractors and partners that meet our rigid standards for the completion of work and we will conduct sufficient due diligence on expenditures.

Enbridge and its' affiliates are experts in the risk management of commodity exposures and costs. We do however realize that market conditions for commodities such as electricity and natural gas fluctuate and need to be managed. This project by its design is a way to manage commodity exposure over time. With the known cost of assets installed and predictable nature of solar radiation (on a seasonal and annual basis), we can converted what would normally be commodity risk into a fixed and level cost for energy. This is a major achievement of this type of renewable project, and will ensure that projects like this are considered even with the currently low cost of traditional heating fuels we are seeing now. The risks around operating costs can be minimized through prudent design and by using low cost heat transport mediums such as water.

Decommissioning will occur at the end of the equipment life, which is anticipated to be 30 years. The equipment will be such that it can remain in location without the need for removal. It will be replaced if and when it is no longer required. The contract with the site hosts will include provisions for the removal of equipment to address this issue.

Enbridge believes that the risk mitigation strategy we intend to employ and our prudent management of similar utility and energy technology will result in a successful outcome for this project and will minimize the risk to participants include NRCan.

## 2.3 Impact and Expected Outcomes

### 2.3.1 Innovation

The project technology and concept are highly innovative in the aspect of the integration of the solar thermal production equipment, storage and the existing thermal heat generation system on a unit basis. The integration of solar thermal water heating is a known technology and is in current deployment by a number of entities in Canada, including the proponent. The unique and innovative aspect is the integration of this into an existing heating system versus only a water heating system, and the use of larger external volume storage. Thermal storage in concrete, tanks, stone and underground devices are unique in Canada and have not yet been developed in a manner to provide extended service. The use of concentrated solar in Canada has also not been field trialed in Canada.

The use of a solar collection based district energy system with deep geological storage is currently in use in Canada. The system is a residential community with 800 collectors, with deep geological thermal storage. The Drakes Landing Solar Community (www.dlsc.ca) is currently in operation and will provide background information for this project. The key differences between this project and the DSLC is that a large geological storage system is being used instead of discrete units for individual sites, only one type of solar panel is being used (flat panel), and most importantly, that this was a new build project that was fully integrated from the outset and was not designed for retrofit markets as this project is, and lastly, it was designed for a prime solar region of Canada (southern Alberta) which is different than that of Ontario and other regions with less of a solar resource, thus emphasizing storage.

The implications of fully developing this project into a large scale commercial enterprise are clear. If the project is able to provide more than 50% of the heating requirements of an end user, and the costs and efficiencies can be improved, the ability to scale up and remove the traditional heating system for a dwelling, leaving only minimal traditional (fossil fuelled) heating as a back up system. This system could also be designed to run on “green” fuels such as biogas or landfill gas or potentially wind if electrically heated. This would be a major shift in the construction and operation of heating systems in Canada and would lead to increased GHG reductions and fuel use. It would also provide the basis for further investments in Canadian infrastructure development, an increase in employment for installations and the potential to export.

Another key feature will be the ability to retrofit existing heating systems with green technology and the work required to integrate the two systems (traditional and solar/storage). This integration work will permit other projects to benefit from the knowledge gained.

### 2.3.2 Impact of Future Deployment

The future impact of wide scale deployment of this project will be to reduced the need for carbon based fuels in Canada, reduce emissions and bring the micro generation of renewal thermal energy to the individual homeowner, business, institution or commercial enterprise that is fully locked into accepted norms. If the storage component of this project can be expanded to provide seasonal storage, there is the possibility of being able to remove a greater potion of a buildings heating load from the tradition energy transmission network and provide in combination with more efficient buildings an ability to completely eliminate tradition heating infrastructure requirements. This would provide for greater planning flexibility for builders, communities, and make some housing projects more feasible, particularly in more remote locations. Extension of these technologies to become integrated elements of the home (i.e. collections are structural element in the roof, and storage is incorporated in the foundation), would further enhance the feasibility of the technology and reduce any barriers that might exist for wide scale adoption.

The deployment plan into 2020 and out to 2050 would see the winning technologies for the Canadian context become the norm for new home construction as part of a fully integrated system for home heating. The storage element of the project would become part of the homes structure and increase the cost effectiveness of this type of system, further enhancing competitiveness for the Canadian context and for export markets.

A wholesome adoption of these technologies would then result in them becoming the primary system choice for new and retrofit thermal heating systems. The full integration of the technology into the structure of the building and the preconstruction of the storage elements would lead to further advances on the cost and efficiency fronts.

To elaborate on the future benefits of this project. Once the testing is complete much of the development work will be complete, thus eliminating $1.9 million of costs to achieve a “one of many” case. This will instantly enhance the economics of the project, but it will still not be fully economic for an end user. The expected gains on efficiency and economies of scale will be required to ensure wide spread adoption. We anticipate the following scenarios to occur. One is the introduction of a higher than planned energy savings rate. The project is currently anticipating a 50% saving, but with a 75% savings, the economics for the one of many plus this boost in savings is dramatic. The introduction of improved capital costs, as modelled here a 1/3 reduction in pricing without an improvement in savings also yields a better case for improved economics. Lastly the combination of these two favourable outcomes yields a project that would be fully able to stand on its own merits and thus could become a standard in and of itself.

**t Benefits**

| Item | Project | One of Many | Higher Savings | Reduced Capital | Savings + Capital |
|---|---|---|---|---|---|
| Project Costs | | | | | |
| Capital | $ 33,060 | $ 33,060 | $ 33,060 | $ 22,041 | $ 22,041 |
| Labour / Services | $ 9,326 | | | | |
| Total Costs | $ 42,386 | $ 33,060 | $ 33,060 | $ 22,041 | $ 22,041 |
| Participant Costs | | | | | |
| Conventional Equipment | $ 5,500 | $ 5,500 | $ 5,500 | $ 5,500 | $ 5,500 |
| Incremental Costs and Benefits | | | | | |
| Incremental Project Cost | $ 36,886 | $ 27,560 | $ 27,560 | $ 16,541 | $ 16,541 |
| Fuel Savings | $ 14,282 | $ 14,282 | $ 21,422 | $ 14,282 | $ 21,422 |
| Emissions Costs | $ 1,393 | $ 1,393 | $ 1,990 | $ 1,393 | $ 1,990 |
| Net Incremental Costs | $ 21,211 | $ 11,885 | $ 4,148 | $ 866 | $ (6,871) |

If all Canadian homes adopted some form of solar thermal energy collection, a portion of the 1,000 PJ of energy used for heating and water heating could be reduced. As each region has a diverse source of heating fuels the exact impact would be based on the regional distribution of displaced fuels, system efficiency, size and location.

The project is being designed (sized) for thermal applications in the franchise area of Enbridge Gas Distribution, but their applicability could be expanded to include other regions of the country. For example homes in temperate climates such as British Columbia could potentially fully displace their natural gas usage through the work of this project, while for the summer periods; northern communities could do the same and have excess energy for storage in the initial parts of the winter seasons if the storage equipment can be sized to provide it.

### 2.3.3 Evidence of Receptor Interest

The interest in this type project is well established. The Governments of Canada and Ontario have done research to support the conclusion that by 2011 over 700 building in Canada would have the interest to participate in this type of initiative and this project would provide a base of up to 200 of that number. The focus of the current NRCan proposal has been on the commercial sector, and it is using an incentive model to attempt to get projects under development. Saskatchewan recently introduced a program to do similar work, the Solar Heating Initiative for Today (SHIFT) program.

Enbridge as a participant in the Bullfrog Power Inc. solar water heating project, has found interest in adopting solar water heating program to provide space heating and incorporate storage technologies to expand the level of energy produced to reduce fuel consumption and GHG emissions.

Solar collectors in numerous forms exists in both within the Canadian and global market place, thus supply of units (fabrication) is no an issue. Enbridge does not wish at this stage to team up with a specific manufacturer for this project, as that may bias the open competition (via RFP) for equipment for this project. Storage equipment for this type of application, particularly subsurface, is not mature. Enbridge intends to design and build in conjunction with engineering consultants and builders the appropriate test facilities. The deployment of the concept is a key function of this project, and as a Canada's largest gas distribution utility we have the ability to promote this project, though our marketing and administrative organization as well as through our government and community relations groups. We have over 1.9 million active customers to draw upon for sites and have overwhelming support to conduct "green" activities by our key stakeholders. As Enbridge has previously managed the largest fleet of rental water heaters in Canada, this size and type of project is well within the scope of our competencies.

As the project is in the design phase, the customer (receptor) sites will be determined. This will expand the "team" members in the project. We firmly believe there will be no issues with addition of host and host sites for this project. The hosts will have an economic interest in the project and will be actively work with the equipment to ensure the project meets their needs.

### 2.3.4 Information Dissemination

The core elements of the information dissemination plan for the project involves the availability of data to interested parties via reports and electronic (web) information, which we anticipate will be provided as aggregate data for the various technology combination types. This approach is required as the current state of privacy legislation requires that individual installations not be identified without the consent of owners. Further granularity will be provided only with owner consent, which will be vigorously sought for every project. We anticipate that many site owners will want to have their experiences shared with others as they will be early adopters of this technology and act as information conduits for this project and other initiative to reduce GHGs in Canada.

The plan calls for an initial report to review any of the available literature on the topic and provide for the opening of a broader discussion on the information with key stakeholder groups. It is anticipated that university, colleges, governments (provincial and municipal) as well as trade groups will be involved in the discussion with documents on the project being circulated for their information and review. This will form the basis of the non-portal based information exchange series. This will also provide an opportunity to get other stakeholders involved from the educational and trade communities, who may be able to provide additional resources to the project, but have not yet been canvassed for their interest in participating.

The next phase will provide an open call to key channel partners and potentially through media if the channel partner approach does not provide the expected level of interest. Our target is approximately 200 unit installations, which may be executed as two multi-residential structures or up to 200 individual homes with approximately 5 to 20 units per technology combination. It is expected that filling this test requirement will not be an issue and that parties interested in participation will exceed the number of units available. Enbridge will need to work with NRCan and potential partners to see if the program can be extended to service the demand.

A series of reports will provide information on specific aspects of the project and the information learned along the way. The design phase of the project will include the above mentioned literature review. The system design work interim report will provide an opportunity to provide input on the project's preliminary setup, equipment, calculations and other design parameters before any final choices on equipment, technology or sites have been made. This report is a critical step in ensuring sufficient peer review is conducted and feedback is incorporated into system design.

The next interim report will be completed after sites, RFP types, codes, permits and consultants are selected. This will provide the audience with information on the last elements of the design phase which should provide a detailed list of the issues and requirements for getting final approvals before getting to the development phase of the project. As Enbridge is an active participant in the utility community and must comply with a myriad of codes, standards, etc. we are extremely capable in facilitating many of the discussions which will drive the requirements of municipalities, code committees, standard setting bodies would expect of these types of implementations. We anticipate that all prior participants will provide comment before the next milestone event which is site selection.

The release of site information will be compliant with privacy legislation, but it is anticipated that selected sites and alternative sites, in case of participants not being able to proceed, will be available to participating parties and if consent the public at large. This will be followed by a media release to highlight the public start of the project and provide the public with an opportunity to follow the developments and create interest in the boarder community.

Once the design and development phase is complete a final report will summarize all of the information from prior reports and provide the information necessary to replicate this project and further development in the field. The project implementation phase will include interim reports on the equipment choices, installation experience and the net energy efficiency of the plant. A final report will be issued with the release of the project to the full scale test period.

During the project analysis and reporting phase, a web based report of the technology choices with daily (if possible real time data will be available on select applications). This phase will include Monthly Data Summary Reports, Annual Detailed Performance Reporting (multiple reports). This will be the primary delivery to stake holders of semi-processed data. The monthly reports, efficiency calculations and annual reports will address the need to keep clear and easily accessible information for multiple stakeholders at various sophistication levels.

The full analysis of the data created during the project phase will be put into a draft report and validated against project expected results. This will see peer review and then a final Performance and Project Report with conclusions and performance winners. It will include future recommendations, a media release, technical papers and conference presentations as required.

The project infrastructure will still be available for use, it is has a longer life cycle than that of the CEF reporting requirements. It is anticipated some stakeholder groups, users and Enbridge may wish to keep the project monitoring equipment operational for degradation calculations and continued system maintenance purposes.

**Section 3 - CEAA Checklist**

**3.1 Project Overview in the CEAA Context**

Below is the completed Canadian Environmental Assessment Act Checklist as included in the Clean Energy Fund Application.

This project involves the modification of heating systems of existing structures for which municipal and local building approvals (HVAC, Plumbing and Building Permits) will be the primary regulation for this project.

**3.2 CEAA Project Screening Checklist**

**General:**

**1. Project Title**:

Residential Solar Space Heating Project

**2. Name:**

Enbridge Gas Distribution Inc.
500 Consumer Road
North York, Ontario M2J 1P8
PO Box 650
Scarborough, Ontario M1K 5E3

Contact:
Owen Schneider
Manager, New Ventures
Tel: 416 495 6493
Fax: 416 495 6163
E-mail: owen.schneider@enbridge.com

**3. Other Participating Organizations:**

To be Determined

Typically Existing Property Owners and Property Developers with Residential or Commercially Zoned Property within Greater Toronto Area Municipalities in Ontario, Canada.

**Project Location:**

**4. Description of Characteristics of Locations:**

The exact project locations have not yet been determined. The proponent is willing to work with NRCan to either select sites or determine exact site selection criteria earlier than they are proposed in this plan to facilitate any requirements of NRCan. The site will be determined through a detailed site selection process which will meet the requirements of the CEAA. The sites will be in the franchise area of Enbridge Gas Distribution Inc. in the Greater Toronto Area. The sites will be at existing residential, multi-residential, developed subdivisions (i.e. serviced lots), and some small commercial properties. The sites will be within urban and suburban settings and will not impact the areas traditionally screened in a CEA Act screening.

**5. Principal Activities:**

The equipment to be installed for this project will be pre-manufactured solar collectors of three varieties. They will be installed after the applicable, building, plumbing and HVAC permits are received from municipalities and will be installed after the site selection and permitting stages, which will be in the spring and summer of 2011. The units will typically be installed in one to two days. Small crews of two to five installers will bring the solar collector mounting hardware to the roof, install them on the trusses and/or other points. Then the solar collectors will be mounted to them. In the heating space, the heat exchanger, pumps, etc. will be installed, and the control equipment. Then piping between the solar collectors and heat exchangers will be installed. All installation will take place with common hand and power tools used by HVAC installers and plumbers.

As for the properties in the project with external underground storage, the appropriate utility locates will be conducted, permits will be obtained for the construction of the concrete storage unit. It is anticipated that they will be located in backyards (or in rare cases side yards) and require the same permitting application process as a swimming pool. The construction process will involve the digging of a hole to house the concrete storage unit or plastic piping and the trenches required to put the piping between the unit and house. The units will be installed, piping connected and tested, then the trenches and hole will be filled and the site fully restored (grass laid, paving, etc.) It is anticipated that this will take no more than 2 to 5 days, and will involve the equipment normally used in the construction of a swimming pool and in the installation of a gas service, such as trenching equipment, backhoes and “bobcat” type miniature excavators.

Once the solar collectors, storage units and the associated control and heat exchange equipment and piping are connected, the heat transfer fluid will be filled and the systems tested. After which the data gathering and transmission equipment will be activated and tested. Once these systems are fully operational, the project testing phase can begin. Monitoring will occur for three years, and the equipment will function for a total of 30 years. Thereafter equipment will be removed if no longer serviceable.

In general, the installation and operation of this equipment is completely noiseless, does not release any harmful emissions into the environment and is understood well by the proponent and scientific community. No temporary structures or infrastructure other than those named above.

**6. CEA Act Checklist:**

| Y | N | U | |
|---|---|---|---|
| **Determination of Physical Work under the *CEA Act*** | | | |
| √ | | | Does any phase of the proposal involve the **construction, operation, modification, decommissioning, abandonment or other activity** in relation to a built structure that has a fixed location and is not intended to be moved frequently? |
| | √ | | Is this operation the same as the operation of an existing physical work for which an environmental assessment has already been completed? |
| | √ | | Will the physical work be located within 30 m of a body of water? |
| √ | | | Will the physical work be located on a serviced lot? |
| | √ | | Will the physical work be located on a Federal Real Property? |
| | √ | | Does the physical work involve of the construction, decommissioning or abandonment of a hydroelectric generating station with a production capacity of 200 MW or more? |
| | √ | | Does the physical work involve the expansion of a hydroelectric generating station that would result in the increase in production capacity of 50% or more and 200MW or more? |
| | √ | | Does the physical work involve the construction, decommissioning or abandonment of a tidal power electrical generating station with a production capacity of 5MW or more, or an expansion of such a station that would result in an increase in production capacity of more than 35%? |
| | √ | | Does the physical work involve the proposed construction, decommissioning or abandonment of a structure for the diversion of 10 000 000 $m^3$/a or more of water from a natural water body or an expansion of such a structure that would result in an increase in diversion capacity of more than 35%? |

| **Determination of Assessable Activities under the *CEA Act*** | | | |
|---|---|---|---|
| | √ | | Activity takes place in a National Park or National Nature Reserve in Canada |
| | √ | | Activity takes place on First Nation lands |
| | √ | | Activity takes place in the North (Yukon, Nunavut, or the Northwest Territories) |
| | √ | | Activity takes place on a Federal Real Property |
| | √ | | Activity takes place in or within 30 metres of the right-of-way of a power line, a natural gas line, or a railway line |
| | √ | | Activity will discharge potentially polluting substances into a body of water. |
| | √ | | Destruction of fish other than by fishing |
| | √ | | Sampling or prospecting for ores or minerals |
| | √ | | Disposal of a prescribed nuclear substance other than in a laboratory equipped for such disposal |
| | √ | | Deposit of a deleterious or other substance into the environment (in the earth, air, or water) |
| | √ | | Any kind of remediation of contaminated land |
| | √ | | Deposit of oil, oil wastes or any other substances harmful to migratory birds in waters or in areas frequented by migratory birds |
| | √ | | Killing or removal of migratory birds, their nests, eggs, or carcasses or other physical activities that may require a permit or other authorisation under the *Migratory Birds Regulations* or *Migratory Bird Sanctuary Regulations* |
| | √ | | The removal or damaging of vegetation and/or the carrying on of agricultural activities or the disturbance or removal of soil in a wildlife area that requires a permit under section 4 of the *Wildlife Area Regulations* under the *Canada Wildlife Act* |
| | √ | | Physical activities that are carried on in Canada and that are intended to threaten the continued existence of a biological population in an ecodistrict, either directly or through the alteration of its habitat |
| | √ | | Establishment or operation of a field camp in a single location that will be used for 200 person-days or more within a calendar year |
| | √ | | Seismic surveying involving more than 50 kg of chemical explosive in a single blast; or marine or freshwater seismic surveying, if during the survey the air pressure measured at a distance of one metre from the source would be greater than 275.79 kPa (40 lbs/sq in) |

| **Infrastructure Programs** | | | |
|---|---|---|---|
| | √ | | Has the proponent applied to receive funding from other programs (federal or other jurisdictions) for this project? If so, please specify the program and department. |
| | √ | | Is the purpose of the project to improve energy efficiency in a municipal or community building/facility? |
| | √ | | Will the project be carried out within 250 m of an environmentally sensitive area? |

**Section 4 – Project Description – CEAA Required Information**

**4.1 – General Information**

**General:**

**Name and Nature of Project:** Residential Solar Space Heating Project. This project plans to use and integrate solar collectors, thermal storage and control devices to displace fossil fuel heating in dwellings.

**Location:** Urban and suburban communities within the distribution franchise of Enbridge Gas Distribution Inc. in the Greater Toronto Area, Ontario.

**Distribution List:** No external parties to Enbridge Gas Distribution and NRCan have been given this document.

**Consultations:** No information consultations have been held with any level of Government, Aboriginal peoples, or the public as of today, September 14th, 2009.

**Other Environmental Assessments Required:** This project does not meet the requirements for an Ontario environmental assessment, or any other processes including land claims, etc. It will be subject to the requirement of the Ontario Building Code and the specific requirements of the municipalities of the Great Toronto Area, Ontario..

**Contacts:**

**Proponent Name:**
Enbridge Gas Distribution Inc.
500 Consumers Road
North York, Ontario M2J 1P8
Mailing Address:
Enbridge Gas Distribution Inc.
PO Box 650
Scarborough, Ontario M1K 5E3

**Co-Proponent:**

Clean Energy Fund Program
Office of Energy Research and Development
Natural Resources Canada
58 Booth Street 14th floor
Ottawa, Ontario K1A 0E4

**Individual Contacts:**
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Scarborough, Ontario M1K 5E3
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E-mail: patrick.hoey@enbridge.com

**Federal Involvement:**

Federal funding of the project is to be provided by:

Clean Energy Fund Program
Office of Energy Research and Development
Natural Resources Canada
58 Booth Street 14th floor
Ottawa, Ontario K1A 0E4

No Federally owned land is being used or requested for use in this project.

**Authorizations:**

No Federally issued permits, licenses or authorizations will be required for this project. No provincial authorizations will be required. An Ontario Electrical Safety Authority inspection on any unique electrical equipment may be required. Local / Municipal building, plumbing, and HVAC permits and inspections will be required.

**4.2 – Aboriginal and Stakeholder Consultations**

**Aboriginal Groups Interested or Affected:**

This project will be carried out on existing dwellings, therefore it is anticipated that it will not require any stakeholder consultations as the affected groups are not normally consulted with for residential building permits for existing structures.

Enbridge has not carried out any stakeholder consultations for this project. We anticipate that adjacent properties may require consultation as part of the building permits process, as determined by the local municipality.

**4.3 – Project Information**

**Project Components / Structures:**

The project will involve the installation solar collection equipment on the roofs of existing dwellings. The panels will be approximately 5 $m^2$ to 15 $m^2$ in size. They will have piping to connect them to the existing heating units of dwellings. The storage aspect of the project features tanks located in the basement of dwellings, tubing placed under ground in the back (or side) yards of these dwellings, or buried concrete storage units. It is anticipated they will be located under up to 50 $m^2$ of land in the yard and have tank capacities up to 10,000 litres in the basement.

**Project Activities:**

Units will be installed after the applicable, building, plumbing and HVAC permits are received from municipalities and will be installed after the site selection and permitting stages, which will be in the spring and summer of 2011. The units will typically be installed in one to two days. Small crews of two to five installers will bring the solar collector mounting hardware to the roof, install them on the trusses and/or other points. Then the solar collectors will be mounted to them. In the heating space, the heat exchanger, pumps, etc. will be installed, and the control equipment. Then piping between the solar collectors and heat exchangers will be installed. All installations will take place with common hand and power tools used by HVAC installers and plumbers.

As for the properties in the project with external underground storage, the appropriate utility locates will be conducted, permits will be obtained for the construction of the concrete storage unit. It is anticipated that they will be located in backyards (or in rare cases side yards) and require the same permitting application process as a swimming pool. The construction process will involve the digging of a hole to house the concrete storage unit or plastic piping and the trenches required to put the piping between the unit and house. The units will be installed, piping connected and tested, then the trenches and hole will be filled and the site fully restored (grass laid, paving, etc.) It is anticipated that this will take no more than 2 to 5 days, and will involve the equipment normally used in the construction of a swimming pool and in the installation of a gas service, such as trenching equipment, backhoes and “bobcat” type miniature excavators.

Once the solar collectors, storage units and the associated control and heat exchange equipment and piping are connected, the heat transfer fluid will be filled and the systems tested. After which the data gathering and transmission equipment will be activated and tested. Once these systems are fully operational, the project testing phase can begin. Monitoring will occur for three years, and the equipment will function for a total of 30 years. Thereafter equipment will be removed if no longer serviceable.

In general, the installation and operation of this equipment is completely noise less, does not release any harmful emissions into the environment and is understood well by the proponent and scientific community. No temporary structures or infrastructure other than those named above.

**Resources and Materials Used:**

The project will use commercially manufactured solar collection equipment, which involves proprietary processes with copper, plastics, glass, and ferrous and stainless steel. The storage aspect of the project will involve steel tanks, plastic tubing, and concrete.

The specific amounts of raw materials used for this project will be difficult to calculate as finished products will be incorporated. Some potable water will be used as a heat transfer medium, and minimal other infrastructure, as this project is typically only installing equipment on existing structures.

The excavation requirements will be minimal, with approximately 10 $m^3$ per site for concrete storage systems, and even less for tube based systems. Trenching will be required, and all installations will be designed to retain any excess fill on site.

The project design does not generate or require the use of any materials that are toxic or hazardous and it will not create any hazardous by products. The project will test any heat transfer materials both pre and post use to ensure they meet these requirements.

**Waste Disposal:**

The project is anticipated to use water as the heat transfer medium. Water is non-hazardous and can be disposed in residential sewage streams. In some tests sites the project may require the use of food grade

glycol (propylene glycol – USP grade) as a heat transfer medium. It is non-hazardous, but if testing proves it is after use, then it will be handled by a waste management process and disposed of according to environmental regulations.

**4.4 – Project Site Information**

**General Project Locations:**

The exact project locations have not yet been determined. The proponent is willing to work with NRCan and other Federal Agencies to either select sites or determine exact site selection criteria earlier than they are proposed in this plan to facilitate any requirements of NRCan. The site will be determined through a detailed site selection process which will meet the requirements of the CEAA. The sites will be in the franchise area of Enbridge Gas Distribution Inc. in the Greater Toronto Area, Ontario. The sites will be at existing residential, multi-residential, developed subdivisions (i.e. serviced lots), and some small commercial properties. The sites will be within urban and suburban settings and will not impact the areas traditionally screened in a CEA Act screening. Enbridge will provide specific project locations when they are determined.

**Environmental Features:**

The project design will ensure that the terrain, water, air, vegetation, fish and wildlife habitats are not impacted by the activities of the project. The installation of solar panels and accessory equipment is not typically governed by environmental regulation when installed on residential dwellings. The selection of dwellings which do not meet the requirements of a Federal EA is a paramount selection criterion. Fish, fish habitat and navigable water will not be near any project sites.

**Land Use:**

The project will be conducted on currently valid residentially and potentially commercially zoned land. It will not affect agricultural, recreational or industrial lands. The adjacent sites may have this zoning, but the municipal building permit process will ensure that this project fits within the compatible uses of the project lands. Typically, the installation of HVAC and plumbing related equipment does not require any zoning issues to be addressed. For projects in Toronto, zoning exists to permit all solar installations without changes in zoning.

Contamination from past land use will have had to have been resolved prior to our project, as we will be installing equipment on existing structures and will ensure that permits will permit the equipment to be used.

The project will not be conducted on Indian reserves or lands currently or traditionally used by Aboriginal peoples.

The project will not be conducted in or around important or designated environmental or cultural sites, such as national parks, heritage or other protected sites. It is anticipated that the project would be fully compatible use for on these sites.

**4.5 – Requirements Relating to Fish, Fish Habitat and Navigable Waters**

The project will no be conducted or have activities take place in a water body or within 30 metres of one. As such, it is anticipated to have no impact on fish, fish habitats or navigable waters.

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# VECC INTERROGATORY #2

## INTERROGATORY

Reference Exhibit A Tab 1 Schedule 3 Page 4 para. 11

Preamble: The Solar Space Heating initiative is a pilot technology evaluation [emphasis added} to test a variety of solar thermal collectors and combined thermal storage alternatives. The pilot will involve the design and development of systems for a number of sites within the Enbridge franchise area. Following installation, the sites will be monitored for three years and the project results made publicly available.

a) Position/discuss the Pilot Project and assets relative to the Boards Guidelines *"Regulatory and Accounting Treatments for Natural Gas Utility-Owned Qualifying Facilities or Assets"* and Specifically Facilities of Type c) in the Ministers Directive and Section 3.1 of the Guidelines.

b) Discuss how this project differs from the SHSC Solar Water Heating Initiative EB-2009-0154 Phase II which the Board rejected.

c) Will SHSC be one of the potential sites for the Multi-Residential demonstration project?

## RESPONSE

a) All assets and equipment will be owned by the pilot site owners. As such, the equipment installed at pilot site locations does not fall under the Board's guidelines "Regulatory and Accounting Treatment for Natural Gas Utility-Owned Qualifying Facilities or Assets".

b) This project differs from the SHSC Solar Water Heating Initiative EB-2009-0154 Phase II for the following reasons:

- This initiative does not focus on the low income sector.
- It is a separate initiative that focuses on different technologies (solar space heating) than those identified in EB-2009-0154 Phase II (solar water heating)
- EGD is not asking for SSM or TRC credits that come as a result of this i initiative.
- This initiative is not a market transformation program with the intent to

Witnesses: P. Hoey
A. Mandyam

accelerate the deployment of mature technologies. This initiative is a research pilot project.

c) At this time no discussions with SHSC have occurred about this research pilot project.

Witnesses: P. Hoey
A. Mandyam

# VECC INTERROGATORY #3

## INTERROGATORY

Reference: Exhibit A Tab 1 Schedule 3 Page 8 Paras 22 and 31

Preamble: "The project has similarities to the Industrial Sector Pilot Program approved by the Board in the 2010 DSM Plan (EB-2009-0154). Like the Industrial Pilot Program, the budget for the Solar Thermal Space Heating Pilot is proposed to be incremental to the DSM budget for 2010 as determined by the formulaic budget escalator detailed in EB-2006-0021, but still included in rates. Additionally, neither project will impact the formulaic DSM target, or contribute TRC results for the purposes of SSM calculation."

a) Confirm that the Solar Pilot costs /accts will be separated from the base DSM program for 2010-2012 and will not access the DSMVA or LRAMVA or SSMVA

b) Will interest be charged on the account balance?

## RESPONSE

a) Solar Space Heating Program costs/accounts will be separated from the base DSM program for 2010-2014 and will not access the DSMVA or LRAMVA or SSMVA.

b) Interest will be charged in the same manner as all other deferral accounts.

Witnesses: P. Hoey
A. Mandyam

# VECC INTERROGATORY #4

## INTERROGATORY

Reference Exhibit A Tab 1 Schedule 3 Page 9 para 25 and 26

Preamble: "The maximum anticipated budget is $8.5 million over the five year duration of the pilot. As illustrated in the table below, most costs are incurred in Phase 2, Implementation, as the systems are purchased and installed."

a) If not already provided in the response to VECC IR #1 provide a budget breakdown by year (similar to para 26) that shows inter alia EGDs estimated gross and net Capital and O&M costs.

## RESPONSE

A description of the project and the budget has been provided in the application (Exhibit A, Tab 1, Schedule 3, p. 10, paragraph 26). EGD's contribution will only be O&M expenditures.

Also please see VECC Interrogatory #1 at Exhibit #1, Tab 2, Schedule 1.

Witnesses: P. Hoey
A. Mandyam

# VECC INTERROGATORY #5

## INTERROGATORY

Reference: Exhibit A Tab 1 Schedule 3 Page 9 para 29 and 33

Preamble: "It is anticipated that, where appropriate, the Company will seek approval for the clearance of amounts recorded in a specific year's deferral account at the same time that the Company applies for approval for clearance of the same year's other DSM deferral and variance accounts".

a) Provide the Name(s) of the Account(s) for which approval is sought.
b) Provide details of the Accounting Entries.
c) Provide details of how the account(s) will be audited and provided to ratepayers as part of EGDs plan to recover the (net) balance in the Account (if approved):
    i. During the IRM period
    ii. Upon Rebasing
    iii. Other recovery/timing
d) How does EGD plan to allocate the costs to customers/classes assuming the board finds this appropriate? Provide details of the principles that will apply.
e) Based on the preliminary estimate of costs and the sectoral project plan, provide am *illustrative* schedule that shows the potential allocation of the (net) costs to ratepayers.

## RESPONSE

a) The account can go under any name. EGD suggests calling the account the DSM Solar Space Heating Research deferral account.

b) Accounting entries have not been finalized at this time. EGD will follow similar procedures as other Board approved deferral accounts.

c) NRCan will audit the work completed and invoices paid. In addition, this deferral account would require the usual annual application for approval to clear any amounts through the current Board processes.

d) The exact allocation plan cannot be determined at this time. EGD's intent for the remaining $4.5 million is to recover those costs from partners and participants as well as other funding agencies prior to seeking any funding from ratepayers.

Witnesses: P. Hoey
A. Mandyam

However it is foreseen that, as with other DSM programs, the rate class that enjoys the benefit of the costs incurred will be allocated such costs net of the recovery from third parties. This is aligned with the principles found in EB-2006-0021. At this time, EGD foresees allocating costs only to Rate 1 and 6 customers as these customers will be reciving any current or future benefit. No funds are expected to be collected from industrial customer rate classes.

e) As discussed in d) above, Enbridge cannot provide an illustrative schedule that shows the potential allocation of the (net) costs to ratepayers at this time.

Witnesses: P. Hoey
A. Mandyam

# VECC INTERROGATORY #6

## INTERROGATORY

Reference: Exhibit A Tab 1 Schedule 3 Page 12 para 34

Preamble: The Company welcomes any suggestions that members of the DSM Consultative may have at a future DSM Consultative meeting. Unfortunately, given the NRCan requirement that a Contribution Agreement be executed before March 31, 2010, and to provide sufficient time to allow for the processing of this Application it was not possible for the Company to seek input from the DSM Consultative prior to the filing of this Application.

a) Provide a Copy of the Minutes/Notes on this topic from the February 17, 2010 DSM Consultative Meeting.

## RESPONSE

a) Please find attached a copy of the presentation made on Feb. 17, 2010. The overview of the initiative and the following discussion did not provide sufficient material to warrant action items or the distribution of notes.

Witnesses: P. Hoey
A. Mandyam

# DSM Consultative Meeting

February 17, 2010

Filed: 2010-03-04
EB-2010-0029
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# Agenda

| | | |
|---|---|---|
| **Welcome and Introductions** | **Marco** | **1:00pm** |
| **Safety Minute** | **Marco** | **1:15pm** |
| **2009 Annual Report and Audit Update** | **Marco** | **1:30pm** |
| **2010 Status of Programs and Planned Update filing** | **Patricia** | **1:45pm** |
| **Break** | | **2:15pm.** |
| **2011 Plans Concepts** | **Patricia** | **2:30pm** |
| **Solar Thermal Project** | **Andrew** | **3:00pm** |
| **Closing Remarks** | **Andrew** | **3:30pm** |

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# Skier Responsibility Code


- Always stay in control – must be able to stop, or avoid other people & objects.
- People ahead of you have the right of way. It is your responsibility to avoid them.
- Do not stop where you obstruct a trail, or are not visible from above.
- Whenever starting downhill or merging into a trail, look uphill and yield to others.
- If involved in or witness to a collision or accident, remain at the scene.
- Always use devices to help prevent runaway equipment.
- Observe and obey all posted signs and warnings.
- Keep off closed trails and out of closed areas.
- If your ability is impaired, do not use lifts or terrain.
- Prior to using any lift, you must have the knowledge and ability to load, ride and unload safely.



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# Skier Responsibility Code

## ALPINE RESPONSIBILITY CODE


THERE ARE ELEMENTS OF RISK THAT COMMON SENSE AND PERSONAL AWARENESS CAN HELP REDUCE. REGARDLESS OF HOW YOU DECIDE TO USE THE SLOPES, ALWAYS SHOW COURTESY TO OTHERS. PLEASE ADHERE TO THE CODE LISTED BELOW AND SHARE WITH OTHERS THE RESPONSIBILITY FOR A SAFE OUTDOOR EXPERIENCE.

1. *Always stay in control. You must be able to stop, or avoid other people or objects.*
2. *People ahead of you have the right-of-way. It is your responsibility to avoid them.*
3. *Do not stop where you obstruct a trail or are not visible from above.*
4. *Before starting downhill or merging onto a trail, look uphill and yield to others.*
5. *If you are involved in or witness a collision or accident, you must remain at the scene and identify yourself to the Ski Patrol.*
6. *Always use proper devices to help prevent runaway equipment.*
7. *Observe and obey all posted signs and warnings.*
8. *Keep off closed trails and closed areas.*
9. *You must not use lifts or terrain if your ability is impaired through use of alcohol or drugs.*
10. *You must have sufficient physical dexterity, ability and knowledge to safely load, ride and unload lifts. If in doubt, ask the lift attendant.*

**Know the Code - Be Safety Conscious**
**It is Your Responsibility**

ONTARIO SNOW RESORTS ASSOCIATION

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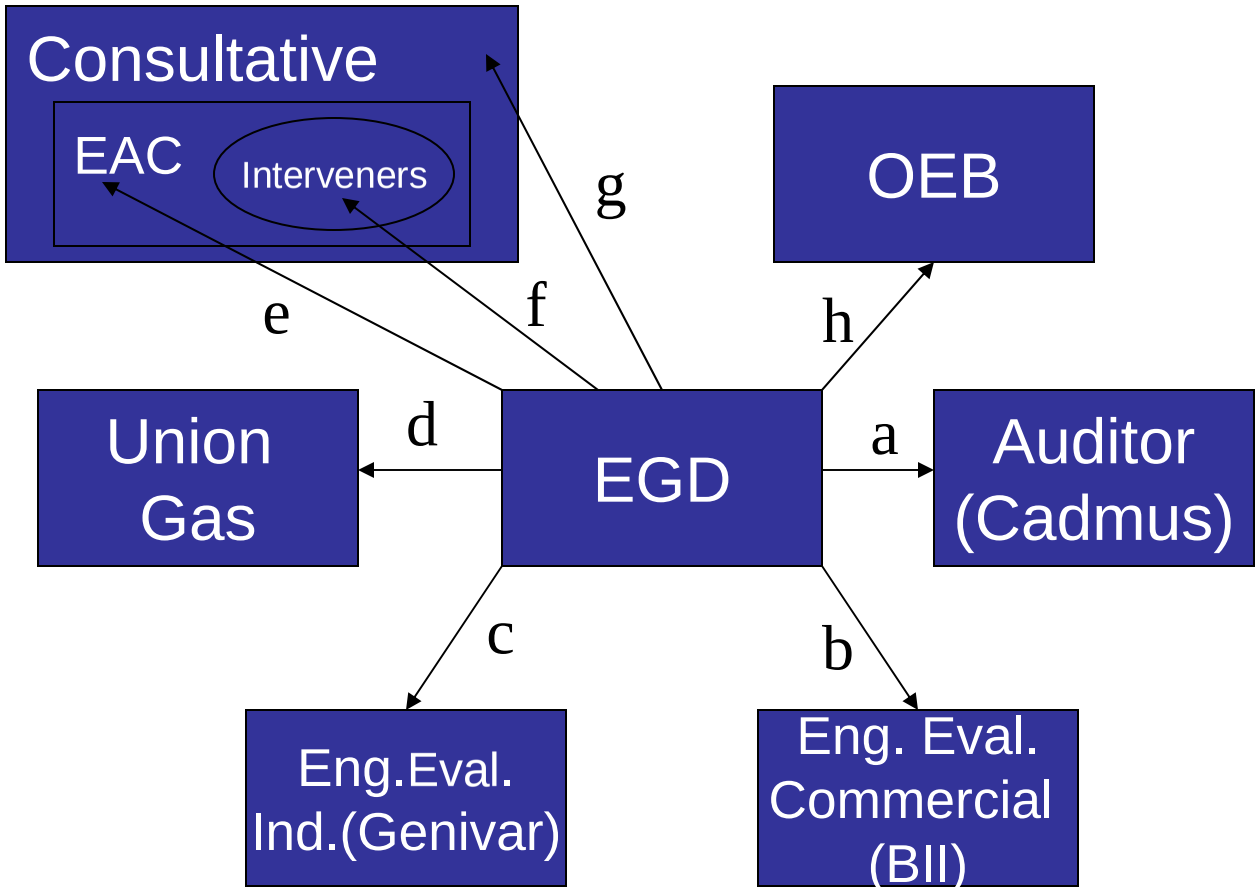
# 2009 DSM Audit Partner Map




**2009 EAC**

Ian Mondrow – Industrial Gas Users Association (IGUA)

Chris Neme – Green Energy Coalition (GEC)

Norm Rubin – Energy Probe

Judith Ramsay – Enbridge Gas Distribution

**Relationship to EGD**

a. Performance

b. Performance

c. Performance

d. Consultative

e. Advisory

f. Advisory

g. Consultative

h. Regulatory & Approvals

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# 2009 DSM Audit Dates of Interest

| | |
|---|---|
| RFP issued | Completed |
| Contract awarded (to Cadmus) | Completed |
| Contract signed | Completed |
| Auditor Review of Custom Project Engineering Reviews | In Process |
| Auditor Meeting At Enbridge Offices | Completed |
| **2009 DSM Annual Report circulated** | **Friday, April 07** |
| Comments on DSM Annual Report from EAC and Consultative | Friday, April 16 |
| **Draft Work Plan** | **Friday, April 09** |
| Meeting with EAC to review scope and work plan | Thursday, April 15 |
| **Final Detailed Work Plan** | **Friday, April 16** |
| Progress meetings with EAC | Weekly |
| **Draft Audit Report #1 submitted** | **Friday, May 28** |
| Review Meetings with EAC | Week of May 31st |
| **Draft Audit Report #2 submitted** | **Friday, June 04** |
| Review Meeting with EAC | Wednesday, June 09 |
| **Final Audit Report submitted** | **Friday, June 11** |



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# 2010 DSM Portfolio Update

DSM Consultative Meeting
February 17, 2010
P. Squires

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# Preliminary 2009 Results

| | TRC | $$ |
|---|---|---|
| Budget | $210.4 million | $24.3 million |
| Preliminary Actual | $212.1 million | $25.4 million |
| Variance | 0.8% | 4.5% |

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# How did we achieve these results?

- Increased Commercial incentives and the Industrial incentive cap to be more attractive during recession
- Increased focus on largely untapped Small Commercial sector
- Cancelled the furnace program early (Sept vs. Dec)
- Cancelled all Novitherm promotional activity in last half of year
- Managed staff vacancies until January 2010
- Deferred or cancelled several fixed cost expenditures (e.g. advertising, sponsorships, etc.)

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# Challenges for 2010

- Residential Mass Market DSM has matured and high TRC measures are rare. We are working to identify some mass market initiatives to deliver in 2010 – only TAPS and Low Income are currently available.
  - Pstat and Novitherm will not be delivered due to low TRC
  - High efficiency furnaces now code
  - Tankless water heaters TRC negative
- Heavy emphasis on high TRC small commercial programs (e.g. pre-rinse spray valves) but limited time offer on lower TRC small commercial programs (rooftops, Air Doors) to protect budget

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# Challenges for 2010

- Continued focus on large commercial/industrial sectors, but will face challenges in the face of “competition” from large incentive budgets from other industry players:
  - OPA (e.g. $10 million cap per project on direct connect industrial customers)
  - BOMA (recently announced doubling of incentives for commercial sector electric CDM)
- Rapidly evolving landscape for electric LDCs is impacting our gas DSM programs now
  - Approx. one-third of our historic TRC has come from induced electricity savings – at risk now due to CDM

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# 2010 Plan Update – New Measures

- ESK (Res New Construction)
- Air tap (Res)
- Solar pool heaters (Res)
- Electronic spark ignition fireplaces (Res)
- High efficiency boilers (Res)
- Water heater setback (Res)
- Outdoor resets (Res)
- 0.64 GPM pre-rinse spray valve (Commercial)
- Occupancy sensors (Commercial)
- Recommissioning (Commercial)
- Showerheads (Multi-Res)

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# Stretching our budget dollar in 2010

- Magazine advertising all but cancelled
- Sponsorships will be limited
- Streamlining marketing materials

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# 2011 DSM Plan Concepts

DSM Consultative Meeting
February 17, 2010
P. Squires

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# 2011 DSM Plan Context

1. Our 3-year plan framework has been stretched into a 5-year plan framework
   - Budget/target escalators were not designed to last five years
2. Electric LDC's will be launching CDM in 2011, creating competition for the customers' limited conservation dollars
3. Traditional gas DSM programs are reaching maturity, particularly in residential sector
4. Emergence of renewable technologies and focus on emissions reductions

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# 2011 Plan Concepts

1. Reduced focus on resource acquisition and increased focus on market transformation
   - **Benefits:**
     - New program development opportunities
     - Consideration of renewable technologies
   - **Implications:**
     - MT scorecard metrics to approve
     - MT incentive to approve

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# 2011 Plan Concepts

2. Removal of electricity savings from TRC calculation (gas utilities claim gas savings, LDCs claim electricity savings)
   - Benefits:
     - Eliminates “competition” with LDCs for the same customer
     - Better positions EGD to cooperate and coordinate program delivery with electric LDC’s
   - Implications:
     - SSM curve would have to be re-calibrated

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# 2011 Plan Concepts

3. Tracking of SCT benefits in addition to TRC
   - Benefits:
     - Can communicate DSM results in terms of GHG emissions
     - Can examine program opportunities that might pass an SCT screening but not a TRC screening
   - Implications:
     - Minor systems enhancements to enable SCT reporting in addition to traditional TRC reporting



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# 2011 Plan Concepts

4. Other ideas?



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# Solar Thermal Space Heating Project

DSM Consultative Meeting
February 17, 2010
Andrew Mandyam

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# Project Overview

Initiative is a pilot technology evaluation

- to test a variety of solar thermal collectors and combined thermal storage alternatives and to evaluate space heating applications

Five year duration from 2010 through 2014

- The pilot will involve the design and development of systems for a number of sites within the Enbridge franchise area
- Following installation, the sites will be monitored for three years and the project results made publicly available.

Three solar collector technologies and Thermal Storage media will be tested:

- Flat panel,
- Evacuated tube and concentrating collectors
- Tank storage,
- Geothermal, and thermal mass storage

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# Key Objectives

Expand the use of solar thermal technology from its current applications to include space heating

To increase the potential for thermal storage applications in both new buildings and retrofits

Investigate:

- the best type of solar thermal collectors for a space heating application
- best methods for the installation of thermal storage in locations remote of the collection arrays
- the best integration platform, methods and operations protocols
- the ability to provide these systems as retrofits to both air and existing hot water heated buildings

Assess the technologies using DSM metrics

- for example, the Total Resource Cost Test (TRC) and the Societal Cost Test (SCT).

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# Summary

Enbridge has been exploring solar thermal technology to displace space heating load as part of its ongoing DSM development

Government of Canada has recognized Enbridge's DSM development

- Ministry of Natural Resources Canada (NRCan) Clean Energy Fund grant awarded to Enbridge in January, 2010

The maximum total program budget over five years is $8.5 million

- NRCan has committed to fund up to $3.975 million
- NRCan and Enbridge are to sign the Contribution Agreement before March 31, 2010
- Enbridge is actively seeking other funding partners

Enbridge is seeking expedited approval to establish a DSM project deferral account for each of 2010 to 2014

- Net costs of the project will be reported in the DSM Annual Report
- The DSM Consultative will receive an annual informational report in respect of the pilot project operation



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# CLOSING REMARKS



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