Nova Scotia Utility and Review Board

IN THE MATTER OF *The Public Utilities Act*, R.S.N.S. 1989, c.380, as amended

- and -

IN THE MATTER OF An Application to Approve Nova Scotia's Electricity Demand Side Management Plan for 2011

Evidence of NSPI
As Interim DSM Administrator

February 26, 2010

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Appendices

1.0 INTRODUCTION

This Evidence is filed in support of an electricity Demand Side Management (DSM) conservation and energy efficiency plan for 2011 (2011 DSM Plan). The Evidence is filed with the Nova Scotia Utility and Review Board (UARB, Board) by Nova Scotia Power Inc. (NSPI, the Company) in its role as interim administrator of electricity DSM programs for Nova Scotia. During 2010, the responsibility for administration of DSM programs will be transferred to Efficiency Nova Scotia Corporation (Efficiency NS), which will have responsibility for execution and management of the 2011 DSM Plan as approved by the UARB.

On January 26, 2010, the Governor in Council proclaimed the *Efficiency Nova Scotia Corporation Act*[1], which established a new electricity DSM program administrator, Efficiency NS. On the same day, the first Board of Directors of Efficiency NS was announced. Efficiency NS will be operational for program transition in 2010. NSPI is therefore filing the 2011 DSM Plan as interim DSM Administrator. Efficiency NS will prepare and file the DSM plan for 2012 and beyond.

In its May 7, 2008 Decision[2], the UARB approved NSPI's DSM programs for 2008 and 2009 with an energy savings target of 66.3 GWh at an investment level of up to $12.9 million. During 2008 and 2009, as interim DSM administrator, NSPI established and offered to customers a portfolio of DSM programs. NSPI is pleased to report that the energy savings achieved by the programs exceed the target and the cost of the programs was within the budget set by the UARB, as discussed in more detail in Section 2 of this Evidence.

[1] *Efficiency Nova Scotia Corporation Act*, R.S.N.S. 2009,c.3.
[2] NSUARB-NSPI-P-884.

In 2009, NSPI updated its Integrated Resource Plan (IRP).[3] The IRP Update continues to support DSM as an important part of the least cost resource plan for meeting Nova Scotia's future electricity requirements and confirmed that DSM should continue to be pursued to its cost-effective potential.

The 2010 DSM Plan was approved by the UARB on August 4, 2009.[4] The 2010 programs are currently underway and will continue to grow during the year, providing positive momentum for the proposed programs of the 2011 DSM Plan. The 2011 DSM Plan will continue to contribute meaningfully to the least-cost IRP resource requirements. Section 3 of this Evidence provides an overview of the 2011 Plan.

In addition to filing the 2011 DSM Plan, NSPI will work closely with Efficiency NS to facilitate an efficient transition of the 2010 DSM programs from NSPI to Efficiency NS and to ensure the associated energy savings are on track to achieve the Board approved targets for 2010. The Board approved 2009 IRP Update Action Plan calls for the formation of a collaborative working group to support the efficient transition of DSM programming from NSPI to the new Administrator.

> Following establishment of Efficiency Nova Scotia Corporation, develop Terms of Reference for a collaborative working group that includes Efficiency Nova Scotia Corporation, NSPI and UARB staff and consultants to support efficient transition to the new Administrator and pursuit of DSM investments consistent with the IRP and Board approved plans. [5]

Once Efficiency NS is operational, NSPI, UARB staff and its consultants and Efficiency NS will establish the collaborative working group and begin the transition process. As ordered by the UARB, the Program Development Working Group (PDWG) will remain in its advisory capacity at least until the new administrator is operational.

[3] 2009 Integrated Resource Plan Update Report, November 30, 2009.
[4] NSUARB-NSPI-P-884(2).
[5] 2009 Integrated Resource Plan Update Report, November 30, 2009, page 35.

In the 2010 DSM proceeding, as suggested by the Board's consultant, Dr. Nichols, the UARB directed NSPI to undertake a study to consider the use of fuel choice in DSM programs, so that its results could be considered in the 2011 DSM Plan. In consultation with the PDWG, these studies have recently been completed and the study reports are included with this filing. Fuel substitution is further discussed in Section 5.

In its 2010 Decision the UARB approved recovery of DSM program costs using the DSM Cost Recovery Rider. Preliminary calculations based on the proposed 2011 program costs are referenced in Section 6. This is provided for information purposes only. The 2011 DSM Rider allocations are scheduled to be established by the UARB in October 2010 in a separate Application.

With this Application, NSPI seeks approval of the 2011 DSM Plan.

2.0 2008/2009 RESULTS

Nexus Market Research, recently changed to NMR Group (NMR), was hired by NSPI to conduct independent evaluations of the 2008 and 2009 DSM programs. The UARB has hired its own independent consultant, Gil Peach & Associates, to perform verification of the evaluated results.

The 2008 program evaluation report of NMR and the verification report of Gil Peach & Associates were released to stakeholders by the UARB on October 30, 2009. The Board subsequently established a timeline for comments on those reports. No comments were received.

The 2009 evaluation results will be filed concurrently with this submission. NSPI expects that the Board's verification consultant will file its report on 2009 programs shortly thereafter. The 2008 and 2009 results are summarized in Figure 2.1.

Figure 2.1

2008/2009 Results

	GWh Target	GWh Result	MW Target	MW Result	Evaluated	Verified
2008	16.06	21.41	2.09	4.68	✓	✓
2009	50.26	64.37	6.76	10.26	✓	
Total	66.32	85.78	8.85	14.94	✓	

NSPI invested $11.85 million in 2008 and 2009 to achieve these results. This represents 92 percent of the Board approved 2008/2009 DSM expenditures of $12.9 million. NSPI will amortize these expenditures over a period of six years as approved by the Board in the 2009 General Rate Application (GRA) Decision, or until the amortization schedule is revisited in a GRA.

The 2008/2009 DSM Plan investment is shown in Figure 2.2.

Figure 2.2

2008/2009 DSM Plan Investment

Program	**Incentives & 3rd Party Delivery Agents ($ thousands)**	**Administration & Expenses ($ thousands)**	**Consulting ($ thousands)**	**Total ($ thousands)**
Efficient Products	3,755	70	175	4,000
Existing Houses	985	30	55	1,070
Low Income Households	885	115	80	1,080
New Houses	95	30	55	180
Prescriptive Rebate	340	30	30	400
Custom	1,850	545	215	2,610
Small Business Direct Installation	1,696	230	214	2,140
New Construction	0	5	10	15
Education and Outreach	0	0	0	0
Development and Research	10	220	125	355
TOTAL	**9,616**	**1,275**	**959**	**11,850**

3.0 OVERVIEW OF DSM PROGRAMS

NSPI received the advice and assistance of its consultant Summit Blue Consulting LLC, now part of Navigant Consulting Inc., (Navigant), in the development of the 2011 DSM Plan. The proposed program investment and savings are challenging yet achievable, and are consistent with the continued ramp-up and success of DSM in Nova Scotia.

Delivery of 2011 DSM programs is expected to cost $41.9 million. Projected incremental demand and energy savings are 30.9 MW and 158.5 GWh, respectively.

DSM program costs and energy savings targets from the 2009 IRP Update for 2008 to 2013 are shown in Figure 3.1. While program approval is being requested for the 2011 DSM Plan only, this table provides context in that it shows DSM projections for future years consistent with the DSM targets from the 2009 IRP Update.

Figure 3.1

DSM Targets 2008-2013 (From 2009 IRP Update)

Year	Incremental Demand Savings (MW)	Cumulative Demand Savings (MW)	Incremental Energy Savings (GWh)	Cumulative Energy Savings (GWh)	Incremental Program Cost ($ millions)	Cumulative Program Cost ($ millions)
2008*	2.1	2.1	16.1	16.1	3.2	3.2
2009*	6.8	8.8	50.3	66.3	9.7	12.9
2010**	16.6	25.2	81.1	147.5	22.6	35.5
2011***	30.9	56.1	145.7	293.2	41.9	77.4
2012****	44.0	100.1	204.9	498.1	60.6	138.0
2013****	63.5	163.6	305.3	803.4	81.9	219.9

Notes:
Numbers may not sum exactly due to rounding
* Approved Programs (expressed in 2008 dollars)
** Approved Programs (expressed in 2010 dollars)
*** Proposed 2011 DSM Targets (expressed in 2011 dollars)
**** Potential DSM investment in future years - for context only (expressed in 2011 dollars)

The 2009 IRP Update analysis resulted in a least cost Reference Plan, confirming the 2007 IRP finding that the most cost effective approach to meeting load requirements and emissions constraints is accomplished through significant investment in DSM combined with new renewable generation and upgrades to NSPI's existing generation fleet. The 2009 IRP Update Report confirms NSPI's commitment to pursuing targeted DSM savings stating:

> NSPI will support pursuit of DSM in the context of alignment with the IRP trajectory and Board approved plans through targeted program implementation with appropriate measurement and verification until the establishment and transition to the new DSM Administrator, Efficiency Nova Scotia Corporation. Following Efficiency Nova Scotia Corporation becoming operational, NSPI will continue to support the success of DSM programming in the context of IRP targets.
>
> Success in DSM is critical to NSPI's Reference Plan and therefore will require ongoing assessment and monitoring to ensure that it is sustainable both economically and in terms of energy savings. This assessment will be ongoing over the near term and long term. [6]

[6] 2009 Integrated Resource Plan Update Report, November 30, 2009, page 31.

3.1 Proposed 2011 Programs

Figure 3.2 presents estimates of program expenses, the number of program participants or units, the incremental annual energy savings (GWh) and demand savings (MW), and the total resource cost (TRC) test ratio for the 2011 DSM programs.

Figure 3.2

2011 DSM Plan**

2011 DSM Plan	Budget (millions) *($)	Number of Units / Participants / Facilities	Incremental Annual Net Energy Savings at Generator	Incremental Annual Net Demand Savings at Generator	Total Resource Benefit/Cost Ratio
			(GWh)	(MW)	(TRC)
Residential					
Efficient Products	3.45	64,477	16.5	1.8	1.9
Existing Houses	6.94	2,553	15.3	3.7	2.1
Low Income Households	5.29	1,188	8.6	1.6	2.1
New Houses	4.30	1,201	9.9	2.6	1.8
Residential Subtotal	**19.99**	**69,418**	**50.2**	**9.7**	**2.0**
C&I					
Prescriptive	5.23	192,701	32.6	6.3	2.9
Custom	8.23	175	57.2	11.1	2.9
Small Business Direct Install	6.37	700	18.5	3.8	3.0
C&I Subtotal	**19.83**	**193,576**	**108.2**	**21.2**	**2.9**
Multi Sector					
Education and Outreach	1.08	-	-	-	-
Development and Research	1.00	-	-	-	-
Multi Sector Subtotal	**2.08**	**-**	**-**	**-**	**-**
TOTAL	**41.90**	**262,994**	**158.5**	**30.9**	**2.4**

Note:
* Figures are expressed in 2011 dollars
**Supporting data is included in Attachment A

Numbers may not sum exactly due to rounding

Descriptions of the programs that form the 2011 DSM Plan are provided in Appendix A.

The details of the programs put forward in this plan for 2011 implementation will be further developed and refined in 2010 and 2011 by Efficiency NS. It is anticipated that through a DSM working group, Efficiency NS will have latitude and flexibility to make appropriate mid-course adjustments to the programming mix within the total target amount.

It is anticipated that processes of Evaluation and Annual Savings Verification for the 2011 DSM programs will continue as developed for the 2008-2009 DSM programs:

- DSM Program Evaluation (Process and Impact) will be undertaken by an independent firm under contract with Efficiency NS.
- DSM Annual Savings Verification will be undertaken by an independent firm under contract with the Board.

4.0 UPDATED AVOIDED COSTS

Avoided costs of energy and capacity are used within TRC (benefit-cost ratio) calculations for screening measures and programs when developing DSM portfolios. These avoided costs were recently updated using the latest base assumptions and optimized plans developed for the 2009 IRP Update.

The methodology utilized for the DSM avoided cost calculation compares the costs of a plan that does not include DSM with the costs of the 2009 IRP Base Case Plan A which includes DSM. This method uses the same assumptions as those used in 2009 IRP Update.

The levelized avoided cost of energy for DSM is estimated at $166/MWh. This represents an increase from $95/MWh, the previous value. The introduction of physical "hard" caps associated with CO_2, further reductions in other emissions and increased Renewable Energy Standard assumptions underlying the 2009 IRP Update are among the reasons for this increase and are inherently accounted for within these updated costs.

The levelized avoided cost of demand for DSM evaluation purposes is estimated at $79/kW of annual system peak. This value is based on deferring combined cycle natural gas units. This value is higher than the previous avoided cost of demand value of $63/kW because the incremental 20 percent for reserve margin requirements is now also included.

5.0 FUEL SUBSTITUTION

The potential for fuel substitution within Nova Scotia for inclusion in DSM programs was raised during the Board proceedings for the 2010 DSM Plan. Consultant to the Board, Dr. David Nichols, recommended an independent study of the residential potential opportunities in Nova Scotia to encourage the use of efficient non-electric technologies in lieu of electric technologies. The Board's Decision issued on August 4, 2009 stated:

> [44] The Board has reviewed the evidence and agrees that the study as suggested by Dr. Nichols is useful and should be undertaken as soon as possible so that its recommendations can be considered as part of the 2011 DSM Plan. [7]

The Board's Amended Order issued on August 31, 2009 directed as follows:

> 8. Study to consider the use of fuel choice to be undertaken now so that its results can be considered in the 2011 DSM Plan.[8]

In September 2009, NSPI engaged Navigant to conduct an analysis of the potential for fuel substitution in the residential new construction and existing buildings markets. Navigant identified and characterized specific measures that entailed switching from electric baseboard heat, electric hot water heating, and electric cooking and clothes drying to an alternate source of fuel or energy in both single and multi-family dwellings. Navigant's report is included as Appendix B.

To explore policy issues associated with fuel substitution as a DSM program, NSPI, with input from the PDWG, issued a Request for Proposals (RFP) for a second study in September 2009. The objective of this study was to determine whether the promotion of alternative fossil fuel energy sources is an appropriate avenue to achieving electric energy savings within electric DSM programs and, if so, to identify how this is best achieved.

[7] NSUARB-NSPI-P-884(2), August 4, 2009, paragraph 44.
[8] NSUARB-NSPI-P-884(2), August 31 2009, page 2.

The scope of work included a summary of policy experience and current practices in other jurisdictions, a proposed framework for analysis of fuel substitution opportunities, a proposed high-level approach for inclusion of fuel substitution strategies within an existing DSM portfolio, policy guidance and a stakeholder engagement strategy. Dunsky Energy Consulting (DEC) was the successful proponent to this RFP. DEC's report is included as Appendix C.

Fuel substitution as an electric DSM approach has unique features compared to conventional DSM. DEC has identified items for further consideration by the DSM Administrator if it were to contemplate implementing fuel substitution in sectors where potential exists. These items for consideration include: the treatment of air emissions resulting from fuel substitution measures, long term price forecasts and price volatility associated with non-electric fuels, cost sharing with other utilities and equality issues associated with the promotion of specific fuels. DEC suggests that the DSM Administrator continue to advance the dialogue on fuel substitution through engaging the PDWG, appropriate government departments, and other energy suppliers or associations. NSPI agrees with this recommended approach and will consult with these stakeholders to obtain their input and feedback.

The 2011 Plan provides a portfolio of programs with flexibility to enable the DSM Administrator to make mid-course adjustments. Should stakeholders conclude that fuel substitution measures are cost effective and appropriate for inclusion in DSM programming, this flexibility will permit the DSM Administrator to pursue these opportunities.

6.0 DSM COST RECOVERY

6.1 Allocation of DSM Program Costs Among Rate Classes

For information purposes, NSPI has provided a preliminary estimate of the proposed 2011 DSM program costs allocated among rate classes. Please refer to Appendix D. This preliminary allocation utilizes the methodology approved by the Board in its 2010 DSM Decision. The Municipal Class allocation calculations are based on 2009 loads by sector. Updated relative sector share information for use in calculating the 2011 DSM Rider, to be submitted to the UARB on or before October 1, will be made available to NSPI by the municipal class customers in June, 2010. The latter date was agreed to by NSPI and MEUNSC in September of 2009 as a deliverable from the implementation of the directive number 10 of the Board's decision.

> 10. NSPI to work with MEUNSC to establish a preferred approach for the calculation of their portion of DSM costs.[9]

6.2 DSM Rider Administration - Annually Adjusted Rates and Open Access Transmission Tariff (OATT)

In its submission for approval of 2010 DSM Rider amounts, NSPI did not request 2010 DSM cost recovery for 1P-RTP tariffs or for OATT because they are optional rates, and at the time the 2010 DSM Rider was submitted, no sales were forecast under these tariffs. As a result, no revenue contribution was required or anticipated to recover associated DSM costs.

Since that submission there has been OATT usage by one Municipal Class customer. Customers within this municipality continue to access DSM Programs and their associated funding. There is no mechanism in place to recover DSM costs from

[9] NSUARB-NSPI-P-884(2), August 31, 2009, page 2.

Wholesale Municipal customers when they migrate some or all of their electricity supply to a third party supplier.

In the event that eligible large customers move some or all of their loads to an Annually Adjusted Rate (such as the 1P-RTP) there is also no mechanism in place to recover the associated portion of DSM costs from these customers.

Without changes to the approved DSM Cost Recovery Rider mechanism, outstanding DSM costs arising from the above situations would be recovered through the balancing adjustment mechanism of the Rider. These outstanding DSM costs would, however, be recovered from other customers taking power under the rates for which a DSM Rider has been approved. In the future, the Board may wish to consider changes to the DSM cost recovery methodology. One possible solution could be to require customers, who migrate load from a tariff which has a DSM Rider to a tariff that does not, to continue to pay the DSM Rider value associated with the tariff from which the load migrated. This would continue until a DSM charge for the optional rate is approved in the next DSM Rider proceeding.

NSPI is not proposing at this time that the Board make changes to the tariff or to the DSM cost recovery methodology. Early results of customer migration among rate classes suggest that the affect on recovery of DSM costs is not material. NSPI will continue to monitor the load migration situation and should its magnitude grow, NSPI may approach the UARB in the future with the request to revise the cost recovery tariff to ensure the cost allocation methodology is working as intended.

7.0 CONCLUSION

DSM programs that help customers conserve and use energy more efficiently are successfully underway in Nova Scotia. The proposed 2011 DSM plan is reasonable, achievable and aligns with targets filed as part of the 2009 IRP Update. The Company looks forward to working with Efficiency NS to ensure that DSM programs are consistent with the trajectory presented in the 2009 IRP Update. Approval and implementation of the 2011 DSM Plan will contribute to the success of electricity DSM in Nova Scotia and help to ensure that the associated environmental and cost benefits envisioned in the IRP are achieved.

NSPI respectfully requests Board approval of the 2011 DSM Plan.

Appendix A

2011 DSM Plan

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Overview of Goals, Budgets, and Benefit-Cost Ratios

The 2011 DSM Plan presents a detailed overview of the proposed electric efficiency programs targeted at the residential, commercial and industrial sectors, with associated implementation costs, savings, and benefit-cost results. Although this plan presents detailed information on the approach and electrical energy efficiency measures, it is anticipated that, upon implementation, portions of the plan will be revised as required to reflect new information or changing market conditions.

Created with input from stakeholders and Summit Blue Consulting, LLC, now part of Navigant Consulting Inc, (Navigant), the plan is designed as a comprehensive portfolio of DSM programs to deliver significant electric efficiency savings. Proper coordination between the programs is essential to maximizing results.

The plan proposes to invest a total of $41.9 million (in 2011 dollars) on electrical energy efficiency programs and targets 158.5 GWh and 30.9 MW of incremental installed annual net savings at generator in 2011. The total DSM Plan investment is in line with the 2009 IRP Update values adjusted to 2011 dollars. Total savings, as well as savings by sector, are also in keeping with 2009 IRP Update projected electrical energy and demand savings. Figure 1-1 presents program budgets, the number of program units, participants or facilities, the incremental annual GWh energy and the MW demand savings at generator, and the total resource cost test (TRC) ratio for the 2011 DSM programs.

Figure 1-1 2011 DSM Budget, Participants, and Savings**

2011 DSM Plan	Budget (millions) *($)	Number of Units / Participants / Facilities	Incremental Annual Net Energy Savings at Generator	Incremental Annual Net Demand Savings at Generator	Total Resource Benefit/Cost Ratio
			(GWh)	(MW)	(TRC)
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C&I Subtotal	**19.83**	**193,576**	**108.2**	**21.2**	**2.9**
Multi Sector					
Education and Outreach	1.08	-	-	-	-
Development and Research	1.00	-	-	-	-
Multi Sector Subtotal	**2.08**	**-**	**-**	**-**	**-**
TOTAL	**41.90**	**262,994**	**158.5**	**30.9**	**2.4**

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(U) Units

(P) Participants

(F) Facilities

1.2 DSM Programs

The proposed programs for the 2011 DSM Plan include:

Residential Programs:

- Efficient Products
- Existing Houses
- Low Income Households
- New Houses

Commercial and Industrial (C&I) Programs:

- Prescriptive Rebate
- Custom
- Small Business Direct Install

Multi-Sector Programs:

- Education and Outreach
- Development and Research

The following sections present general descriptions for the programs that comprise the 2011 DSM Plan.

2.0 RESIDENTIAL PROGRAMS

This section provides overviews of the four residential DSM programs:

- Efficient Products
- Existing Houses
- Low Income Households
- New Houses

2.1 Efficient Products

2.1.1 Objective

The objective is to produce long-term electrical energy savings in the consumer sector by increasing the sale and installation of energy efficient lighting, appliances, consumer electronics and other mass-market products.

2.1.2 Target Market

All customers who use or purchase the types of products covered by the program are able to participate.

2.1.3 Program Duration

The Efficient Products program was launched in 2008 and is ongoing.

2.1.4 Program Description

The program builds on the widely-recognized ENERGY STAR® brand, promoting ENERGY STAR® labeled products to consumers and offering financial incentives for selected products that meet or exceed the ENERGY STAR® level of performance. The program addresses the following barriers:

- customer awareness
- pricing
- concerns about product quality
- availability of range and variety of efficient products

The program is expected to expand its focus to selected home appliances, consumer electronics, and savings that may be available through turn-in of inefficient or spare appliances.

Program design may be modified as appropriate to produce long-term electrical energy savings in the consumer sector.

2.1.5 Eligible Measures

Measures may include:

- lighting
- washing machines
- refrigerators
- freezers
- humidifiers
- consumer electronics
- turn-in of spare appliances

2.1.6 Program Strategy

The DSM Administrator may employ the services of an implementation contractor for the sales and/or installation of the energy efficient products or measures. Key elements of the strategy may include:

- building partnerships with the retailers who sell efficient products, with the objective of increased stocking, promotion and market share for sales of ENERGY STAR® labeled products
- working thorough upstream market channels to influence the supply and pricing of selected electrical energy efficient products
- direct installation strategies
- consumer marketing and education to increase customer demand for electrical energy efficient products in general and in particular increase consumer awareness of and demand for ENERGY STAR® labeled products

2.2 Existing Houses

2.2.1 Objective

The program seeks to promote comprehensive, cost-effective electrical energy efficiency improvements to existing homes through:

- marketing and promotion of the benefits of home energy efficiency improvements
- provision of home energy assessments by qualified individuals
- financial assistance for recommended, cost-effective measures

2.2.2 Target Market

The program is open to all existing houses within the province of Nova Scotia.

2.2.3 Program Duration

The program was launched in 2009 and is ongoing.

2.2.4 Program Description

The program continues to build upon the Existing Houses program, seeking to maximize cost-effective electrical savings in all homes.

The program may be enhanced by:

- additional marketing and promotion of the EnerGuide for Existing Houses program, both to increase consumer awareness and demand in general, with particular focus on increasing participation
- additional financial incentives to increase the adoption of cost-effective electrical measures in all homes, and space-heat savings measures in homes with electric space heat

2.2.5 Eligible Measures

Eligible measures attracting incentives may include:

- lighting and lighting fixture retrofits and/or replacements
- efficiency measures that reduce electric water heating energy use including drain water heat recovery systems and solar domestic water systems
- selective ENERGY STAR® electric appliance upgrades
- efficient motor upgrade for furnace
- selected emerging measures to control appliances or electronics
- other custom, site-specific electric efficiency measures that are determined to be cost effective

In homes with electric space heating, incentives may be provided for a full range of envelope and heating system measures that are determined to be cost-effective on a site-specific basis. These may include:

- comprehensive air-sealing to reduce building envelope leakage
- ENERGY STAR® windows and doors
- insulation of attics, walls, crawl spaces and basements
- upgrade of heating system to more efficient technology
- electronic programmable thermostats
- other custom, site-specific electric heat-saving measures that are determined to be cost effective

2.2.6 Program Strategy

The DSM Administrator would seek to harmonize program design and implementation into a uniform and efficient, province-wide program where funding from all sources is integrated and benefits are maximized. The DSM Administrator would determine which program management and implementation functions it chooses to conduct with in-house staff, as well as the functions of contractors to the DSM Administrator.

2.3 Low Income Households

2.3.1 Objective

The long-term objective of the program is to implement cost-effective electrical energy savings measures for low income customers.

2.3.2 Target Market

The Low Income program targets low income, residential houses across Nova Scotia. For weatherization and insulation upgrade measures, the program targets electrically heated homes. The program includes various housing types such as single detached, mobile/mini homes, and duplexes. The program may be modified to include rental participants as policies and procedures are established. Participant recruitment includes outreach to certain groups that may be more likely to live on a low income such as seniors, special needs, single parents, and the unemployed or under-employed.

2.3.3 Program Duration

The program was launched in 2009 and is ongoing.

2.3.4 Program Description

The Low Income program helps facilitate the implementation of cost-effective electrical energy efficient measures in residential low income houses. The DSM measures are provided and installed at no cost to program participants.

Currently, the program is broken down into two categories of energy efficient upgrades; Scope I and Scope II. Scope I measures include building envelope upgrades such as draft proofing and insulating the basement, crawl spaces, walls and attic if required. Other building envelope work outside of the standard scope may be proposed by the contractors if work needs to be done to allow them to complete the standard Scope I upgrades. This work is completed on a case-by-case basis as appropriate. Scope II upgrades cover measures such as installing compact fluorescent lamps (CFLs), insulating the electric water tank and hot water piping, installing low flow shower heads and faucet aerators, providing power bars and auto shut-off electric kettles, installing clothes lines and replacing eligible freezers and refrigerators with ENERGY STAR® appliances.

The funding for Scope I upgrades to electrically heated homes comes from electricity customers. If the home has both electric and non-electric heating, the funding is proportional to the estimated use of electric space heating. The funding for the Scope II electric DSM upgrades, for all homes regardless of their heating source, comes from electricity customers.

The Nova Scotia Department of Community Services (DCS) and Service Nova Scotia and Municipal Relations (SNSMR) are active organizations who help to market the program to qualifying low income individuals. DCS and SNSMR pre-screen the participants to ensure they meet the program criteria. The income criteria used for electrically heated homes is the government's pre-tax, post transfer Low Income Cut-Off (LICO). Additionally, Low Income Outreach Agents are used to supplement the efforts of the DCS and SNSMR through in-field recruitment of participants who heat mainly with electricity and fall within the income criteria. The participant's home must be safe and accessible in order for the contractors to perform the upgrades.

2.3.5 Eligible Measures

The program covers the following electrical DSM measures:

- customer education (explanations, brochures, tip sheets, etc.)
- replacement of incandescent lamp with CFLs
- replacement of halogen torchiere with CFL torchiere
- replacement of ceiling (flush mount) halogen fixtures with CFL compatible fixtures
- replacement of broken or un-covered outdoor porch light fixtures to accommodate CFLs
- replacement of primary refrigerator and stand-alone freezer
- removal of second refrigerator and freezer
- provision of electric kettle with auto shut-off
- provision of power bars to facilitate reduction in standby loss
- installation of a clothes line

<u>Building envelope measures (homes with electric space heat):</u>

- attic, wall, and basement insulation
- air sealing/weather stripping
- outside and storm door installation or replacement
- programmable thermostats
- faceplate insulators

Hot water measures (homes with electric hot water):

- tank wrap for electric hot water heater
- pipe wrap for exposed hot water pipes
- low flow showerheads
- low flow kitchen faucet aerators
- low flow bathroom faucet aerators

Additional work recommended by the delivery agents may be done if it is deemed appropriate for the home. It is important to maintain the health and safety of both the occupant and the building; therefore some additional work may have to be done to allow for all the Scope I upgrades to be completed. Any additional work is assessed on a case-by-case basis.

2.3.6 Program Strategy

The Low Income program employs Service Organizations and their Energy Advisors who operate throughout the province. The Service Organizations are selected through a competitive Request for Proposal (RFP) process.

Program implementation is carried out by the contracted Service Organizations. Implementation policies and procedures are currently in place with Service Organizations and could be modified as appropriate to enhance the implementation of cost-effective electrical energy efficient measures in residential low income households as the program evolves.

2.4 New Houses

2.4.1 Objective

The objective of this program is to encourage the use of electrical energy efficient design and products in the residential new construction market. Specific program objectives include:

- encouraging homebuilders to participate in the EnerGuide for New Houses (EGNH) program
- increasing the number of homes built to high levels of energy efficiency
- increasing the number of new homes installing ENERGY STAR® labeled products including windows, heating systems, insulation, lighting, appliances, and other measures such as solar hot water heating, and drain-water heat recovery
- encouraging homebuilders to include additional energy efficient products that may not be captured within the EGNH program
- creating greater market awareness of the benefits of energy efficient new homes and generating greater market demand for their construction
- supporting the establishment and growth of a high performance residential new construction building community, and promoting energy efficient design, building materials, equipment and building practices

2.4.2 Target Market

This program is available to all builders and owner/builders of new houses throughout Nova Scotia.

2.4.3 Program Duration

The program was launched in 2009 and is ongoing.

2.4.4 Program Description

Each year, approximately 3,000 new houses are built in Nova Scotia, creating new demand for electricity. Given the predominance of builder and consumer choice to use electric space heating in residential new construction, these new homes represent an important, time-sensitive opportunity to secure electrical energy savings that will exist for many years.

The existing framework and infrastructure of the EnerGuide for New Houses and R-2000 programs provide a valuable foundation that can be built upon to achieve DSM objectives in this market. This program may be delivered in partnership with Service Organizations to maximize electrical energy savings in all residential new construction.

Energy assessments and practical design advice is provided to builders prior to construction of new houses. Using data on the planned building envelope and equipment, along with the expected energy consumption, suggested improvements are given to the builder that could be incorporated into the home's design to improve its expected energy performance. The home is then rated on a scale of 0-100 based on its modeled energy performance. Upon completion, a final, as-built inspection and rating is provided along with eligible financial incentives.

2.4.5 Eligible Measures

The DSM Administrator may revise eligible measures as appropriate in accordance with current market conditions, technology development, evaluation measurement and verification results, and program implementation experience. The program may require that new homes achieve a minimum EnerGuide rating to push the limits above standard building code requirements.

2.4.6 Program Strategy

The strategies used by the DSM Administrator to achieve the objectives for the EGNH and R-2000 program are expected to include:

- more extensive promotion and marketing of the program
- provision of, or support for, contractor training and education
- provision of financial incentives for electrical savings measures

The incentive strategy is designed to maximize acquisition of cost effective electrical energy savings. Incentives may be for individual measures, packages of measures, and/or overall levels of building energy efficiency.

3.0 COMMERCIAL & INDUSTRIAL (C&I) PROGRAMS

This section provides descriptions of the following C&I DSM programs proposed for 2011:

- Prescriptive Rebate
- Custom
- Small Business Direct Installation

3.1 Prescriptive Rebate

3.1.1 Objective

The overall objective of the Prescriptive Rebate program is to secure cost-effective electrical energy savings for non-residential customers in the retrofit and new construction markets through promotion of high efficiency equipment such as electric lighting, HVAC, motors/drives, refrigeration, compressed air and vending machines.

3.1.2 Target Market

All non-residential customers are eligible to participate in this incentive offering when they purchase qualifying equipment or services. Rebates will be available for retrofit and new construction applications. The program will be designed to offer cross-cutting technologies that address a variety of market sectors and industries. Proactive outreach efforts will utilize a targeted strategy to influence specific market participants.

3.1.3 Program Duration

The Prescriptive Rebate program is targeted for launch in 2010 and will be ongoing.

3.1.4 Program Description

The program is designed to work through existing market channels to enhance the competitiveness of high efficiency equipment and to encourage the adoption of targeted technologies.

The program will stimulate market provider investment in stocking and promoting efficient products through a targeted outreach effort. Implementation staff will train and equip market providers to convey the energy and monetary savings benefits to consumers and communicate equipment eligibility requirements.

3.1.5 Eligible Equipment

The Prescriptive Rebate program will target equipment where the unit electrical energy savings can be reliably predicted and therefore standard per-measure savings (deemed savings) and incentive levels can be established. This simplifies the application process and reduces administrative costs. The rebates and associated measures will be delivered through existing market channels.

Examples of program measures are summarized below. This listing is provided for illustrative purposes only. The detailed program design will establish eligible equipment and incentive levels as needed in accordance with current market conditions, technology development, evaluation, measurement and verification results, and program implementation experience. Incentive levels and delivery approaches will be designed to complement other C&I programs, while minimizing the potential for free-ridership though overlap of incentives from multiple sources.

<u>Lighting</u>

- compact fluorescent lamps (screw-in and pin-based fixtures)
- LED exit signs
- high-performance T8 lamps, ballasts, and fixtures

- T5 lamps, ballasts, and fixtures
- high-bay fluorescent fixtures
- pulse start metal halide lamps
- electronic dimming ballasts and bi-level ballasts
- occupancy sensors
- LED traffic signals
- others as applicable

Heating Ventilation and Air Conditioning (HVAC)

- high efficiency packaged HVAC equipment (Packaged terminal air-conditioners (PTAC), rooftop units)
- enthalpy and dry-bulb economizer controls for HVAC systems
- programmable thermostats
- reflective window films
- energy management systems (EMS)
- others as applicable

Motors and Drives

- NEMA Premium® motors
- Adding adjustable speed drives (ASD) for relevant equipment such as fans and pumps.

Refrigeration

- controls for evaporative fan motors or door heaters
- zero energy doors
- high-efficiency evaporate fan motors
- floating heat pressure controls
- discus or scroll compressors

- reach-in coolers or freezers
- premium efficiency ice makers
- economizer controls
- others as applicable

<u>Compressed Air</u>

- variable frequency drive for screw compressor
- air receiver/tanks for load/no-load compressor
- cycling refrigerated dryer
- no-loss drain
- air entraining air nozzle
- others as applicable

<u>Vending Machine</u>

- vending machine controller

3.1.6 Program Strategy

The initiative will affect the purchase and installation of high-efficiency technologies through a combination of market push and pull strategies that stimulate market demand while simultaneously increasing market provider investment in stocking and promotion in defined market channels.

The incentives and market awareness efforts will increase demand by both educating business customers about the energy and monetary savings benefits associated with efficient products and by equipping market providers to communicate those benefits directly to their customers. To address first-cost barriers, this initiative will use financial incentives, expected to be in the range of 20 percent to 40 percent of the incremental cost of purchasing qualifying technologies.

3.2 Custom

3.2.1 Objective

The C&I Custom program objective is to secure cost-effective electrical energy savings from efficiency projects in new construction and retrofit of existing non-residential facilities. The program helps C&I customers implement a wide range of electrical energy savings projects that would not otherwise be implemented.

3.2.2 Target Market

This program targets industrial and commercial customers. Eligible retrofit projects are those expected to save at least 20,000 kWh of electrical energy per year. Customers may choose to aggregate multiple sites into a single retrofit project, where cost effectiveness is improved and incentives from other C&I programs do not apply.

Although new construction and major renovation projects are currently eligible for the Custom program, it is being enhanced to provide for additional technical services that are tailored to the new construction market. All C&I new construction projects and substantial renovations that are in the planning or early design stages will be eligible for these technical services.

3.2.3 Program Duration

The Custom program was launched in 2008 and is ongoing. The Energy Savings Account (ESA) option was developed in 2009. The technical services component for new construction is currently under development.

3.2.4 Program Description

The Custom program has both a standard path and an ESA path. The program works with eligible customers to identify and implement cost-effective electrical energy and demand saving measures on a case-by-case custom basis. Measures of both fundamental types are included:

- market-driven (lost opportunity) measures, such as planned equipment replacement, new construction, renovation, expansion and equipment replacement on burn-out; where the program can result in higher efficiency choices than would otherwise have been purchased
- discretionary retrofit (resource acquisition) measures, where energy-efficient lighting, HVAC equipment, refrigeration, motors, process equipment or building envelope components are replaced prior to the end of their useful lives as a cost-effective retrofit (also referred to as early retirement)

The following technical and financial assistance components of the standard program are planned for 2011:

- assisting customers in identifying and securing the services of qualified third-party sources of technical expertise
- providing incentives and rebates for initial scoping studies or audits of existing facilities, as well as detailed engineering assessments for specific retrofit projects
- providing funding for technical assistance to achieve more efficient designs in new facilities and major renovation projects
- providing financial implementation incentives for cost-effective electrical energy efficiency projects

The Custom program offers an ESA option in accordance with the requirements outlined in the May 7, 2008 DSM Settlement Agreement.[1] The ESA option is available to customers who pay over $1 million annually to NSPI for electricity. Although the

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[1] NSUARB-NSPI-P-884.

eligibility requirements differ for the ESA option, ESA projects will be delivered through the established Custom program.

Technical assistance services for new construction and major renovations will work through building owners, their agents, and the design community to capture the long-term electrical energy efficiency opportunities that are either only available, or available at substantially lower cost, during the design and construction of new buildings, additions, and renovations in the non-residential market. To secure these opportunities, it is necessary to overcome barriers, such as:

- resistance in the design community to adopt new practices and technologies
- reluctance by owners to accept increased first cost for efficient options
- removal of proposed high efficiency equipment through value engineering
- tendency to overdesign individual systems for worst-case conditions rather than efficiency of an integrated system over the range of expected operating conditions

As applicable, the more efficient designs for new construction projects will be eligible for implementation incentives through the Custom or the Prescriptive Rebate programs.

Program design may be modified as appropriate to secure cost-effective electrical energy savings for retrofit and new construction non-residential customers.

3.2.5 Eligible Measures

Eligible measures must save electrical energy and may vary given the need to respond to custom applications. Examples include:

- process optimization
- refrigeration upgrades
- compressed air upgrades

- monitoring and/or control systems
- equipment and applications not addressed through other C&I programs

3.2.6 Program Strategy

Engineering and the installation of electrical energy efficient products or measures are conducted by third parties, as selected by the customer.

Custom implementation incentives are negotiated based on an amount determined to overcome incremental cost investment barriers for market-driven and new construction measures, and the full-cost investment barrier for retrofit projects. The DSM Administrator may also offer financing for the customer share of total project costs to maximize savings within the program budget.

New construction technical services will provide participating customers with financial support for incremental consulting services that deliver a more efficient facility design than would be built in the absence of this assistance. Additional funding, in the form of implementation incentives though the Custom program and rebates through the Prescriptive Rebate program, will be available to participants who opt for the qualifying efficient designs. Incentives will be based on the incremental electrical energy savings and the difference in measure costs between the proposed design features and a baseline design conforming to Canada's Model National Energy Code for Buildings (with appropriate adjustments to baseline efficiency that reflect current market practices). The DSM Administrator will pre-approve all incentives for new construction technical services.

The ESA option provides incentives totaling up to 70 percent of a customer's DSM program payments, for use on eligible projects within the Custom program. When requested by the customer, the DSM Administrator will analyze the ESA option and present the results for customer review, which may lead to subsequent enrolment.

The recruitment of participants with custom projects is highly dependent upon referrals and networking with program allies and DSM Administrator staff to identify projects that have a high probability of implementation. Due to their complexity, custom projects can have longer lead times for implementation. As a result, proactive marketing is used to queue projects for future months and years.

3.3 Small Business Direct Installation

3.3.1 Objective

This program seeks to acquire electrical energy savings through the direct installation of energy efficient measures in small businesses, primarily through high-performance lighting retrofits.

3.3.2 Target Market

The Small Business Direct Installation program targets non-residential customers having an average peak monthly demand of less than 100 kW, or an annual electricity use of less than 300,000 kWh. This includes small retail, convenience and grocery stores, small offices, service stations, restaurants and lodgings, non-profit organizations, small government facilities, and institutional and health care facilities. Chains operating multiple facilities in the province and franchise operations are not targeted by the program.

The delivery model targets designated geographic areas that are assigned to service providers. During the first phase (from the June 2008 launch through 2009), the program was available to customers in the Dartmouth and Pictou County areas. In 2010, the program expanded to six geographical areas that cover all of Nova Scotia.

3.3.3 Program Duration

The Small Business Direct Installation program was launched in 2008 and is ongoing.

3.3.4 Program Description

The program employs the use of implementation contractors to provide electrical energy efficiency services to small businesses. These services range from opportunity identification (the audit), to the direct installation of energy efficient lighting upgrades, through to disposal of the old lighting materials. Typical projects include the upgrade of T12 fluorescent lamps and older technology ballasts to High Performance and low wattage T8 lamps and ballasts (and replacement of old fixtures where appropriate), replacement of High Intensity Discharge (HID) fixtures with High Performance T8 or T5 fixtures, replacement of incandescent exit signs with LED exit signs, and CFL retrofits and installation of occupancy sensor lighting controls.

As the program evolves, the range and emphasis of lighting technologies may shift, and the DSM Administrator may expand the range of measures to include selected non-lighting measures, either for direct installation or follow-up treatment through another program strategy. For example, auditors currently identify opportunities suited to controls and free-cooling retrofits for walk-in coolers and walk-in freezers, which can be addressed through the C&I Custom program.

Program design may be modified as appropriate to acquire electrical energy savings through the direct installation of energy efficient measures in small businesses.

3.3.5 Eligible Measures

Eligible measures may include:

- high efficiency T8 lamps and ballasts
- T5 lamps and ballasts
- LED exit signs
- CFL lamps
- occupancy sensor lighting controls

3.3.6 Program Strategy

The implementation contractor is responsible for marketing the program to customers. Once the implementation contractor generates a lead, they send the customer request to the DSM Administrator for review and determination of eligibility for the program. The implementation contractor then conducts the lighting audit at no charge to the customer, using an audit tool provided by the DSM Administrator. The DSM Administrator reviews all audits submitted by the implementation contractor and grants approval to proceed. Once approval has been granted by the DSM Administrator, the implementation contractor orders the materials, installs the materials, and removes the old materials.

The DSM Administrator may authorize the implementation contractor to work with third parties (such as local business associations or Chambers of Commerce) to further advance program participation. In addition, the DSM Administrator may provide targeted marketing support and either approves or develops all program marketing materials.

The level of incentives provided for installations is determined by the DSM Administrator. The program incentive currently covers 80 percent of the overall project cost. The DSM Administrator may also offer financing to cover the balance of customer costs.

Depending on the development of other programs and the timing of their implementation, the DSM Administrator may vary outreach and marketing strategies, project eligibility thresholds, and other program design features to increase opportunities for participation, to balance the costs and savings of the overall portfolio, or to otherwise achieve the objectives of the DSM Plan within the established budget.

4.0 MULTI SECTOR PROGRAMS

This section provides descriptions of the following multi-sector programs:

- Education and Outreach
- Development and Research

4.1 Education and Outreach

4.1.1 Objective

This program objective is to generate higher levels of participation in DSM programs through increasing customer awareness of the value of energy efficiency that leads to customers taking energy efficiency actions through the DSM program portfolio.

4.1.2 Target Market

The target market for Education and Outreach program is all Nova Scotians. This includes owners and renters living in all housing types, from single family to multi-family dwellings, as well as C&I customers. Additionally, education and outreach programs may be developed and implemented in educational institutions, from schools to vocational programs, and institutions of higher education.

4.1.3 Program Duration

The Education and Outreach program is ongoing.

4.1.4 Program Description

A key to achieving performance targets for energy reductions is customer awareness of the value that energy efficiency yields, resulting in energy efficiency actions through the DSM program portfolio. Systematic education and outreach efforts are an important undertaking that affects customer knowledge and perceptions, as well as encourages higher levels of participation in DSM programs. Accordingly this program would:

- provide general energy efficiency information to consumers on ways to conserve energy, reduce peak demand, achieve cost effective energy savings and lower their electric utility bills
- conduct activities that increase public awareness of the value of energy efficiency and the value of participating in DSM programs
- connect customers to appropriate DSM programs and services

Among the options the DSM Administrator may develop and implement as part of this program are:

- provision of general energy efficiency information, assistance and referrals through a toll-free telephone call center
- establishment and maintenance of a web site with general energy efficiency information, assistance and links to other resources
- production and distribution of written energy efficiency materials
- provision of on-line energy analysis software and other energy savings calculators
- development of classroom curriculum
- public speaking and presentations on energy efficiency
- development and placement of stories in the media on energy efficiency

The savings resulting from the Education and Outreach Program are captured through participation in the other DSM programs.

4.1.5 Program Strategy

The DSM Administrator will determine which program management and implementation functions it chooses to conduct with in-house staff, and which may be provided by program implementation contractors, or provided in cooperation with other programs addressing energy outreach and education, including educational institutions.

4.2 Development and Research

4.2.1 Objective

The program objective is to identify and learn more about new energy efficient technologies and program strategies with potential to capture additional electrical energy savings.

4.2.2 Program Description

This program will continue to explore and evaluate opportunities for future DSM programming. This may include activities such as market assessments, baseline evaluations and demonstration projects. Although no electrical energy or demand savings are associated with this program, it is anticipated that the cost effectiveness of other DSM programs would be improved over time by implementing the learning gained through the Development and Research program.

The DSM Administrator will focus attention on emerging electrical energy efficiency strategies and technologies. This would include maintaining awareness of energy efficiency strategy and technology development, as well as evaluation results and energy efficiency activities in other jurisdictions.

Additionally, this program manages the ongoing operational and maintenance services associated with the DSM data system.

Attachment 1
DSM Technical Tables

Residential

Commercial and Industrial

Table 1: Residential--Efficient Products--Program Results by Measure

Measure Name --savings at generator --2011 $	For Plan Year 2011					
	A Peak Demand Savings (kW)	B First Year Energy Savings (MWh)	C Total Avoided Cost Benefits ($)	D TRC Costs ($)	E = C - D Total Net Resource Benefits ($)	F = C / D TRC (Ratio)
CFL: Screw-In (<=15W), direct install	22	218	$128,383	$35,323	$93,060	3.6
CFL: Screw-In (16-24W), direct install	17	167	$98,183	$25,580	$72,603	3.8
CFL: Screw-In (>=25W), direct install	86	855	$504,360	$141,560	$362,800	3.6
CFL: Torchiere	102	772	$601,160	$277,572	$323,589	2.2
LED Holiday Lights (300 bulb string)	58	177	$260,939	$157,957	$102,982	1.7
Refrigerator Recycling - removal of secondary refrigerator	561	7,083	$3,095,179	$895,047	$2,200,132	3.5
Freezer Recycling - removal of secondary freezer	166	2,097	$752,913	$273,979	$478,934	2.7
High Efficiency Clothes Washer - Tier 2	363	2,742	$2,657,140	$2,682,328	-$25,189	1.0
Clothes Dryer - Gas Fuel Switch	56	886	$840,999	$529,396	$311,603	1.6
Low Flow Showerhead	180	802	$720,396	$241,884	$478,512	3.0
Faucet Aerator	154	689	$618,664	$142,087	$476,577	4.4
Program Total	**1,764**	**16,488**	**$10,278,316**	**$5,402,713**	**$4,875,604**	**1.9**

Table 2: Residential--Existing Houses--Program Results by Measure

Measure Name --savings at generator --2011 $	For Plan Year 2011					
	A Peak Demand Savings (kW)	B First Year Energy Savings (MWh)	C Total Avoided Cost Benefits ($)	D TRC Costs ($)	E = C - D Total Net Resource Benefits ($)	F = C / D TRC (Ratio)
Hot Water Heater Tank Wrap	140	622	$366,695	$168,369	$198,327	2.2
Hot Water Heater Pipe Insulation	29	129	$139,902	$13,836	$126,066	10.1
Solar Hot Water Heater, with electric backup	2	686	$839,234	$669,716	$169,518	1.3
Drain Water Heat Recovery (30-42% efficient)	0	13	$19,423	$14,260	$5,163	1.4
Drain Water Heat Recovery (42% efficient or higher)	1	130	$199,755	$88,541	$111,214	2.3
Attic Insulation, R12-R50	649	2,527	$4,411,302	$859,096	$3,552,206	5.1
Add R9 to Base R12R13-R30	1,021	3,980	$6,946,157	$2,688,207	$4,257,950	2.6
Air Sealing (30% reduction)	307	1,195	$2,085,425	$673,032	$1,412,394	3.1
Energy Star Doors	233	909	$1,586,861	$814,975	$771,886	1.9
Air Source HP w/electric resistance backup	207	805	$1,092,490	$992,683	$99,807	1.1
Air Source HP w/o electric resistance backup	322	1,255	$1,702,056	$1,548,470	$153,585	1.1
Ground Source Heat Pump	660	2,573	$4,490,536	$2,929,092	$1,561,444	1.5
Programmable Thermostat	114	444	$402,210	$73,192	$329,018	5.5
Program Total	**3,683**	**15,268**	**$23,775,447**	**$11,351,264**	**$12,254,666**	**2.1**

Table 3: Residential--Low Income Households--Progam Results by Measure

Measure Name --savings at generator --2011 $	For Plan Year 2011					
	A Peak Demand Savings (kW)	B First Year Energy Savings (MWh)	C Total Avoided Cost Benefits ($)	D TRC Costs ($)	E = C - D Total Net Resource Benefits ($)	F = C / D TRC (Ratio)
CFL: Screw-In (<=15W), direct install	9	93	$54,771	$29,931	$24,839	1.8
CFL: Screw-In (16-24W), direct install	7	71	$41,887	$22,279	$19,608	1.9
CFL: Screw-In (>=25W), direct install	37	365	$215,170	$118,778	$96,392	1.8
CFL: Torchiere	33	325	$251,490	$155,350	$96,140	1.6
LED Holiday Lights (300 bulb string)	9	26	$38,563	$27,525	$11,038	1.4
Refrigerator Recycling - removal of secondary refrigerator	3	1,522	$664,925	$424,111	$240,814	1.6
Hot Water Heater Tank Wrap	111	496	$292,235	$223,390	$68,845	1.3
Hot Water Heater Pipe Insulation	25	110	$119,166	$31,526	$87,640	3.8
Low Flow Showerhead	42	185	$166,375	$85,511	$80,864	1.9
Faucet Aerator	31	137	$123,286	$50,286	$73,000	2.5
Attic Insulation, R12-R50	377	1,467	$2,561,383	$762,971	$1,798,412	3.4
Add R9 to Base R12R13-R30	591	2,303	$4,020,246	$1,970,452	$2,049,793	2.0
Air Sealing (30% reduction)	178	694	$1,210,884	$515,663	$695,221	2.3
Energy Star Doors	135	528	$921,397	$568,228	$353,169	1.6
Programmable Thermostat	30	262	$228,706	$90,237	$138,469	2.5
Program Total	**1,616**	**8,584**	**$10,910,483**	**$5,076,239**	**$5,834,243**	**2.1**

Table 4: Residential--New Houses--Program Results by Measure

Measure Name --savings at generator --2011 $	For Plan Year 2011					
	A Peak Demand Savings (kW)	B First Year Energy Savings (MWh)	C Total Avoided Cost Benefits ($)	D TRC Costs ($)	E = C - D Total Net Resource Benefits ($)	F = C / D TRC (Ratio)
EnerGuide85 Homes	2,641	9,905	$17,371,793	$9,772,793	$7,599,000	1.8

Table 5: Residential--Efficient Products--Measure Characterizations

Measure Name --savings at generator --2011 $	Measure Life (Years)	Peak Demand Savings per Unit (Watts)	Annual Energy Savings per Unit (kWh)	One-Time Incremental Measure Cost ($)	Present Value of Avoided Cost Benefits ($)	Program Admin. Cost ($)	Total Resource Benefit-Cost (Ratio)
CFL: Screw-In (<=15W), direct install	7	4	38	$3	$30	$3	3.6
CFL: Screw-In (16-24W), direct install	7	5	45	$3	$36	$4	3.8
CFL: Screw-In (>=25W), direct install	7	6	58	$4	$45	$5	3.6
CFL: Torchiere	9	32	242	$65	$242	$22	2.2
LED Holiday Lights (300 bulb string)	16	6	19	$15	$31	$2	1.7
Refrigerator Recycling - removal of secondary refrigerator	5	87	1,100	$90	$679	$49	3.5
Freezer Recycling - removal of secondary freezer	4	78	984	$90	$502	$39	2.7
High Efficiency Clothes Washer - Tier 2	11	77	584	$519	$683	$53	1.0
Clothes Dryer - Gas Fuel Switch	11	43	688	$349	$773	$62	1.6
Low Flow Showerhead	10	35	158	$33	$182	$14	3.0
Faucet Aerator	10	19	86	$10	$99	$8	4.4

Table 6: Residential--Existing Houses--Measure Characterizations

Measure Name --savings at generator --2011 $	Measure Life (Years)	Peak Demand Savings per Unit (Watts)	Annual Energy Savings per Unit (kWh)	One-Time Incremental Measure Cost ($)	Present Value of Avoided Cost Benefits ($)	Program Admin. Cost ($)	Total Resource Benefit-Cost (Ratio)
Hot Water Heater Tank Wrap	7	94	417	$84	$368	$29	2.2
Hot Water Heater Pipe Insulation	12	34	152	$6	$198	$11	10.1
Solar Hot Water Heater, with electric backup	15	11	3,995	$3,620	$5,279	$280	1.3
Drain Water Heat Recovery (30-42% efficient)	20	3	590	$623	$910	$41	1.4
Drain Water Heat Recovery (42% efficient or higher)	20	6	1,213	$740	$1,871	$85	2.3
Attic Insulation, R12-R50	20	1,270	4,950	$1,336	$8,790	$346	5.1
Add R9 to Base R12R13-R30	20	934	3,638	$2,203	$6,461	$255	2.6
Air Sealing (30% reduction)	20	210	819	$404	$1,454	$57	3.1
Energy Star Doors	20	160	623	$515	$1,107	$44	1.9
Air Source HP w/electric resistance backup	15	2,759	10,752	$12,500	$16,369	$753	1.1
Air Source HP w/o electric resistance backup	15	4,298	16,751	$19,500	$25,502	$1,173	1.1
Ground Source Heat Pump	20	4,803	18,718	$20,000	$33,239	$1,310	1.5
Programmable Thermostat	10	136	528	$50	$618	$37	5.5

Table 7: Residential--Low Income Households--Measure Characterizations

Measure Name --savings at generator --2011 $	Measure Life (Years)	Peak Demand Savings per Unit (Watts)	Annual Energy Savings per Unit (kWh)	One-Time Incremental Measure Cost ($)	Present Value of Avoided Cost Benefits ($)	Program Admin. Cost ($)	Total Resource Benefit-Cost (Ratio)
CFL: Screw-In (<=15W), direct install	7	4	38	$3	$30	$10	1.8
CFL: Screw-In (16-24W), direct install	7	5	45	$3	$36	$11	1.9
CFL: Screw-In (>=25W), direct install	7	6	58	$4	$45	$14	1.8
CFL: Torchiere, Replace 300W Halogen	9	29	286	$65	$281	$72	1.6
LED Holiday Lights (300 bulb string)	16	6	19	$15	$31	$5	1.4
Refrigerator Recycling - removal of secondary refrigerator	5	2	1,392	$90	$822	$298	1.6
Hot Water Heater Tank Wrap	7	94	417	$84	$368	$104	1.3
Hot Water Heater Pipe Insulation	12	34	152	$6	$198	$38	3.8
Low Flow Showerhead	10	35	158	$33	$182	$39	1.9
Faucet Aerator	10	19	86	$10	$99	$22	2.5
Attic Insulation, R12-R50	20	1,270	4,950	$1,336	$8,790	$1,237	3.4
Add R9 to Base R12R13-R30	20	934	3,638	$2,203	$6,461	$910	2.0
Air Sealing (30% reduction)	20	210	819	$404	$1,454	$205	2.3
Energy Star Doors	20	160	623	$515	$1,107	$156	1.6
Programmable Thermostat	10	60	528	$50	$572	$132	2.5

Table 8: Residential--New Houses--Measure Characterizations

Measure Name --savings at generator --2011 $	Measure Life (Years)	Peak Demand Savings per Unit (Watts)	Annual Energy Savings per Unit (kWh)	One-Time Incremental Measure Cost ($)	Present Value of Avoided Cost Benefits ($)	Program Admin. Cost ($)	Total Resource Benefit-Cost (Ratio)
EnerGuide85 Homes	20	2,200	8,250	$7,000	$14,727	$1,140	1.8

Table 9: Commercial--Prescriptive Existing Buildings-- Program Results by Measure

Measure Name --savings at generator --2011 $	For Plan Year 2011					
	A Peak Demand Savings (kW)	B First Year Energy Savings (MWh)	C Total Avoided Cost Benefits ($)	D TRC Costs ($)	E = C - D Total Net Resource Benefits ($)	F = C / D TRC (Ratio)
CFL - Screw-in weighted Watts	1,140	4,997	$1,395,963	$210,095	$1,185,868	6.6
CFL - Hard-wired weighted Watts	774	3,416	$3,713,747	$264,601	$3,449,146	14.0
LED Exit	59	716	$956,387	$363,287	$593,101	2.6
T8/T5 w/Electronic Ballast	1,047	4,730	$6,328,524	$2,690,536	$3,637,988	2.4
Super T8	406	1,879	$2,508,975	$2,212,175	$296,799	1.1
Delamping w/Reflectors (2 lamp)	392	1,696	$2,278,445	$491,705	$1,786,740	4.6
Occupancy Sensor Motion Detector	127	948	$643,787	$204,314	$439,472	3.2
50W MH HID fixture- indoor	82	410	$543,937	$138,383	$405,553	3.9
75W MH HID fixture- indoor	20	103	$136,299	$87,216	$49,083	1.6
100W MH HID fixture- indoor	68	350	$463,574	$80,439	$383,135	5.8
250W PS MH HID fixture- indoor	36	348	$444,016	$38,446	$405,570	11.5
50W MH HID fixture- outdoor	27	193	$249,801	$85,095	$164,706	2.9
75W MH HID fixture- outdoor	4	33	$42,520	$36,331	$6,189	1.2
100W MH HID fixture- outdoor	18	135	$174,956	$39,857	$135,099	4.4
175W PS MH HID fixture- outdoor	129	916	$1,187,311	$82,565	$1,104,746	14.4
250W PS MH HID fixture- outdoor	105	772	$997,944	$106,809	$891,135	9.3
Outdoor Lighting Controls	0	45	$30,149	$21,034	$9,115	1.4
T5 Interior High Bay Flourescent Fixture	186	1,098	$1,438,929	$292,376	$1,146,552	4.9
EMS System	0	1,220	$1,490,335	$1,015,151	$475,184	1.5
Programmable Thermostat	-9	90	$81,386	$9,265	$72,121	8.8
Economizer	0	283	$240,359	$213,524	$26,835	1.1
Program Total	**4,613**	**24,377**	**$25,347,343**	**$8,683,203**	**$16,664,140**	**2.9**

Table 10: Commercial--Prescriptive New Construction-- Program Results by Measure

Measure Name --savings at generator --2011 $	For Plan Year 2011					
	Peak Demand Savings (kW)	First Year Energy Savings (kWh)	Total Avoided Cost Benefits ($)	TRC Costs ($)	Total Net Resource Benefits ($)	TRC
CFL - Screw-in weighted Watts	117	510	$142,379	$46,952	$95,427	3.0
CFL - Hard-wired weighted Watts	83	362	$393,493	$46,195	$347,298	8.5
T8/T5 w/Electronic Ballast	632	2,810	$3,765,620	$1,703,679	$2,061,941	2.2
Super T8	43	189	$253,404	$224,122	$29,282	1.1
Delamping w/Reflectors (2 lamp)	17	75	$100,766	$25,599	$75,167	3.9
Occupancy Sensor Motion Detector	17	130	$87,982	$34,312	$53,670	2.6
250W PS MH HID fixture- indoor	5	49	$61,911	$7,781	$54,130	8.0
175W PS MH HID fixture- outdoor	18	129	$167,335	$18,093	$149,242	9.2
250W PS MH HID fixture- outdoor	15	109	$141,128	$20,560	$120,568	6.9
Outdoor Lighting Controls	0	6	$3,914	$3,023	$891	1.3
T5 Interior High Bay Flourescent Fixture	135	860	$1,121,358	$269,661	$851,697	4.2
Prem Motor < =10 HP	31	140	$188,182	$80,696	$107,486	2.3
Prem Motor > 10HP	20	90	$120,204	$33,724	$86,480	3.6
Adjustable Speed Drives for Fans & Pumps	496	1,981	$2,680,592	$632,277	$2,048,315	4.2
Compressed Air Controls	25	251	$320,077	$174,185	$145,892	1.8
Convection Oven	16	73	$64,994	$29,202	$35,792	2.2
Hot Water Circulation Pump Time Clock	0	71	$87,124	$26,731	$60,393	3.3
EMS System	0	132	$160,812	$116,343	$44,469	1.4
Programmable Thermostat	0	3	$2,634	$446	$2,188	5.9
Motor Upgrade for Fans & Compressors	30	137	$182,807	$18,271	$164,536	10.0
High efficiency, low temperature compresser	2	15	$16,177	$5,634	$10,544	2.9
Evap Fan Controller for Med. Temp Walk-in	17	93	$129,914	$9,713	$120,200	13.4
Program Total	**1,721**	**8,213**	**$10,192,807**	**$3,527,199**	**$6,665,609**	**2.9**

Table 11a: Commercial--Custom Existing Buildings-- Program Results by Measure

Measure Name --savings at generator --2011 $	For Plan Year 2011 A Peak Demand Savings (kW)	B First Year Energy Savings (MWh)	C Total Avoided Cost Benefits ($)	D TRC Costs ($)	E = C - D Total Net Resource Benefits ($)	F = C / D TRC (Ratio)
Prem Motor < =10 HP	344	1,464	$1,968,654	$882,533	$1,086,121	2.2
Prem Motor > 10HP	230	970	$1,306,147	$386,959	$919,189	3.4
Adjustable Speed Drives for Fans & Pumps	6,117	22,776	$31,040,378	$7,473,398	$23,566,980	4.2
Compressed Air Controls	166	1,657	$2,111,118	$1,165,431	$945,687	1.8
Convection Oven	527	2,428	$2,175,787	$1,001,856	$1,173,931	2.2
Spray Nozzles	115	1,383	$604,387	$182,570	$421,817	1.8
Hot Water Circulation Pump Time Clock	0	3,153	$3,852,440	$1,219,780	$2,632,659	2.2
Retrocommissioning	61	955	$823,668	$978,504	-$154,836	3.3
Motor Upgrade for Fans & Compressors	942	4,237	$5,671,207	$601,848	$5,069,358	9.4
High efficiency, low temperature compresser	71	452	$480,038	$167,007	$313,031	2.9
Evap Fan Controller for Med. Temp Walk-in	420	2,327	$3,238,873	$263,637	$2,975,236	12.3
Strip Curtains	61	526	$188,715	$53,458	$135,256	3.5
Custom	1,475	10,221	$13,263,249	$7,323,746	$5,939,503	1.8
T5 Interior High Bay Flourescent Fixture	11	57	$76,111	$19,071	$57,040	4.0
LED Exit	3	51	$67,751	$28,752	$38,998	2.4
T8/T5 w/Electronic Ballast	101	433	$581,914	$264,029	$317,885	2.2
Delamping w/Reflectors (2 lamp)	39	163	$220,152	$58,558	$161,594	3.8
Occupancy Sensor Motion Detector	15	106	$72,046	$28,723	$43,323	2.5
50W MH HID fixture- outdoor	2	11	$14,466	$4,334	$10,131	3.3
75W MH HID fixture- outdoor	1	3	$3,625	$2,484	$1,141	1.5
100W MH HID fixture- outdoor	2	9	$12,328	$2,698	$9,631	4.6
250W PS MH HID fixture- indoor	4	41	$52,712	$7,074	$45,638	7.5
50W MH HID fixture- outdoor	3	22	$28,734	$11,119	$17,616	2.6
75W MH HID fixture- outdoor	0	4	$4,614	$4,156	$457	1.1
100W MH HID fixture- outdoor	2	15	$18,819	$5,160	$13,659	3.6
175W PS MH HID fixture- outdoor	13	93	$121,101	$14,028	$107,073	8.6
250W PS MH HID fixture- outdoor	11	79	$102,007	$15,649	$86,357	6.5
Outdoor Lighting Controls	0	6	$3,814	$3,003	$811	1.3
Program Total	**10,737**	**53,641**	**$68,104,854**	**$22,169,567**	**$45,935,286**	**3.1**

Table 11b: Commercial--Custom New Construction-- Program Results by Measure

Measure Name --savings at generator --2011 $	For Plan Year 2011 Peak Demand Savings (kW)	First Year Energy Savings (kWh)	Total Avoided Cost Benefits ($)	TRC Costs ($)	Total Net Resource Benefits ($)	TRC
Custom	338	3,516	$4,473,780	$2,519,404	$1,954,376	1.8

Table 12: Commercial--Small Business Direct Install-- Program Results by Measure

Measure Name --savings at generator --2011 $	For Plan Year 2011					
	A Peak Demand Savings (kW)	B First Year Energy Savings (MWh)	C Total Avoided Cost Benefits ($)	D TRC Costs ($)	E = C - D Total Net Resource Benefits ($)	F = C / D TRC (Ratio)
CFL - Screw-in weighted Watts	785	3,341	$933,475	$266,809	$666,665	3.5
CFL - Hard-wired weighted Watts	523	2,239	$2,439,464	$259,621	$2,179,842	9.4
LED Exit	22	422	$555,521	$225,570	$329,951	2.5
T8/T5 w/Electronic Ballast	1,032	4,406	$5,924,750	$2,476,957	$3,447,793	2.4
Super T8	271	1,155	$1,552,833	$1,496,126	$56,707	1.0
Delamping w/Reflectors (2 lamp)	583	2,511	$3,373,802	$824,732	$2,549,070	4.1
Occupancy Sensor Motion Detector	160	1,187	$806,176	$298,344	$507,832	2.7
250W PS MH HID fixture- indoor	49	470	$599,797	$69,521	$530,275	8.6
50W MH HID fixture- outdoor	35	245	$317,724	$117,428	$200,296	2.7
75W MH HID fixture- outdoor	6	42	$54,557	$48,199	$6,357	1.1
100W MH HID fixture- outdoor	24	174	$224,569	$57,670	$166,899	3.9
175W PS MH HID fixture- outdoor	175	1,238	$1,603,902	$157,948	$1,445,954	10.2
250W PS MH HID fixture- outdoor	143	1,048	$1,355,112	$184,323	$1,170,789	7.4
Outdoor Lighting Controls	0	4	$2,454	$1,850	$604	1.3
Program Total	**3,805**	**18,480**	**$19,744,134**	**$6,485,098**	**$13,259,036**	**3.0**

Table 13: Commercial--Office--Measure Characterizations

Measure Name --savings at generator --2011 $	Measure Life (Years)	Peak Demand Savings per Unit (Watts)	Annual Energy Savings per Unit (kWh)	One-Time Incremental Measure Cost ($)	Present Value of Avoided Cost Benefits ($)	Program Admin. Cost ($)	Total Resource Benefit-Cost (Ratio)
Prescriptive - Existing							
CFL - Screw-in weighted Watts	3	64	248	$4	$108	$7	6.3
CFL - Hard-wired weighted Watts	12	72	277	$15	$368	$8	13.1
LED Exit	16	-	179	$83	$244	$5	2.6
T8/T5 w/Electronic Ballast	15	27	104	$57	$158	$3	2.4
Super T8	15	9	36	$46	$55	$1	1.0
Delamping w/Reflectors (2 lamp)	15	44	171	$50	$261	$5	4.2
Occupancy Sensor Motion Detector	8	88	577	$89	$542	$17	3.7
250W PS MH HID fixture- indoor	15	101	848	$71	$1,198	$25	11.3
50W MH HID fixture- outdoor	15	45	316	$130	$452	$9	2.9
75W MH HID fixture- outdoor	15	13	101	$108	$144	$3	1.2
100W MH HID fixture- outdoor	15	38	275	$73	$393	$8	4.4
175W PS MH HID fixture- outdoor	15	157	1,110	$67	$1,589	$33	14.4
250W PS MH HID fixture- outdoor	15	90	656	$71	$937	$20	9.3
Outdoor Lighting Controls	8	-	240	$105	$206	$7	1.4
T5 Interior High Bay Flourescent Fixture	15	129	1,188	$280	$1,669	$36	4.8
EMS System	15	-	817	$494	$1,078	$25	1.9
Programmable Thermostat	11	(394)	1,371	$86	$1,229	$41	9.1
Economizer	10	-	212	$153	$215	$6	1.1
Custom - Existing							
Prem Motor < =10 HP	15	19	77	$42	$117	$7	2.1
Prem Motor > 10HP	15	9	34	$11	$52	$3	3.2
Adjustable Speed Drives for Fans & Pumps	15	268	915	$219	$1,419	$82	4.2
Hot Water Circulation Pump Time Clock	15	-	991	$312	$1,308	$89	3.0
LED Exit	16	-	179	$83	$244	$16	2.3
T8/T5 w/Electronic Ballast	15	27	104	$57	$158	$9	2.1
Delamping w/Reflectors (2 lamp)	15	44	171	$50	$261	$15	3.6
Occupancy Sensor Motion Detector	8	88	577	$89	$542	$52	2.8
250W PS MH HID fixture- indoor	15	101	848	$71	$1,198	$76	7.4
50W MH HID fixture- outdoor	15	45	316	$130	$452	$28	2.6
75W MH HID fixture- outdoor	15	13	101	$108	$144	$9	1.1
100W MH HID fixture- outdoor	15	38	275	$73	$393	$25	3.6
175W PS MH HID fixture- outdoor	15	157	1,110	$67	$1,589	$100	8.6
250W PS MH HID fixture- outdoor	15	90	656	$71	$937	$59	6.5
Outdoor Lighting Controls	8	-	240	$105	$206	$22	1.3

Table 14: Commercial--Office--Measure Characterizations

Measure Name --savings at generator --2011 $	Measure Life (Years)	Peak Demand Savings per Unit (Watts)	Annual Energy Savings per Unit (kWh)	One-Time Incremental Measure Cost ($)	Present Value of Avoided Cost Benefits ($)	Program Admin. Cost ($)	Total Resource Benefit-Cost (Ratio)
Small Business Direct Install							
CFL - Screw-in weighted Watts	3	64	248	$4	$108	$17	3.4
CFL - Hard-wired weighted Watts	12	72	277	$15	$368	$19	9.1
LED Exit	16	-	179	$83	$244	$12	2.4
T8/T5 w/Electronic Ballast	15	27	104	$57	$158	$7	2.2
Delamping w/Reflectors (2 lamp)	15	44	171	$50	$261	$12	3.8
Occupancy Sensor Motion Detector	8	88	577	$89	$542	$39	3.1
250W PS MH HID fixture- indoor	15	101	848	$71	$1,198	$57	8.5
50W MH HID fixture- outdoor	15	45	316	$130	$452	$21	2.7
100W MH HID fixture- outdoor	15	38	275	$73	$393	$19	3.9
175W PS MH HID fixture- outdoor	15	157	1,110	$67	$1,589	$75	10.2
250W PS MH HID fixture- outdoor	15	90	656	$71	$937	$44	7.4
Prescriptive - New Construction							
CFL - Screw-in weighted Watts	3	64	248	$4	$108	$20	3.0
CFL - Hard-wired weighted Watts	12	72	277	$15	$368	$22	8.2
T8/T5 w/Electronic Ballast	15	27	104	$57	$158	$8	2.2
Delamping w/Reflectors (2 lamp)	15	44	171	$50	$261	$14	3.7
Occupancy Sensor Motion Detector	8	88	577	$89	$542	$46	2.9
250W PS MH HID fixture- indoor	15	101	848	$71	$1,198	$68	7.8
175W PS MH HID fixture- outdoor	15	157	1,110	$67	$1,589	$89	9.2
250W PS MH HID fixture- outdoor	15	90	656	$71	$937	$52	6.9
Outdoor Lighting Controls	8	-	240	$105	$206	$19	1.3
T5 Interior High Bay Flourescent Fixture	15	129	1,188	$280	$1,669	$95	4.1
Prem Motor < =10 HP	15	19	77	$42	$117	$6	2.2
Prem Motor > 10HP	15	9	34	$11	$52	$3	3.3
Adjustable Speed Drives for Fans & Pumps	15	268	915	$219	$1,419	$73	4.3
Hot Water Circulation Pump Time Clock	15	-	991	$312	$1,308	$79	3.1
EMS System	15	-	817	$494	$1,078	$65	1.8
Programmable Thermostat	11	(394)	1,371	$86	$1,229	$110	5.9

Table 15: Commercial--Retail--Measure Characterizations

Measure Name --savings at generator --2011 $	Measure Life (Years)	Peak Demand Savings per Unit (Watts)	Annual Energy Savings per Unit (kWh)	One-Time Incremental Measure Cost ($)	Present Value of Avoided Cost Benefits ($)	Program Admin. Cost ($)	Total Resource Benefit-Cost (Ratio)
Prescriptive - Existing							
CFL - Screw-in weighted Watts	3	78	319	$4	$138	$10	6.8
CFL - Hard-wired weighted Watts	12	72	295	$15	$388	$9	13.6
LED Exit	16	20	179	$83	$261	$5	2.7
T8/T5 w/Electronic Ballast	15	27	110	$57	$167	$3	2.5
Super T8	15	9	36	$46	$55	$1	1.0
Delamping w/Reflectors (2 lamp)	15	44	182	$50	$276	$5	4.4
Occupancy Sensor Motion Detector	8	52	392	$89	$365	$12	2.6
250W PS MH HID fixture- indoor	15	84	856	$71	$1,196	$26	11.3
50W MH HID fixture- outdoor	15	45	316	$130	$452	$9	2.9
75W MH HID fixture- outdoor	15	13	101	$108	$144	$3	1.2
100W MH HID fixture- outdoor	15	38	275	$73	$393	$8	4.4
175W PS MH HID fixture- outdoor	15	157	1,110	$67	$1,589	$33	14.4
250W PS MH HID fixture- outdoor	15	90	656	$71	$937	$20	9.3
Outdoor Lighting Controls	8	0	240	$105	$206	$7	1.4
T5 Interior High Bay Flourescent Fixture	15	106	1,201	$280	$1,668	$36	4.8
EMS System	15	0	525	$494	$693	$16	1.3
Programmable Thermostat	11	317	1,103	$86	$1,402	$33	9.4
Custom - Existing							
Prem Motor < =10 HP	15	19	77	$42	$117	$7	2.1
Prem Motor > 10HP	15	9	34	$11	$52	$3	3.2
Adjustable Speed Drives for Fans & Pumps	15	277	943	$219	$1,463	$85	4.3
Hot Water Circulation Pump Time Clock	15	0	1,148	$312	$1,515	$103	3.4
LED Exit	16	20	179	$83	$261	$16	2.4
T8/T5 w/Electronic Ballast	15	27	110	$57	$167	$10	2.2
Delamping w/Reflectors (2 lamp)	15	44	182	$50	$276	$16	3.7
Occupancy Sensor Motion Detector	8	52	392	$89	$365	$35	2.1
250W PS MH HID fixture- indoor	15	84	856	$71	$1,196	$77	7.4
50W MH HID fixture- outdoor	15	45	316	$130	$452	$28	2.6
75W MH HID fixture- outdoor	15	13	101	$108	$144	$9	1.1
100W MH HID fixture- outdoor	15	38	275	$73	$393	$25	3.6
175W PS MH HID fixture- outdoor	15	157	1,110	$67	$1,589	$100	8.6
250W PS MH HID fixture- outdoor	15	90	656	$71	$937	$59	6.5
Outdoor Lighting Controls	8	0	240	$105	$206	$22	1.3

Table 16: Commercial--Retail--Measure Characterizations

Measure Name --savings at generator --2011 $	Measure Life (Years)	Peak Demand Savings per Unit (Watts)	Annual Energy Savings per Unit (kWh)	One-Time Incremental Measure Cost ($)	Present Value of Avoided Cost Benefits ($)	Program Admin. Cost ($)	Total Resource Benefit-Cost (Ratio)
Small Business Direct Install Lighting							
CFL - Screw-in weighted Watts	3	78	319	$4	$138	$22	3.5
CFL - Hard-wired weighted Watts	12	72	295	$15	$388	$20	9.3
LED Exit	16	20	179	$83	$261	$12	2.5
T8/T5 w/Electronic Ballast	15	27	110	$57	$167	$7	2.3
Delamping w/Reflectors (2 lamp)	15	44	182	$50	$276	$12	3.9
Occupancy Sensor Motion Detector	8	52	392	$89	$365	$26	2.3
175W PS MH HID fixture- outdoor	15	157	1,110	$67	$1,589	$75	10.2
250W PS MH HID fixture- outdoor	15	90	656	$71	$937	$44	7.4
Prescriptive - New Construction							
CFL - Screw-in weighted Watts	3	78	319	$4	$138	$25	3.1
CFL - Hard-wired weighted Watts	12	72	295	$15	$388	$24	8.4
T8/T5 w/Electronic Ballast	15	27	110	$57	$167	$9	2.3
Super T8	15	9	35	$45	$53	$3	1.0
Delamping w/Reflectors (2 lamp)	15	44	182	$50	$276	$15	3.8
Occupancy Sensor Motion Detector	8	52	392	$89	$365	$31	2.2
250W PS MH HID fixture- indoor	15	84	856	$71	$1,196	$69	7.8
175W PS MH HID fixture- outdoor	15	157	1,110	$67	$1,589	$89	9.2
250W PS MH HID fixture- outdoor	15	90	656	$71	$937	$52	6.9
Outdoor Lighting Controls	8	0	240	$105	$206	$19	1.3
T5 Interior High Bay Flourescent Fixture	15	106	1,201	$280	$1,668	$96	4.1
Prem Motor < =10 HP	15	19	77	$42	$117	$6	2.2
Prem Motor > 10HP	15	9	34	$11	$52	$3	3.3
Adjustable Speed Drives for Fans & Pumps	15	277	943	$219	$1,463	$75	4.4
Hot Water Circulation Pump Time Clock	15	0	1,148	$312	$1,515	$92	3.5
EMS System	15	0	525	$494	$693	$42	1.2
Programmable Thermostat	11	317	1,103	$86	$1,402	$88	6.4

Table 17: Commercial--Food and Accomodations--Measure Characterizations

Measure Name --savings at generator --2011 $	Measure Life (Years)	Peak Demand Savings per Unit (Watts)	Annual Energy Savings per Unit (kWh)	One-Time Incremental Measure Cost ($)	Present Value of Avoided Cost Benefits ($)	Program Admin. Cost ($)	Total Resource Benefit-Cost (Ratio)
Prescriptive - Existing							
CFL - Screw-in weighted Watts	3	64	367	$4	$153	$11	7.0
CFL - Hard-wired weighted Watts	12	72	411	$15	$522	$12	16.1
LED Exit	16	20	179	$83	$261	$5	2.7
T8/T5 w/Electronic Ballast	15	27	154	$57	$224	$5	3.3
Super T8	15	9	49	$46	$71	$1	1.4
Delamping w/Reflectors (2 lamp)	15	44	254	$50	$370	$8	5.8
Occupancy Sensor Motion Detector	8	28	391	$89	$351	$12	2.6
250W PS MH HID fixture- indoor	15	58	1,189	$71	$1,614	$36	13.9
50W MH HID fixture- outdoor	15	45	316	$130	$452	$9	2.9
75W MH HID fixture- outdoor	15	13	101	$108	$144	$3	1.2
100W MH HID fixture- outdoor	15	38	275	$73	$393	$8	4.4
175W PS MH HID fixture- outdoor	15	157	1,110	$67	$1,589	$33	14.4
250W PS MH HID fixture- outdoor	15	90	656	$71	$937	$20	9.3
Outdoor Lighting Controls	8	-	240	$105	$206	$7	1.4
T5 Interior High Bay Flourescent Fixture	15	74	1,680	$280	$2,275	$50	6.3
Programmable Thermostat	11	(137)	885	$86	$870	$27	6.9
Custom - Existing							
Prem Motor < =10 HP	15	19	77	$42	$117	$7	2.1
Prem Motor > 10HP	15	9	34	$11	$52	$3	3.2
Adjustable Speed Drives for Fans & Pumps	15	277	945	$219	$1,466	$85	4.3
Convection Oven	10	393	1,812	$585	$2,077	$163	2.2
Spray Nozzles	5	308	3,703	$156	$2,293	$333	3.3
Hot Water Circulation Pump Time Clock	15	-	1,103	$312	$1,455	$99	3.3
Retrocommissioning	10	97	1,914	$1,500	$2,000	$172	1.0
Motor Upgrade for Fans & Compressors	15	348	1,565	$202	$2,340	$141	6.1
High efficiency, low temperature compresser	12	173	1,100	$767	$1,383	$99	1.3
Evap Fan Controller for Med. Temp Walk-in	16	447	2,474	$144	$3,754	$223	9.4
Strip Curtains	4	31	269	$8	$140	$24	3.0
LED Exit	16	20	179	$83	$261	$16	2.4
T8/T5 w/Electronic Ballast	15	27	154	$57	$224	$14	2.9
Delamping w/Reflectors (2 lamp)	15	44	254	$50	$370	$23	4.6
Occupancy Sensor Motion Detector	8	28	391	$89	$351	$35	2.1
250W PS MH HID fixture- indoor	15	58	1,189	$71	$1,614	$107	8.3
50W MH HID fixture- outdoor	15	45	316	$130	$452	$28	2.6
75W MH HID fixture- outdoor	15	13	101	$108	$144	$9	1.1
100W MH HID fixture- outdoor	15	38	275	$73	$393	$25	3.6
175W PS MH HID fixture- outdoor	15	157	1,110	$67	$1,589	$100	8.6
250W PS MH HID fixture- outdoor	15	90	656	$71	$937	$59	6.5
Outdoor Lighting Controls	8	-	240	$105	$206	$22	1.3

Table 18: Commercial--Food and Accomodations--Measure Characterizations

Measure Name --savings at generator --2011 $	Measure Life (Years)	Peak Demand Savings per Unit (Watts)	Annual Energy Savings per Unit (kWh)	One-Time Incremental Measure Cost ($)	Present Value of Avoided Cost Benefits ($)	Program Admin. Cost ($)	Total Resource Benefit-Cost (Ratio)
Small Business Direct Install Lighting							
CFL - Screw-in weighted Watts	3	64	367	$4	$153	$25	3.6
CFL - Hard-wired weighted Watts	12	72	411	$15	$522	$28	10.3
LED Exit	16	20	179	$83	$261	$12	2.5
T8/T5 w/Electronic Ballast	15	27	154	$57	$224	$10	3.0
Delamping w/Reflectors (2 lamp)	15	44	254	$50	$370	$17	5.0
Occupancy Sensor Motion Detector	8	28	391	$89	$351	$26	2.3
250W PS MH HID fixture- indoor	15	58	1,189	$71	$1,614	$80	9.8
50W MH HID fixture- outdoor	15	45	316	$130	$452	$21	2.7
100W MH HID fixture- outdoor	15	38	275	$73	$393	$19	3.9
175W PS MH HID fixture- outdoor	15	157	1,110	$67	$1,589	$75	10.2
250W PS MH HID fixture- outdoor	15	90	656	$71	$937	$44	7.4
Prescriptive - New Construction							
CFL - Screw-in weighted Watts	3	64	367	$4	$153	$29	3.1
CFL - Hard-wired weighted Watts	12	72	411	$15	$522	$33	9.2
T8/T5 w/Electronic Ballast	15	27	154	$57	$224	$12	2.9
Super T8	15	9	49	$45	$71	$4	1.3
Delamping w/Reflectors (2 lamp)	15	44	254	$50	$370	$20	4.7
Occupancy Sensor Motion Detector	8	28	391	$89	$351	$31	2.2
250W PS MH HID fixture- indoor	15	58	1,189	$71	$1,614	$95	8.9
175W PS MH HID fixture- outdoor	15	157	1,110	$67	$1,589	$89	9.2
250W PS MH HID fixture- outdoor	15	90	656	$71	$937	$52	6.9
Outdoor Lighting Controls	8	-	240	$105	$206	$19	1.3
T5 Interior High Bay Flourescent Fixture	15	74	1,680	$280	$2,275	$134	5.0
Prem Motor < =10 HP	15	19	77	$42	$117	$6	2.2
Prem Motor > 10HP	15	9	34	$11	$52	$3	3.3
Adjustable Speed Drives for Fans & Pumps	15	277	945	$219	$1,466	$76	4.4
Convection Oven	10	393	1,812	$585	$2,077	$145	2.2
Hot Water Circulation Pump Time Clock	15	-	1,103	$312	$1,455	$88	3.4
Programmable Thermostat	11	(137)	885	$86	$870	$71	5.0
Motor Upgrade for Fans & Compressors	15	348	1,565	$202	$2,340	$125	6.4
High efficiency, low temperature compresser	12	173	1,100	$767	$1,383	$88	1.4
Evap Fan Controller for Med. Temp Walk-in	16	447	2,474	$144	$3,754	$198	10.1

Table 19: Commercial--Miscellaneous--Measure Characterizations

Measure Name --savings at generator --2011 $	Measure Life (Years)	Peak Demand Savings per Unit (Watts)	Annual Energy Savings per Unit (kWh)	One-Time Incremental Measure Cost ($)	Present Value of Avoided Cost Benefits ($)	Program Admin. Cost ($)	Total Resource Benefit-Cost (Ratio)
Prescriptive - Existing							
CFL - Screw-in weighted Watts	3	69	311	$4	$133	$9	6.7
CFL - Hard-wired weighted Watts	12	72	328	$15	$426	$10	14.4
LED Exit	16	14	179	$83	$256	$5	2.7
T8/T5 w/Electronic Ballast	15	27	123	$57	$183	$4	2.7
Super T8	15	9	41	$46	$60	$1	1.2
Delamping w/Reflectors (2 lamp)	15	44	203	$50	$302	$6	4.8
Occupancy Sensor Motion Detector	8	56	453	$89	$419	$14	3.0
250W PS MH HID fixture- indoor	15	81	964	$71	$1,336	$29	12.2
50W MH HID fixture- outdoor	15	45	316	$130	$452	$9	2.9
75W MH HID fixture- outdoor	15	13	101	$108	$144	$3	1.2
100W MH HID fixture- outdoor	15	38	275	$73	$393	$8	4.4
175W PS MH HID fixture- outdoor	15	157	1,110	$67	$1,589	$33	14.4
250W PS MH HID fixture- outdoor	15	90	656	$71	$937	$20	9.3
Outdoor Lighting Controls	8	-	240	$105	$206	$7	1.4
T5 Interior High Bay Flourescent Fixture	15	103	1,356	$280	$1,871	$41	5.3
EMS System	15	-	573	$494	$755	$17	1.4
Programmable Thermostat	11	(71)	1,120	$86	$1,167	$34	8.5
Custom - Existing							
Prem Motor < =10 HP	15	19	77	$42	$117	$7	2.1
Prem Motor > 10HP	15	9	34	$11	$52	$3	3.2
Adjustable Speed Drives for Fans & Pumps	15	274	934	$219	$1,449	$84	4.2
Hot Water Circulation Pump Time Clock	15	-	1,081	$312	$1,426	$97	3.2
Motor Upgrade for Fans & Compressors	15	348	1,565	$67	$2,340	$141	10.1
High efficiency, low temperature compresser	12	173	1,100	$256	$1,383	$99	3.3
Evap Fan Controller for Med. Temp Walk-in	16	447	2,474	$48	$3,754	$223	12.7
Strip Curtains	4	31	269	$3	$140	$24	3.6
LED Exit	16	14	179	$83	$256	$16	2.4
T8/T5 w/Electronic Ballast	15	27	123	$57	$183	$11	2.4
Delamping w/Reflectors (2 lamp)	15	44	203	$50	$302	$18	4.0
Occupancy Sensor Motion Detector	8	56	453	$89	$419	$41	2.4
250W PS MH HID fixture- indoor	15	81	964	$71	$1,336	$87	7.7
50W MH HID fixture- outdoor	15	45	316	$130	$452	$28	2.6
75W MH HID fixture- outdoor	15	13	101	$108	$144	$9	1.1
100W MH HID fixture- outdoor	15	38	275	$73	$393	$25	3.6
175W PS MH HID fixture- outdoor	15	157	1,110	$67	$1,589	$100	8.6
250W PS MH HID fixture- outdoor	15	90	656	$71	$937	$59	6.5
Outdoor Lighting Controls	8	-	240	$105	$206	$22	1.3

Table 20: Commercial--Miscellaneous--Measure Characterizations

Measure Name --savings at generator --2011 $	Measure Life (Years)	Peak Demand Savings per Unit (Watts)	Annual Energy Savings per Unit (kWh)	One-Time Incremental Measure Cost ($)	Present Value of Avoided Cost Benefits ($)	Program Admin. Cost ($)	Total Resource Benefit-Cost (Ratio)
Small Business Direct Install Lighting							
CFL - Screw-in weighted Watts	3	69	311	$4	$133	$21	3.5
CFL - Hard-wired weighted Watts	12	72	328	$15	$426	$22	9.6
LED Exit	16	14	179	$83	$256	$12	2.5
T8/T5 w/Electronic Ballast	15	27	123	$57	$183	$8	2.5
Delamping w/Reflectors (2 lamp)	15	44	203	$50	$302	$14	4.3
Occupancy Sensor Motion Detector	8	56	453	$89	$419	$31	2.6
250W PS MH HID fixture- indoor	15	81	964	$71	$1,336	$65	9.0
50W MH HID fixture- outdoor	15	45	316	$130	$452	$21	2.7
100W MH HID fixture- outdoor	15	38	275	$73	$393	$19	3.9
175W PS MH HID fixture- outdoor	15	157	1,110	$67	$1,589	$75	10.2
250W PS MH HID fixture- outdoor	15	90	656	$71	$937	$44	7.4
Prescriptive - New Construction							
CFL - Screw-in weighted Watts	3	69	311	$4	$133	$25	3.1
CFL - Hard-wired weighted Watts	12	72	328	$15	$426	$26	8.6
T8/T5 w/Electronic Ballast	15	27	123	$57	$183	$10	2.5
Super T8	15	9	39	$40	$58	$3	1.2
Delamping w/Reflectors (2 lamp)	15	44	203	$50	$302	$16	4.1
Occupancy Sensor Motion Detector	8	56	453	$89	$419	$36	2.5
250W PS MH HID fixture- indoor	15	81	964	$71	$1,336	$77	8.2
175W PS MH HID fixture- outdoor	15	157	1,110	$67	$1,589	$89	9.2
250W PS MH HID fixture- outdoor	15	90	656	$71	$937	$52	6.9
Outdoor Lighting Controls	8	-	240	$105	$206	$19	1.3
T5 Interior High Bay Flourescent Fixture	15	103	1,356	$280	$1,871	$109	4.4
Prem Motor < =10 HP	15	19	77	$42	$117	$6	2.2
Prem Motor > 10HP	15	9	34	$11	$52	$3	3.3
Adjustable Speed Drives for Fans & Pumps	15	274	934	$219	$1,449	$75	4.4
Hot Water Circulation Pump Time Clock	15	-	1,081	$312	$1,426	$86	3.3
EMS System	15	-	573	$494	$755	$46	1.3
Programmable Thermostat	11	(71)	1,120	$86	$1,167	$90	5.8
Motor Upgrade for Fans & Compressors	15	348	1,565	$67	$2,340	$125	10.9
High efficiency, low temperature compresser	12	173	1,100	$256	$1,383	$88	3.4
Evap Fan Controller for Med. Temp Walk-in	16	447	2,474	$48	$3,754	$198	14.0

Table 21: Industrial--Manufacturing--Measure Characterizations

Measure Name --savings at generator --2011 $	Measure Life (Years)	Peak Demand Savings per Unit (Watts)	Annual Energy Savings per Unit (kWh)	One-Time Incremental Measure Cost ($)	Present Value of Avoided Cost Benefits ($)	Program Admin. Cost ($)	Total Resource Benefit-Cost (Ratio)
Prescriptive - Existing							
CFL - Screw-in weighted Watts	3	67	304	$4	$130	$9	6.7
CFL - Hard-wired weighted Watts	12	70	321	$15	$417	$10	14.2
LED Exit	16	20	175	$85	$256	$5	2.6
T8/T5 w/Electronic Ballast	15	18	92	$57	$136	$3	2.0
Super T8	15	9	41	$46	$60	$1	1.2
50W MH HID fixture- indoor	15	87	436	$134	$644	$13	3.9
75W MH HID fixture- indoor	15	26	137	$112	$202	$4	1.6
100W MH HID fixture- indoor	15	74	377	$75	$555	$11	5.8
T5 Interior High Bay Flourescent Fixture	15	232	1,181	$286	$1,742	$35	4.9
Custom - Existing							
Prem Motor < =10 HP	15	18	92	$42	$136	$8	2.4
Prem Motor > 10HP	15	8	42	$11	$63	$4	3.7
Adjustable Speed Drives for Fans & Pumps	15	179	894	$217	$1,321	$80	4.0
Compressed Air Controls	15	35	353	$217	$494	$32	1.8
Custom	15	61,460	425,793	$266,763	$610,385	$38,321	1.8
T5 Interior High Bay Flourescent Fixture	15	232	1,181	$286	$1,742	$106	4.0
LED Exit	16	20	175	$85	$256	$16	2.3
T8/T5 w/Electronic Ballast	15	18	92	$57	$136	$8	1.9
50W MH HID fixture- indoor	15	87	436	$134	$644	$39	3.3
75W MH HID fixture- indoor	15	26	137	$112	$202	$12	1.5
100W MH HID fixture- indoor	15	74	377	$75	$555	$34	4.6
Prescriptive - New Construction							
CFL - Screw-in weighted Watts	3	67	304	$4	$130	$24	3.0
CFL - Hard-wired weighted Watts	12	70	321	$15	$417	$26	8.6
T8/T5 w/Electronic Ballast	15	18	92	$57	$136	$7	1.9
Super T8	15	9	39	$40	$58	$3	1.2
T5 Interior High Bay Flourescent Fixture	15	232	1,181	$286	$1,742	$94	4.1
Prem Motor < =10 HP	15	18	92	$42	$136	$7	2.5
Prem Motor > 10HP	15	8	42	$11	$63	$3	3.9
Adjustable Speed Drives for Fans & Pumps	15	179	894	$217	$1,321	$72	4.1
Compressed Air Controls	15	35	353	$217	$494	$28	1.8
Custom - New Construction							
Custom	15	40,973	425,793	$266,763	$594,154	$38,321	1.8

Appendix B

Navigant Consulting
Fuel Substitution Potential Analysis

2010 TO 2019 FUEL SUBSTITUTION POTENTIAL ANALYSIS

February 24, 2010

NAVIGANT CONSULTING

Submitted to:
John Aguinaga, P. Eng., MBA
Manager, Conservation and Energy Efficiency
Nova Scotia Power Inc.
P.O. Box 910 Halifax, NS,
B3J 2W5
ph (902) 428-6364
fax (902) 428-6066
John.aguinaga@nspower.ca

Submitted by:

Navigant Consulting, Inc. (formerly Summit Blue Consulting, LLC)
1722 14th Street, Suite 230
Boulder, CO 80302
720.564.1130

Prepared by:

Randy Gunn, Managing Director
Navigant Consulting
312.938.4242
randy.gunn@navigantconsulting.com

Stu Slote, Managing Consultant
Navigant Consulting
802.860.0017
stu.slote@navigantconsulting.com

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1 EXECUTIVE SUMMARY

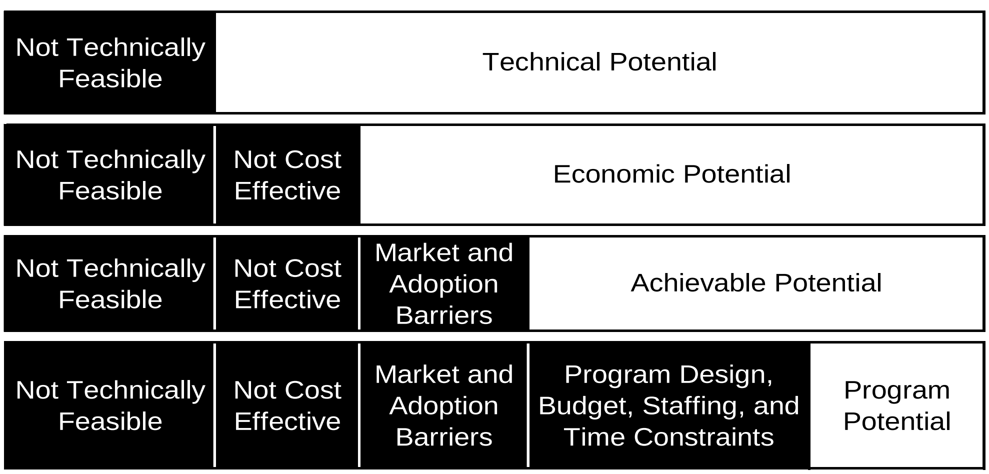
The purpose of this study is to conduct a potential analysis of fuel substitution in Nova Scotia in the residential market. A potential analysis of fuel substitution – switching from electric-fueled equipment to equipment using a non-electric fuel (natural gas, oil, propane, cordwood, wood pellets or solar energy) - was conducted over ten years – for 2010 to 2019.

The next section discusses the approach to estimating the residential fuel substitution potential. That section is followed by an overview of fuel substitution potential results for 2010 to 2019.

1.1 Approach to Estimating Residential Fuel Substitution Potential

As detailed in Figure 1, there are four major types of fuel substitution potential: (1) *technical* potential for all technologies, (2) *economic* potential, the amount of fuel substitution available that is cost effective, (3) *achievable* potential, the amount of fuel substitution available under current market conditions and available investments, and (4) *program* potential, the amount of fuel substitution available given limited resources, available time and duration of the energy efficiency program planning period. Fuel substitution measures that were known not to be cost-effective were pre-screened out of consideration from all potential scenarios.

Figure 1. The Four Stages of Energy Efficiency Potential



Reproduced from "Guide to Resource Planning with Energy Efficiency November 2007" written by the US EPA. Figure 2-1

Navigant Consulting, Inc. (NCI, formerly Summit Blue) undertook the residential fuel substitution potential study with the following key tasks:

- Develop baseline consumption profiles and initial building simulation model specifications
- Characterize the residential fuel substitution measures
- Conduct benefit-cost analysis of residential fuel substitution measures
- Estimate fuel substitution potentials

Each of these tasks is summarized below.

1.1.1 Develop Residential Baseline Consumption Profiles and Initial Residential Building Simulation Model Specifications

Navigant Consulting conducted this task by characterizing the NSPI residential service territory in terms of customer numbers, as well as age and size of the household/housing stock. Residential sales data delivered by NSPI provide a good starting point to determine customer energy use in broad end-use categories, such as lighting, heating and domestic hot water. This data was supplemented by data collected during a survey of NSPI's Online Customer Advisory Panel and onsite assessments conducted in the last quarter of 2009 on behalf of NSPI. This information is used to estimate savings from fuel substitution measures.

1.1.2 Characterize the Residential Fuel Substitution Measures

Characterization of residential fuel substitution measures requires:

1) Estimating the baseline energy consumption for each end-use (heating, lighting, domestic hot water, etc.) or unit energy consumption ("UEC")
2) Estimating the incremental savings from each measure – improving from the baseline to the new technology
3) Determining the incremental costs and lifetimes for each of the new technologies
4) Determining cost effectiveness of measures

In addition, the baselines must consider that different classes of buildings have different penetrations of technologies, such as existing homes compared to new construction.

For climate-*dependent* measures, Navigant used a combination of building simulation modeling using the eQuest model and engineering estimates to derive fuel substitution measure per unit savings. Building prototypes were developed based on the information gathered during the aforementioned survey of NSPI's Online Customer Advisory Panel and onsite assessments.

For the residential sector, Navigant used four prototypes: single family new and existing construction, and multi-family new and existing construction. With all prototypes, the eQuest simulation model was calibrated for electric use to the baseline residential energy profile and the fuel substitution measure savings impacts were estimated using the calibrated models.

For the climate-*independent* measures, Navigant utilized various resources, including data from Natural Resources Canada, Conserve Nova Scotia, the U.S. Department of Energy's ENERGY STAR Program[1], and manufacturer and national retailer data. Other measures were analyzed using engineering principles, such as steady-state heat loss, rated power, and hours of operation. Spreadsheet models were the primary tool used to develop the energy savings estimates for the climate-independent measures.

[1] http://www.energystar.gov/.

For Fuel substitution measure costs, Navigant used a variety of sources including but not limited to the DEER database, contractor estimates, the ENERGY STAR website, U.S, DOE's EERE (Energy Efficiency and Renewable Energy), ACEEE (American Council for an Energy-Efficient Economy), Efficiency Vermont, NRCan, various primary online resources, and other Navigant internal cost resources. All costs were adjusted where necessary by geographic multiplier factors contained in industry sources, such as the RS Means *Mechanical Cost Data*. Where possible costs were obtained from multiple sources and reconciled based on engineering judgment.

For Fuel substitution measure lifetimes, a combination of resources was used, including manufacturer data, typical economic depreciation assumptions, the DEER database, the ENERGY STAR Website, industry trade organizations, various TRM reports, U.S. EPA, U.S. DOE, CBEEDAC, ACEEE, and various studies reviewed for this project. As with measure costs, where possible measure lifetimes were obtained from multiple sources and reconciled based on engineering judgment.

The fuel substitution measures were evaluated with respect to each of the four main standard cost tests, with the total resource benefit-cost tests used to determine cost-effectiveness.[2]

Participant test: measures are cost effective from this perspective if the reduced electric costs to the participating customer from the measure exceed the after-incentive cost of the measure to the customer.

Utility (or program administrator) ("UCT") cost test: measures are cost effective from this perspective if the costs avoided by the measures' energy and demand savings are greater than the utility's costs to promote the measure, including customer incentives.

Ratepayer impact measure ("RIM") test: measures are cost effective from this perspective if their avoided costs are greater than the sum of the utility's costs and the "lost revenues" caused by the measure.

Total resource cost ("TRC") test: measures are cost effective from this perspective if their avoided costs are greater than the sum of the measure costs and the utility's administrative costs.

1.1.3 Estimate Residential Fuel Substitution Potential

Navigant Consulting developed estimates of residential fuel substitution measure potentials in terms of technical, economic, and "achievable" potential (the results that are realistic for the DSM Administrator to achieve through cost-effective demand-side management programs). Economic potential was estimated using the TRC test as the economic "screen" to apply to technical potential estimates in order to determine whether the measures are "cost-effective" or not.

To estimate achievable potential, a computer model was used to estimate conversion rates from inefficient products to more efficient products for retrofit and replacement measures, as well as installation rates in new buildings for new construction markets.

1.2 Residential Fuel Substitution Potential Results

[2] California Public Utilities Commission. California Standard Practice Manual Economic Analysis of Demand-Side Programs and Projects, October 2001, http://drrc.lbl.gov/pubs/CA-SPManual-7-02.pdf.

The cumulative net annual residential fuel substitution potential savings (achievable potential) in 2019 through retrofitting existing homes is estimated to be approximately 217 GWh at generator, about 4.3% of forecast sales, and approximately 126 MW at generator, about 4.5% of peak winter demand, as shown in Figures 2 and 3. These results assume a net-to-gross impact ratio of 1.0, whereby free ridership is assumed to be offset by spillover impacts for this analysis. This is a conservative estimate based average home energy usage. Homes with higher than average usage would result in higher fuel savings from fuel substitution measures. This analysis is not informed by a comparison of fuel switching efforts in other jurisdictions, since there is very limited fuel substitution program activity at the present time.

Figure 2. Projected Cumulative Annual Net Energy Savings at Generator – 2010 to 2019

Energy Potential (MWh)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Retrofit Fuel Switch	8,189	16,959	26,952	39,695	58,010	84,681	119,059	153,258	186,076	217,552
Percent of Sector Forecast	0.17%	0.36%	0.57%	0.83%	1.20%	1.74%	2.43%	3.11%	3.75%	4.36%

Figure 3. Projected Cumulative Annual Net Winter Peak Demand Savings at Generator – 2010 to 2019

Demand Potential (kW)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Retrofit Fuel Switch	4,770	9,878	15,698	23,119	33,785	49,316	69,332	89,241	108,342	126,658
Percent of Sector Forecast	0.18%	0.38%	0.59%	0.86%	1.25%	1.82%	2.55%	3.26%	3.93%	4.57%

2 RESIDENTIAL FUEL SUBSTITUTION POTENTIAL METHODOLOGY AND RESULTS

2.1 Methodology – DSM RAM

This section describes the fuel substitution potential analysis approach and method.

Navigant Consulting's DSM Resource Assessment Model ("DSM-RAM") is a model based on the integration of fuel substitution measure impacts and costs, utility customer characteristics, utility load forecasts, and utility avoided costs and rate schedules. The model utilizes a "bottom-up" approach in that the starting points are the study area building stocks and equipment saturation estimates, forecasts of building stock decay and new construction, fuel substitution technology data, past fuel substitution program accomplishments, and decision maker variables that help drive the achievable potential scenario.

The baseline estimates of building stocks and equipment saturations came from data gathered from the survey of NSPI customers using the Online Customer Advisory Panel.

DSM-RAM estimates technical, economic, and achievable fuel substitution resource potential as defined below:

- **Technical fuel substitution potential** describes the amount of fuel substitution savings that could be achieved, not considering economic and market barriers, by customers installing fuel substitution measures. Technical potential is calculated as the product of the fuel substitution measures' savings per unit, the quantity of applicable equipment in each facility, the number of facilities in a utility's service area, and 100% – the measure's current market saturation. Technical potential estimates include fuel substitution measures that may not be cost effective, and technical potential does not consider market barriers, such as customer's lack of awareness of fuel substitution measures. Therefore, technical fuel substitution potential estimates do not provide a realistic basis for setting fuel substitution program goals.

- **Economic fuel substitution potential** describes the amount of technical fuel substitution potential that is "cost-effective," as defined by the results of the TRC test. The program benefits for the TRC test include the avoided costs of generation, transmission, and distribution investments and avoided fuel costs due to the energy conserved by the fuel substitution programs. The costs for the TRC test are the fuel substitution measure costs, plus the fuel substitution program administration costs. The TRC test does not consider economic or market barriers to customers installing fuel substitution measures.

- **Achievable fuel substitution potential** estimates the amount of fuel substitution potential that could be captured by realistic fuel substitution programs that include cost effective fuel substitution measures over the forecast period covered by this fuel substitution potential analysis. Achievable fuel substitution potential can vary with fuel substitution program parameters, such as the magnitude of rebates or incentives offered to customers for installing fuel substitution measures and, thus, many different scenarios can be modeled.

Within the achievable fuel substitution potential assessment, the individual measures are modeled by expected type of fuel substitution program design. Three different program design options are included in DSM-RAM.

- **New Construction (NC)** means measures that are installed at the time of new construction. Baseline technologies may be different in the new construction market, and implementation costs are often different due to the different technologies, either the energy efficient or base technology.
- **Replace on Burnout/Renovation/Remodel (ROB)** means that a fuel substitution measure is not implemented until the existing technology it is replacing fails, or is implemented as part of a planned renovation or remodel. In each of these situations the owner would be replacing any existing equipment and therefore the baseline is what would have been installed as part of a standard installation. An example would be an energy efficient water heater being purchased after the failure of the existing water heater, or as part of a planned renovation.
- **Existing Retrofit (ER)** means that the fuel substitution measure would be implemented immediately even though the existing equipment may have some remaining useful life. For instance, installing an energy efficient stove/oven is usually implemented before an existing stove/oven fails.

Cost Effectiveness Tests

DSM-RAM employs several financial tests, including the cost effectiveness tests described in Appendix C: the Total Resource Cost Test (TRC), Utility Cost Test (UCT), Participant Cost Test (PCT) and Rate Impact Measure (RIM) tests.

Simple Customer Payback

The decision model of DSM-RAM includes simple customer payback as part of its analysis. The calculation takes measure cost less the incentive received and divides it by first year energy bill savings.

Fuel Substitution Measure Levelized Cost/kWh

Fuel substitution supply curves are based on the fuel substitution measure cost per kWh, levelized over the lifetime of the measure. It is calculated by multiplying fuel substitution measure costs by the Capital Recovery Factor (“CRF”), then dividing by the first year kWh savings.

2.2 Overall Residential Fuel Substitution Potential Results

The cumulative net annual residential fuel substitution potential savings (achievable potential) in 2019 is through retrofitting existing homes estimated to be approximately 217 GWh at generator, about 4.3% of forecast sales, and approximately 126 MW at generator, about 4.5% of peak winter demand, as shown in Figures 4 and 5. These results assume a net-to-gross impact ratio of 1.0, whereby free ridership is assumed to be offset by spillover impacts for this analysis. This is a conservative estimate based average home energy usage. Homes with higher than average usage would result in higher fuel savings from fuel substitution measures. This analysis is not informed by a comparison of fuel switching efforts in other jurisdictions, since there is very limited fuel substitution program activity at the present time.

Measures were included in the potential analysis based on several factors, including:

- market type – new construction, replacement or existing retrofit
- building type – single-family or multifamily
- end use – space heat, hot water, drying or cooking
- operating efficiency
- cost-effectiveness

The potential analysis focused solely on the existing retrofit market, given the high saturation of electrically-heated single-family houses and multifamily buildings. Since electric resistance space heat has an extremely long useful life, equipment replacement less often occurs, as compared with domestic water heaters, clothes washers or cookstoves, which eventually will need to be replaced. The new construction and replacement markets were not analyzed in the potential analysis due to the potential difficulty in attributing a homeowner's decision to newly install non-electric fueled equipment independent of the New and Existing Houses Programs.

Figure 4. Projected Cumulative Annual Net Energy Savings at Generator – 2010 to 2019

Energy Potential (MWh)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Retrofit Fuel Switch	8,189	16,959	26,952	39,695	58,010	84,681	119,059	153,258	186,076	217,552
Percent of Sector Forecast	0.17%	0.36%	0.57%	0.83%	1.20%	1.74%	2.43%	3.11%	3.75%	4.36%

Figure 5. Projected Cumulative Annual Net Winter Peak Demand Savings at Generator – 2010 to 2019

Demand Potential (kW)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Retrofit Fuel Switch	4,770	9,878	15,698	23,119	33,785	49,316	69,332	89,241	108,342	126,658
Percent of Sector Forecast	0.18%	0.38%	0.59%	0.86%	1.25%	1.82%	2.55%	3.26%	3.93%	4.57%

3 Residential Fuel Substitution Measure Characterizations and Analysis

After estimating baseline consumption, characterization of fuel substitution measures requires: 1) determining the list of measures to evaluate, 2) estimating the incremental savings from each measure – improving from the baseline to the new technology, 3) determining the incremental costs and lifetimes for each of the new technologies, and 4) determining cost effectiveness

3.1 Measure List

The first step in the measure characterization process is to develop appropriate sets of measures for inclusion in this study. The scope of this study clearly limited the field to measures that are candidates for residential fuel substitution, specifically the end-uses of space heating, domestic water heating, combined/integrated space and water heating, cooking and clothes drying. Measure efficiency levels were based on various code or efficiency recommendations such as code minimums, ENERGY STAR requirements, CEE Tiers, U.S. EPA levels, etc.

Estimates of energy and demand savings, measure costs, and equipment lifetimes in the residential sectors were then developed.

3.2 Measure Replacement Categories

Measure replacement categories are as follows:

- **New Construction (NC)** means measures that are installed at the time of new construction. Baseline technologies may be different in the new construction market.
- **Replace on Burnout/Renovation/Remodel (ROB)** means that a fuel substitution measure is not implemented until the existing technology it is replacing fails, or is implemented as part of a planned renovation or remodel. In each of these situations the owner would be replacing any existing equipment and therefore the baseline is what would have been installed as part of a standard installation. An example would be an energy efficient water heater being purchased after the failure of the existing water heater, or as part of a planned renovation.
- **Existing Retrofit (ER)** means that the fuel substitution measure would be implemented immediately even though the existing equipment may have some remaining useful life. For instance, installing an energy efficient stove/oven is usually implemented before an existing stove/oven fails.

Analytically, these design options affect the savings estimates and measure costs.

The energy savings of replace on burnout measures is the incremental difference in energy use between the efficient measure and standard or code-compliant alternatives.[3] The incremental measure cost is the difference between a standard code-compliant unit and the efficient measure. On the other hand, there is minimal incremental labor cost for the delivery and installation of the replace on burnout unit since the customer would have borne those costs, regardless, when replacing the failed unit.

New construction measures share many of the same characteristics of replace on burnout, since the baseline is again code-compliant. The primary difference between new construction and replace on burnout is installation costs for new construction tend to be lower than for ROB.

In existing retrofit situations the characterization can claim full energy savings between the baseline existing inefficient equipment and the efficient measure for the period of remaining useful life of the existing equipment. For the post remaining useful life period (i.e., after the existing equipment would have been replaced on schedule), the measure can only claim the estimated savings between the replacement standard efficiency item that would have been installed, had a high efficiency measure not been installed. In the case of electric baseboard heat, clothes drying and cooking, this is essentially the same as the savings for the period of remaining useful life, as the efficiency of the standard baseline electric appliances has not changed appreciably (for example: roughly 100% efficient electric baseboard heat for existing equipment and replacement equipment).

For equipment replacement situations, the incremental measure cost is the difference between the full measure cost and the discounted present value of the scheduled future replacement cost (i.e., cost of replacement at the end of the existing equipment’s remaining useful life). This incremental cost represents a permanent shift of the scheduled equipment replacement schedule rather than artificially disregarding the future cost of replacement in the analysis.

3.3 Energy Savings Estimates

Navigant utilized measure appropriate methods for estimating savings for climate-dependent measures such as space heating and for climate-independent measures, such as water heating, cooking and clothes drying.

3.3.1 Climate-Dependent Measures

For climate-*dependent* measures, Navigant used a combination of building simulation modeling using the eQuest model and engineering estimates to derive fuel substitution measure per unit savings. We first developed building prototypes based on the information analyzed for the Market and Technology Profiles discussed in the previous section.

For the residential sector, Navigant used three prototypes: single family new and existing construction, and multi-family existing construction.

[3] For example, replacing an old refrigerator (1500 kWh/year) on burn-out will save a lot of energy, because the efficiency of this appliance has improved greatly over the past 20 years. New code-compliant refrigerators (500 kWh) might save 67% of the energy consumed by the machine being replaced, but the savings from the ENERGY STAR refrigerator (425 kWh) measure is only the difference between the ENERGY STAR and code compliant unit (75 kWh) or about 15%.

With all prototypes, the eQuest simulation were calibrated for electric use to the baseline residential energy profile and then estimated the fuel substitution measure savings impacts using the calibrated models.

3.3.2 Climate-Independent Measures

For the climate-*independent* measures, Navigant utilized various resources, including data from Natural Resources Canada, Conserve Nova Scotia, the U.S. Department of Energy, ENERGY STAR Program[4], and manufacturer and national retailer data. Other measures were analyzed using engineering principles, such as steady-state heat loss, rated power, and hours of operation. Spreadsheet models were the primary tool used to develop the energy savings estimates for the climate-independent measures.

3.4 Measure Costs

For Fuel substitution measure costs, Navigant used a variety of sources including but not limited to the DEER database, contractor estimates, the ENERGY STAR website, U.S. DOE's EERE (Energy Efficiency and Renewable Energy), ACEEE (American Council for an Energy-Efficient Economy), Efficiency Vermont, NRCan, various primary online resources, and other Navigant internal cost resources. All costs were adjusted where necessary by geographic multiplier factors contained in industry sources, such as the RS Means *Mechanical Cost Data*. Where possible costs were obtained from multiple sources and reconciled based on engineering judgment.

3.5 Measure Lifetimes

For Fuel substitution measure lifetimes, a combination of resources was used, including manufacturer data, typical economic depreciation assumptions, the DEER database, the ENERGY STAR Website, industry trade organizations, various TRM reports, U.S. EPA, U.S. DOE, CBEEDAC, ACEEE, and various studies reviewed for this project. As with measure costs, where possible measure lifetimes were obtained from multiple sources and reconciled based on engineering judgment.

3.6 Cost-Effectiveness

The cost-effectiveness analysis of the energy conservation and demand response measures involved developing a list of possible measures, quantifying the necessary data inputs, and then applying tests to determine the cost-effectiveness of each measure given the input parameters. Key inputs to the cost-effectiveness tests are avoided energy and capacity costs, electricity prices, other fuels pricing, measure specific inputs, energy and demand savings, equipment useful life and measure incremental costs.

Following are four cost-effectiveness test methods:[5]

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[4] http://www.energystar.gov/.

[5] California Public Utilities Commission. *California Standard Practice Manual Economic Analysis of Demand-Side Programs and Projects*, October 2001.

1. **Total resource cost ("TRC") test:** a measure is cost effective from this perspective if the avoided costs are greater than the sum of the measure costs and the fuel substitution program administrative costs.

2. **Ratepayer impact measure ("RIM") test:** a measure is cost effective from this perspective if the avoided costs are greater than the sum of the measure's fuel substitution program costs and the measure's resulting "lost revenues."

3. **Participant test**: a measure is cost-effective from this perspective if the resulting reduction in electric costs to the participating customer exceeds the participant's after-rebate cost of the measure.

4. **Utility (or Program administrator) cost ("UCT") test**: a measure is cost-effective from this perspective if the costs avoided by the resulting energy and demand savings are greater than the utility fuel substitution program costs to promote the measure, including customer rebates.

In line with standard industry practice, Navigant Consulting primarily uses the TRC test to determine which the cost-effectiveness of DSM measures.

APPENDIX A. RESIDENTIAL BASELINE CONSUMPTION PROFILES

This appendix describes the development of the baseline market profiles and baseline technology profiles.

A.1 Residential Baseline Energy Profile

Several methods were used to establish baseline energy profiles depending on the measure type considered.

A.1.1 Space Heating and Integrated Space & Water Heating Baseline Energy Profile

For the Space Heating and Integrated Space and Water Heating measures, a DOE2.2 simulation energy model was used to compare the baseline and fuel switching measure energy consumptions. The residential baseline energy profiles were based on average baseline energy consumption data for NSPI customers. Residential construction specifications and end use load profiles were based primarily on results from the recent onsite assessments of a subset of NSPI customers conducted by a local Contractor.

Space Heating. Electric baseboard heating was used as the baseline system and annual energy use in the baseline models was calibrated to reflect consumption data for existing and new Nova Scotia homes based on NSPI customer load data.

Domestic Hot Water. Annual electricity consumption for homes with electric domestic hot water was calculated using seasonally-adjusted mains water temperatures and consumption data from Conserve Nova Scotia published reports, as well as energy end use estimates from NRCan.

Lighting, A**ppliances and Plug Loads.** The starting points for generating loads such as lighting, appliances and miscellaneous plug loads were the results from the on-site assessments and the survey of NSPI's Online Customer Advisory Panel. Annual energy use was calibrated to expected energy end use breakdowns for each category.

A.1.2 Domestic Hot Water Baseline Energy Profile

Annual electricity consumption for homes with electric domestic hot water was calculated using seasonally-adjusted mains water temperatures and consumption data from Conserve Nova Scotia published reports, as well as energy end use estimates from NRCan.

A.1.3 Clothes Drying Baseline Energy Profile

Annual electricity consumption for homes with an electric clothes dryer was calculated using the U.S. DOE Energy Conservation Standards Rulemaking Framework Document for Residential Clothes Dryers and Room Air Conditioners. This method specifies the average number of dryer cycles per year per household which was then used to estimate annual energy consumption for a typical household based on standard dryer efficiency levels.

A.1.4 Cooking Baseline Energy Profile

Annual electricity consumption for homes with an electric range was calculated using the methodology described in Appendix 6A: Cooktops and Ovens: Determination of Energy-Using Components, from the U.S. DOE's Technical Support Document for Residential Cooking Products. This method quantified the annual average electric range (stove and oven combined) energy consumption per year per household.

APPENDIX B. ONLINE CUSTOMER ADVISORY PANEL SURVEY

B.1 Introduction

Navigant and NSPI partnered with Corporate Research Associates (CRA) to create a survey to administer to a subset of NSPI's Online Customer Advisory Panel. An extensive amount of demographic data is collected from NSPI customers during the panel enrollment process. The panel is representative of NSPI's customers by design.

The survey portion of the Residential Fuel Substitution Potential Study was expanded to encompass three research steps:

- A short lighting survey was offered to over 1,500 NSP customers and achieved a 71% response rate. Customers were asked to walk through their home and yard to count the number of CFL and other types of bulbs in use. The results were used to determine CFL penetration inside and outside the average customer home.
- An invitation to a longer survey on home energy usage was sent to 2,697 panel members. A total of 1,905 surveys were completed between November 20th and 27th, representing a response rate of 72%.
- At the end of the Home Energy Usage Survey, NSP customers were asked if they were interested in a home visit to count the light bulbs in their home. Over 800 panel members expressed interest in this phase of the study.

B.2 NSPI Residential Customer Lighting Study

The Lighting Study was offered to 1,574 panel members with a 71% response rate.

B.2.1 Major Findings – The Lighting Study

- 91% of panel members have at least one Compact Fluorescent Light inside their home.
- Respondents reported an average of 34 bulbs inside their homes; almost half (47%) are compact fluorescent lights.
- Respondents reported an average of five bulbs outside the home; on average, two of the five are compact fluorescent bulbs.

B.3 NSPI Residential Customer Energy Usage Study

The Energy Usage Study was offered to 3000 panel members with a 72% response rate.

B.3.1 Major Findings – Energy Usage Study

Key finding relating to this study are summarized in the following bullets:

- 75% of Nova Scotia Power customers are not planning on switching their main fuel at this time. The remaining customers are split between those who are definitely or probably interested (12%) and those who are unsure (13%). No regional differences were found on the propensity to switch fuel.

- Over 10% of panel respondents said that cost would be their primary reason for fuel switching.

- Of the 12% of customers who answered the question, electricity, wood and wood pellets were the most popular new fuel choices.

- Comparing the lighting study with the Energy Usage Study revealed a similar number of reported CFL's per household. Customers participating in the Lighting Study, who counted their light bulbs, reported a mean of 17.63 while customers participating in the Fuel Switching Study reported a mean of 19.65 per household suggesting that estimating the number of CFLs results in a slight over estimation of the number of CFLs per household.

Appendix C. Residential On Site Surveys

Overview

This Appendix provides an overview of NSPI's approach to conducting the on-site survey and a summary of key findings.

C.1 Introduction

On behalf of Navigant Consulting, MJM Energy conducted on-site surveys with a representative sample of residential customers throughout the province of Nova Scotia. These customers, including 50 single-family and 18 multifamily households, first participated in the online panel survey conducted by Corporate Research Associates on behalf of Navigant Consulting. The purpose of the surveys was to gather virtually complete inventories of customers' major energy using equipment. This report summarizes the results of these surveys.

The following sections make up the remainder of this report:

- **Methodology** contains a brief description of the survey methodology.
- **Basic Home Characteristics** contains descriptions of the surveyed homes: type, age, size, demographics.
- **HVAC**, **Water Heating**, **Lighting and Miscellaneous Equipment** sections provide in-depth details on the specific equipment types found at the surveyed sites.

C.2 Methodology

The study method was an on-site data collection process using trained energy survey staff, provided by MJM Energy on behalf of Navigant Consulting, supported by a telephone recruiting process. Sixty-eight residential customers were surveyed (including 50 single-family and 18 multifamily households that first participated in the online panel survey), reflecting the province-wide distribution of customers across geographic, dwelling type, dwelling age and age of head of household.

MJM Energy staff administered a 26-page detailed customer equipment and facility survey, including a battery of decision making questions, for each customer surveyed.

This section provides details on the sample design, survey design and implementation, and the sample disposition.

C.2.1 Sample Design

The sample was designed to reflect the geography, dwelling type, dwelling age and head-of-household age of Nova Scotia's electricity consumers. The target sampling statistic for the sample was a 90% confidence interval and 10% relative error about a 50% response distribution. This requirement yielded a minimum sample size of 68. Survey recruiting and scheduling commitments resulted in 68 customers actually being surveyed.

C.2.2 Survey Design and Implementation

The on-site survey procedure and survey form used for this study evolved from successfully developed and deployed procedures and forms used in previous studies. The survey form comprised a comprehensive set of questions to enumerate equipment, structural characteristics and consumer decision making including familiarity with a variety of energy efficiency measures. A copy of the survey is appended at the end of this document.

The survey process was as follows. First, a pool of consumer names and associated contact information was obtained from the online panel first conducted based on those customer who indicated they would participate in an onsite survey. The onsite sample pool was drawn randomly from the online panel participants who agreed to participate in a follow up onsite survey. These self-selected customers became the basis for onsite survey recruiting. A computerized scheduling system was set up and populated with the sample pool records. The scheduling system incorporated segment quota control parameters for the various sample control segments so that as each segment quota was reached no further prospects were called in that segment. This process enabled the sample to be recruited efficiently and ensured a representative sample of Nova Scotia electric consumers.

Surveys were scheduled to optimize the survey geography so as to minimize surveyor travel. Upon scheduling a given survey, the MJM Energy surveyors were deployed on a regional basis to conduct the surveys. Surveys took two to three hours depending on the complexity of a given dwelling. Upon completion of the survey, the survey data were entered into a database for analytic use. The survey process was performed during December 2009.

C.3 Major Findings

- The average single-family home is 2,352 square feet. On average, 2,112 square feet of a single-family home is conditioned space.
- The average multi-family home is 1,305 square feet. On average, 1,271 square feet of a multi-family home is conditioned space.
- Four percent of single-family and no multi-family homes have a central air-conditioning system. 50% of the single family home A/C systems are energy efficient.
- Eight percent of single-family and seventeen percent of multi-family homes have room air-conditioners. 32% of the single family home Air conditioners and none of the multi-family unit room air conditioners are energy efficient.
- Almost two-thirds (63%) of primary water heaters in single-family homes are electric, while 37% are fueled by oil. Almost four-fifths (79%) of primary water heaters in multi-family homes are electric, while 21% are fueled by oil. None of the water heaters are energy efficient.
- 82% of single family home water heaters have no insulation or tank wrap; in multi-family homes, 72% have no insulation or tank wrap. The balance of units in both cases have 2” insulation and

tank wrap. Almost one-quarter (24%) of single family home water heaters have pipe wrap near the water heater. 11% of pipes near the water heater in multi-family homes have pipe wrap.

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APPENDIX E. GLOSSARY OF TERMS

Achievable Potential: the amount of energy use that efficiency can realistically be expected to displace assuming the most aggressive program scenario possible (such as providing end-users with payments for the entire incremental cost of more efficient equipment). This is often referred to as maximum achievable potential. Achievable potential takes into account real-world barriers to convincing end-users to adopt efficiency measures, the non-measure costs of delivering programs (for administration, marketing, tracking systems, monitoring and evaluation, etc.), and the capability of programs and administrators to ramp up program activity over time.

Cost-effectiveness: a measure of the relevant economic effects resulting from the implementation of an energy efficiency measure. If the benefits outweigh the cost, the measure is said to be cost-effective.

Cumulative Annual: refers to the overall savings occurring in a given year from both new participants and savings continuing to result from past participation with measures that are still in place. Cumulative annual does not always equal the sum of all prior year incremental values as some measures have relatively short measure lives and, as a result, their savings drop off over time.

Demand Response: the ability to provide peak load capacity through demand management (load control) programs. This methodology focuses on curtailment of loads during peak demand times thus avoiding the requirement to find new sources of generation capacity.

Early Replacement: refers to an efficiency measure or efficiency program that seeks to encourage the replacement of functional equipment before the end of its operating life with higher-efficiency units

Economic Potential: the subset of the technical potential screen that is economically cost-effective as compared to conventional supply-side energy resources. Both technical and economic potential screens are theoretical numbers that assume immediate implementation of efficiency measures, with no regard for the gradual "ramping up" process of real-life programs. In addition, they ignore market barriers to ensuring actual implementation of efficiency. Finally, they only consider the costs of efficiency measures themselves, ignoring any programmatic costs (such as marketing, analysis, administration) that would be necessary to capture them.

Effective Useful Life (EUL"): the number of years (or hours) that the new energy efficient equipment is expected to function. Useful life is also commonly referred to as "measure life."

End-use: a category of equipment or service that consumes energy (e.g., lighting, refrigeration, heating, process heat).

Energy Efficiency: using less energy to provide the same or an improved level of service to the energy consumer in an economically efficient way. Sometimes "conservation" is used as a synonym, but that term is usually taken to mean using less of a resource even if this results in a lower service level (e.g., setting a thermostat lower or reducing lighting levels). This recognizes that energy efficiency includes using less energy at any time, including at times of peak demand through demand response and peak shaving efforts.

Free Rider: participants in an energy efficiency program who would have adopted an energy efficiency technology or improvement in the absence of a program of financial incentive.

Incremental: savings or costs in a given year associated only with new installations happening in year.

Market Characterization: refers to evaluations focused on the evaluation of program-induced market effects when the program being evaluated has a goal of making longer-term lasting changes in the way a market operates. These evaluations examine changes within a market that are caused, at least in part, by the energy efficiency programs attempting to change that market.

Measure: any action taken to increase efficiency, whether through changes in equipment, control strategies, or behavior. Examples are higher-efficiency central air conditioners, occupancy sensor control of lighting, and retro-commissioning. In some cases, bundles of technologies or practices may be modeled as single measures. For example, an ENERGY STAR™ home package may be treated as a single measure.

Megawatt ("MW"): a unit of electrical output, equal to one million watts or one thousand kilowatts. It is typically used to refer to the output of a power plant.

Megawatt-hour ("MWh"): one thousand kilowatt-hours, or one million watt-hours. One MWh is equal to the use of 1,000,000 watts of power in one hour.

Net-to-gross ("NTG") Ratio: a factor representing net program savings divided by gross program savings that is applied to gross program impacts to convert them into net program load impacts

Portfolio: either a collection of similar programs addressing the same market, technology, or mechanisms; or the set of all programs conducted by one organization.

Program: a mechanism for encouraging energy efficiency. May be funded by a variety of sources and pursued by a wide range of approaches. Typically includes multiple measures.

Program Potential: the efficiency potential possible given specific program funding levels and designs. Often, program potential studies are referred to as "achievable" in contrast to "maximum achievable."

Replace on Burnout ("ROB"): a fuel substitution measure is not implemented until the existing technology it is replacing fails. An example would be an energy efficient water heater being purchased after the failure of the existing water heater.

Retrofit: refers to an efficiency measure or efficiency program that seeks to encourage the replacement of functional equipment before the end of its operating life with higher-efficiency units (also called "early retirement") or the installation of additional controls, equipment, or materials in existing facilities for purposes of reducing energy consumption (e.g., increased insulation, low flow devices, lighting occupancy controls, economizer ventilation systems).

Technical Potential: the theoretical maximum amount of energy use that could be displaced by efficiency, disregarding all non-engineering constraints such as cost-effectiveness and the willingness of end-users to adopt the efficiency measures. It is often estimated as a “snapshot” in time assuming immediate implementation of all technologically feasible energy saving measures, with additional efficiency opportunities assumed as they arise from activities such as new construction.

Appendix C

Dunsky Energy Consulting
Fuel Substitution Report

FUEL CHOICE / SWITCHING AS AN ELECTRIC DEMAND SIDE MANAGEMENT STRATEGY

POLICY WHITE PAPER AND PLANNING GUIDANCE

A **DUNSKY ENERGY CONSULTING** REPORT

Philippe Dunsky, ***President***
Jeffrey Lindberg, ***Consultant***

For **NOVA SCOTIA POWER INCORPORATED**
Under the direction of Anne-Marie Curtis and Allison Fitzpatrick

February 25th, 2010

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TABLES

ACRONYMS

CNS:	Conserve Nova Scotia
CO2e:	Carbon dioxide equivalent
DHW:	Domestic hot water
DSM:	Demand-Side Management
E20 FS:	Electric-to-other-fuel fuel switching
E2G FS:	Electric-to-gas fuel switching
ENS:	Efficiency Nova Scotia
Hg:	Mercury
IRP:	Integrated Resources Plan
NC:	New Construction
NOx:	Nitrous Oxides
NSPI:	Nova Scotia Power Incorporated
O2E FS:	Other-fuel-to-electric fuel switching
PCT:	Participant Cost Test
PDWG:	Program Development Working Group
SCT:	Societal Cost Test
SO2:	Sulphur Dioxide
TRC:	Total Resource Cost Test
UARB:	Nova Scotia Utility and Review Board

EXECUTIVE SUMMARY

MANDATE

This report was commissioned by Nova Scotia Power (NSPI) to provide guidance on the treatment of fuel switching opportunities as part of electric demand side management (DSM) programs in Nova Scotia. Specifically, we were engaged by NSPI to provide five deliverables:

1. **Jurisdictional Review**: A review of nine North American case studies where E2O fuel switching opportunities have been formally considered;
2. **Framework for Analysis**: Recommendations regarding an appropriate framework for screening E2O fuel switching opportunities, including an initial, high level assessment of five fuels (natural gas, oil, propane, cordwood and wood pellets);
3. **Policy Guidance:** Guidance on specific, policy-related questions raised by fuel switching's unique characteristics;
4. **High-Level Approach**: A suggested approach to incorporating fuel switching opportunities into *current* DSM planning; and
5. **Stakeholder Engagement**: Guidance on engaging stakeholders with an interest in fuel switching opportunities.

Below we introduce the concept of fuel switching in Nova Scotia, and then proceed to summarize both the findings and recommendations contained in the body of the report.

AN INTRODUCTION TO FUEL SWITCHING IN NOVA SCOTIA

What Do We Mean by 'Fuel Switching'?

Fuel Switching refers to the replacement of equipment using one source of energy with equipment using a different source of energy to accomplish the same end use. This report focuses on fuel switching *away from electricity* towards other fuels – the goal being to reduce electricity loads –, and uses the generic term "electric-to-other" (E2O) fuel switching. For example, replacing an electric water heater with a gas-fired one is a form of E2O fuel switching. The term "fuel choice" is sometimes used to refer to new construction markets, where DSM programs are working to influence the *choice* of future fuels, rather than encouraging the replacement of an existing one, but we use the single term "fuel switching" for both purposes.

This report considers "switching" options to the following fuels: natural gas, heating oil, propane, cordwood and wood pellets. It does not consider demand side renewable electricity generation (e.g. small wind and solar), which NSPI treats as conventional DSM.

Why Is Fuel Switching of Interest?

Nova Scotia has set ambitious greenhouse gas emissions reduction targets, particularly for electricity generation. Meeting these and other air pollution reduction targets will require significant investments in new power generation, principally from wind farms and biomass combustion plants, as well as pollution control technologies.

Some of these new costs can be avoided by first *reducing electricity demand*, through investments in energy efficiency and other "demand side management" (DSM) strategies. This is why Nova Scotia has also adopted aggressive DSM targets, to be achieved by incentive programs and other strategies to influence market decisions. Alongside pure energy efficiency improvements, fuel switching away from electric heating is a complementary approach to reducing electric demand, and can thus contribute to meeting DSM goals.

How Significant Is the Fuel Switching Resource?

While exploring options for developing new analytical tools and designing new DSM programs, it is important to keep the *materiality* of the potential fuel switching resource in mind. A small potential resource may not be worth expending substantial effort to understand, whereas a substantial resource justifies further investigation

Navigant Consulting's recently completed residential potential study provides a basis for estimating the materiality of the potential resource.[1] Their results suggest that the achievable residential potential will begin at roughly eight (8) annual, incremental GWh in 2010 and scale up to over 30 GWh/year by 2016. For comparison, their forecasted residential savings level in 2013 (13 GWh) is equivalent to 4% of the total combined DSM plan target for that year.

Unlike improvements in energy efficiency, switching to other sources of heating can lead directly to new air emissions (from the new heating source). As a result, we undertook to estimate the approximate carbon emissions associated with the residential fuel switching resource identified by Navigant. Our initial assessment suggests that greenhouse gas emissions would be relatively insignificant: cumulative annual emissions of 27 kilotonnes of CO_2e after 10 years.[2] For comparison, this level of emissions is equivalent to roughly 1% of NSPI's emissions reduction target in 2020 relative to 2010 levels. Furthermore, this does not account for the emissions *reductions* that would occur if the fuel switching leads to a reduction in fossil-fuel based electric power generation.

In other words, our analysis suggests that fuel switching as an electric DSM strategy is worthy of further examination, given the *moderately significant* contribution it could make to achieving provincial DSM goals, and the *negligible* non-electric air emissions it could generate.

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[1] Although the potential study does not formally apply the 'robustness' criterion we propose in this report, the it nonetheless consists largely of measures (residential gas and cordwood retrofits) that we have identified as being robustly cost-effective. We also note that the commercial achievable potential may be significant.

[2] CO_2e = carbon dioxide equivalent, a typical measure of greenhouse gas warming potential.

How Can Nova Scotia Screen This Resource?

As with standard energy efficiency opportunities, pursuit of Nova Scotia's fuel switching opportunities requires the province's DSM Administrator to develop incentive programs and other strategies to encourage the market make decisions that differ from business-as-usual. However, designing these programs requires a framework for identifying which fuel switching opportunities are even worth pursuing at all.

Most jurisdictions that explicitly pursue fuel switching opportunities accomplish this by treating them the same way they treat other demand-side management opportunities, including energy efficiency: individual 'measures' are defined, and their potential savings and costs are calculated. Standard cost-effectiveness tests are then performed to screen measures and identify those whose overall benefits exceed their costs.[3] Once this screening is completed, market research helps determines if the market is already taking up those measures: if not, a program may be warranted; if so, a program may be unnecessary, or else screening results may be adjusted to account for the likelihood that only a portion of potential program participants would actually represent real savings beyond their own business-as-usual decisions.

Nova Scotia already has a well-developed framework for screening conventional DSM measures and designing and implementing programs. To take advantage of fuel switching opportunities, the province's DSM Administrator will want to adjust that framework to account for a few important differences between fuel switching and more conventional energy efficiency measures. In this report, we provide guidance on that framework, and use a version of it in conducting an initial screening of fuel switching opportunities.

The DSM Administrator will also want to work with government and other stakeholders on a few policy questions raised by this unique resource.

[3] A good example of a fuel switching measure would be replacing baseboard electric heating in an existing home with a gas furnace. Benefits would consist of the value of the avoided electricity consumption of the home well into the future. Costs would include removing baseboards, installing a furnace and duct work, annual maintenance costs, and the cost of new gas consumption. Depending on the environmental constraints or screening policies in place, the air emissions caused by the gas furnace (CO2 and other pollutants) may also be assigned a cost, just as the avoided power plant emissions might be assigned a benefit. All benefits and costs are calculated over the course of the 'measure life' – the number of years for which savings are considered, determined based on assumptions about the average life of the equipment and about how long the average household would have heated with baseboards without the program's intervention. Finally, all future streams of costs and benefits are typically "discounted" (using an agreed-upon discount rate) to effectively compare all benefits and costs on a common basis.

NOVA SCOTIA'S CURRENT DSM SCREENING FRAMEWORK

Nova Scotia's DSM framework is similar to that of many jurisdictions. In its 2007 Integrated Resources Planning process, a long-term planning exercise, NSPI identified DSM as the lowest cost option for meeting its environmental constraints (air emissions and renewable energy targets). This led to the adoption of an ambitious long term DSM target, and NSPI, as the current DSM Administrator, has been rapidly expanding DSM programs to reach this target.*

The UARB requires that a form of the Total Resource Cost (TRC) test be used to screen DSM measures and programs for cost-effectiveness. The table below summarizes the benefits and costs included in a complete TRC, with all benefits and costs typically calculated as net present values over the measures' lifetimes. Because some of these components matter more for fuel switching than for standard energy efficiency measures, and because Nova Scotia has historically focused only the latter, some of these components are not currently addressed in NSPI's and the UARB's version of the TRC. **These items, particularly important when considering fuel switching, are indicated below in bold.**

Components of a complete Total Resource Cost (TRC) test

BENEFITS	+ avoided electric supply costs + avoided baseline equipment purchase costs + avoided baseline equipment operation and maintenance + avoided environmental compliance costs **avoided other fuel supply costs**
COSTS	– measure purchase and installation costs – measure operation and maintenance costs – **increased other fuel supply costs** – **other fuel connection costs** – **other fuel environmental compliance costs**

* *By DSM Administrator, we refer to the organization responsible for designing and implementing ratepayer-funded electric DSM programs in the province. This role is currently filled by Nova Scotia Power, but will soon transfer to a recently created independent entity, Efficiency Nova Scotia.*

SUMMARY OF KEY DELIVERABLES

Below we summarize the findings of each of the five deliverables that were the focus of our work, namely: the jurisdictional review, the framework for analysis (including a high-level opportunity analysis of five fuel switching options across residential and commercial markets), guidance on select policy issues, and next steps (including a high-level approach for consideration in the current planning phase, and issues around stakeholder engagement) on the road toward pursuing the fuel switching opportunity.

Jurisdictional Review

To inform discussions about refinements to Nova Scotia's DSM frameworks and policy, we reviewed policies and frameworks adopted in twenty-one North American regions that have given consideration to fuel switching opportunities. We then prepared nine case studies, which we group into three categories:

✓ ***Considered and implemented***: Efficiency Vermont, New York State Energy Research and Development Agency, Puget Sound Energy (Washington State), Wisconsin Focus on Energy, and Efficiency New Brunswick.

× ***Considered and rejected***: Energy Trust of Oregon, Snohomish County Public Utility Department (Washington State).

~ ***Currently being considered***: BC Hydro, Northwest Power and Conservation Council.

Our review of the North American experience suggests that:

- **Fuel switching programs are relatively uncommon**: Many regions have simply not considered fuel switching opportunities. Others have considered them but rejected their pursuit, either due to a perceived lack of cost-effective opportunities, concerns about energy price volatility, or competitive issues between energy suppliers. A relative few have adopted fuel switching strategies, with some notable successes.

- **Most regions that pursue fuel switching treat it as a conventional DSM resource**: A strong majority use the same analytical framework and cost-effectiveness tests, with minor changes to reflect fuel switching's reliance on non-electric fuels.

- **CO2e is increasingly accounted for in program screening**: Most jurisdictions attributed a value to CO2e emissions, in anticipation of future regulation, for screening purposes.

- **Future energy price volatility is a concern**: One case study (Oregon) opted not to implement fuel switching programs in part because of concerns about the volatility of non-electric fuel prices. Others (Vermont and Wisconsin) addressed volatility via cost-benefit screening and prudent communications with potential participants.

These findings will help to inform our framework and policy recommendations.

Framework for Analysis

Our basic premise in proposing a framework for Nova Scotia is that fuel switching should be treated consistently with other DSM measures, except to the extent that it has unique features. Indeed, the fact that fuel switching involves the active promotion of other energy sources, rather than merely consuming electricity more efficiently, implies three unique considerations:

- **Fuel costs**: Whereas the cost of most energy efficiency measures is largely incurred at the outset, fuel switching involves both initial (equipment) *and* ongoing (fuel) costs.
- **Air emissions**: Whereas electrical energy efficiency has either no or incidental impact on a customer's emissions profile, fuel switching has a direct impact.
- **Risk**: Whereas electrical energy efficiency primarily eliminates electricity consumption, fuel switching encourages consumption of other fuels, many of which are more price volatile (e.g., natural gas) may even face periodic supply shortages (e.g., wood pellets).

These differences should to be accounted for when considering and screening fuel switching measures, when determining overall fuel switching targets, and when designing and implementing programs. Our framework discusses each of these issues and makes seven detailed recommendations, reproduced on the following page. These reflect four *broader* principles:

1. **Fuel switching targets are best determined through the IRP process.** As with energy efficiency, the integrated resource planning (IRP) process allows NSPI to compare all options and determine, at least in theory, the optimal portfolio of resources (including fuel switching) to balance supply and demand. This implies that the fuel switching potential be assessed[4], and that the study results be fed into the IRP process.[5]

2. **Screening of fuel switching opportunities should be consistent with other DSM.** Since the Total Resource Cost (TRC) test is currently used in the province for screening conventional DSM, the same test should apply to fuel switching opportunities, adjusted to account for areas of significant difference.

3. **Emissions from the new fuel must be accounted for.** Fuel switching programs involve the direct promotion of non-electric fuels, some of which have their own emissions profiles. In order to reflect the spirit of provincial regulations and policy drivers, these emissions should be accounted for in two ways: first, by calculating and valuing net emissions impacts in the measure screening process[6], and second, by ensuring that the program administrator (whether or not NSPI) includes those emissions in their reporting.

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[4] An "achievable potential study" will assess the size and cost of the province's achievable fuel switching resource.

[5] NSPI used its 2007 IRP process to identify optimal DSM levels. The subsequent 2009 IRP Update assumed a set level of energy savings from DSM programs.

[6] Emissions values can reflect NSPI's equivalent cost to control emissions, the cost of reductions via other strategies, or the social cost of air emissions themselves.

4. **Relative fuel price volatility and supply issues require a conservative approach.** Unlike conventional DSM, fuel switching exposes participants and society to new risks. Since cost-effectiveness is sensitive to fuel price forecasts, program administrators should be conservative both in determining which opportunities to pursue (screening) and in communicating with consumers (implementation).

SUMMARY OF FRAMEWORK RECOMMENDATIONS

IRP PROCESS

1) **Treat fuel switching distinctly (if possible).** If emissions generated from fuel switching are treated consistently with NSPI's direct emissions, as we recommend below, then the IRP process should ideally consider fuel switching opportunities distinctly from energy efficiency ones. If this is not practical, e.g. if the material impact (size) of these resources falls within the IRP error band, then the use of proxy emissions prices or values would be needed to ensure consistent integration of fuel switching within a single, overall DSM resource.

OTHER FUEL COSTS

2) **Include non-electric fuel costs**: Include non-electric fuel costs and associated connection costs in the TRC test for both conventional DSM and E2O FS measures. Costs should reflect long-run avoided costs, as with other DSM, to the extent possible.

AIR EMISSIONS

3) **Report net emissions from fuel switching efforts.** This is essential to ensuring clarity, transparency and accountability.

4) **Value non-electric emissions in cost-effectiveness screening,** but revisit this should non-electric fuel prices come to internalize compliance costs similar to NSPI's.

5) **Consider site energy and supplier-level upstream emissions only** when calculating fuel switching emissions, to ensure consistency with electric emissions accounting (standard EPA multipliers may serve as a reasonable proxy for Nova Scotia's analytical purposes). This implies disregarding broader life-cycle emissions impacts, at least until such time as a similar approach is used for NSPI emissions.

ADDRESSING RISK

6) **Be Conservative.** The DSM Administrator should use sensitivity analyses to determine the robustness of fuel switching measure cost-effectiveness under a variety of price forecasts, and only implement programs that are robustly cost-effective from both the societal and participant perspectives. Program communications should also explicitly address these concerns.

7) **Be Dynamic:** The Administrator should carefully monitor market conditions when planning and implementing fuel switching programs, and be ready to adjust incentive levels or eliminate programs should market conditions change significantly.

Policy Guidance

We provide policy guidance on five interrelated issues, of which two are especially relevant.

- **The Two-Way Street Concept**: Heritage Gas will eventually engage in DSM efforts, and the provincial government already does so for non-electric fuels, via Conserve Nova Scotia. To ensure consistency, all DSM efforts for non-electric fuels should give some consideration to cost-effective fuel switching *towards* electricity, using a similar framework as that proposed for electric DSM.

  That said, we are not aware of significant available, cost-effective opportunities.

- **Cost-Sharing**: While not essential to the pursuit of cost-effective fuel switching as an electric DSM measure, there exists mutually beneficial opportunity for cost sharing with Heritage Gas and/or with unregulated energy suppliers. Indeed, the UARB could require contributions from Heritage Gas to the extent that natural gas ratepayers benefit from fuel switching toward that energy source. Similarly, the provincial government could require unregulated energy suppliers to contribute where they and/or their existing customers may benefit from similar measures. The provincial government could also contribute where additional societal benefits are present.

  We underscore, however, that the DSM Administrator should pursue robustly cost-effective fuel switching opportunities regardless of others' contributions.

Movement on both of these issues may involve engaging government to obtain policy direction.

WHERE ARE THE FUEL SWITCHING OPPORTUNITIES?

While not the focus of this mandate, Dunsky Energy Consulting conducted a simplified, preliminary assessment of opportunities for fuel switching to a variety of energy sources, for both space and water heating, in both residential and commercial markets. The table below summarizes the results. **Note that this analysis could be supplanted by the results of Navigant Consulting's Achievable Potential Study.**

	GAS	OIL	PROPANE	CORDWOOD	WOOD PELLETS
COST-EFFECTIVENESS	**SPACE / WATER HEAT: robust for all markets**	No opportunity		**SPACE HEAT: robust for residential**	**SPACE / WATER HEAT: - Robust for commercial markets** - Long term resid. opp. if prices improve
MARKET OPPORTUNITY	**- Retrofit opportunity** - NC may already be transformed	Little interest	Unknown	Realistic residential opp may be severely limited – TBD	**- Commercial appears to have potential** - Res. NC may eventually have potential
RISK	Reliable supply, but price volatility			Reliable, stable price	**Shifting market: reliability, price TBD**
POLICY ISSUES	**Economic development benefit**	Air quality issues	Unknown	**Air quality issues, Econ. dev't benefit**	**Economic development benefit**
OVERALL POTENTIAL	✓ **Retrofit market**	Low	Low	? **Consider** dual-fuel* in Resid.	✓ **Commercial markets** ? **Consider** in Res NC

DHW: *Domestic Hot Water; NC: New Construction market; Res: residential; Opp: Opportunity.*
Dual-fuel: *partial replacement of electric load, for example by installing a wood stove in conjunction with electric heating.*

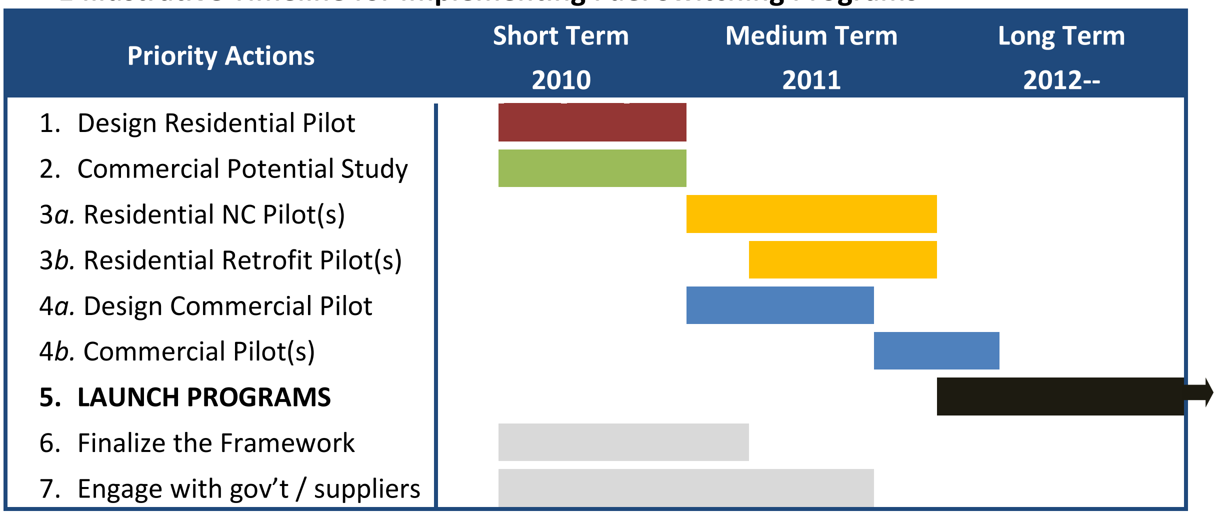
As we can see, the primary opportunities involve fuel switching toward natural gas (retrofit market), wood pellets (commercial markets, possibly residential in the future) and, in theory at least, cordwood (residential dual fuel markets, though the real market opportunity remains unclear). Fuel switching opportunities *specific to* water heating were not, in and of themselves, found to be robustly cost-effective, aside from some natural gas applications.

Finally, it is worth noting that in a number of cases, air-source heat pumps, while not explicitly covered by the scope of this mandate, were found to be similarly cost-effective. In particular, they may be of interest to the residential new construction market, where the use of central heating ensures homes are "future-ready" – able to integrate renewable heat options as they become more competitive. The current DSM Administrator is already addressing this opportunity with targeted incentives; should electric baseboard heating retain a significant market share of new construction, more aggressive measures may need to be considered.

High Level Approach

We considered the steps that the DSM Administrator could take in order to integrate fuel switching opportunities into future DSM plans, and provided recommendations for the short (2010), medium (2011) and long terms (2012 and beyond). These recommendations include seven priority actions, as illustrated in the chart below.

1 Illustrative Timeline for Implementing Fuel Switching Programs



The timeline above is illustrative, and assumes that action can begin as of the second quarter of 2010. Engagement on the last two issues in particular is not fully under the control of the DSM Administrator. The individual steps are explained in further detail in the body of this report, but nor are they essential to launching fuel switching programs.

Stakeholder Engagement

Although Nova Scotia possesses well-developed stakeholder engagement processes for DSM planning, fuel switching impacts on at least two additional categories: government and non-electric energy suppliers. Fuel switching is affected by, and may impact provincial policies in several areas, notably: air quality and climate change strategies; energy policy; economic development; and non-electric DSM activities. Energy suppliers have the potential to play a significant role in E2O FS, both as collaborators and co-funders. We provide a list of potential stakeholders and suggest two possible approaches to group discussions with fuel switching stakeholders:

- **An enlarged PDWG**: The existing DSM Program Development Working Group could be expanded for special sessions to discuss fuel switching issues.
- **A standalone committee**: The DSM Administrator could develop a standalone committee to discuss fuel switching issues.

CONCLUSION

Fuel switching away from electricity to other energy sources has the potential to be an important component of Nova Scotia's electric DSM portfolio. Although it has unique aspects, it has been successfully screened and/or implemented in a number of other regions using standard DSM cost-benefit methodologies and program design strategies.

The same approaches can be used to integrate fuel switching into the province's efforts to move towards a cleaner, more efficient energy economy. We believe the framework for analysis and high level approach proposed here can form a solid basis for moving forward on this opportunity.

INTRODUCTION

CONTEXT

Nova Scotia Power, Inc. (NSPI) is a vertically-integrated electric utility supplying over 97% of Nova Scotia's electricity needs. It is regulated by the Nova Scotia Utility and Review Board (UARB). In recent years, NSPI has developed an aggressive demand side management (DSM) plan that aims to achieve energy savings roughly equivalent to 2% of total demand each year over the next twenty-five years.

Recently, the Nova Scotia government passed legislation to establish an independent administrator for electric DSM programs, Efficiency Nova Scotia (ENS). ENS is to be established as of March 31st, 2010. The exact timeline for the transition of responsibility for DSM programs from NSPI to ENS is unclear, but will likely occur in 2010. For simplicity's sake, this paper uses the term "DSM Administrator" to refer to both NSPI in its current role and ENS in its future role.

To date, DSM plans have largely not considered 'fuel switching' DSM measures.[7] Fuel switching, also known as fuel substitution or fuel choice, refers to the replacement of electric equipment with efficient non-electric technologies in order to reduce electric consumption and/or load. This report uses the term "electric-to-other-fuel fuel switching" ('E2O FS') to refer to this concept.

The issue of E2O FS was raised during NSPI's 2010 DSM Plan application. The UARB's

What Do We Mean By "Fuel Switching"?

Fuel Switching refers to the replacement of equipment using one source of energy with equipment using a different source of energy to accomplish the same end use. For example, replacing an electric water heater with a gas-fired water heater is electric-to-gas fuel switching ("E2G FS" in this report); converting a heating oil-fired furnace to an electric air-source heat pump is an example of oil-to-electric fuel switching ("O2E FS"). This report focuses on fuel switching *away from electricity* towards other fuels – the goal being to reduce electricity loads –, and uses the term "electric-to-other-fuel fuel switching", or "E2O FS".

The term "fuel choice" is sometimes used to refer to new construction markets, where DSM programs are working to influence the *choice* of future fuels, rather than encouraging the replacement of an existing option.

This report uses the term fuel switching interchangeably for both existing and new construction markets, and considers E2O FS to the following fuels: natural gas, heating oil, propane, cordwood and wood pellets. It does not consider demand side renewables (eg. wind, solar, geothermal), which Nova Scotia treats as conventional DSM and which are specifically outside the scope of our mandate.

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[7] One exception is an incentive for residential air source heat pumps in new construction, which provides higher incentives for heat pumps with non-electric back-up heating sources.

consultant, Dr. Nichols, suggested that a study be undertaken to:

"…determine whether or not significant opportunities exist in Nova Scotia to encourage using efficient non-electric technologies in lieu of electric technologies in existing or new construction…at a minimum the residential market should be addressed…"

The Board agreed and subsequently ordered that NSPI, as the DSM Administrator, "study the consideration of the use of fuel choice…to be undertaken now so that its results can be considered in the 2011 DSM Plan".

MANDATE

NSPI has undertaken two projects to respond to this direction. Firstly, it has engaged Navigant Consulting (formerly Summit Blue) to conduct a residential E2O FS potential study. Secondly, it has commissioned our firm, Dunsky Energy Consulting (DEC), to provide guidance on the appropriate use of fuel switching strategies in DSM Plans.

Specifically, our mandate consists of five interrelated deliverables:

1. **Jurisdictional Review**: A summary of policy experience and current practices in other jurisdictions, focusing in particular on nine case studies.

2. **Analytical Framework and Initial Screening:** A framework for analyzing E2O FS efficiency opportunities, including specific guidance on DSM cost-effectiveness tests, the treatment of externalities, and the timeframe for analysis. This deliverable also includes a preliminary, high-level cost-effectiveness screening and analysis of a variety of fuel switching opportunities.

3. **Policy Guidance**: A discussion of specific policy issues raised by E2O FS, notably cost-sharing, fuel switching from non-electric fuels towards electric end-uses, and the need for government policies and/or guidance.

4. **High-Level Approach**: A high-level strategy for phasing fuel choice/switching strategies, where appropriate, into DSM planning via pilots, further study, and full programs, including a timeline allowing for post implementation review, optimization and regulatory engagement.

5. **Stakeholder Engagement**: Guidance on engaging key Nova Scotian stakeholders, and on understanding the relevance of fuel choice/switching from their perspectives.

CONSULTATIONS

This report takes into account the results of individual interviews with NSPI staff and external stakeholders, as well as feedback from the DSM Program Development Working Group (PDWG) and an internal NSPI team. **It is, however, an independent analysis and does not necessarily reflect the views of NSPI or stakeholders.**

Internal NSPI interviews:

- Bob Boutilier, Director, Regulatory Affairs
- Anne-Marie Curtis, Director, Conservation and Energy Efficiency
- Allison Fitzpatrick, Project Manager, Conservation and Energy Efficiency
- Nicole Godbout, Regulatory Counsel
- Lia MacDonald, Director, Planning and Performance
- Terry Toner, Director, Environmental Services

Stakeholder interviews:

- Allan Crandlemire, Executive Director, Conserve Nova Scotia
- Gordan Dickie, General Manager, Shaw Resources
- Ray Ritcey, President, Heritage Gas

Program Design Working Group Conference Call participants:

- Anne-Marie Curtis, Director, Conservation and Energy Efficiency, NSPI
- Mel Whalen, President, Multeese Consulting (Chair)
- Nancy Brockway, Principal, NBrockway & Associates, representing consumers
- Albert Dominie, Consultant, representing the Municipal Electric Utilities of Nova Scotia Cooperative
- Blair Hamilton, Policy Director, Vermont Energy Investment Corporation (Consultant to the PDWG)
- James McDuff, Associate, McInnis Coopers Lawyers, representing industrials
- Cheryl Ratchford, Energy Coordinator, Ecology Action Centre
- John Aguinaga, Manager, Conservation and Energy Efficiency, NSPI
- Nicole Cadek, Project Coordinator, Conservation and Energy Efficiency, NSPI

While we have benefitted tremendously from the thoughts, consideration and input of all of the people who kindly discussed these issues with us, **our findings, conclusions and recommendations are solely the responsibility of Dunsky Energy Consulting.**

JURISDICTIONAL REVIEW

INTRODUCTION

To inform the framework and policy guidance provided in this report, we conducted a review of E2O FS policies in other jurisdictions, focusing on nine case studies. Case studies were drawn from jurisdictions that had seriously considered E2O FS, with the goal of ensuring a mix of jurisdictions having adopted and not adopted E2O FS, as well as a mix of Canadian and U.S. cases.

The nine case studies are presented in the table below.

2 Case Studies - Status

Jurisdiction	E2O FS Considered and Implemented	E2O FS Considered, Not Implemented	E2O FS Under Consideration
Efficiency New Brunswick (ENB)	✓		
Efficiency Vermont (EVT)	✓		
New York State Energy Research and Development Agency (NYSERDA)	✓		
Puget Sound Energy (PSE)(Washington)	✓		
Wisconsin Focus on Energy (FoE)	✓		
Energy Trust of Oregon (ETO)		✓	
Snohomish County Public Utility Department (SCPUD)(Washington)		✓	
BC Hydro			✓
Northwest Power and Conservation Council (NPCC)			✓

Although the majority of our case studies have implemented some form E2O FS, this is not the case for North America as a whole. Most jurisdictions with active DSM programs do not currently have E2O FS in place. Some have simply not considered it; other have considered it but found little or no opportunity; and others have chosen to not implement cost-effective E2O FS programs for other reasons, most commonly to do with equity and competitive issues.

Beyond our nine case studies, we are also aware of twelve other jurisdictions having considered E2O FS, presented in the table below.

Jurisdiction	E2O FS Planned or In Place	E2O FS Considered, Not Implemented	E2O FS Raised, Not Seriously Considered
California[NC]	✓		
Rhode Island⧫	✓		
Ontario[NC]	✓		
District of Columbia⧫		✓	
Kansas⧫		✓	
Maryland⧫		✓	
Oklahoma⧫		✓	
Pennsylvania⧫		✓	
Quebec*		✓	
Virginia ⧫		✓	
Connecticut*			✓
Massachusetts*			✓

*NC: Based on prior Navigant Consulting research; ⧫: based on other sources; *jurisdiction contacted.*

For each case study, we reviewed available program documentation and conducted interviews with government or utility representatives whenever possible. Our focus was on understanding six issues, all of which are related to the framework and policy guidance described later in this report:

1. Drivers and context for considering E2O FS
2. Treatment of E2O FS relative to treatment of conventional DSM
3. Treatment of air emissions (context, treatment, calculation, valuation)
4. Treatment of price volatility and participant risk
5. Cost-sharing
6. Other-fuel-to-electric fuel switching (O2E FS)

Trends from the nine jurisdictions are summarized for each of the six issues in separate sections below, followed by more detailed summaries of each case study. Note that answers to all six questions were not available for all case studies, and for the New York State Energy Research and Development Agency (NYSERDA) in particular.

DRIVERS AND CONTEXT

The table below summarizes the drivers and context behind each of our nine case studies' interest in fuel switching. These drivers are often critical to the choices they have made.

3 Case Studies - Drivers and Context

	Type of Organization	Funding	E2O FS Driver	Programs in Place
ENB	Government agency targeting all fuels DSM	Gvt	Provincial directive within greenhouse gas plan; otherwise fuel neutral	Limited –res. new construction only
EVT	Third-party electric DSM provider	ratepayer	DSM strategy	All opportunities targeted, mix of res and comm.
NYSERDA	Government agency, electric & gas DSM	ratepayer	DSM strategy (presumed)	Appears limited
PSE	Electric & gas IOU*	ratepayer	DSM strategy	Res. Programs in place, comm. programs planned.
FoE	Third party electric& gas DSM provider	ratepayer	DSM strategy	All opportunities targeted, mix of res and comm.
ETO	Third party electric& gas DSM provider	ratepayer	Fuel neutral due to price volatility, practical constraints	None
SCPUD	Electric public utility	ratepayer	DSM strategy	None
BC Hydro	Electric crown utility	ratepayer	DSM strategy	None
NPCC	Regional electric planning body	NA	DSM within regional IRP process	NA

**IOU: Investor-owned utility*

Key findings:

E20 FS is principally considered as a conventional DSM measure. In seven of nine case studies, the driver for considering E2O FS is electric energy conservation. The exception is Efficiency New Brunswick, which has adopted a fuel neutral policy for practical reasons to do with energy supplier equity concerns, but was directed by the provincial government to incent non-electric systems in residential new construction as a greenhouse gas mitigation strategy. The Energy Trust of Oregon also sees E2O FS as a DSM measure, but is fuel neutral in part because of its need to work with multiple energy suppliers.

E2O FS TREATMENT RELATIVE TO CONVENTIONAL DSM

The table below summarizes the treatment of conventional DSM and E2O FS by each of our nine case studies for easy comparison.

4 Case Studies - Treatment of E2O FS

	Conventional DSM	E2O FS	Inclusion of non-electric fuel costs
ENB	Reliance on federal analysis, informal SCT screening	None - Measures included due to provincial GHG plan	NA
EVT	SCT + ~10% environmental adder , ~5% risk adder	SCT + ~10% adder	yes
NYSERDA	TRC	TRC	yes
PSE	TRC +10% DSM adder	TRC +10% DSM adder	yes
FoE	SCT	SCT	yes
ETO	SCT and UCT	None	yes
SCPUD	TRC +10% environmental adder	TRC + 10% environmental adder	yes
BC Hydro	TRC (50% adder for potential)	TRC	yes
NPCC	TRC	TRC	yes

TRC: Total Resource Cost Test; SCT: Social Cost Test; UCT: Utility Cost Test

Key findings:

E2O FS is treated as per conventional DSM: With the exception of ENB and ETO, all case studies use consistent cost-effectiveness testing for DSM and E2O FS. The only notable differences are in Vermont and British Columbia, where adders reflecting the value of DSM relative to future non-electric fuel price instability are not included when screening E2O FS.

Non-electric fuel costs are included: All seven case studies using cost-effectiveness screening tests took the standard approach to calculating non-electric fuel costs within the TRC and SCT tests. Non-electric fuel costs were calculated using energy supplier costs and discount rates.

TREATMENT OF AIR EMISSIONS

The table below summarizes the treatment of air emissions by each of our nine case studies for easy comparison.

5 Case Studies - Air Emissions

	Air Emissions (primarily CO2e)	Life Cycle E2O FS Emissions Treatment
ENB	CO2e unquantified driver for government-mandated E2O FS	NA
EVT	Generic environmental adder; have had separate adders per non-electric fuel in the past; approach under review	Site emissions (for reporting purposes)
NYSERDA	CO2e measured but no value attributed	Site emissions (reporting purposes)
PSE	CO2e and other emissions valued using anticipated state policy costs	Site emissions
FoE	CO2e @ $50/tonne	Site emissions
ETO	Unknown	NA
SCPUD	CO2e @ $10/tonne plus generic 10% DSM adder	Site emissions
BC Hydro	Not considered in TRC (may change in future IRPs); provincial CO2e plan significant factor in E2O FS discussions	Site emissions
NPCC	CO2e @ $0-$100/tonne value, $47 average	Site emissions

Key findings:

CO2e increasingly valued in cost-effectiveness tests: Utilities and DSM agencies are increasingly moving from the use of generic environmental adders towards specific values for CO2e, based on either market forecasts of compliance costs, or estimates of societal CO2e impacts.

E2O FS emissions calculated according to site emissions: Where considered, E20 FS emissions were calculated according to site-level emissions, with energy supplier and extraction/refinement/transportation emissions not considered.

PRICE VOLATILITY AND PARTICIPANT RISK

The table below summarizes the treatment of price volatility by each of our nine case studies for easy comparison.

6 Case Studies - Price Volatility

	Approach
ENB	Not considered – fuel switching is government mandated
EVT	Program auditors will only recommend measures that pass both the TRC and the PCT by a significant margin. TRC test for E2O FS also excludes a reliability benefits adder normally included for DSM. Potential risks are discussed with participants.
NYSERDA	Unknown.
PSE	Not seen as an issue because gas-fired generation is the dominant resource affecting electricity prices.
FoE	Volatility not considered in measure screening. Potential risks are discussed with participants.
ETO	Volatility and participant risk are prime drivers of ETO's fuel neutrality policy.
SCPUD	Not considered because no E2G FS measures past the initial economic screening process, but SCPUD would take it into account in future program design should E2G FS measures pass cost-benefit tests.
BC Hydro	Potential study used 50% adder on avoided costs for all DSM measures *except* E2O FS, to reflect uncertainties in future supply costs. BC Hydro was conservative in its assumptions re participant willingness to consider E2O FS, because of price volatility.
NPCC	Not considered.

Key findings:

Volatility is a significant issue: Price volatility is considered in some way by most jurisdictions for which we have information.

Strategies focus on project level: EVT and FoE are the two case studies that both implement E2O FS and consider price volatility. In both cases, their strategy focuses on informing customers of the potential impacts of price volatility or supply issues.

COST-SHARING

The table below summarizes the treatment of cost-sharing by each of our nine case studies for easy comparison.

7 Case Studies - Cost-Sharing

	Approach
ENB	NA – all ENB programs are government funded.
EVT	None. EVT will consider any existing E2O FS subsidies offered by other energy suppliers when setting its own incentive levels, but has not negotiated with energy suppliers or government re cost sharing. It pursues all cost-effective E2O FS regardless of contributions from other energy suppliers.
NYSERDA	Unknown.
PSE	Gas funds are used to pay for connection costs.
FoE	Electric and gas utility funds are not broken out at measure or program level. There is no cost sharing in place with wood and oil suppliers.
ETO	NA – no programs in place.
SCPUD	Not considered because no E2G FS measures passed the initial economic screening process.
BC Hydro	NA – no programs in place.
NPCC	NA – regional IRP planner.

Key findings:

There appears to be no clear model for cost sharing. None of our case studies provide a clear model for cost sharing in the Nova Scotian context. EVT, as an electric-only DSM provider, comes the closest to Nova Scotia's current and future context, but has no cost-sharing in place.[8]

[8] Note that Efficiency Nova Scotia has the possibility of eventually administering both electric and non-electric DSM programs, a dual role also recently taken on by Efficiency Vermont.

OTHER-FUEL-TO-ELECTRIC FUEL SWITCHING (O2E FS)

The table below summarizes the treatment of O2E FS by each of our nine case studies for easy comparison.

8 Case Studies - O2E FS

	Approach
ENB	Not formally considered. ENB is fuel neutral outside of its government GHG reductions mandate, which only addressed E2O FS.
EVT	No programs in place; we are not aware of any specific policies on O2E FS.
NYSERDA	Unknown.
PSE	Not considered because of presumed lack of opportunity.
FoE	Gas-to-electric FS in place where cost-effective (limited industrial measures)
ETO	None due to fuel neutral policy.
SCPUD	NA – electric utility
BC Hydro	No gas-to-electric FS in place; we are not aware of specific policies on their inclusion in gas DSM programs.
NPCC	NA – mandate only extends to electric resource planning

Key findings:

Little O2E FS in place: Of our nine case studies, only Focus on Energy currently includes O2E FS in its gas DSM programs.

ANALYTICAL FRAMEWORK

INTRODUCTION

This paper looks at the question of how Nova Scotia's electric demand-side-management (DSM) Administrator should evaluate E2O FS as a DSM measure, including in the context of NSPI's least-cost, integrated resource planning process.

Our basic premise in developing this framework is that E2O FS should be treated consistently with other DSM measures (primarily energy efficiency), except to the extent that it has unique features that set it apart from other DSM.

This leads to three key questions:

1. How does the DSM Administrator currently treat DSM measures?
2. How does E2O FS differ from conventional DSM?
3. What changes, if any, should be made to the existing DSM framework to appropriately consider E2O FS?

HOW SIGNIFICANT IS NOVA SCOTIA'S E2O FS POTENTIAL?

A key consideration when developing our analytical framework has been the approximate size of the E2O FS resource in the province. For example, if the resource is very likely to be small, then it may not make sense to invest substantial effort into developing analytical inputs, and proxy values may be sufficient. On the other hand, if E2O FS is a significant potential source of savings, more effort is warranted.

Navigant Consulting's recently completed residential potential study provides a basis for estimating the materiality of the potential resource. Their results suggest that the achievable residential potential will begin at roughly eight (8) annual, incremental GWh in 2010 and scale up to over 30 GWh/year by 2016. For comparison, their forecasted residential savings level in 2013 (13 GWh) is equivalent to 4% of the total combined DSM plan target for that year.

Unlike improvements in energy efficiency, switching to other sources of heating can lead directly to new air emissions (from the new heating source). As a result, we undertook to estimate the approximate carbon emissions associated with the residential fuel switching resource identified by Navigant. Our initial assessment suggests that greenhouse gas emissions would be relatively insignificant: cumulative annual emissions of 27 kilotonnes of CO_2e after 10 years. For comparison, this level of incremental annual emissions is equivalent to roughly 1% of NSPI's emissions reduction target in 2020 relative to 2010 levels. Furthermore, this does not account for the emissions *reductions* that would occur if the fuel switching leads to a reduction in fossil-fuel based electric power generation.

HOW DOES NOVA SCOTIA CURRENTLY TREAT DSM MEASURES?

NSPI, in consultation with stakeholders, determined the appropriate level of DSM to pursue within its 2007 Integrated Resources Plan (IRP) process, which considered achievable DSM opportunities alongside supply-side resources. The cost and size of the achievable DSM resource in the province was identified via a potential study. The DSM Administrator develops annual DSM plans that aim to achieve the DSM savings levels identified by the 2007 IRP. DSM plans are approved by the UARB, and must demonstrate that programs and individual measures meet standard cost-effectiveness tests. The “Total Resource Cost” (TRC) test is used to screen both individual measures and programs.

THE IRP PROCESS

Integrated Resource Planning, or IRP, is a comprehensive planning process whose goal is to develop a robust portfolio of investments to balance supply and demand at the least cost (and risk) for society. To this end, IRP notably seeks to ensure treatment of both supply- and demand-side options on a level playing field, and typically takes a long-run planning perspective.

NSPI developed its first full Integrated Resources Plan in 2007, in collaboration with the UARB and in consultation with stakeholders. An updated IRP was completed in November 2009. In both cases, the IRP “forms the foundation for the Company's future investment decisions”, and informs the UARB and stakeholders on the broader planning context behind specific capital projects. It is, however, a strategic exercise rather than a prescriptive one, with all tactics presented in the action plan requiring formal application to the UARB.

The 2007 IRP considered three scenarios for achievable DSM, based on an energy efficiency potential study developed by its DSM consulting team, Navigant Consulting. The 2007 IRP adopted the most ambitious option, which led to an effective DSM target equal to roughly 2% of total demand annually. This DSM target has essentially been maintained as an input in the 2009 IRP update and is used as the basis for DSM filings, most recently the 2010 DSM Plan.

It is unclear at this date how appropriate levels of DSM will be identified in the future. We assume that the UARB will require the future DSM Administrator to either submit multiple DSM scenarios to subsequent NSPI IRP processes, or simply require the Administrator to obtain the maximum level of achievable, cost-effective DSM.

NSPI's ENVIRONMENTAL CONSTRAINTS

As with any utility, NSPI's IRP seeks to identify the least-cost long-term solutions for meeting customer needs. In NSPI's case, these solutions must also prove optimal within the confines of a series of environmental policy constraints, namely:

Renewable Energy Requirements

- *Incremental Requirements:* The province adopted legislation in 2007 setting out minimum targets for electricity generation of new (post-2001) low-impact renewable generation sources:
  - 5% of sales as of 2010 (in-province, independent power producers; subsequently revised to 2011)
  - 10% of sales as of 2013 (NSPI and independent power producers)
- *Cumulative Targets:* The provincial government has set out an overall target for renewable energy that 25% of Nova Scotia's energy will be supplied by renewable energy in 2015, in this case including existing (pre-2001) renewable sources.
- *Longer-term Targets:* It is possible that the province may increase the RES and overall goals. The 2009 IRP base case assumes that RES targets will increase to 12% in 2016 and 14% in 2019 of post-2001 generation.

Greenhouse Gas Emissions Caps

- *Current Caps:* The province adopted legislation in 2009 setting hard caps for GHG emissions by electricity generators in the province for 2010-2020. The following caps apply to all facilities (NSPI represents over 97% of electricity generation in the province).

Greenhouse Gas Emissions Caps

Compliance Period	Cumulative annual Cap (Mt CO2e)	Equivalent Annual Cap (Mt CO2e/yr)
2010-2011	19.22	**9.61**
2012-2013	18.50	**9.25**
2014-2016	26.32	**8.77**
2017-2019	24.06	**8.02**
2020	7.50	**7.50**

- *Future Targets:* The province is likely to increase the stringency of hard caps post 2020. The federal government is also likely to implement a cap-and-trade emissions trading scheme nationally as of 2011 or 2012. The 2009 IRP Update therefore assumes in its Base Case that the current utility cap continues to drop to 5.9 million tonnes CO2e in 2030.

Other Emissions Caps

- *Current Caps*: Provincial air quality regulations have set escalating reductions caps for NSPI's SO2, NOx and Hg emissions.
- *Future Targets*: The IRP assumes significant additional targets for each pollutant.

All of these constraints are considered in the resource planning process, and impact the resulting plan. In particular, they lead to a gradual 'greening of the grid', with future resource additions and increments having lower if any emissions impacts compared to than current mix.

HOW DOES E2O FS DIFFER FROM CONVENTIONAL DSM?

E2O FS measures are in many ways similar to conventional DSM measures. The DSM program uses incentives and other strategies to convince end-users to adopt cost-effective technologies that result in reduced electricity consumption and electric load. There are four main differences between E2O FS and conventional DSM:

- Increases in non-electric fuel consumption
- Associated environmental impacts (air emissions)
- Implications for non-electric energy suppliers
- Additional implications for participants (price volatility)

The first two differences in some ways make E2O FS more analogous to supply-side resources, as is illustrated in the table below:

Cost Components of Supply- and Demand-Side Resources

	Supply-Side (e.g. Gas Plant)	**DSM 1: E2O FS** (e.g. Gas Furnace)	**DSM 2: Efficiency** (e.g. CFL bulbs)
CAPITAL	Power Plant cost	Furnace incr. cost	CFL incr. cost
FUEL	Fuel Costs	Fuel Costs	---
EMISSIONS	Plant Emissions	Measure Emissions	---

INCREASES IN NON-ELECTRIC FUEL CONSUMPTION

Most conventional DSM measures simply reduce electric use, although some measures can cause incidental increases or decreases in non-electric fuel uses.[9]

E2O FS, however, can cause substantial and *direct* increases in non-electric fuel consumption. These increases – and associated costs and risks (price volatility, security of supply) should be taken into account when screening E2O FS measures.

[9] For example, using compact fluorescent lighting (CFLs) in an oil-heated home reduces the waste heat emitted by conventional incandescent bulbs, thereby slightly increasing oil consumption.

ASSOCIATED AIR EMISSIONS

Unlike conventional energy efficiency measures, DSM strategies aimed at increasing the use of non-electric fuels leads to associated emissions of environmental pollutants. To the extent the province seeks to minimize air emissions, these should also be considered in any analysis of the relative costs and benefits of E2O opportunities.

IMPLICATIONS FOR NON-ELECTRIC ENERGY SUPPLIERS

E2O strategies raise several important policy issues, considered in our Policy Guidance section on page 61.

IMPLICATIONS FOR PARTICIPANTS

Unlike conventional DSM, E2O FS exposes participants to uncertainty around future non-electric energy prices relative to electricity. We discuss this issue on page 39.

HOW CAN THE DSM ADMINISTRATOR SCREEN E2O MEASURES?

We believe that E2O FS can largely be screened using Nova Scotia's existing DSM framework, with a few important nuances:

1. **The use, if practical, of separate E2O FS scenarios in the IRP process**
2. **The inclusion of other fuel costs in the Total Resource Cost (TRC) test**
3. **Several issues relating to air emissions:**
   a. Their treatment relative to NSPI emissions targets
   b. Calculating net emissions
   c. Valuing emissions

Because E2O FS involves a long term switch to other fuel sources, however, it must include an important additional step beyond the DSM framework:

4. **Explicitly considering risks posed by price volatility and supply adequacy.**

Below we expand on each of these issues.

IRP SCENARIOS

As discussed, NSPI's 2007 IRP process considered three DSM energy and demand savings scenarios. Each DSM scenario was treated as a demand-side resource in the model, to be compared against new generation options.[10]

The achievable E2O FS potential, once identified, could be considered as a measure within the DSM scenario. However, E2O FS is different than energy efficiency measures in that it generates direct air emissions. We make the argument below that these emissions should be treated consistently with NSPI emissions when screening E2O FS and identifying optimum targets (see page 35).

Because managing total NSPI emissions is a principal driver in the IRP process, a theoretical approach to identifying E2O FS levels in future IRPs would be to develop separate scenarios for each E2O FS fuel. Each scenario could then be treated as a separate alternative to generation resources.

However, practical limitations in the IRP software may make this difficult – resources with relatively small absolute levels of emissions cannot be effectively evaluated. For example, in the

[10] Based on the DSM levels selected in the 2007 IRP, the 2009 IRP Update assumed two percent energy savings per year across all resource plans.

2009 IRP process, an E2O FS resource with an annual emissions profile less than 100 kT of CO2e would have had so little impact on total emissions that it would have been effectively treated as a zero-emissions resource. Given that the annual achievable E2O FS resource may fall well under this threshold, separate E2O FS scenarios may not be useful for future IRPs. In this case, NSPI could include E2O FS in DSM scenarios for future IRPs, and account for the impact of E2O FS emissions by pricing emissions, as discussed on page 36.

RECOMMENDATION:

1) **Treat fuel switching distinctly (if possible).** If emissions generated from fuel switching are treated consistently with NSPI's direct emissions, as we recommend below, then the IRP process should ideally consider fuel switching opportunities distinctly from energy efficiency ones. If this is not practical, e.g. if the material impact (size) of these resources falls within the IRP error band, then the use of proxy emissions prices or values would be needed to ensure consistent integration of fuel switching within a single, overall DSM resource.

OTHER FUEL COSTS

As outlined on the following page, under the standard Total Resource Cost (TRC) test methodology, non-electric fuel costs (specifically the non-electric fuel supplier's avoided costs) are included in the overall cost of DSM resources. Avoided costs are used rather than rates because the TRC test measures cost-effectiveness from the perspective of all ratepayers as a group. Similarly, network connection costs (in the case of gas) must also be treated as costs, again from the perspective of the fuel energy supplier cost. In both cases, future costs must be discounted using a discount rate reflecting each energy supplier's average cost of capital.

This approach to the TRC test is standard and has been used in all of the case studies considered in our jurisdictional review[11].

Nova Scotia's TRC resembles the standard approach indicated above, with the caveat that it has not historically considered non-electric fuel costs and savings, for simplicity. This approach has not likely had significant consequences, since non-electric fuel costs and savings, in the absence of fuel switching measures, are only incidental. However, to the extent fuel switching measures are to be specifically addressed, and to ensure consistent comparisons, we recommend that the DSM Administrator adjust its screening of all DSM measures to include non-electric fuel impacts.

[11] With the exception of those jurisdictions that do not screen programs with cost-effectiveness tests.

COST-BENEFIT TESTS

Among the five standard cost-benefit tests developed for energy efficiency, the only appropriate tests for screening measures as part of an IRP process are the Total Resource Cost (TRC) test and the Social Cost Test (SCT). The TRC reflects an "all ratepayers" perspective, while the SCT reflects a somewhat broader, societal perspective.

The UARB requires the use of the TRC test to screen DSM measures and programs. The table below summarizes the benefits and costs included in a *standard* TRC, with all benefits and costs typically calculated as net present values over the lifetime of the measure. Items in bold are particularly important when considering E2O FS.

TRC Benefits and Costs

	TRC
Benefits	• avoided electric supply costs • avoided baseline equipment purchase costs • avoided baseline equipment operation and maintenance • avoided environmental compliance costs • **avoided 'other' fuel supply costs**
Costs	• measure purchase and installation costs • measure operation and maintenance costs • **increased 'other' fuel supply costs** • **'other' fuel connection costs** • **'other' fuel environmental compliance costs**
Discount rate	• Utility's weighted average cost of capital

1. The five standard tests are: the Total Resource Cost test, the Social Cost Test, the Utility Cost Test, the Participant Cost Test, and the Ratepayer Impact Measure test. The tests were originally developed in California and have been widely adopted across North America, with many variations in name and methodology.

This approach to screening E2O FS measures requires that discount rates and forecasts of long term avoided costs be developed for all fuel sources. In the case of natural gas, this can be done using well-established methodologies within the DSM approval process. For unregulated fuels with multiple energy suppliers, an avoided cost study can be conducted, although using retail prices as a proxy – with minor adjustments – can prove both reasonably precise and far less cost- and time-intensive.

RECOMMENDATION:

2) **Include non-electric fuel costs**: Include non-electric fuel costs and associated connection costs in the TRC test for both conventional DSM and E2O FS measures. Costs should reflect long-run avoided costs, as with other DSM, to the extent possible.

AIR EMISSIONS

NSPI faces significant constraints on its future emissions of greenhouse gasses (often expressed as CO2e – carbon dioxide equivalent emissions). It faces similar constraints on emissions of nitrous oxides (NOx), sulphur dioxide (SO2), and mercury (Hg).

Unlike conventional DSM, E2O FS measures may produce air emissions due to increases in non-electric fuel use. Emissions levels per end-use GJ are generally significantly lower than NSPI's current emissions profile – from 0% to 40% of NSPI emissions, depending on the fuel and the pollutant.

Although emissions rates from non-electric fuels are far below NSPI's current emissions mix, they are still significant. Furthermore, to the extent they are compared with the emissions profiles of the long-run generation mix avoided by DSM (wind, biomass and natural gas, as identified in NSPI's Integrated Resources Plan), emissions from non-electric fuels are even more important.

This leads to three key questions:

1. How should E2O FS emissions be reported relative to NSPI emissions targets?
2. How should emissions be valued in cost-effectiveness tests?
3. How should 'net' E2O FS emissions be calculated?

In considering these questions, we emphasize that, as a practical matter, the solution chosen should take into account the time and cost involved, on the one hand, and the size of the expected E2O fuel switching opportunity, on the other hand.

REPORTING RELATIVE TO NSPI TARGETS

There are three potential reporting options. E2O FS emissions could be reported as part of NSPI's own generation emissions, reported separately, or not reported at all. The principal argument for reporting E2O FS emissions as part of (or alongside) NSPI's generation emissions is that E2O FS programs are designed and funded in order to reduce electric consumption and therefore NSPI emissions.

On the other hand, E20 FS emissions are clearly different from NSPI's other emissions, since they are influenced by the DSM Administrator, rather than directly produced by NSPI as in the case of electricity generation. Additionally, once Efficiency Nova Scotia takes responsibility for DSM programming, any E2O FS emissions will have been caused by separate programs not under NSPI control (although still ratepayer-funded). This situation suggests that separate reporting of E2O FS emissions, perhaps as part of DSM Administrator annual reports, may be appropriate.

Finally, the argument could be made that there is no need to report on E2O FS emissions at all, since 'natural' fuel switching is not reported on per se, or is captured in sectoral emissions covered by other greenhouse gas emissions mitigation programs. For example, if an NSPI customer chose to convert from electric space heating to gas space heating today (without any DSM incentives or encouragement), the resulting gas combustion emissions would not be attributed to NSPI. This argument is problematic, however, since program-induced fuel switching – or the share of fuel switching that is deemed to be net of market effects – by definition would not have occurred without the program's intervention.

We recommend the second approach for reporting. E2O FS emissions should be reported on for the sake of transparency and clarity, by the entity responsible for ensuring program performance, i.e., the DSM Administrator. The emissions reported should be net of any avoided electric generating emissions (the emissions that would have been associated with the long term avoided resource mix).

RECOMMENDATIONS:

3) **Report net emissions from fuel switching efforts.** This is essential to ensuring clarity, transparency and accountability.

VALUING EMISSIONS

NSPI faces additional costs in order to meet its emissions caps. These costs are captured in electric DSM avoided costs, which reflect a resource mix that meets NSPI emissions caps. They are therefore already considered in DSM cost-effectiveness screening. Non-electric heating fuel prices, however, do not currently reflect the cost of equivalent emissions reductions targets.[12] This suggests that a cost – or "adder" - should be assigned to E2O FS emissions when screening E2O FS measures.

Eventually, the province or the federal government may impose costs, such as a carbon tax on heating fuels, which aim to encourage reduced consumption. To the extent these costs achieve a relative emissions reduction similar to NSPI's targets, the "adder" could be removed.

Emissions "adders" could reflect an estimate of NSPI's cost of compliance with its emissions caps, the equivalent cost of reducing emissions in the non-electric residential heating fuels sector, or a more generic societal cost of emissions. Developing precise adders for each pollutant will be a complex task. For example, NSPI's compliance costs are difficult to separate

[12] The province's 2009 Climate Change Action Plan does specifically address non-electric heating fuels, setting a reduction target and indicating that it will be achieved via a mix of education, energy efficiency incentives, building codes and appliance standards. However, none of these measures, aside from appliance standards to a certain degree, are reflected in the cost.

out by pollutant, since actions to reduce one pollutant generally reduce others as well.[13] Where markets eventually develop for environmental emissions permits, market price forecasts can be used as adders. This will likely be the case for CO2e, but emissions permit markets for other pollutants are less probable.

RECOMMENDATIONS:

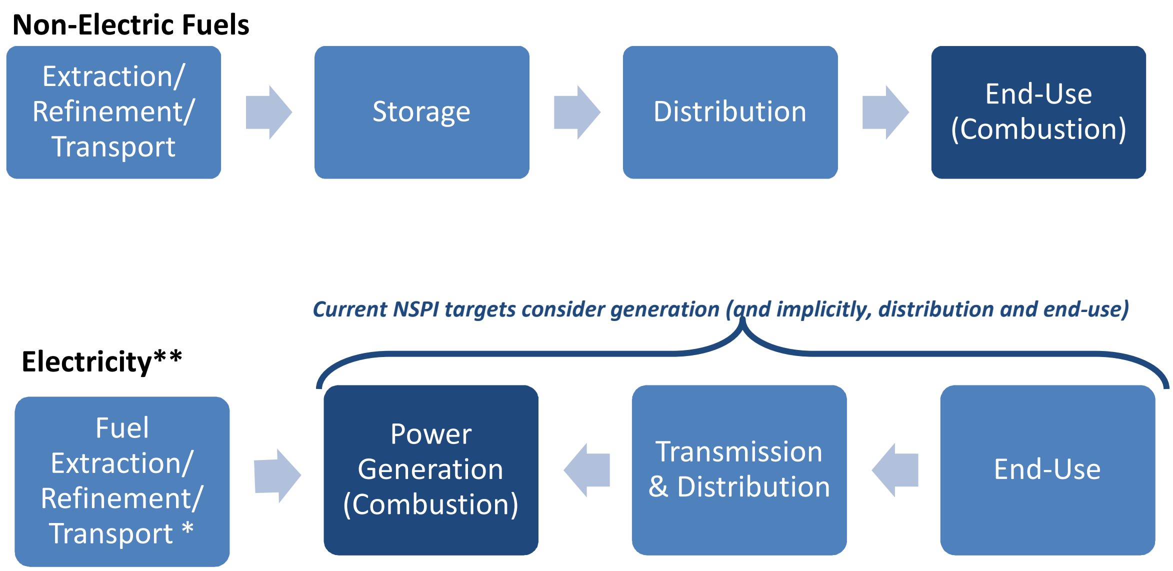
4) **Value non-electric emissions in cost-effectiveness screening,** but revisit this should non-electric fuel prices come to internalize compliance costs similar to NSPI's.

CALCULATING NET EMISSIONS

Determining the emissions caused by burning non-electric fuels is relatively straightforward. The literature provides standard emissions factors per GJ of energy that can be applied to the energy consumption of each E2O FS participant. These emissions are often referred to as 'site-level' emissions because they occur at the point of end-use. Beyond site emissions, additional emissions are caused by the extraction, refining, and transport of the fuel. These emissions can be referred to as 'upstream' emissions, and the combination of site and upstream amount to 'life-cycle' emissions. The diagram below illustrates this concept.

[13] We explored the possibility of identifying NSPI compliance costs using IRP modelling runs, i.e. running scenarios with and without each emissions cap, and identifying the incremental cost of complying with each regulatory constraint. This is likely to be difficult and time consuming and may not lead to precise estimates. Among other challenges, compliance costs generated via an IRP run will vary greatly based on the order in which emissions are solved for. Similarly, we considered the development of separate avoided costs for each E2O FS resource as an alternative to using emissions adders, but it is likely to be impractical due to the small size of the resource and the complexity of avoided cost studies.

9 Energy Use Life Cycle Emissions



**NA for wind/solar/hydro*
***Beyond the elements presented here, a full Life Cycle Assessment could include the emissions created during generation plant construction, etc.*

To what extent should life cycle emissions be considered when evaluating E2O FS? Treatment of DSM should respect the spirit of the province's emissions targets for NSPI, which currently do not consider life cycle emissions from the extraction, refinement and transportation of the fuel used to produce electricity. Only the emissions produced when generating electricity are considered. Although no emissions are directly created by electricity distribution and end-use, NSPI's caps implicitly cover these activities, since the amount of electricity generated must be sufficient to compensate for line-losses and the inefficiency of end-use equipment.

A consistent treatment for E2O FS emissions would consider not only site-level emissions, but also any emissions caused by fuel storage and distribution ('energy supplier emissions'). This approach would put E2O FS emissions on a level playing field with NSPI emissions, which for regulatory purposes do not go beyond energy supplier emissions. We do not suggest that emissions from fuel extraction, refinement and transport be considered.

An alternative interpretation of NSPI's emissions caps is that, since they were set in the context of a provincial climate change plan, any E2O FS life cycle emissions that occur in the province should be considered. For example, when considering gas that is extracted in Nova Scotia, extraction, refining and transportation emissions should be considered. On the other hand, these emissions would not be considered for fuels produced outside the province, such as coal. We suggest that this approach would not be consistent with NSPI's current emissions targets, which only consider generation emissions, regardless of the origin of the fuel used, and notably does not consider emissions from other NSPI activities.

In practice, energy supplier emissions per GJ of non-electric fuel are likely to be minimal. The US Environmental Protection Agency developed multiplication factors to account for energy supplier energy use as part of its Energy Star Portfolio Manager program.[14] As can be seen from the table below, these factors do not substantially change overall energy use. We suggest they can be used as a rough proxy for considering E2O FS energy supplier emissions.

10 EPA Energy Multipliers

Fuel	EPA Multiplier
Natural Gas	1.047
Oil	1.010
Propane	1.010
Wood	1.000

RECOMMENDATIONS:

5) **Consider site energy and supplier-level upstream emissions only** when calculating fuel switching emissions, to ensure consistency with electric emissions accounting (standard EPA multipliers may serve as a reasonable proxy for Nova Scotia's analytical purposes). This implies disregarding broader life-cycle emissions impacts, at least until such time as a similar approach is used for NSPI emissions.

RISK: PRICE VOLATILITY AND SUPPLY ADEQUACY

Compared with conventional DSM, E2O FS introduces two new and important variables: future fuel price volatility, and supply adequacy. Indeed, non-electric fuels, with the possible exception of cordwood, are historically more volatile than electricity prices, while wood pellets may present greater supply risks than traditional resources.[15] This has three implications:

First, from a total resource perspective, volatile relative fuel prices make the cost-effectiveness of measures less certain; more risky. This means that the DSM Administrator will need to run sensitivity analyses to ensure that all E2O FS measures it adopts are robust – i.e. remain cost effective under a variety of future price forecasts.

Second, from the participant perspective, volatile non-electric fuel prices – in addition to supply risks – can make E2O FS less attractive and constitute an important market barrier, one

[14] See http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_benchmark_comm_bldgs for more details.

[15] Where avoided generating resources use the same fuel as fuel switching measures, this issue is less important, since electricity avoided costs can be expected to fluctuate with the price of the non-electric fuel. This is the case for jurisdictions that rely on gas-fired generation and are considering electric-to-gas fuel switching. This does not appear to be the case for NSPI, whose avoided resources are a mix of wind and biomass, as well as some gas-fired generation.

that does not apply to standard energy efficiency measures (where no – or incidental – fuel consumption increases are at play). The DSM Administrator should take this into account when planning E2O FS programs, and ensure incentive levels and other services are sufficient to overcome this barrier. Moreover, the Administrator should give particular consideration to minimizing the likelihood that its E2O FS programs could lead to *increased* participant costs due to fuel price hikes. Doing so requires a combination of a conservative approach to determining which FS opportunities are in its participants' interests (sensitivity analyses using the Participant Cost Test), and explicit consideration of both price and supply risks, where applicable, in any E2O FS program communications.

Third, changes in relative fuel prices can change market baseline conditions. Notably, E2O FS may become more attractive to consumers if non-electric fuel prices drop significantly, eliminating the need for an E2O FS program or reducing the need for incentives (or simply increasing free ridership). The DSM Administrator should take this into account when designing its internal E2O FS program processes, by ensuring program staff follow market conditions closely and are able to dynamically adapt programs to evolving market conditions. Adaptive program management should be explicitly stated in any regulatory program approvals.

RECOMMENDATIONS:

6) **Be Conservative.** The DSM Administrator should use sensitivity analyses to determine the robustness of fuel switching measure cost-effectiveness under a variety of price forecasts, and only implement programs that are robustly cost-effective from both the societal and participant perspectives. Program communications should also explicitly address these concerns.

7) **Be Dynamic:** The Administrator should carefully monitor market conditions when planning and implementing fuel switching programs, and be ready to adjust incentive levels or eliminate programs should market conditions change significantly.

FRAMEWORK SUMMARY

The framework we propose for E2O FS is based on two guiding principles:

- **Consistency** with the treatment of conventional DSM and with the spirit of provincial electric generation emissions targets; and
- **Adaptation** where E2O FS has unique features that require a combination of both conservative analyses and dynamic program planning.

The text box on page 42 summarizes our recommendations. We discuss the practical implications of these recommendations below.

IMPLICATIONS FOR THE DSM ADMINISTRATOR

Assuming that the province and UARB accept our proposed framework, the DSM Administrator will need to determine the best approach for integrating E2O FS potential into DSM scenarios for future NSPI IRP processes. In the interim, we recommend that the DSM Administrator adopt a general target of obtaining all achievable, *robustly* cost-effective E2O FS, and screen E2O FS measures using the TRC test. When using the TRC, we recommend that conventional DSM avoided costs be used, and that environmental compliance cost “adders” are applied to account for E2O FS emissions. To undertake this screening, the DSM Administrator will need to develop or obtain:

- Supplier cost forecasts for each non-electric fuel (rates can be a proxy with minor adjustments)[16];
- Assumed discount rates for each non-electric fuel;
- Emissions compliance costs for each type of regulated air emission; and
- A screening policy for robustness, that identifies the minimum conditions under which E2O FS measures must remain cost-effective in order to be included in program.

A version of these inputs are currently being developed for NSPI’s ongoing residential E2O FS potential study. The same inputs, or a future iteration, can be used in a later commercial/institutional/industrial potential study. The results of these studies can then be used to develop E2O FS program designs. Program designs should be based on a clear understanding of market trends, future non-electric fuel reliability issues, and participant risks due to fuel price volatility.

[16] These may be developed in the context of non-electric DSM efforts.

SUMMARY OF FRAMEWORK RECOMMENDATIONS

IRP PROCESS

1) **Treat fuel switching distinctly (if possible).** If emissions generated from fuel switching are treated consistently with NSPI's direct emissions, as we recommend below, then the IRP process should ideally consider fuel switching opportunities distinctly from energy efficiency ones. If this is not practical, e.g. if the material impact (size) of these resources falls within the IRP error band, then the use of proxy emissions prices or values would be needed to ensure consistent integration of fuel switching within a single, overall DSM resource.

OTHER FUEL COSTS

2) **Include non-electric fuel costs**: Include non-electric fuel costs and associated connection costs in the TRC test for both conventional DSM and E2O FS measures. Costs should reflect long-run avoided costs, as with other DSM, to the extent possible.

AIR EMISSIONS

3) **Report net emissions from fuel switching efforts.** This is essential to ensuring clarity, transparency and accountability.

4) **Value non-electric emissions in cost-effectiveness screening,** but revisit this should non-electric fuel prices come to internalize compliance costs similar to NSPI's.

5) **Consider site energy and supplier-level upstream emissions only** when calculating fuel switching emissions, to ensure consistency with electric emissions accounting (standard EPA multipliers may serve as a reasonable proxy for Nova Scotia's analytical purposes). This implies disregarding broader life-cycle emissions impacts, at least until such time as a similar approach is used for NSPI emissions.

ADDRESSING RISK

6) **Be Conservative.** The DSM Administrator should use sensitivity analyses to determine the robustness of fuel switching measure cost-effectiveness under a variety of price forecasts, and only implement programs that are robustly cost-effective from both the societal and participant perspectives. Program communications should also explicitly address these concerns.

7) **Be Dynamic:** The Administrator should carefully monitor market conditions when planning and implementing fuel switching programs, and be ready to adjust incentive levels or eliminate programs should market conditions change significantly.

INITIAL ASSESSMENT OF FUELS

INTRODUCTION

In order to provide an initial sense of the potential for E2O FS in Nova Scotia, we have conducted a preliminary, high-level assessment of each of the five fuels under consideration (gas, heating oil, propane, cordwood and wood pellets). This assessment is comprised of two parts.

1. **Economic Analysis**: We have conducted a high-level analysis of the cost-effectiveness of E2O FS for various residential and commercial space heating and domestic hot water end-uses, using approximate measure costs and savings assumptions. Although in no way as precise or complete as a full-scale potential study, this analysis gives a preliminary sense of the potential cost-effectiveness for each opportunity. **Note that it will be supplanted in part by a comprehensive residential potential study conducted in parallel with our work.**[17]

2. **Practical Assessment**: Based on stakeholder interviews and other research, we broadly assess each fuel in terms of:
   - *Risk*: how reliable is future supply?
   - *Baseline conditions*: is there a need for market intervention, or have participant economics already transformed the market?
   - *Other policy issues*: Are there other policy issues that need to be considered (environmental or economic drivers)?

We also consider a third issue, ensuring 'future-ready' heating systems in residential new construction.

[17] The results of the potential analysis were not available in time to fully integrate into this report. Discrepancies between the two studies are likely, due to our high-level analysis, which was based on generic costs and savings adapted from other jurisdictions. Where there are discrepancies, Navigant's analysis should take precedence.

This analysis was conducted at a high level and, as such, suffers from a number of limitations, namely:

- *Reliance on approximate avoided costs and discount rates*: Our analysis uses NSPI's most recent DSM avoided costs and discount rates, updated in February 2010. It uses an estimated supply cost for oil provided by NSPI, and proxy costs for natural gas and wood pellets developed by Dunsky Energy Consulting, as well as avoided cost forecasts for propane and cordwood developed originally for Quebec's *Agence de l'efficacité énergétique*.

- *Reliance on approximate measure costs and savings*: The analysis relies on approximate residential heating loads for Nova Scotia and measure costs from a variety of sources, principally the U.S.

- *Does not consider all opportunities*: Our residential analysis considers only forced air furnaces and water heaters. Our commercial analysis considers only space heating and water heating measures for a sample client type. A full review of all potential E2O FS measures will require complete potential studies for all sectors, which is far beyond the scope of this analysis.

- *Does not consider all emissions*: Only CO2e emissions were attributed a cost in this analysis.

- *Economic analysis considers measure costs only*: Program costs were not included in our economic screening of E2O FS measures, since at this stage, program designs are not known.

The economic analysis presented below considers the TRC and PCT perspective and looks at examples of space heating and water heating measures for both the residential and commercial sectors.

ECONOMIC ANALYSIS

INPUTS

Our analysis applied the Total Resource Cost (TRC) Test and Participant Cost Test (PCT) to the following measures, in each case considering both new construction and retrofit markets.

11 Economic Analysis: Measures Considered

End-Use	Base Case	Measure
Residential Space Heat	Electric baseboard heaters (EF 1.00)	Air Source Heat Pump (EF 1.9)*
		Gas furnace (EF .94)
		Oil Furnace (EF .85)
		Propane Furnace (EF .94)
		Wood Furnace (EF .60)
		Wood Pellet Furnace (EF .80)
Domestic Hot Water	Electric water heater (EF .90)	Electric – heat pump (EF 2.2)*
		Gas – condensing (EF .80)
		Gas – conventional high-efficiency (EF .65)
		Gas – tankless (EF .95)
		Oil – conventional (EF .55)
		Propane – conventional high-efficiency (EF .65)
		Propane – tankless (EF .95)
Commercial Space Heating	Electric resistance heaters (EF 1.00)	Gas Boiler (EF .94)
		Oil Boiler (EF .85)
		Propane Boiler (EF .94)
		Wood Biomass Boiler (With Oil Back-Up) (EF .85)
		Wood Pellet Boiler (EF .85)
Commercial Water Heating	Electric water heater (EF. 90)	Gas Boiler (EF .94)
		Oil Boiler (EF .81)
		Propane Boiler (EF .94)

**Electric heat pumps included for comparison purposes.*

The table below summarizes key inputs and indicates their sources.[18]

[18] Note that our levelized costs for electric avoided costs differ from those generally presented by NSPI. We have levelized over a different period and express results in constant 2010 dollars rather than future dollars.

12 Economic Analysis: Key Inputs

Fuel/ Emissions	Levelized Avoided Costs ($2010/GJ - 2010-29)		Levelized Rates ($2010/GJ – 2010-2029)		Supplier Discount Rate (real)
	Residential	Commercial	Residential[9]	Commercial[10]	
Electric (energy)[1]	$36.44	$36. 44	$38.34[11]	$32.70[11]	6.81%[1]
Electric ($/kW)[1]	$58.13[6]	$58.13[6]	-	-	6.81%[1]
Gas	$12.12[2]	$12.12[2]	$15.46	$15.17	8.49%[7]
Oil	$27.28[1]	$27.28[1]	$27.53	$27.28	8%[5]
Propane	$41.75[8]	$32.12[8]	$42.91	$32.12	8%[5]
Wood	$12.35[8]	$8.65[12]	$12.11	$8.48	10%[5]
Wood pellet	$23.80[3]	$13.60[3]	$25.00	$13.60	8%[5]
CO2e[4]	$31/tonne	$31/tonne	-	-	3%[5]

1. Calculated by DEC based on values provided by NSPI. 2. DEC estimated avoided cost. 3. Shaw resources Dec. 2009 value, 1% (real) escalator. 4. 15$ as of 2012, 10% (real) escalator. 5. Working assumption. 6. $/ kW 7. Provided by Heritage Gas. 8. Based on a study conducted for Quebec propane and wood markets. 9. Discount rate 4.71% real. 10. Discount rate 8.00% real. 11. Dec. 2009 rates with 2% annual escalator (real). 12. Commercial wood price assumed to be 30% lower than residential.

Sensitivity Analysis: Each measure was tested against a base case, a high cost scenario (with prices increased by 50% for sensitive fuels, i.e. gas, oil propane and wood pellets), and a high consumption/high cost scenario (with average consumption increased by 50%, peak load by 20%, equipment costs by 20% and prices increased for sensitive fuels). We used the high cost scenario as a guideline for determining if measures were robustly cost-effective (although the DSM Administrator may eventually decide on a higher or lower threshold).[19] Where measures passed the high consumption scenario only, the simultaneous application of a high cost scenario indicates if they are robustly cost effective.

CO2e Emissions: We assumed no avoided CO2e emissions were associated with long-run avoided electric consumption, since NSPI's avoided costs reflect total compliance costs (and, as such, reflect largely zero-emissions generating resources).[20]

Other Environmental Emissions: We did not assign a cost to E2O FS emissions other than CO2e.

Development of Heritage Gas increased supply costs: In the absence of formal Heritage Gas avoided cost estimates, we developed approximate increased supply costs based on the average

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[19] See also discussion in footnote 14 on page 39.

[20] It is furthermore unclear if FS would supplement – or replace – other DSM.

Heritage Gas $/GJ Gas Cost Recovery Rate for 2006-2008, adding a 10% adder to cover customer service costs, and using an annual escalator based on NSPI wholesale gas price forecasts.[21]

This avoided cost estimate is approximate and should be validated if possible.

RESIDENTIAL SPACE HEATING RESULTS

Our analysis of residential space heating assumed an average heating load of 60 GJ/year, based on estimates from the federal Office of Energy Efficiency (OEE), and an average electric system peak requirement of 7.57 kW. These values reflect an assumption that the large majority of electrically-heated homes in Nova Scotia were built after 1996. Note that our "high cost, high consumption" scenario in the case of residential space heating is equivalent to the OEE's estimates of average consumption for homes built between 1978 and 1996.

The following tables present TRC and PCT ratio results for the base case, high cost and high consumption/high cost scenarios. Results are presented for new construction and retrofit markets, with and without the impacts of CO2e costs. PCT results reflect current market conditions –i.e., no program in place. Test ratios above 1 are indicated in blue, and results below 1 are indicated in orange.

[21] For information purposes, we compared the resulting levelized avoided cost for the 2010-2029 period with that of Gaz Métro, Quebec's primary gas utility. We found that they were similar enough to be considered reasonable at first glance, with our estimate for Heritage Gas ($12.12/GJ) coming in very close to that of Gaz Metro ($12.67/GJ).

13 Benefit/Cost Ratios - Residential Space Heating: Base Case Scenario

Measure	Societal Perspective: TRC With $/CO2e Retrofit	TRC With $/CO2e NC	TRC Without $/CO2e Retrofit	TRC Without $/CO2e NC	Participant Perspective: PCT Retrofit	PCT NC
Electric ASHP	0.76	1.28	0.76	1.28	0.94	1.56
Gas Furnace	1.13	1.54	1.21	1.69	1.17	1.61
Oil Furnace	0.83	1.04	0.90	1.14	0.77	0.94
Propane Furnace	0.70	0.84	0.73	0.88	0.61	0.71
Wood Furnace	1.11	1.49	1.11	1.49	0.91	1.14
Wood Pellet	0.85	1.07	0.85	1.07	0.73	0.88

14 Benefit/Cost Ratios - Residential Space Heating: High Cost Scenario*

Measure	Societal Perspective: TRC With $/CO2e Retrofit	TRC With $/CO2e NC	TRC Without $/CO2e Retrofit	TRC Without $/CO2e NC	Participant Perspective: PCT Retrofit	PCT NC
Electric ASHP	**0.76**	**1.28**	0.76	1.28	0.94	1.56
Gas Furnace	**0.98**	**1.27**	1.04	1.38	0.93	1.18
Oil Furnace	**0.65**	**0.76**	0.68	0.82	0.58	0.67
Propane Furnace	**0.52**	**0.60**	0.54	0.62	0.44	0.49
Wood Furnace	**1.11**	**1.49**	1.11	1.49	0.91	1.14
Wood Pellet	**0.67**	**0.79**	0.67	0.79	0.56	0.65

*The results of this scenario – indicated in bold on the left of the table – indicate which measures are *robustly* cost-effective according to our criteria.

15 Benefit/Cost Ratios – Residential Space Heating: High Consumption & Cost Scenario

Measure	Societal Perspective: TRC With $/CO2e Retrofit	TRC With $/CO2e NC	TRC Without $/CO2e Retrofit	TRC Without $/CO2e NC	Participant Perspective: PCT Retrofit	PCT NC
Electric ASHP	0.99	1.52	0.99	1.52	1.23	1.87
Gas Furnace	1.14	1.40	1.23	1.53	1.06	1.26
Oil Furnace	0.68	0.77	0.73	0.82	0.63	0.69
Propane Furnace	0.54	0.59	0.56	0.61	0.47	0.50
Wood Furnace	1.29	1.62	1.29	1.62	1.07	1.28
Wood Pellet	0.73	0.83	0.73	0.83	0.63	0.69

Our analysis leads to two key findings:

- **Potential Opportunity: Gas and Cordwood.** The only robustly cost-effective space heating measures identified by this analysis were for natural gas and cordwood furnaces, which were particularly cost-effective for high-use (pre-1996) homes and the new construction market. Gas retrofits were on the border of robust cost-effectiveness, at 0.98 when a CO2e price is included, leading us to consider them as essentially cost-effective. No robustly cost-effective opportunities were found for propane, oil or wood pellet furnaces. We do note, however, that unlike oil, gas and propane, a mature wood pellets market may raise less concern over price volatility; as such, robustness may be less of an issue.

- **Air-source heat pumps are similarly advantageous.** This report is focused on non-electric fuel sources as alternatives to electricity, notably for space heating. Given existing market shares, our space heating analysis used electric resistance baseboard heating as the baseline for comparing alternative fuels. However, our analysis also finds that in a variety of cases, air-source heat pumps can be similarly – and in some cases more – cost-effective as gas and cordwood alternatives.

DOMESTIC HOT WATER RESULTS

We conducted a similar analysis for residential domestic hot water opportunities.

For purposes of this analysis, we assumed an average water heating load of 11 GJ/year and winter peak capacity savings of 0.0629 kW, based on Ontario's characterization of electric to natural gas fuel switching.[22]

The following tables present TRC and PCT ratio results for the base case, high cost and high consumption/high cost scenarios. Results are presented for new construction and retrofit markets, with and without the impacts of CO2e costs. PCT results reflect current market conditions –i.e., no program in place. Test ratios above 1 are indicated in blue, and results below 1 are indicated in orange.

[22] See http://www.powerauthority.on.ca/Storage/97/9274_V_1_02_2009_MA_List_-_MM_14Apr_2009.pdf, page 178.

16 Benefit/Cost Ratios – Residential Hot Water: Base Case Scenario

Measure	Societal Perspective: TRC With $/CO2e Retrofit	TRC With $/CO2e NC	TRC Without $/CO2e Retrofit	TRC Without $/CO2e NC	Participant Perspective PCT Retrofit	PCT NC
Electric – heat pump	0.94	1.49	0.94	1.49	1.09	1.70
Gas – condensing	0.91	1.14	0.94	1.21	0.92	1.12
Gas – conv. high-e	1.12	1.50	1.19	1.64	1.06	1.34
Gas – tankless	1.24	1.60	1.31	1.71	1.24	1.51
Oil – conventional	0.51	0.61	0.53	0.63	0.54	0.64
Propane – conv. high-e	0.51	0.58	0.53	0.60	0.52	0.58
Propane – tankless	0.68	0.78	0.70	0.81	0.70	0.78

17 Benefit/Cost Ratios – Residential Hot Water: High Cost Scenario*

Measure	Societal Perspective: TRC With $/CO2e Retrofit	TRC With $/CO2e NC	TRC Without $/CO2e Retrofit	TRC Without $/CO2e NC	Participant Perspective PCT Retrofit	PCT NC
Electric – heat pump	**0.94**	**1.49**	0.94	1.49	1.09	1.70
Gas – condensing	**0.78**	**0.96**	0.81	1.00	0.76	0.89
Gas – conv. high-e	**0.91**	**1.14**	0.95	1.22	0.82	0.97
Gas – tankless	**1.06**	**1.31**	1.11	1.38	1.00	1.17
Oil – conventional	**0.39**	**0.45**	0.40	0.46	0.41	0.46
Propane – conv. high-e	**0.37**	**0.41**	0.38	0.42	0.37	0.40
Propane – tankless	**0.51**	**0.56**	0.52	0.58	0.51	0.55

*The results of this scenario – indicated in bold on the left of the table – indicate which measures are *robustly* cost-effective according to our criteria.

18 Benefit/Cost Ratios – Residential Hot Water: High Consumption & Cost Scenario

Measure	Societal Perspective: TRC With $/CO2e Retrofit	TRC With $/CO2e NC	TRC Without $/CO2e Retrofit	TRC Without $/CO2e NC	Participant Perspective PCT Retrofit	PCT NC
Electric – heat pump	1.22	1.96	1.22	1.96	1.41	2.24
Gas – condensing	0.90	1.07	0.93	1.13	0.85	0.98
Gas – conv. high-e	0.99	1.22	1.05	1.30	0.88	1.03
Gas – tankless	1.20	1.45	1.26	1.54	1.11	1.28
Oil – conventional	0.42	0.47	0.43	0.48	0.43	0.48
Propane – conv. high-e	0.38	0.41	0.39	0.42	0.38	0.40
Propane – tankless	0.54	0.59	0.55	0.60	0.54	0.57

This analysis suggests there are **limited opportunities for domestic hot water** fuel switching. Indeed, only high efficiency and tankless gas water heaters are robustly cost effective, principally for new construction and high consumption households, although tankless water heaters are a possibility for retrofit markets. As with residential space heating, electric heat pumps present an interesting and cost-effective option.

COMMERCIAL SPACE HEATING

Our base case for commercial space heating is a 2000 m2 building with a heating load of 720 GJ and a peak system demand of 140 kW, based on industry standard estimates adjusted for the Nova Scotian climate.

Note that the commercial sector is substantially more diverse than the residential (single-family home) market, and that heating loads and peak demand vary. Our analysis below is based on a single reference case and is not representative of the entire sector.

The following tables present TRC and PCT ratio results for the base case, high cost and high consumption/high cost scenarios. Results are presented for new construction and retrofit markets, with and without the impacts of CO2e costs. PCT results reflect current market conditions –i.e., no program in place. Test ratios above 1 are indicated in blue, and results below 1 are indicated in orange.

19 Benefit/Cost Ratios – Commercial Space Heating: Base Case

Measure	Societal Perspective: TRC With $/CO2e Retrofit	TRC With $/CO2e NC	TRC Without $/CO2e Retrofit	TRC Without $/CO2e NC	Participant Perspective: PCT Retrofit	PCT NC
Gas Boiler	1.29	1.90	1.39	2.12	0.80	1.18
Oil Boiler	0.86	1.09	0.92	1.20	0.58	0.75
Propane Boiler	0.83	1.05	0.87	1.12	0.55	0.70
Wood Boiler (Oil Back-Up)	0.95	1.24	0.95	1.24	0.64	0.85
Wood Pellet Boiler	1.26	1.84	1.26	1.84	0.79	1.16

20 Benefit/Cost Ratios – Commercial Space Heating: High Cost Scenario*

Measure	Societal Perspective: TRC With $/CO2e Retrofit	TRC With $/CO2e NC	TRC Without $/CO2e Retrofit	TRC Without $/CO2e NC	Participant Perspective: PCT Retrofit	PCT NC
Gas Boiler	**1.11**	**1.53**	1.18	1.67	0.67	0.91
Oil Boiler	**0.67**	**0.81**	0.71	0.86	0.45	0.54
Propane Boiler	**0.64**	**0.77**	0.67	0.80	0.42	0.51
Wood Boiler (Oil Back-Up)	**0.89**	**1.15**	0.89	1.15	0.64	0.85
Wood Pellet Boiler	**1.05**	**1.42**	1.05	1.42	0.66	0.89

*The results of this scenario – indicated in bold on the left of the table – indicate which measures are *robustly* cost-effective according to our criteria.

21 Benefit/Cost Ratios – Commercial Space Heating: High Consumption & Cost Scenario

Measure	Societal Perspective: TRC With $/CO2e Retrofit	TRC With $/CO2e NC	TRC Without $/CO2e Retrofit	TRC Without $/CO2e NC	Participant Perspective: PCT Retrofit	PCT NC
Gas Boiler	1.25	1.61	1.35	1.77	0.78	0.98
Oil Boiler	0.70	0.80	0.75	0.86	0.49	0.57
Propane Boiler	0.67	0.77	0.70	0.80	0.46	0.53
Wood Boiler (Oil Back-Up)	1.04	1.27	1.04	1.27	0.80	1.02
Wood Pellet Boiler	1.17	1.47	1.17	1.47	0.77	0.97

This analysis suggests that only natural gas and wood pellet boilers are robustly cost-effective opportunities for the commercial space heating market, in particular for new construction and high-consumption retrofit markets. Wood boilers become cost effective for both markets for high consumption buildings. Wood pellets are notably very cost-effective compared to residential wood pellet opportunities, because bulk costs are less than two thirds of retail residential costs.

COMMERCIAL WATER HEATING

Our base case for commercial water heating is 30-unit hotel – a good example of a relatively high-use commercial building for hot water. We assumed annual end-use energy needs of 173 GJ, based on industry interviews. We assumed peak capacity savings of 0.73 kW, based on an extrapolation of residential data.

Note that the commercial sector is substantially more diverse than the residential (single-family home) market, and that hot water needs and peak demand vary. Our analysis below is based on a single reference case and is not representative of the entire sector.

The following tables present TRC and PCT ratio results for the base case, high cost and high consumption/high cost scenarios. Results are presented for new construction and retrofit markets, with and without the impacts of CO2e costs. PCT results reflect current market conditions –i.e., no program in place. Test ratios above 1 are indicated in blue, and results below 1 are indicated in orange.

22 Benefit/Cost Ratios – Commercial Hot Water: Base Case

	Societal Perspective				Participant Perspective	
	TRC With $/CO2e		TRC Without $/CO2e		PCT	
Measure	Retrofit	NC	Retrofit	NC	Retrofit	NC
Gas Boiler	1.37	1.67	1.50	1.86	1.28	1.60
Oil Boiler	0.84	0.94	0.91	1.04	0.77	0.88
Propane Boiler	0.84	0.94	0.89	1.00	0.63	0.69

23 Benefit/Cost Ratios – Commercial Hot Water: High Cost Scenario*

	Societal Perspective				Participant Perspective	
	TRC With $/CO2e		TRC Without $/CO2e		PCT	
Measure	Retrofit	NC	Retrofit	NC	Retrofit	NC
Gas Boiler	**1.12**	**1.32**	1.21	1.44	0.98	1.16
Oil Boiler	**0.62**	**0.67**	0.66	0.72	0.56	0.61
Propane Boiler	**0.61**	**0.67**	0.64	0.70	0.45	0.48

*The results of this scenario – indicated in bold on the left of the table – indicate which measures are *robustly* cost-effective according to our criteria.

24 Benefit/Cost Ratios – Commercial Hot Water: High Consumption & Cost Scenario

	Societal Perspective				Participant Perspective	
	TRC With $/CO2e		TRC Without $/CO2e		PCT	
Measure	Retrofit	NC	Retrofit	NC	Retrofit	NC
Gas Boiler	1.25	1.40	1.36	1.54	1.05	1.19
Oil Boiler	0.64	0.68	0.68	0.72	0.58	0.61
Propane Boiler	0.64	0.67	0.67	0.71	0.46	0.48

This analysis suggests that gas is the only robustly cost-effective fuel for E2O FS in the commercial water heating sector, in particular for new construction and high consumption buildings.

PRACTICAL ASSESSMENT

While a critical facet, cost-effectiveness cannot alone determine the value proposition for fuel switching opportunities. Other, practical factors – how risky the new resource may be, both in terms of price volatility and supply reliability; to what extent customers are already making the switch (or choice) toward the new fuel; and the extent to which the new fuel contributes to or conflicts with other policy goals, like environmental protection or economic development – also come into play.

Below we provide a brief, high-level assessment of each of these qualitative concerns for each main fuel source. We also provide our "bottom line" assessment of the broad merits of each.

NATURAL GAS

Risk: Gas supply is reliable in the short, medium and long term, but long term price forecasts are uncertain. Nova Scotia has a secure domestic supply (Sable Offshore Energy Project), and access to North American supplies. Gas markets have seen substantial price volatility in the last five years. Although recent developments in unconventional resources (shale gas) have led to suggestions that North American gas reserves are much larger than previously thought, the long term costs of these resources are still an issue of debate.

Baseline: According to Heritage Gas, 95% of residential and commercial new construction selects natural gas as a heating fuel in areas where gas is available. Heritage Gas has also indicated to us that its gas network will extend to over 90% of Nova Scotia's new construction market within the next two to four years. If this is accurate, it suggests that there are virtually no E2G FS opportunities in the new construction market, since natural market forces are already causing this shift. This analysis is supported by our Participant Cost Test results for residential markets, which suggest that natural gas is cost-effective for participants even under a high cost scenario. It is supported to a lesser degree by our PCT results for the commercial market. Regardless of our preliminary test results, it should be confirmed by an independent market study or by the UARB.

In the residential retrofit market, Heritage Gas indicates it has had little interest in conversion from electric heating to natural gas, due to the cost of distribution systems (ducts or hydronics). This creates a potential market opportunity for E2G FS as a DSM measure. In the commercial retrofit market, Heritage Gas reports had little information on electric to gas conversions, making this a market to be investigated further.

Policy Issues: There are two distinct policy issues apparent for gas, both favourable to E2G FS. Environmentally, gas is a relatively clean burning fossil fuel, especially compared with heating oil, the dominant energy source in the province (though not as compared with our assumed *long-run* generation resource mix (largely renewables)). Economically, the government has shown that it is interested in encouraging the development of natural gas as a heating fuel in order to create a domestic market for provincially produced gas. This interest is demonstrated by the creation of the industry-funded Natural Gas Market Development Fund, mandated by the province.

A third, unique aspect of gas is that it is the sole non-electric fuel subject to UARB oversight.

Bottom Line: Natural Gas is a reliable and, in the short-term at least, environmentally attractive fuel, but comes with higher price volatility. The principal E2O FS opportunity is likely to be in residential retrofit markets, as well as possibly commercial retrofit markets.

CORDWOOD

Risk: Cordwood is likely to remain reliably available in Nova Scotia given the province's abundant biomass resources and low entry costs for suppliers. In Quebec, for example, a most recent forecast of cordwood avoided costs assumes no price increase beyond inflation.

On the other hand, Nova Scotia and the Atlantic region in general are planning significant new biomass power generation facilities and have a growing wood pellet industry, both of which can put pressure on cordwood prices.

Baseline: Cordwood heating makes up a small percentage of residential energy sources – less than 11 percent of all heating in 2005, and less than three percent of new construction. It is unlikely to be widely adopted as a *primary* residential heating source, because of the level of effort required. A more interesting potential residential E2O FS opportunity may be partial conversions, as wood stoves may be an attractive combination with electric heating for some consumers.[23] An additional residential issue worth keeping in mind is the additional home insurance cost associated with wood heat – typically a 50%-100% increase in Nova Scotia.[24] Commercial applications appear much more promising from a cost-effectiveness perspective, and are likely to suffer less from owner reluctance due to effort levels. We currently have little information on commercial market interest.

Policy Issues: Cordwood is a provincial resource but has relatively high emissions of particulate matter, which can contribute significantly to smog in urban areas.

Bottom Line: Cordwood is a robustly cost-effective resource worthy of further investigation, especially for dual-fuel heating measures. Furthermore, installing woodstoves to reduce residential heating loads by 50% remains robustly cost effective, even when capacity savings are assumed to be reduced by two thirds. The DSM Administrator should, however, discuss particulate matter issues with provincial and municipal governments before embarking on electric-to-cordwood FS programs.

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[23] Peak savings will need to be carefully estimated in the case of dual-fuel systems.

[24] We have taken this cost into account in our analysis.

OIL

Risk: Oil supplies are likely to remain stable in the mid-to-long term, but oil prices will remain subject to strong volatility.

Baseline: The general provincial trend is to move away from heating oil whenever economic alternatives exist, because of price volatility and (to a certain degree) increasing concerns about oil tank leakage liability issues. As such, it would be difficult to get the market to reverse its current direction.

Policy Issues: Heating oil's higher emissions of CO2e and other pollutants make it unlikely to receive government support.

Bottom Line: Heating oil is an unlikely candidate based on our preliminary economic analysis, and appears to have no positive additional drivers from either a participant risk or societal perspective.

PROPANE

Risk: Propane supplies are likely to remain stable in the mid-to-long term, but with the same volatile pricing faced by other fossil fuels.

Baseline: High prices relative to other sources make propane a marginal fuel choice.

Policy Issues: No policy issues identified.

Bottom Line: Propane is an unlikely candidate for E2O FS given its poor TRC performance in our preliminary economic analysis and the absence of any policy drivers in its favour.

WOOD PELLETS

Risk: Nova Scotia has a substantial wood pellet export industry, and a large production surplus relative to domestic consumption (domestic use is roughly ten percent of total provincial output). The wood pellet industry is growing rapidly, expanding operations and obtaining economies of scale. Prices have remained very stable until recently, with few shifts in the last decade despite substantial price increases in biomass feedstocks. Despite this past stability, pellet producers indicate that they are facing increased pressure from biomass prices, and have further concerns regarding mid and long-term supplies because of new biomass power generation plans in the region. Both Nova Scotia and US consumers have also faced periodic short-term pellet shortages in the last few years, as demand grew exponentially and producers and retailers struggled to maintain supply.

Baseline: Pellet stove sales have increased dramatically in Nova Scotia, principally in response to high heating oil prices. They remain, however, a relatively small share of Nova

Scotia's residential fuel mix. We do not have data on commercial sales, but they are clearly a cost-effective alternative at today's prices.

Policy Issues: We assume that provincial governments will likely favour pellet fuels as a locally produced and clean burning fuel. Pellet stove particulate emissions, while substantially higher than oil or gas, are half that of (cord)wood stoves.

Bottom Line: Pellet stoves are a laudable fuel choice, given their use of renewable resources, near-zero net CO2e emissions (assuming sustainable forestry practices), and local sourcing. While not currently a *robustly* cost-effective alternative to electricity for residential space heating[25], they are close to cost-effective (at current prices) for new construction and, as such, are worthy of further consideration. Indeed, wood pellets could prove a positive mid- to long-term opportunity if – though *only if* – current shifts in market fundamentals lead to stable or lower prices, and stable supplies. Commercial sector opportunities appear particularly promising and worthy of further study, due to substantially lower bulk costs.

[25] Even for dual-fuel applications, where pellet stoves replace only part of the heating load and do not require ductwork.

TRENDS IN NEW CONSTRUCTION: FUTURE-READY SYSTEMS

Electric resistance heating has recently overtaken oil to become the dominant choice of heating system in residential new construction in Nova Scotia. Yet to the extent that homes are built to use baseboard resistance heat, homeowners are by and large "locked in" to electric heating for the long term, since retrofitting existing homes to install ducts or other heat distribution systems is an expensive and disruptive undertaking.

As a result, homeowners are far less likely to switch to more efficient electric technologies (air source and ground source heat pumps), to cost-effective non-electric fuels (such as natural gas) or to renewable heat options (wood pellets, solar) that may become available or more appealing in the future.

This "lost opportunity" can be significant. For example, many natural gas substitution opportunities, while cost-effective, will have been lost before the gas distribution network has a chance to expand into those areas. The same goes for wood pellets, whose industry may mature over the coming decade to offer a reliable, competitive heating source. Policy-driven pressures related to climate agreements are likely to hasten the competitiveness of renewable sources.

Building homes to offer fuel flexibility – to in effect be "future ready" – by integrating heat distribution systems raises interesting challenges. In effect, valuing the benefits of flexibility under standard DSM protocols, while possible, is fraught with uncertainty.

As an alternative, we chose to include air-source heat pumps (ASHP) in our screening of alternative heating sources, and found them to be a cost-effective alternative to baseboard electric. While we did not assess other heat pump options (e.g. ground-source heat pumps), we note that heat pumps as a whole feature a heat distribution system and, as such, provide the flexibility for homes to choose other fuel sources in the future. As such, heat pumps offer a "future-ready", flexible alternative to both electric baseboard *and* other fuels, and can facilitate cost-effective future E2O FS once gas networks have arrived in the area or other fuels (for example, wood pellets) become cost-effective and reliable.

NSPI is currently addressing this ASHP opportunity via new construction incentives. If, despite these incentives, a substantial portion of builders continue to choose to install electric baseboard heating, the DSM Administrator may wish to consider more aggressive options.[26]

Recommendation: In addition to considering cost-effective alternatives, the DSM Administrator should continue to promote cost-effective heat pumps in new construction markets, and in particular prioritize distribution systems that can be adapted to non-electric fuels. If electric baseboard heating continues to have significant market share, the Administrator should consider additional action. [27]

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[26] At the most aggressive end of the spectrum, Vermont has effectively banned electric space heating in new residential construction via its Act 250 legislation. A similar approach in Nova Scotia would presumably require provincial intervention

[27] This approach also appears in line with earlier work on the question of E2O FS by the DSM Collaborative.

SUMMARY OF FINDINGS

The table below synthesizes the results of both our economic analysis and practical assessment of non-electric fuel switching opportunities in residential markets.

25 Initial Assessment of Fuels: Summary

	GAS	OIL	PROPAN E	CORDWOOD	WOOD PELLETS
COST-EFFECTIVENESS	**SPACE HEAT AND HOT WATER: robust for all markets**	No opportunity		**SPACE HEAT: robust for residential**	**SPACE/ WATER HEAT: - robust for comm markets** - long term Res. opp. if prices improve
MARKET OPPORTUNITY	**- RETROFIT opportunity** - NC may already be transformed	Little interest	Unknown	Realistic residential opp may be severely limited – TBD	**- Commercial appears to have potential** - Res. NC may eventually have potential
RISK	Reliable supply, but price volatility			Reliable, stable price	**Shifting market: reliability, price TBD**
POLICY ISSUES	**Economic development benefit**	Air quality issues	Unknown	**Air quality issues; Econ. dev't benefit**	**Econ. dev't benefit** Supply uncertainty
OVERALL POTENTIAL	✓ Retrofit market	Low	Low	? Consider dual-fuel* in Res	✓ Commercial markets ? Consider in Res NC

DHW: *Domestic Hot Water; NC: New Construction market; Res: residential; Opp: Opportunity.*
****Dual-fuel:*** *partial replacement of electric load, for example by installing a wood stove in conjunction with electric heating.*

As we can see, the primary opportunities identified for E2O FS programs involve natural gas (retrofit market), cordwood (Residential dual fuel markets), and wood pellets (commercial markets, possibly residential in the future). Fuel switching opportunities *specific to* water heating were not, in and of themselves, found to be robustly cost-effective, aside from some natural gas applications. Finally, it is worth noting that in a number of residential cases, air-source heat pumps, while not explicitly covered by the scope of this mandate, were found to be a similarly cost-effective option as the opportunities described above. In particular, they may be of interest for the residential new construction market, where the use of central heating ensures homes are "future-ready".

POLICY GUIDANCE

Beyond the analytical framework, fuel switching raises several important policy questions:

1. **Electric Ratepayer Interests**: Is the provision of incentives for alternative fuel sources in the best interest of electric ratepayers in Nova Scotia?

2. **Gas ratepayer Interests**: Both NSPI and the local natural gas distribution utility are regulated by the UARB. Should the best interest of natural gas consumers be considered and how can that be done?

3. **Two-Way Street Concept**: If electric ratepayer funds are used to promote the use of efficient natural gas technologies, should gas ratepayer funds be used to promote the usage of efficient electric technologies?

4. **Cost Sharing**: Should electric ratepayers pay exclusively for the promotion of natural gas technologies under electric DSM programs, or is a cost sharing model more appropriate? What are the considerations for development of the cost sharing framework? And what about other fossil fuels?

5. **Government Policies**: Are supporting government policies (or other information) needed or do they already exist?

We briefly address each of these issues in the sections below.

ELECTRIC RATEPAYER INTERESTS

Question

"Is the provision of incentives for alternative fuel sources in the best interest of electric ratepayers in Nova Scotia?"

Commentary

Electric ratepayer interests are essentially identical to those targeted in the IRP process: achieving the lowest-cost and lowest-risk portfolio of investments that reliably balances supply and demand within established environmental or other regulatory constraints.

As with conventional DSM measures, E2O FS measures that are selected by the IRP process (or that pass the TRC test, and are thus considered a lower cost measure than the marginal supply-side resource mix) can definitely contribute to that goal.

Because of potential relative price volatility, E2O FS measures must be treated more conservatively than conventional DSM measures, as discussed on page 37. As long as the DSM Administrator ensures that it promotes only *robustly* cost-effective E2O FS measures, using both the TRC *and* Participant Cost Tests, it will be protecting electric ratepayer interests.

GAS RATEPAYER INTERESTS

Question

Both NSPI and the local natural gas distribution utility are regulated by the UARB. Should the best interest of natural gas consumers be considered and how that can be done?

Commentary

The principal impact of electric-to-gas fuel switching (E2G FS) on natural gas ratepayers will be to increase the volume of natural gas sales and in some cases the number of gas customers.

Regarding the possible addition of new customers, the UARB already requires Heritage Gas to demonstrate that its plans for expansion, its decision-making process for adding new customers and its fee structure for new connections are in the best interests of gas ratepayers.

Regarding the possible increase of gas sales to existing customers, we assume that the UARB already sets gas rates such that they reflect the utility's marginal costs. As such – and especially in the case of a new gas utility with significantly underutilized capacity – volume increases should normally be in all customers' interests. That said, it is *conceivable* that some load profiles generate increased capacity costs that are not fully compensated by existing gas rates.

While we believe the existing regulatory framework should be sufficient to ensure that any E2G FS efforts will also be in existing gas ratepayers' interests, the UARB should ensure the absence of exceptions. Should any exceptions arise, we would anticipate that the DSM Administrator and Heritage Gas would work to avoid negative impacts on existing ratepayers, and that ultimately, the UARB would consider both perspectives in its rulemaking.

TWO-WAY STREET CONCEPT

Question

If electric ratepayer funds are used to promote the use of efficient natural gas technologies, should gas ratepayer funds be used to promote the usage of efficient electric technologies?

Note: We broaden this question to also ask if DSM programs targeting other fuels should also consider fuel switching towards electricity.

Commentary

In principle, fuel switching can indeed be a "two-way street". Gas utilities should screen all DSM opportunities, including gas-to-electric fuel switching (G2E FS), using an approach very similar to the one we have outlined for E2O FS. We would also argue that propane, oil and cordwood DSM efforts – especially to the extent they are undertaken by an independent, third-party organization - should use a similar cost-effectiveness screening approach for both conventional DSM and fuel switching. By using the TRC test and including all supplier costs, discount rates, and environmental constraints, least-cost and least-risk solutions for all Nova Scotian consumers can, in theory at least, be found.

In practice, however, this is not currently the approach used in Nova Scotia. Heritage Gas, as a new and relatively small utility, has not yet begun to undertake DSM programs. Conserve Nova Scotia (CNS), a government-funded agency responsible for propane, oil and wood DSM efforts, does not formally use cost-effectiveness tests in designing programs.[28] CNS has also adopted a policy of fuel neutrality in order to avoid conflicts and equity issues between energy suppliers.

Furthermore, it is unlikely – though not impossible – that fuel-to-electricity fuel switching opportunities would be cost-effective, at least in the near-term.

Ultimately, both Heritage Gas, CNS, and any other organizations with a future non-electric DSM mandate should be tasked with addressing their own fuel switching opportunities, though in the case of government entities such as CNS, government should provide policy guidance (see Question 5). However, the limited likely scope of such opportunities suggests that the DSM Administrator should not link its own E2O FS efforts to the existence of reciprocal initiatives.

[28] CNS' principal current DSM programs mirror federal programs and assume that these program designs are cost effective. CNS has conducted a DSM potential study for non-electric fuels and program designs have generally built on the study results, thus ensuring a degree of informal cost-effectiveness screening.

COST SHARING

Question

Should electric ratepayers pay exclusively for the promotion of natural gas technologies under electric DSM programs, or is a cost sharing model more appropriate? What are the considerations for development of the cost sharing framework? What about other fossil fuels?

Commentary

Fundamentally, robustly cost-effective E2O FS is in the interests of electric ratepayers, and remains so even if DSM programs pay the full cost of the measure. However, depending on program design, non-participating electric customers may experience a rate impact, while non-participating gas customers – and alternative fuel suppliers – may benefit from E2O FS. While this does not affect the societal economics of the fuel switching opportunity, it does raise real equity issues.

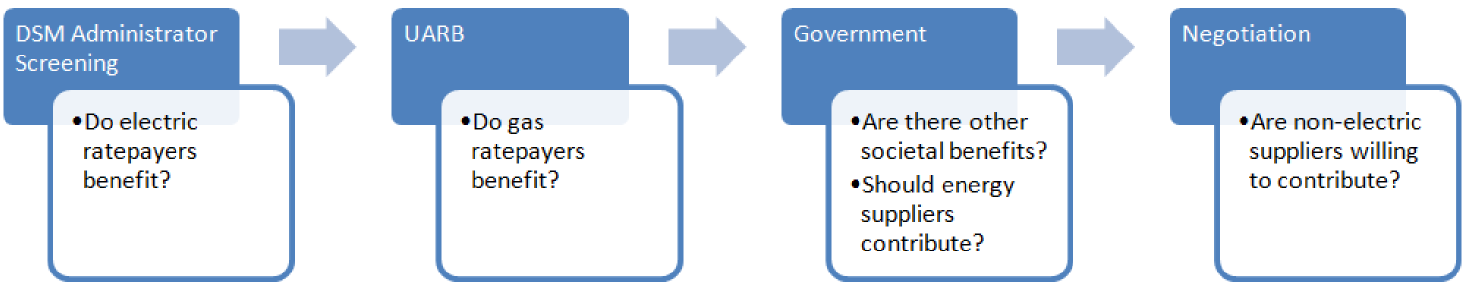
Because of the high fixed costs of gas distribution networks, gas ratepayers generally benefit from increased natural gas consumption, unless the network is at or near capacity (which is not the case in the short to medium term in Nova Scotia). Existing Heritage Gas ratemaking cases should contain sufficient economic analysis to determine the added value of additional consumption (from distinct load profiles) to existing ratepayers. This constitutes the value proposition to Heritage Gas ratepayers as a whole, and as such, represents the maximum value that the gas utility and its customers could contribute to electric fuel switching efforts.

For non-regulated fuels, the same principal of value applies: fuel consumers will benefit from increased volume to the extent that it reduces energy suppliers' fixed costs relative to variable costs, and thus allows energy suppliers to reduce per-unit energy costs for consumers. For some fuels, significantly increased volume could also reduce costs by allowing economies of scale. For example, high-volume wood pellet production combined with bulk delivery (rather than retail sale) could bring down costs substantially.

Ideally, the UARB (in the case of gas) and the government (in the case of unregulated fuels) could determine suppliers' and/or government's share of E2O FS costs based on consideration of (a) their respective value propositions, and (b) expected rate impacts on NSPI's non participating customers. Ultimately, cost sharing should be directed with a view to ensuring an equitable distribution of costs and benefits among each supplier's non-participating customers, while not forfeiting pursuit of the socially cost-effective E2O FS opportunity.

Specifically, we suggest that the UARB and the provincial government have key roles in developing cost-sharing policies. However, we should underscore that the DSM Administrator should consider implementing robustly cost-effective E2O FS measures regardless of whether or not cost-sharing policies are in place, since such measures will be in the interests of ratepayers even without cost sharing. In this situation, the Administrator should rely on direct negotiation with energy suppliers

The diagram below summarizes our proposed, high-level approach to a cost-sharing framework.



1. The DSM Administrator identifies robustly cost-effective measures and required level of incentive.

2. The UARB identifies gas ratepayer benefits and establishes a cost-sharing policy.

3. Government evaluates societal and supplier benefits, establishes contribution framework.

4. Alternative: in absence of gvt policy, DSM Administrator negotiates directly with energy suppliers.

GOVERNMENT POLICIES

Question

Are supporting government policies (or other information) needed or do they already exist?

Commentary

In developing our framework for analysis and answering other policy questions, we identified two areas where supporting government policies are needed:

1. **Fuel switching towards electricity**: As discussed in Policy Question 3, the provincial government may need to reconsider the fuel neutrality policy adopted for non-electric DSM efforts (currently managed by Conserve Nova Scotia) should the DSM Administrator undertake E2O FS programs.

2. **Cost sharing**: As discussed in Policy Question 4, the provincial government could assist by adopting policies regarding government and energy supplier contributions to E2O FS.

HIGH LEVEL APPROACH

This section considers the steps that the DSM Administrator could take in order to integrate E2O FS opportunities into future DSM plans. We break out actions into the short term (2010), medium term (2011) and long term (2012 and beyond), and recommend seven priority actions.

Short Term (2010): Finalizing Research, Developing Programs

To begin implementing E2O FS programs or measures, the DSM Administrator will need to do two things in parallel.

1. **Residential Pilot Program Design**: Based on the results of the recent residential E2O FS potential study, the DSM Administrator should have sufficient information to identify the most cost-effective and pressing opportunities for incorporating E2O FS into DSM plans. In order to launch pilots by 2011, designs should be completed by the fall of 2010. This would allow sufficient time to launch and fill RFPs, engage with market actors, and otherwise lay the groundwork during the fourth quarter of 2010.

2. **Commercial Potential Study**: A full potential study should be conducted for the commercial/institutional/industrial sector by the fall of 2010, to allow program design to occur during fall 2010 and/or winter 2011.

Medium Term (2011): Pilot Programs

Pilot programs may range from fully stand-alone E2O FS programs to simply integrating E2O FS measures into existing multi-measure programs such as Existing Houses program.

3. **Residential Pilot Programs**: The DSM Administrator will want to launch one or more programs in each of the two primary residential markets, new construction and retrofit markets.
    a. **New Construction**: pilot programs can begin in the winter of 2011, since programs will want to focus on working directly with builders and developers at the design stage. This should focus on ensuring measure uptake during the summer 2011 building season.
    b. **Retrofit**: Again, pilots can launch in the winter or spring of 2011, to take advantage of the renovation season (spring-fall).

4. **Commercial/Institutional/Industrial Pilot Programs**:
    a. **Design**: We assume that program design phase will be completed over the winter of 2011, allowing RFPs and other groundwork to be completed over the summer.
    b. **Launch**: We assume a fall 2011 pilot program launch will be possible, with programs developed for both the retrofit and new construction markets.

Long Term (2012 and beyond): Full Implementation

5. **Regular Programs**: Once pilots have been completed, the DSM Administrator will be able to launch full programs in all areas with significant potential.

Complementary Elements

While moving forward on programs, the DSM Administrator will likely wish to simultaneously engage government, suppliers and other stakeholders on two other fronts:

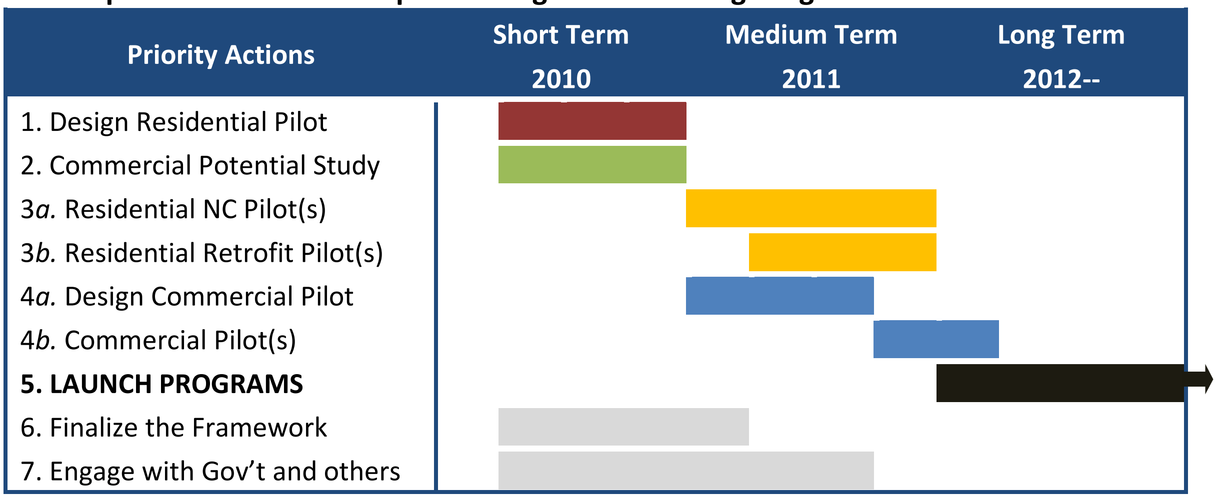
6. **Refining the Framework**: the Administrator will need to adopt the framework as recommended, make any modifications it sees fit, and (possibly) obtain approval from the UARB. This may include further engagement of stakeholders, although the PDWG has already reviewed the principles of our proposed framework. It may also involve further study to:
    a. **Confirm avoided costs and discount rates** for non-electric energy sources. <u>However, values from the recently completed residential potential study may be judged sufficiently robust.</u>
    b. **Develop emissions adders** to reflect the social cost of new emissions caused by E2O FS. <u>Conservative proxies may also be used in the interim.</u>

7. **Engagement and Negotiation**: the Administrator will want to begin engaging stakeholders (primarily government and other energy suppliers) on four topics:
    a. Cost-sharing (government and suppliers)
    b. Other-fuel-to-electric fuel switching (O2E FS) (government and suppliers)
    c. Emissions reporting (government)
    d. Broader policy options for discouraging electric space heating in New Construction (government)

As discussed previously, engagement on these issues may require longer timeframes and is not necessary in order to move forward on program design and implementation. If need be, discussions can continue while pilots are designed and launched in the medium term. Indeed, if necessary, full programs can be implemented without completing negotiations or developing complementary policies.

The Gantt chart below is illustrative of our proposed timeline for next steps, with the understanding that specific dates are approximate.

26 Proposed Timeline for Implementing Fuel Switching Programs



STAKEHOLDER ENGAGEMENT

Nova Scotia already possesses two well-developed stakeholder engagement processes for DSM planning: the DSM Program Development Working Group (PDWG), and the UARB ratemaking process. The PDWG brings together key stakeholders to review DSM plans and advise the DSM Administrator on program priorities and strategies. This is complemented by the annual filing of DSM plans to the Utility and Review Board (UARB), which provides stakeholders an opportunity to comment as intervenors.

E2O FS affects a broader range of stakeholders because of the involvement of non-electric fuels and potential issues around air emissions. These stakeholders can be grouped into two categories: government and suppliers.

Government: E2O FS is affected by, and may impact provincial policies in several areas, notably: air quality and climate change strategies; energy policy; economic development; and non-electric DSM activities. We suggest that key stakeholders to engage may include:

1. **The Nova Scotia Department of Environment:** The Department of Environment holds responsibility for the recent development of the Climate Change Action Plan. The Department also provides oversight of Conserve Nova Scotia, the agency currently responsible for non-electric DSM.
   Key Issues: air emissions treatment and costing; non-electric DSM activities (fuel neutrality policy).
2. **The Nova Scotia Department of Energy**: The Department of Energy holds responsibility for the provincial Energy Strategy, including economic development policies aimed at this sector.
   Key Issues: cost-sharing with non-electric energy suppliers; economic development of gas and biofuels sectors.

Suppliers: Energy suppliers have the potential to play a significant role in E2O FS, both as collaborators and co-funders. We suggest that key stakeholders may include:

3. **Canadian Oil Heat Association (COHA)**: COHA brings together oil companies, fuel oil dealers, installers and other market actors in the oil heating industry.
   a. **Key Issues**: review of framework and cost-effectiveness results; cost-sharing (if warranted in future); O2E FS.
4. **Heritage Gas**:
   a. **Key Issues**: review of framework and cost-effectiveness results; cost-sharing; program design; O2E FS.
5. **Canadian Bioenergy Association (CBA)**: CBA in a national nonprofit that brings together individuals, businesses and non-profits to research and lobby for biomass energy applications.
   a. **Key Issues**: program design; cost-sharing.

6. **Wood Pellet Producers**: There are two principal Nova Scotian pellet producers that we are aware of (Enligna and Shaw Resources).
    a. **Key Issues**: review of framework and cost-effectiveness results; cost-sharing; program design; O2E FS.

POTENTIAL APPROACHES

The DSM Administrator will likely want to engage stakeholders in a variety of ways, both via bilateral discussions and larger group consultations. Two possible approaches to group discussions are:

- **An enlarged PDWG**: The PDWG could be expanded for special sessions to discuss E2O FS issues.
- **A standalone E2O FS Committee**: The DSM Administrator could develop a standalone committee to discuss E2O FS issues.

APPENDIX A: CASE STUDY SUMMARIES

EFFICIENCY NEW BRUNSWICK

Drivers and Context: New Brunswick's energy utilities have not historically been required to obtain DSM resources. Instead, the provincial government has taken on this responsibility: in 2006, it created Efficiency New Brunswick (ENB), an arms-length, government funded agency responsible for promoting "the efficient use of energy and the conservation of energy in all sectors of the Province". ENB targets all forms of energy used in buildings.

ENB has also received an indirect mandate to reduce GHG emissions via the New Brunswick Climate Change Action Plan. As well as highlighting the GHG reduction impacts of ENB efforts, the plan specifies that the province will:

> *"Adopt an off-electricity heating strategy for residential and commercial buildings that will include the use of low-GHG technologies and eliminate the installation of new electric baseboards whenever alternatives are available."*[29]

This direction has been incorporated into ENB program design.

The potential purchase of New Brunswick Power by Hydro-Québec may substantially change the emissions profile of electric generation in the province, and may have an impact on future climate change and efficiency policies.

DSM and E2O FS Screening: ENB has not adopted a specific policy for evaluating the cost-effectiveness of its programs and DSM measures at this time. Many of its core programs complement existing federal ecoENERGY programs, and their design assumes that federal program designs have met cost-effectiveness criteria. ENB's initial suite of programs was also developed in consultation with Efficiency Vermont, using an informal cost-effectiveness testing process based on the TRC test and the results of an all-fuels DSM potential study. This design effort used approximated avoided costs developed by Efficiency Vermont. Subsequent programs have either been designed to complement federal programs, or have used program-specific analysis to screen measures.

ENB has not adopted a specific policy on E2O FS, beyond the direction from the provincial climate change plan to discourage new electric baseboard heating. This is accomplished in ENB's residential new construction program, which uses a tiered set of incentives to encourage the use of 'other' fuels for heating and/or the use of central heating systems (to avoid locking-in electric heat via baseboards). The current commercial new construction program does not explicitly discourage electric baseboard heat via its incentive structure. ENB is considering

[29] New Brunswick Climate Change Action Plan 2007-2012, p.14. Available at: http://www.gnb.ca/0009/0369/0015/0001-e.pdf

program design options to do so, but this review may be impacted by the pending Hydro-Québec acquisition of New Brunswick Power.

Aside from new construction space heating, ENB has essentially followed an informal 'fuel-neutral' approach to DSM programs, providing no incentives for E2O FS in existing buildings.

Air Emissions: As discussed above, New Brunswick's Climate Change Action Plan specifically directs ENB to encourage E2O FS for space heating in new construction.

Price Volatility: Not formally considered.

Cost Sharing: All ENB programs are funded by general provincial revenues.

Two-Way Street: Not formally considered.

EFFICIENCY VERMONT

Drivers and Context: Vermont's Public Services Board (PSB) oversees a state-wide electric energy efficiency program under the brand name Efficiency Vermont. The PSB sets targets and budgets for a third-party contractor operating under a long-term franchise. Vermont was a pioneer in considering E2O FS in the 1990s, at a time when it was facing high electricity costs and had relatively abundant biomass resources and low fuel oil prices. Initial programs were developed by utilities, prior to Efficiency Vermont was created. Electric utilities were initially reluctant to include E2O FS in DSM efforts. After extensive discussion, the PSB ordered utilities to include E2O FS in their DSM planning efforts. Utilities and subsequently Efficiency Vermont successfully reached a high percentage of available E2O FS opportunities. Efficiency Vermont continues to offer E2O FS measures as custom measures within its programs.

DSM and E2O FS Screening: DSM programs are screened using the SCT with a 5% adder reflecting the reduced risks of DSM programs relative to generation resources. A generic environmental adder is also used to reflect DSM environmental benefits. E20 FS programs are screened as per DSM.

Air Emissions: Air emissions are currently reflected only in a generic adder to DSM program benefits. This approach is currently under review, and will likely be replaced with a more specific approach to valuing CO2e emissions. When E2O FS was a larger component of DSM programs in Vermont, specific environmental adders were developed for each non-electric fuel to reflect their varying emissions impacts. This approach was replaced with a single adder for simplicity, but may be revisited.

Price Volatility: Price volatility is dealt with on a case by case basis when screening individual projects. Although no formal policy is in place, auditors will not generally recommend measures that have a TRC and/or participant cost test benefit-cost ratio close to 1. Auditors will also ensure that customers are aware of the risks posed by price volatility.

Cost Sharing: Efficiency Vermont will consider any existing E2O FS subsidies offered by other energy suppliers when setting its own incentive levels, but has not negotiated with energy suppliers or government re cost sharing. It pursues all cost-effective E2O FS regardless of contributions from other energy suppliers.

Two-Way Street: No other-fuel-to-electric fuel switching programs are in place.

NEW YORK STATE ENERGY RESEARCH AND DEVELOPMENT AGENCY

Note: portfolio is incomplete due to limited information from NYSERDA.

Drivers and Context: Electric DSM planning in New York is driven by a government-set state goal of reducing energy use 15% by 2015. This has been translated into an Energy Efficiency Resource Standard (EERS) by the New York Public Service Commission (PSC). DSM programs are principally designed and administered by the New York State Energy Research and Development Authority (NYSERDA), although several public utilities run separate programs and investor-owned utilities have recently begun administering some programs alongside NYSERDA. NYSERDA and IOU DSM funding is obtained via a system benefits charge determined by the PSC.

Gas DSM targets are set by the PSC, who determines funding levels by a system benefits charge.

The State Energy Planning Board periodically develops State Energy Plans, which serve a general planning function similar to an integrated resources plan, but utilities, which are not vertically integrated, do not have an IRP process. NYSERDA's most recent published electric DSM potential study (completed in 2003) specifically excludes E2O FS.

We were unable to determine if NYSERDA has a specific policy driving its treatment of E2O FS. In at least one residential program, program funds (via a low-interest loan) are available to cover fuel switching costs, including connection costs. In the case of a commercial program, fuel switching measures are specifically excluded.

DSM and E2O FS Screening: Programs are screened using the SCT, with limited or no environmental adders. Prior to the EERS, NYSERDA used test results to guide program design but did not have to meet specific cost-effectiveness ratios for its programs. Programs designed under the EERS must be cost-effective using the SCT. Treatment of E2O FS is unknown

Air Emissions: CO2e emissions are not currently assigned a value in DSM cost-benefit screening, because price forecasts are volatile. Program CO2e impacts are reported alongside energy savings.

Electric utilities in New York face CO2e caps under the Regional Greenhouse Gas Initiative (RGGI) cap-and-trade system.

Price Volatility: Unknown.

Cost-Sharing: Unknown.

Two-Way Street: Unknown.

PUGET SOUND ENERGY

Drivers and Context: Puget Sound Energy (PSE) is an integrated electric and gas investor-owned utility in Washington. PSE has had a long history of DSM programs, driven by an integrated resource planning process. PSE is also experiencing rapid growth and has historically relied on purchased electricity, making DSM an attractive option. The state has also passed legislation in 2006 requiring that utilities align their IRP process with that used by the Northwest Power and Conservation Council (NPCC – see separate entry), and that utilities "pursue all conservation that is cost-effective, reliable and feasible."

Electric-to-gas fuel switching is included as a DSM measure as part of the IRP process and screened as per other DSM measures. Fuel switching to fuels beyond gas has not been considered. PSE originally considered E2G FS measures on its own initiative, although state regulators were supportive of the inclusion of E2G FS in DSM planning.

PSE currently has several residential E2G FS programs and is planning a set of commercial E2G FS programs. Current E2G FS programs are offered only where PSE electric and gas service territories overlap. However, PSE plans on extending E2G FS programs to its entire electric service territory, including areas where it functions as an electric-only utility.

DSM and E2O FS Screening: DSM targets are set within the IRP process, which also identifies avoided costs. The Washington Utilities and Transportation Commission requires the overall DSM portfolio to meet the TRC test, with DSM benefits augmented by a 10% adder. E2O FS is treated as per conventional DSM.

Air Emissions: PSE assigns costs to CO2e and several other pollutants, based on an analysis of what pollutant taxes would be necessary to achieve state and federal air emissions targets. In practice, only CO2e costs have had a significant impact on measure cost-effectiveness. PSE calculates all E2G FS emissions based on site-level combustion.

Price Volatility: Not seen as an issue because gas-fired generation is the dominant resource affecting electricity prices.

Cost Sharing: Gas funds are used to pay for connection costs.

Two-Way Street: No gas-to-electric FS has been considered to date, PSE having assumed that there are limited or no cost-effective opportunities.

WISCONSIN FOCUS ON ENERGY

Drivers and Context: Wisconsin electric and gas utilities fund a state-wide DSM program known as Focus on Energy (FoE). FoE is funded by a legislatively-set levy of 1.2% of gross utility revenues, administered by a joint utility entity overseen by the Wisconsin Public Service Commission. This approach was put into place in 2008; previously, the Focus on Energy program was run under a different administrative arrangement but with a similar state-wide scope. Utilities can also choose to run additional, voluntary programs. Utilities are not required to use an IRP process, but the Public Services Commission undertakes a biennial Strategic Energy Assessment which performs a similar state-wide function.

E2O FS is an established part of FoE programs, in part because most utilities in the state deliver both electricity and gas. Gas to electric FS is less common but has been undertaken for some industrial processes.

DSM and E2O FS Screening: FoE portfolios for each customer sector (residential, business, agriculture) must have a benefit-cost ratio of 1.2 or more under Wisconsin's 'simple' test, essentially the Social Cost Test. Individual programs are screened for program design guidance only. Environmental externalities are largely valued only where an existing market has assigned value. E2G FS is screened as per conventional DSM, with increased fuel costs considered.

Air Emissions: CO2e is valued at $50/tonne, with both avoided electric emissions and increased gas emissions considered, based on site-level emissions.

Price Volatility: Customers are advised of the potential impacts of price volatility on a case-by-case basis, using the participant cost test and sensitivity analyses.

Cost Sharing: NA - Electric and gas utility funds are not broken out at measure or program level. There is no cost sharing in place with wood and oil suppliers.

Two-way Street: Gas to electric fuel switching is offered by FoE, principally in limited industrial custom applications.

EFFICIENCY TRUST OF OREGON

Planning Context: The Efficiency Trust of Oregon (ETO) is a non-profit agency established by the Oregon Public Utilities Commission in 2002. It designs and administers statewide energy efficiency and renewable energy programs for both electricity and gas, funded by a public purpose charge.

ETO has had a fuel switching policy in place since its creation.[30] Under this policy, ETO can provide program participants with economic analyses of fuel switching measures upon their request, but will not offer incentives for E2O FS or gas-to-electric fuel switching. This policy is based on several considerations. Firstly, regional analyses in the mid-1990s indicated that there were few opportunities for E2O FS programs.[31] Secondly, concerns about the impact of future price volatility on customer economics made ETO reluctant to recommend E2O FS measures. The policy was also driven by ETO's practical need to be seen as a neutral party in its work with both electric and gas utilities.

The policy was most recently reviewed in 2008, and is scheduled for review in 2011. It may be reconsidered if regional studies currently underway show significant fuel switching opportunities, especially as new technologies become available.

In 2004, E2O FS of electric water heaters was specifically targeted as an action item of the state's greenhouse gas mitigation strategy. This measure was subsequently put on hold due to increases in gas prices.

DSM and E2O FS Screening: ETO's DSM programs must pass both the SCT and the Utility Cost Test, although there are exceptions for some types of programs. E2O FS programs have not been considered due to ETO's fuel neutral policy.

Air Emissions: ETO values avoided CO2e emissions in its screening of DSM measures, based on regional values developed by the Northwest Power and Conservation Council.

Price Volatility: Price volatility was a key driver behind ETO's fuel neutrality policy.

Cost Sharing: NA – no programs in place.

Two-Way Street: None due to fuel neutrality policy.

[30] See http://energytrust.org/library/policies/4.03.000-P.pdf.

[31] See separate entry on the Northwest Power and Conservation Council.

SNOHOMISH COUNTY PUBLIC UTILITY DISTRICT

Drivers and Context: Snohomish County Public Utility District (SCPUD) is a public electric utility based in Washington State. It conducts IRPs as per recent state requirements that IRPs be aligned with the methodology used by the Northwest Power and Conservation Council (NPCC – see separate entry). SCPUD equally faces a state requirement to pursue all cost-effective, reliable and feasible conservation.

SCPUD has recently screened E2G FS measures but found no cost-effective opportunities. This screening was conducted with relatively low avoided costs, and may be reviewed once electric avoided costs are recalculated, scheduled for 2010.

DSM and E2O FS Screening: Both forms of DSM are screened using the TRC test with a 10% adder to reflect environmental benefits. Electric-to-oil FS has not been considered because heating oil is a marginal fuel source in the region, and wood is actively discouraged by state and regional policies because of particulate matter concerns.

Air Emissions: CO2e is valued at $10/tonne in cost-benefit screening, with avoided electric emissions based on the regional electricity generation emissions profile (SCPUD avoided costs are based on market electricity rates).

Price Volatility: Not considered because no E2G FS measures past the initial economic screening process, but SCPUD would take it into account in future program design should E2G FS measures pass.

Cost Sharing: Not considered because no E2G FS measures past the initial economic screening process.

Two-Way Street: Unknown.

B.C. HYDRO

Drivers and Context: BC Hydro is a crown-owned electric utility. It has recently (July 2009) been ordered by the British Columbia Utilities Commission (BCUC) to consider fuel switching as a DSM strategy in its next Long Term Acquisition Plan (LTAP), despite BC Hydro having made efforts to argue that fuel switching should not be considered.[32]

The issue of fuel switching was discussed at length in the 2008 LTAP application.[33] Under the Utilities Commission Act, BC Hydro is essentially required to prioritize cost-effective DSM over generation resources. The 2008 LTAP therefore incorporates all achievable DSM. Although BC Hydro's 2007 Conservation Potential Review (CPR) had identified significant cost-effective fuel switching potential, the utility did not include fuel switching in its 2008 LTAP filing, because of unfavourable participant economics (low or negative returns for customers due to low electric rates) and uncertainty around the possibility that the provincial government would act to discourage fuel switching because of negative impacts on in-province greenhouse gas (GHG) emissions.

Terasen Gas, the principal gas utility in the province, intervened in the LTAP hearing to argue that E2G FS should be included as a DSM program. It also argued that E2G FS is a legitimate GHG reduction strategy since surplus BC Hydro capacity exported into the WECC region displaces higher-emissions coal and natural gas fired electricity.

In its decision, the BCUC indicated that an LTAP that does not consider fuel switching cannot be said to have considered all cost-effective DSM opportunities. It ordered BC Hydro to prepare a discrete analysis of the cost effectiveness of fuel switching as part of its next LTAP (likely planned for 2011), specifically requiring analysis of space heating and domestic hot water in residential new construction/major renovations and small commercial applications. The BCUC further recommended that BC Hydro conduct this study in collaboration with Terasen Gas, referencing other LTAP testimony on the benefits of collaborative electric-gas DSM programs. The Commission also rejected BC Hydro's argument that the province's Greenhouse Gas Reductions Target Act (GGRTA) prohibits the consideration of fuel switching.

BC Hydro is currently in discussions with the BCUC on the exact timeline and form of an eventual study on fuel switching as a DSM strategy, and has emphasized the need for provincial government policy direction on this issue.

DSM and E2O FS Screening: BC Hydro's 2007 CRP used the Total Resource Cost test to screen the economic potential of fuel switching measures, with the cost of increased gas consumption included using gas utility avoided costs.

Air Emissions: Environmental costs were not considered in the CRP screening, although this may change in future CRPs as the value of avoided GHG emissions becomes more certain. GHG reductions policies were a central issue in the 2008 LTAP arguments. The provincial government

[32] B.C.'s LTAP process is essentially an integrated resources plan.

[33] BCUC, July 27, 2009. An Application For Approval Of The 2008 Long Term Acquisition Plan : Decision http://www.bcuc.com/Documents/Proceedings/2009/DOC_22471_LTAP_Decision_WEB.pdf

has set definitive GHG reductions targets for B.C., and has apparently informally indicated to both BC Hydro and Terasen Gas that it would not formulate a policy that would cause BC Hydro to incent electric to gas fuel switching. BC Hydro has requested more formal direction from the government regarding fuel switching.

Treatment of price volatility: BC Hydro's CRP considered price volatility in two ways. Firstly, it used a 50% adder on avoided costs for all DSM measures *except* E2O FS, to reflect uncertainties in future supply costs. This adder was not included for E2O FS measures, which face the same uncertainties. Secondly, BC Hydro was conservative in its assumptions of participant willingness to consider E2O FS, because of price volatility.

Cost Sharing: Not considered.

Two-way Street: Not considered.

NORTHWEST POWER AND CONSERVATION COUNCIL

Drivers and Context: The Northwest Power and Conservation Council (NPCC) is a regional body responsible for developing an electric integrated resource plan for the Pacific Northwest (Oregon, Washington, Montana and Idaho.

The NPCC has produced five Power Plans since 1983, the most recent released in 2004. The draft sixth Power Plan is currently under public review. These Power Plans act as integrated resource plans for the region and recommend investment levels for DSM and conventional supply resources. The plans are not, however, binding on utilities, each of which undertakes its own planning process subject to review by state utility commissions. Despite this, NPCC plans are widely seen as being a strong contributor to the high levels of DSM investment in the region. Washington state has also recently enacted legislation requiring utilities to screen DSM using the same criteria and methodology developed by the NPCC.

DSM and E2O FS Screening: To screen DSM, The NPCC Power Plan uses the results of an in-house DSM potential study using a variant of the Total Resource Cost (TRC) Test. The NPCC TRC test uses a discount rate based on an approximation of who will pay for DSM measures. The discount rate is therefore a weighted average of regional electricity utility and participant's cost of capital. The test largely includes the standard TRC benefits and costs, but also includes some non-energy benefits and environmental impacts not included in the standard TRC methodology.[34] The value of energy savings for each measure are calculated based on an annual, hourly load profile, and (under legislative requirement), costs are reduced by 10%. The NPCC includes 'other' fuel savings or costs in the consideration of DSM measures.

The NPCC has periodically considered E2O FS. In 1994, the Council considered the market for electric-to-gas (E2G) FS. It identified ~750 MW of potential but concluded that E2G FS was already being sufficiently incented by natural market forces and that there was no need for utilities to intervene. This study led to the following policy position, reaffirmed in 2004:

> *The Council recognizes that there are applications in which it is more energy efficient to use natural gas directly than to generate electricity from natural gas and then use the electricity in the end-use application. The Council also recognizes that in many cases the direct use of natural gas can be more economically efficient. These potentially cost-effective reductions in electricity use, while not defined as conservation in the sense the Council uses the term, are nevertheless alternatives to be considered in planning for future electricity requirements. The changing nature of energy markets, the substantial benefits that can accrue from healthy competition among natural gas, electricity and other fuels, and the desire to preserve individual energy source choices all support the Council taking a market-oriented approach to encouraging efficient fuel decisions in the region.*

Until recently, similar studies in the region had supported this approach. Among other findings, electric space heat had virtually disappeared from the new construction market.

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[34] For a complete description of the NPCC Conservation Supply Curve methodology, see Appendix E of the draft Sixth Plan, available here: http://www.nwcouncil.org/energy/powerplan/6/E_090309.pdf.

The NPCC is currently (November 2009) undertaking a new study of E2G FS, with final results due in the winter of 2010. The study is co-funded by the Northwest Gas Association and Puget Sound Energy. The need for a new study was driven by three factors: the increasing importance of GHG emissions mitigation; the fact that the marginal generation resource in the region is moving from hydroelectricity to natural gas and renewable energy; and the development of newer, high-efficiency technologies for gas. The results of the study will be incorporated into the final Sixth NPCC Power Plan.

The ongoing E2G FS study will use essentially the same approach as used for conventional DSM. A potential study will be used to develop generic supply curves, which will then be inputted into the IRP modelling process to determine the optimum level of E2G FS to undertake in the region under varying scenarios. However, an additional level of analysis will consider whether or not there is a need to intervene in the region – i.e., if existing market forces are already inducing an appropriate level of E2G FS.

Air Emissions: CO2e emissions are given a monetary value that varies by IRP scenario. CO2e values ranged from $0-$100/tonne CO2e, with an average value of $47.

Price Volatility: The IRP process considers multiple scenarios for future price forecasts and identifies cost-effective E2O FS options for each scenario. The issue of price volatility impacts on program design is not considered because of NPCC's focus on regional planning.

Cost Sharing: Issue not considered.

Two-way Street: Issue not considered (NPCC's mandate is limited to electric planning).

Appendix D

Preliminary Program Cost Allocation

TABLE 1 Allocation of 25% of program costs associated with system benefits.

COLUMN	A	B	C	D	E	F	G	H

Program Cost Recovery by Benefits

System Benefits	25.0%	$10,475,000
Combined Class and Participant Benefits	75.0%	$31,425,000
Total	100.0%	$41,900,000

Functionalization of System Benefit DSM Costs

	Factors
Generation	100%
Transmission	0%
Distribution	0%
Retail	0%

Classification of System Benefit DSM Costs

	Factors[1]
Demand-related	32.9%
Energy-related	67.1%
Total	100.0%

	Demand-related Costs			Energy-related Costs			Total	
Rate Class	3 CP kW Demands[2]	Demand-related	$ Amount	MWh Energy Requirement[3]	Energy-related	$ Amount	Relative Share	Total Amount
Residential Total[5]	3,200,476	48.7%	$1,677,867	4,683,148	36.8%	$2,587,858	40.7%	$4,265,725
Small General	179,891	2.7%	$94,309	283,859	2.2%	$156,857	2.4%	$251,166
General Demand	1,290,681	19.6%	$676,646	2,743,968	21.6%	$1,516,288	20.9%	$2,192,934
Large General	177,953	2.7%	$93,293	452,098	3.6%	$249,825	3.3%	$343,117
Small Industrial	109,669	1.7%	$57,495	268,699	2.1%	$148,480	2.0%	$205,975
Medium Industrial	249,246	3.8%	$130,669	615,341	4.8%	$340,031	4.5%	$470,699
Large Industrial	369,028	5.6%	$193,465	1,004,336	7.9%	$554,985	7.1%	$748,450
ELI 2P-RTP	749,730	11.4%	$393,050	2,141,160	16.8%	$1,183,182	15.0%	$1,576,232
Municipal	113,817	1.7%	$59,669	208,330	1.6%	$115,121	1.7%	$174,790
Unmetered	86,672	1.3%	$45,438	128,418	1.0%	$70,962	1.1%	$116,401
Bowater Mersey (AE only)[4]	42,861	0.7%	$22,470	182,999	1.4%	$101,124	1.2%	$123,594
Gen. Repl./ Load Foll.	(650)	-0.01%	($341)	11,322	0.1%	$6,256	0.1%	$5,916
Wholesale Market Backup/Top-up	-	0.00%	$0	-	0.0%	$0	0.0%	$0
1P-RTP	-	0.0%	$0	-	0.0%	$0	0.0%	$0
Total	**6,569,374**	**100.0%**	**$3,444,030**	**12,723,678**	**100.0%**	**$7,030,970**	**100.0%**	**$10,475,000**
Classification Breakdown		**32.9%**			**67.1%**			**100.0%**

(1) The classification is the weighted average of the fully classified total generation plant portion of rate base as shown under the heading "Fully Classified Rate Base" on line 6 of schedule 2b of the COSS.
(2) Source: Exh 9c line (14) 3 Coincident Peak (3CP) demands COS.
(3) Source: Exh 9a Annual column (3) Energy Requirement.
(4) Statistics for the AE class are predicated on the share of AE class in the total Bowater Mersey figures shown in Exh 9c line (14) and Exh 9a. The Bowater Mersey total include AE and Mersey Basic Block.
(5) All residential rate classes will use the same unit fixed cost estimate.

TABLE 2 Preliminary Allocation of 75% of DSM Program Costs associated with benefits realized by participating classes.

Line #												
1												
2	COLUMN	A	B	C	D	E	F	G	H	I	J	K
3												
4	FORMULA										Σ col A to I	J x 75%
5												
6		Program costs incurred on participating rate classes.										
7	**Program**	Efficient Products	Existing Houses	New Houses	Low Income Households	Prescriptive Rebate	Custom	Small Business DI Lighting	Education & Outreach[1]	Development & Research	All Program Costs Combined	**Program Costs Directly Assigned to Participating rate classes (75% of the total)**
8												
9	**Rate Class**											
10	Residential	$2,879,578	$6,814,755	$4,222,399	$5,194,532	$0	$0	$0	$973,926	$901,784	$20,986,973	$15,740,230
11	Small General	$334,393	$0	$0	$0	$0	$0	$1,296,572	$52,931	$49,010	$1,732,906	$1,299,680
12	General Demand	$167,196	$0	$0	$0	$3,041,521	$4,786,180	$4,735,575	$25,774	$23,864	$12,780,110	$9,585,082
13	Large General	$0	$0	$0	$0	$861,764	$1,356,084	$0	$40	$37	$2,217,926	$1,663,445
14	Small Industrial	$0	$0	$0	$0	$103,393	$162,701	$144,820	$5,109	$4,730	$420,753	$315,565
15	Medium Industrial	$0	$0	$0	$0	$516,966	$813,505	$0	$467	$433	$1,331,371	$998,528
16	Large Industrial	$0	$0	$0	$0	$568,663	$894,855	$0	$89	$83	$1,463,690	$1,097,768
17	ELI 2P-RTP	$0	$0	$0	$0	$0	$0	$0	$4	$4	$9	$6
18	Municipal	$69,657	$126,902	$78,628	$96,731	$138,941	$218,639	$194,554	$13	$12	$924,077	$693,058
19	Unmetered	$0	$0	$0	$0	$0	$0	$0	$21,895	$20,273	$42,167	$31,625
20	Bowater Mersey (AE only)	$0	$0	$0	$0	$0	$0	$0	$2	$2	$4	$3
21	GRLF	$0	$0	$0	$0	$0	$0	$0	$7	$6	$13	$10
22	Wholesale Market Backup/Top-up	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
23	1P-RTP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
24	**Total**	**$3,450,824**	**$6,941,657**	**$4,301,026**	**$5,291,263**	**$5,231,249**	**$8,231,965**	**$6,371,521**	**$1,080,258**	**$1,000,239**	**$41,900,000**	**$31,425,000**

32 Notes:

27 1 Education & Outreach and Development & Research costs allocated based on Customer counts COSS, 2009 Compliance Filing

TABLE 2 a) Estimate of DSM Program participation by rate classes before accounting for the Municipal Class

Line #	COLUMN	A	B	C	D	E	F	G
5		Relative shares of program costs incurred on participating rate classes before Municipal						
6	**Program**	Efficient Products	Existing Houses	New Houses	Low Income Households	C & I Prescriptive Rebate	C & I Custom	Small Business DI Lighting
7	**Rate Class**							
8	Residential	85.0%	100.0%	100.0%	100.0%	0.0%	0.0%	0.0%
9	Small General	10.0%	0.0%	0.0%	0.0%	0.0%	0.0%	21.0%
10	General Demand	5.0%	0.0%	0.0%	0.0%	60.0%	60.0%	76.7%
11	Large General	0.0%	0.0%	0.0%	0.0%	17.0%	17.0%	0.0%
12	Small Industrial	0.0%	0.0%	0.0%	0.0%	2.0%	2.0%	2.3%
13	Medium Industrial	0.0%	0.0%	0.0%	0.0%	10.0%	10.0%	0.0%
14	Large Industrial	0.0%	0.0%	0.0%	0.0%	11.0%	11.0%	0.0%
15	ELI 2P-RTP	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
16	Municipal	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
17	Unmetered	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
18	Bowater Mersey (AE only)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
19	GRLF	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
20	Wholesale Market Backup/Top-up	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
21	1P-RTP	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
22	**Total**	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
23								

TABLE 2 b) Preliminary Estimate of DSM Program participation by rate class after accounting for the Municipal Class

Line #	COLUMN	A	B	C	D	E	F	G
4		Calculation of relative class shares in DSM load reduction effects.						
5	**Program**	Efficient Products	Existing Houses	New Houses	Low Income Households	C & I Prescriptive Rebate	C & I Custom	Small Business DI Lighting
6								
7	**Rate Class**							
8	Residential	83.4%	98.2%	98.2%	98.2%	0.0%	0.0%	0.0%
9	Small General	9.7%	0.0%	0.0%	0.0%	0.0%	0.0%	20.3%
10	General Demand	4.8%	0.0%	0.0%	0.0%	58.1%	58.1%	74.3%
11	Large General	0.0%	0.0%	0.0%	0.0%	16.5%	16.5%	0.0%
12	Small Industrial	0.0%	0.0%	0.0%	0.0%	2.0%	2.0%	2.3%
13	Medium Industrial	0.0%	0.0%	0.0%	0.0%	9.9%	9.9%	0.0%
14	Large Industrial	0.0%	0.0%	0.0%	0.0%	10.9%	10.9%	0.0%
15	ELI 2P-RTP	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
16	Municipal	2.0%	1.8%	1.8%	1.8%	2.7%	2.7%	3.1%
17	Unmetered	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
18	Bowater Mersey (AE only)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
19	GRLF	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
20	Wholesale Market Backup/Top-up	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
21	1P-RTP	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
22	**Total**	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
23								

Relative Shares of Municipal sales in total NSPI sales by sector

DSM-eligible sales by sector	NSPI		Breakdown of Municipal Class Sales by Sector[1]	
Residential	4,196,814,670.10	38.9%	76,722,759	1.8%
General	3,221,740,708.40	50.6%	99,798,756	3.1%
Industrial (before ELI 2P-RTP, GRLF, Mersey BB)	1,759,048,441.10	10.5%	20,709,228	1.2%
	9,177,603,819.60	100.0%	197,230,744	2.1%

1) Source: Municipal electric utility sales and purchase forecasts for 2010 provided by MEUNSC

TABLE 3 Preliminary Allocation of Program Costs among rate classes

Line #									
3	**COLUMN**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
5	**FORMULA**	**Table 2 Column K**		**Table 1 Column H**		**Table 2 Column L**		**C + E**	
7		**Total Expenditure by Rate class**		**System Benefit Costs (25% of the total expenditure allocated to classes using COS methodology)**		**Participating Class benefit Costs (75% of the total expenditure directly assigned to participating classes)**			
8		**$ Amount**	**Relative Share**	**$ Amount**	**Relative Share**	**$ Amount**	**Relative Share**	**$ Amount**	**Relative Share**
9	**Rate Class**								
10	Residential Subtotal	$20,986,973	50.1%	$4,265,725	40.7%	$15,740,230	50.1%	$20,005,955	47.7%
11	Small General	$1,732,906	4.1%	$251,166	2.4%	$1,299,680	4.1%	$1,550,846	3.7%
12	General Demand	$12,780,110	30.5%	$2,192,934	20.9%	$9,585,082	30.5%	$11,778,017	28.1%
13	Large General	$2,217,926	5.3%	$343,117	3.3%	$1,663,445	5.3%	$2,006,562	4.8%
14	Small Industrial	$420,753	1.0%	$205,975	2.0%	$315,565	1.0%	$521,539	1.2%
15	Medium Industrial	$1,331,371	3.2%	$470,699	4.5%	$998,528	3.2%	$1,469,228	3.5%
16	Large Industrial	$1,463,690	3.5%	$748,450	7.1%	$1,097,768	3.5%	$1,846,218	4.4%
17	ELI 2P-RTP	$9	0.0%	$1,576,232	15.0%	$6	0.0%	$1,576,239	3.8%
18	Municipal	$924,077	2.2%	$174,790	1.7%	$693,058	2.2%	$867,848	2.1%
19	Unmetered	$42,167	0.1%	$116,401	1.1%	$31,625	0.1%	$148,026	0.4%
20	Bowater Mersey (AE only)	$4	0.0%	$123,594	1.2%	$3	0.0%	$123,597	0.3%
21	GRLF	$13	0.0%	$5,916	0.1%	$10	0.0%	$5,925	0.0%
22	Wholesale Market Backup/Top-up	$0	0.0%	$0	0.0%	$0	0.0%	$0	0.0%
23	1P-RTP	$0	0.0%	$0	0.0%	$0	0.0%	$0	0.0%
24	Total	$41,900,000	100.0%	$10,475,000	100.0%	$31,425,000	100.0%	$41,900,000	100.0%