Energy Efficiency Initiative Designs and Achievable Potential for Prince Edward Island

Final Report

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I. Introduction and Executive Summary

A. Introduction and Summary of Energy Savings

This report presents a portfolio of cost-effective, all-fuels energy efficiency initiatives that if pursued on Prince Edward Island would substantially reduce energy use and lower greenhouse gas (GHG) emissions by 2017. This study examined energy and GHG savings potential in the following sectors:

- Residential
- Commercial and Institutional (C&I)
- Transportation

The development of this portfolio of initiatives was informed by the estimation of the achievable energy efficiency potential for Prince Edward Island in the 2008 through 2017 timeframe. Different analytical approaches were used to estimate the achievable potential in the buildings (residential and C&I) and transportation sectors. Efficiency opportunities in the industrial and agricultural sector were not part of this study's scope. The province may focus on efficiency opportunities in these sectors at a later date.

While Prince Edward Island (PEI) is a recognized leader in the use of renewable energy development – approximately 18% of its electricity is produced by wind and biomass (wood and municipal solid waste) – the Province has not yet aggressively pursued energy efficiency opportunities. While a limited number of efficiency activities have been implemented as a result of federal, provincial and utility efforts, there has not been a comprehensive set of efficiency initiatives offered to PEI's residents and businesses. This report characterizes this savings opportunity and its corresponding greenhouse gas emissions impacts and proposes a set of initiative designs that could be implemented to attain significant reductions in both energy use and GHG emissions. A ten-year initiative implementation timeframe (2008-2017) is assumed.

Benefits from implementing the proposed initiatives include, but are not limited to:

- Reducing consumer and business energy bills
- Lowering emissions of greenhouse gases and other pollutants
- Stimulating the PEI economy by reducing outflows of consumer energy dollars
- Avoiding or delaying capital expenditures for upgraded transmission or distribution facilities
- Increasing the percentage of energy use met by on-island renewables by reducing energy demand
- Job creation

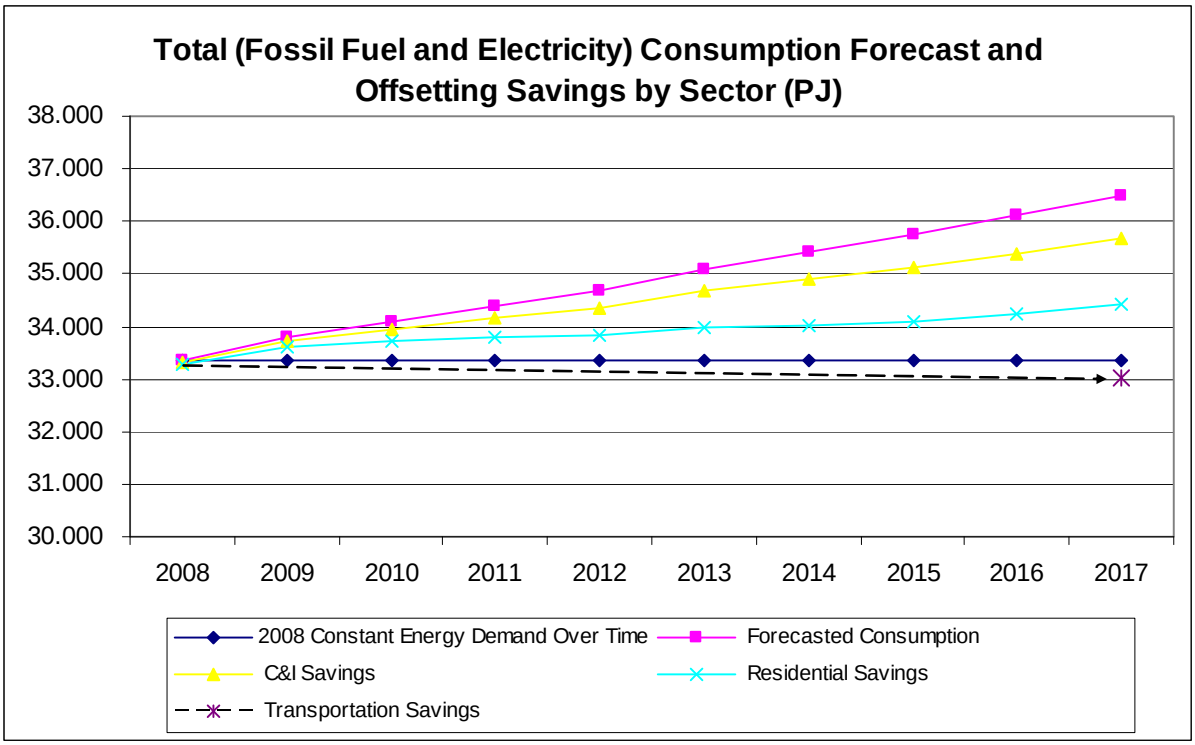
Pursuit of these benefits is generally consistent with both federal and provincial policies, e.g. the Renewable Energy Act, and pronouncements on energy and the environment.

Figure 1 shows how the recommended efficiency initiatives could offset all of the projected energy growth on PEI forecasted by 2017. All energy sources are converted to a common measure of energy: petajoules, or a quadrillion joules. A petajoule (PJ) is equivalent to:

- 25,832,651 litres of home heating fuel oil
- 28,726,473 litres of automotive gasoline
- 277,777,778 kWh of electricity

The top line in the graph represents the forecasted load growth from 2008 to 2017. There is also a flat line projection of 2008 estimated energy use. The other lines represent the reduction in forecasted energy[1] use from the successive implementation of the three sets of recommended initiatives – C&I, then residential and finally transportation[2]. The two sets of building initiatives (C&I and residential) lower the projected energy use in 2017 to a level nearly equivalent to 2008 estimated energy use. The addition of the transportation initiatives lowers energy use in 2017 to less than 2008 estimates.

Figure 1: Annual Energy Savings by Sector versus Forecasted Consumption and 2008 baseline consumption, All energy types (PJ/year)



[1] When expressed as petajoules (PJ), all electricity savings and consumption values reflect primary energy use at generation, i.e., they are adjusted for line losses and are calculated based on a 10,000 Btuh/kWh heat rate.

[2] Annual transportation savings were not explicitly calculated in this study; only cumulative annual savings in 2017. However, for Figure 1 a reasonable extrapolation of annual savings was made based on the 2017 savings estimate and the ramp-up of similar efficiency initiatives.

B. Reference Case Energy Use and Greenhouse Gas Emissions

To serve as a benchmark against which estimated energy and greenhouse gas savings could be compared, reference case energy and GHG projections were developed for each of the sectors examined. Data from multiple sources were aggregated to develop these projections as there are not official provincial energy use or GHG sector level forecasts.

Energy demand for all sectors included in this study is estimated to be 33 petajoules (PJ) in 2008 increasing to 36.5 PJ in 2017. Total energy demand is forecast to grow at a rate of 1% annually for 2008 through 2017 based on information from government and utility sources. The growth rate for electricity is estimated at an average of 2% annually over the same time frame. Oil is estimated to grow at an annual rate of 1%. The rate of growth for propane is forecasted to remain unchanged for 2011 to 2015; however a slight increase is forecasted for 2016 and 2017. Biomass energy use is expected to remain unchanged for 2008-2017.

In the transportation sector, no growth is forecasted for gasoline, ethanol and jet fuel for 2008 through 2017. For diesel fuel, however, a growth rate of 1% is forecasted for 2008 through 2015 with level demand for 2016 and 2017.

Table 1 shows that in 2008 energy use in buildings – the residential and C&I sectors – represents 63% of total energy use compared to 37% for the transportation sector. By 2017, energy use in buildings increases to 65% of total use, while transportation energy use falls to 35% of the total.

Table 1: Projected Energy Demand, All Sectors Combined, By Fuel Type

All Sectors Energy Demand:	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
C&I and Residential Energy Demand:										
Oil (PJ)	6.4	6.5	6.5	6.6	6.6	6.7	6.7	6.8	6.9	7.0
Propane (PJ)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Biomass (PJ)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Sub-Total C&I and Res Fossil Fuel (PJ)	9.6	9.7	9.7	9.8	9.8	9.9	9.9	10.0	10.1	10.2
Sub-Total C&I and Res Fossil Fuel (mm litres #2 fuel oil)	250	252	252	254	255	257	258	260	263	265
Electricity (PJ)	11.4	11.6	11.8	12.0	12.3	12.5	12.8	13.0	13.3	13.6
Sub-Total C&I/Residential (PJ)	21.0	21.3	21.5	21.8	22.1	22.4	22.7	23.0	23.4	23.8
Sub-Total C&I/Residential (in million litres #2 fuel oil)	547	554	559	566	574	582	591	599	609	619
Transportation Energy Demand:										
Motor Gasoline (PJ)	8.2	8.3	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Ethanol (PJ)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Diesel fuel (PJ)	3.7	3.8	3.8	3.8	3.8	3.9	3.9	3.9	3.9	3.9
Jet fuel (PJ)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Sub-Total Transportation Fossil Fuel (PJ)	12.3	12.5	12.6	12.6	12.6	12.7	12.7	12.7	12.7	12.7
Sub-Total Fossil Fuels (in million litres #2 fuel oil)	320	325	328	328	328	330	330	330	330	330
Total Energy Demand (PJ)	33.3	33.8	34.1	34.4	34.7	35.1	35.4	35.7	36.1	36.5
Total Fossil Fuel (PJ)	21.9	22.2	22.3	22.4	22.4	22.6	22.6	22.7	22.8	22.9
Total Fossil Fuel (in million litres #2 fuel oil)	569	577	580	581	583	587	589	590	593	595

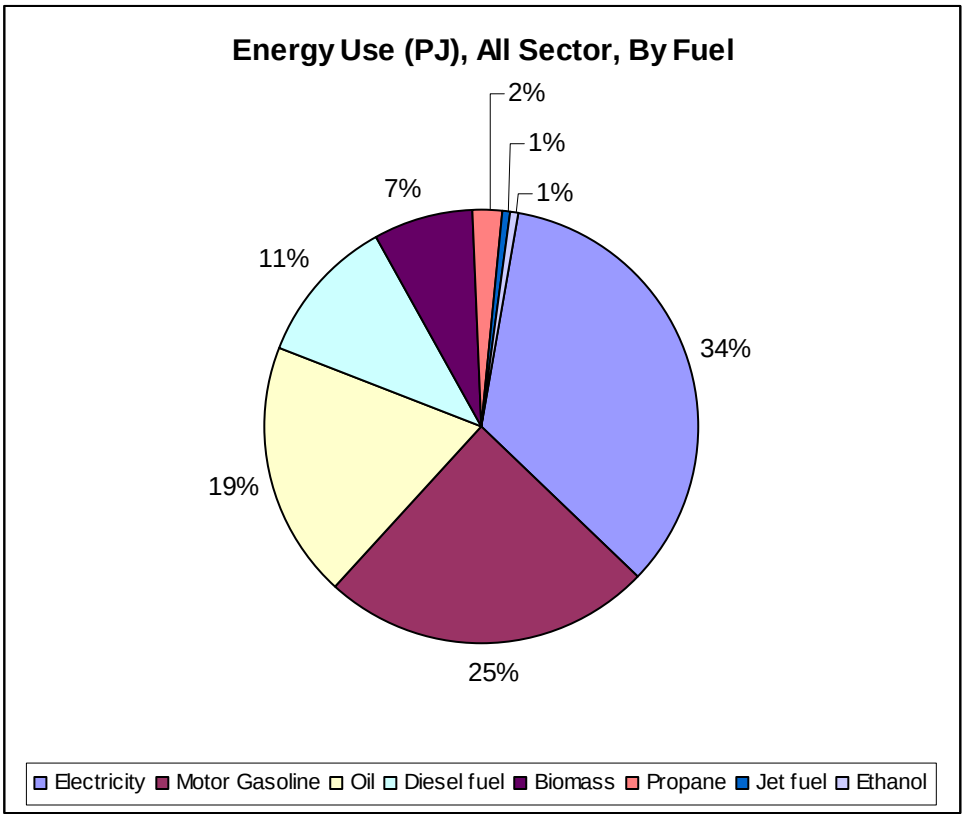
Based on these forecasts the growth rate for greenhouse gas carbon emissions (Table 2) for all sectors included in this study is forecasted to increase approximately 1% annually.

Table 2: Carbon Emissions, All Sectors Combined

All Sectors Greenhouse Gas Emissions	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GHG emissions (Megatons CO2 equivalent)	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4

Total energy use for the sectors included in this study is broken down by fuel type (Figure 2) as follows: 34% of energy consumption is attributable to electricity, 25% to gasoline, 19% to oil, 11% to diesel fuel, 7% to biomass, 2% to propane, 1% to ethanol and 1% for jet fuel.

Figure 2: 2008 Energy Use (PJ), All Sectors Combined, By Fuel Type



C. Technical and Economic Potential Results for the Residential and C&I Sectors

While achievable potential - the amount of cost-effective energy efficiency potential that could be attained through aggressive but realistic, initiative efforts – was the primary analytical objective of this study, estimates of both technical and economic potential were made for the residential and C&I sectors. A review of previous potential studies for Canada and the U.S. yielded estimates of likely percentage reductions in energy use in the residential and C&I sectors. These percentage multipliers were then applied to reference case energy use projections to develop estimates of technical & economic potential for Prince Edward Island.

Table 3 shows the estimated PEI residential and C&I technical and economic potential energy savings using 2017 as the reference year. The technical and economic potential in the building sector are estimated to be 37.64 and 5.94 PJ; respectively. Electricity savings are estimated as 30% for technical potential and 25% for economic potential. Fossil fuel savings are estimated as 35% and 25%; respectively for technical and economic potential. For the combined fuels (electricity and fossil), savings are estimated as 32% for technical potential and 25% for economic potential. For comparative purposes the achievable potential estimates for 2017 are also listed.

Table 3: PEI Technical and Economic Potential Estimates - Residential and C&I Sectors - 2017 Reference Year

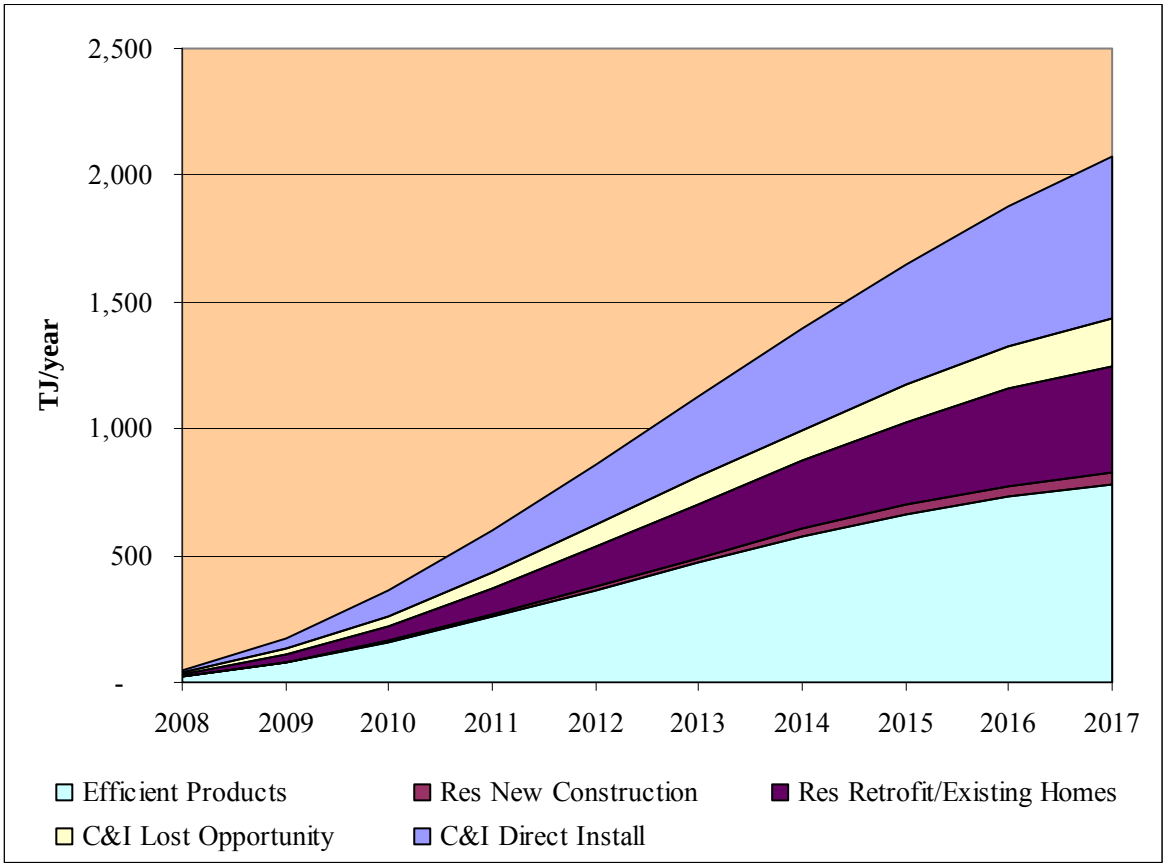
	Consumption/Reduction in Energy Use		
Sector/Fuel	Technical	Economic	Achievable
Electricity			
Residential Base Consumption (2017 PJ)	6.20	6.20	6.20
Residential Savings	1.86	1.55	0.63
C&I Base Consumption (2017 PJ)	7.35	7.35	7.35
C&I Savings	2.21	1.84	0.80
Total Electricity Consumption (2017 PJ)	13.55	13.55	13.55
Total Electricity Savings	4.07	3.39	1.43
Percent Savings	30%	25%	11%
Fossil Fuel & Biomass			
Residential Base Consumption (2017 PJ)	5.20	5.20	5.20
Residential Savings	1.82	1.30	0.44
C&I Base Consumption (2017 PJ)	5.00	5.00	5.00
C&I Savings	1.75	1.25	0.20
Total Fossil Fuel& Biomass Consumption (2017 PJ)	10.20	10.20	10.20
Total Fossil Fuel & Biomass Savings (2017 PJ)	3.57	2.55	0.64
Percent Savings	35%	25%	6%
Total Combined Fuel Consumption (2017 PJ)	23.75	23.75	23.75
Total Combined Fuel Savings	7.64	5.94	2.07
Percent Savings	32%	25%	9%

D. Achievable Potential for the Residential and C&I Sectors

In 2017, the proposed residential and C&I sector initiatives reduce forecasted electricity use by 11% and non-electric energy use by 6% (Table 3). Winter peak demand savings are 17.8 MW. Net economic benefits over the ten-year implementation timeframe are $151 million, including estimated GHG credits with the initiative portfolio having an overall societal benefit cost ratio of 2.8. GHG emissions are reduced by 148,000 tons in 2017. Without any assumed GHG credits, the net economic benefits are $127 million and the portfolio of initiatives has a total resource benefit cost ratio of 2.5.

The largest achievable electricity savings comes from the Efficient Products initiative, primarily from CFLs. The proposed Homes initiative generates the greatest non-electric savings. Across all fuels, the largest achievable savings is from Efficient Products, followed closely by the C&I Direct Install initiative (Figure 3).

Figure 3: Annual Energy Savings by Initiative, All energy types (TJ/year)



E. Achievable Potential for the Transportation Sector

Table 4 summarizes the findings of the analysis, including effectiveness (fuel saved and tonnes of GHG reduced), total social cost, and cost-effectiveness (dollars per litre of fuel saved and tonne of GHG reduced). Negative cost and cost-effectiveness results (shown in red text in parentheses) indicate that there is a net social benefit, e.g., due to fuel savings. The results are presented as annual savings in the year 2017.

Table 4: Transportation Sector Analysis Results (Year 2017)

Strategy	Effectiveness		Cost	Cost-Effectiveness	
	Fuel saved (milllion L)	GHG tonnes reduced	Total Social Cost	Cost per litre	Cost per tonne
1 - Alternative Fuel Subsidy	13.35	31,036	$ 3,437,218	$ 0.26	$ 111
2 - Fuel Economy Feebates	13.17	30,614	$(10,128,937)	$ (0.77)	$ (331)
3 - Gov't Fleet Purchase	0.13	306	$ (83,621)	$ (0.64)	$ (274)
4 - GHG Emission Standards	22.81	53,041	$(14,967,794)	$ (0.66)	$ (282)
5 - Transit Enhancement	0.19	435	$ 1,754,998	$ 9.37	$ 4,032
6-Telecommuting	0.88	2,049	$ (1,268,923)	$ (1.44)	$ (619)
7 - Signal Synchronization	0.33	763	$ (2,459,527)	$ (7.50)	$ (3,224)
8 - Anti-idling campaign	0.08	185	$ 50,272	$ 0.63	$ 272
9 - Education and Outreach	3.46	8,035	$ (1,588,887)	$ (0.46)	$ (198)

Six of the nine strategies are recommended due to high cost-effectiveness and no significant adverse impacts, with the caveat that fuel economy feebate/rebates and GHG emission standards need to be more carefully analyzed before being jointly implemented due to substantial overlap:

- Fuel economy feebates/rebates;
- Government fleet purchases;
- GHG emission standards;
- Telecommuting/compressed work week;
- Traffic signal synchronization; and
- Education/awareness campaigns for non-speed measures.

Two analyzed strategies with low cost-effectiveness were recommended:

- Anti-idling campaign,
- Speed reductions

Of the analyzed strategies, two were recommended to not be implemented:

- Alternative fuel subsidies
- Transit service enhancements

F. Summary of Recommendations

Proposed Initiative Designs

There is considerable cost-effective energy savings potential that could be pursued on Prince Edward Island. Based on the results from the achievable potential analyses, the following initiatives are recommended for implementation on PEI.

Residential Sector

- Efficient Products Initiative – appliances, lighting, windows, and potentially consumer electronics
- Homes Initiative – principally focused on existing homes, leveraging ecoEnergy/EnerGuide audits. Also proposed to have a modest new construction component, though further research on this initiative component is recommended.

Commercial & Institutional Sector

- C&I buildings – a single C&I umbrella initiative that offers multiple participation tracks:
  - Direct install for small/medium customers
  - Retrofit for larger C&I customers
  - Lost opportunity for both equipment replacement and new construction

Transportation Sector

- Vehicle fuel economy incentives;
- Government fleet purchase;
- GHG emission standards;
- Telecommuting/compressed work week;
- Traffic signal synchronization;
- Education and outreach for non-speed measures;
- Anti-idling campaign; and
- Speed reductions.

In developing these proposed initiative designs no presumption was made regarding initiative administration. There are a number of possible administrative models that could be pursued including oversight and implementation by a PEI provincial agency, Maritime Electric, or a newly created efficiency utility.

Proposed incentives for the residential and C&I initiatives consist primarily of consumer rebates, as well as some limited financing offerings. While tax credits could also be implemented to support these proposed initiatives, they are unlikely to have a similar impact and what savings they do generate will often be at a higher cost. Further, it is usually much easier to adjust initiative rebates to reflect changing market conditions and initiative objectives. Modifications to tax credits typically require legislative action, involve longer lead times, and may often be difficult to change once in place.

II. Reference Case for Energy and Carbon

As part of the potential study, a reference case was developed to estimate future PEI energy demand and greenhouse gas carbon emissions. Data in the reference case are organized by year, by sector and by fuel type. Historical data were collected for years 1990 through 2004[3] and projections for the reference case were developed for years 2008 through 2017. Sector categories examined were commercial & institutional (C&I), residential and transportation. Fuel categories for C&I and residential sectors are electricity, oil, natural gas, propane and biomass. Fuel categories for the transportation sector are motor gasoline, diesel fuel, ethanol and jet fuel. The Transportation sector data are further broken down into sub-sectors: road passenger, road freight, transit, air, marine and off-road. Greenhouse gas emissions data are included in each of the sectors above and represented in megatons of carbon dioxide equivalent. The large set of historical data collected provides a solid basis of information from which to estimate future energy demand for fuel use and carbon emissions.

The development of the reference case satisfied two important project needs.

First, the Prince Edward Island provincial government does not perform its own projections of energy use by fuel type and sector. However, information was available from different sources including Natural Resources Canada, Statistics Canada, Baker Consulting, and Maritime Electric to develop a provincial forecast. From these data, projected energy use and carbon emissions data for each sector and by all fuel types were developed.

The second reason for developing a reference case was to establish a useful point of comparison against which to measure technical, economic and achievable potential. This benchmark serves as a reliable starting point for evaluating future energy use and savings estimates.

[3] Biomass usage data was available through 2006

A. Data Sources and Methodology

The following tables reflect the data sources in the reference case categorized by sector (commercial & institutional, residential, and transportation), time frame (historical, and projected) and type (energy demand and carbon emissions).

Data Sources for the Commercial and Institutional Sectors

Canada's Energy Outlook: The Reference Case 2006 is the source for historical and projected data for energy demand (PJ) and carbon emissions. Historical and projected gigawatt hour (GWh) data were obtained from Bob Younker, Director of Corporate Planning at Maritime Electric.

HISTORICAL	Data Source	PROJECTED	Data Source
Energy Demand (PJ)	Canada's Energy Outlook: Reference Case 2006, Appendix V: Provincial Tables, Pg 153	Energy Demand (PJ)	Canada's Energy Outlook: Reference Case 2006, Appendix V: Provincial Tables, Pg 153
Biomass (PJ)	David Godkins, PEI Energy Systems, Year 2006	2006 biomass use held constant	Provincial government estimate
Energy Demand (GWh)	Maritime Electric (Bob Younker, Director of Corporate Planning)	Energy Demand (GWh)	Maritime Electric (Bob Younker, Director of Corporate Planning)
Carbon Emissions	Canada's Energy Outlook: Reference Case 2006, Appendix V: Provincial Tables, Pg 156	Carbon Emissions	Canada's Energy Outlook: Reference Case 2006, Appendix V: Provincial Tables, Pg 156

Data Sources for the Residential Sector

The source for historical data for energy demand (PJ) is Natural Resources Canada's Residential Sector Tables for Prince Edward Island. This source was used because of the greater detail available compared with that found elsewhere. The source for projected data for energy demand and for historical and projected data for carbon emissions is Canada's Energy Outlook: The Reference Case 2006. Historical and projected gigawatt hour (GWh) data were obtained from Bob Younker, Director of Corporate Planning at Maritime Electric.

HISTORICAL	Data Source	PROJECTED	Data Source
Energy Demand (PJ)	Natural Resources Canada, Residential Sector Tables, Prince Edward Island, Table 1	Energy Demand (PJ)	Canada's Energy Outlook: Reference Case 2006, Appendix V: Provincial Tables, Pg 153
Biomass (PJ)	Prince Edward Island Wood Fuel Survey 2006, May 2006, Baker Consulting, Inc.	2006 biomass use held constant	Provincial government estimate
Energy Demand (GWh)	Maritime Electric (Bob Younker, Director of Corporate Planning)	Energy Demand (GWh)	Maritime Electric (Bob Younker, Director of Corporate Planning)
Carbon Emissions	Canada's Energy Outlook: Reference Case 2006, Appendix V: Provincial Tables, Pg 156	Carbon Emissions	Canada's Energy Outlook: Reference Case 2006, Appendix V: Provincial Tables, Pg 156

Data Sources for the Transportation Sector

The source for historical and projected data for energy demand of motor gasoline, diesel fuel and jet fuel is Canada's Energy Outlook: The Reference Case 2006. Projected data for energy demand of ethanol were calculated based on a percent of motor gasoline demand (PJ) as stated in Canada's Energy Outlook: The Reference Case 2006. The source for historical data for energy demand for road passenger, road freight, transit, air, marine and off-road is Natural Resources Canada's, Transportation Sector Tables for Prince Edward Island. Projected data for energy demand for road passenger, road freight, transit, air, marine and off-road are extrapolated from data in NRCan's Transportation tables. The source for historical data for carbon emissions is Natural Resources Canada's, Transportation Sector Tables for Prince Edward Island. Projected data for road passenger, road freight and off-road carbon emissions are extrapolated from data in NRCan's Transportation tables.

Historical	Data Source	Projected	Data Source
Energy Demand (PJ) *Motor Gasoline, Diesel Fuel, Jet Fuel*	Canada's Energy Outlook: Reference Case 2006, Appendix V: Provincial Tables, Pg 153	Energy Demand (PJ) *Motor Gasoline, Diesel Fuel, Jet Fuel*	Canada's Energy Outlook: Reference Case 2006, Appendix V: Provincial Tables, Pg 153
Energy Demand (PJ) *Ethanol*	Calculation: 2% of Motor Gasoline (Canada's Energy Outlook: Reference Case 2006, Pg 23)	Energy Demand (PJ) *Ethanol*	Provincial government estimate of 0 PJ through 2010, then, 2% of Motor Gasoline (Canada's Energy Outlook: Reference Case 2006, Pg 23)
Energy Demand (PJ) *Road Passenger, Road Freight, Transit, Air, Marine, Off-Road*	Natural Resources Canada (NRCan), Transportation Sector Tables, Prince Edward Island, Table 7	Energy Demand (PJ) *Road Passenger*	Extrapolated from 2004 Energy Demand, based on percent (%) change in Motor Gasoline use forecast
		Energy Demand (PJ) *Road Freight*	Extrapolated from 2004 Energy Demand, based on percent (%) change in Diesel fuel use forecast
		Energy Demand (PJ) *Transit, Air, Marine, Off-Road*	Held constant at 2004 levels
Carbon Emissions	Natural Resources Canada,	Carbon Emissions *Road Passenger*	Based on estimates of energy use by sector

	Transportation Sector Tables, Prince Edward Island, Table 4		multiplied by fuel-specific GHG conversion factors. Assumed gasoline for road passengers, diesel for transit
		Carbon Emissions *Road Freight*	Based on estimates of energy use by sector multiplied by fuel specific GHG conversion factors. Mix of gasoline and diesel based on Transportation Sector Tables, Table 3 (Year 2004)
		Carbon Emissions *Off-Road*	Based on estimates of energy use by sector multiplied by fuel-specific GHG conversion factors

In the process of collecting historical data for the reference case, a discrepancy was discovered in the breakdown by sector (Residential, Commercial, Industrial) for PEI electricity use (GWh) between "Canada's Energy Outlook: The Reference Case 2006" and information received from Maritime Electric. Residential sales differ by 30% and the breakdown between industrial and commercial sales is inconsistent although total sales from each source are roughly the same. For example, in 2000, Maritime Electric reports sales data of 957 GWh compared with NRCan's 960 GWh. In Year 2004, Maritime Electric reported total sales to be 1,088 GWh compared with 1,064 GWh reported by NRCan.

Another peculiar finding is the 43% drop in residential GWh sales from 278 GWh in 2000 to 159 GWh in 2004 found in NRCan's "The Reference Case 2006". In comparison, over the same time period, Maritime Electric reported a steady 4% increase. In addition, in the Industrial sector, sales reported by NRCan show a significant increase of 69% from 2000 to 2004, but Maritime Electric reports only a slight increase in GWh sales for the same period.

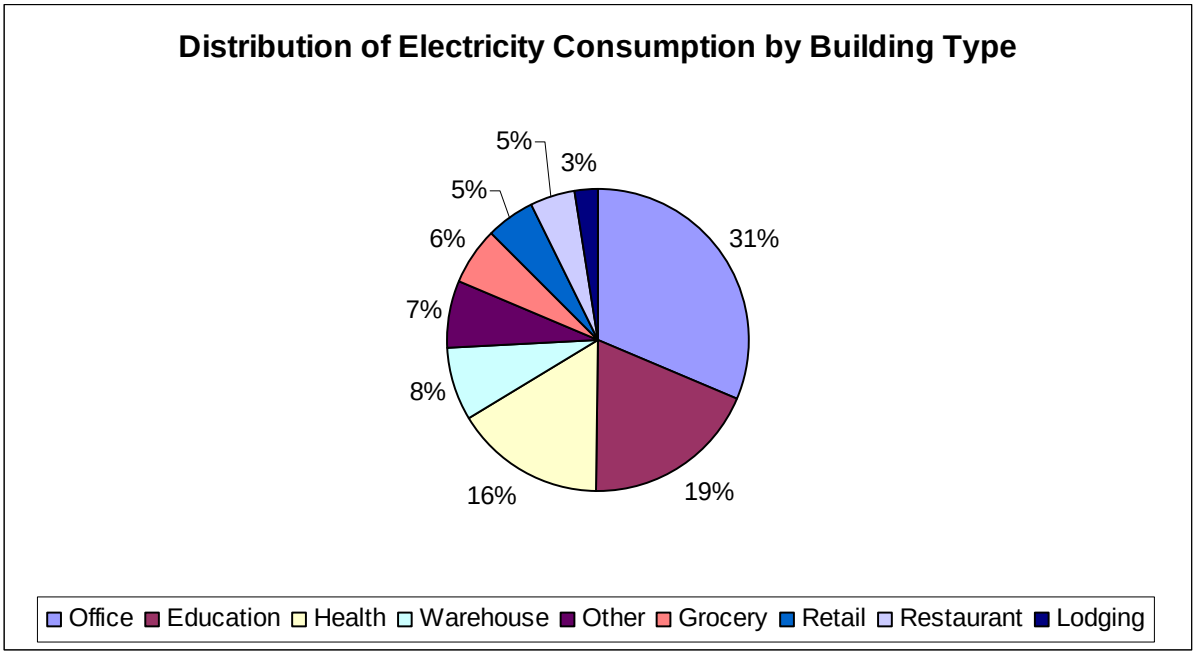
A call to NRCan to discuss these findings, unfortunately, was not fruitful other than discovering the data was sourced from Statistics Canada. NRCan mentioned the possibility that Statistics Canada may have incorrectly calculated the sales data. Given the discrepancies in the historical NRCan data, Maritime Electric data were used.

B. Demographic and Sector Data

Commercial and Institutional Sector:

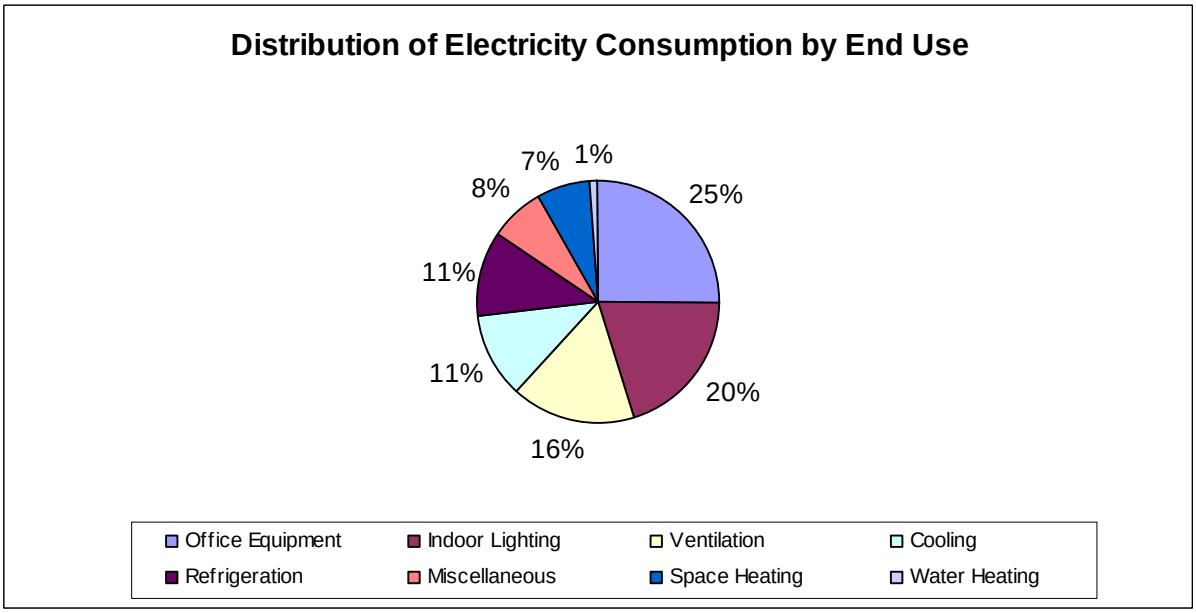
In 2004, the building type with highest electricity consumption was 'office' at 31% of total electricity use. This building type consistently had the highest electricity use during 1990-2004. Education, at 19% and health, at 16% rank second and third, respectively, over the same time span. Warehouse (8%), 'other' including art, entertainment, recreation (7%), grocery (6%), retail (5.5%), restaurant (5%) and lodging (2.5%) round out the C&I Sector energy use. Figure 4 below provides a graphical representation.

Figure 4: Distribution of C& I Electricity Consumption, Year 2004, By Building Type



End use breakdowns for electricity consumption (Figure 5) in 2004 classify office equipment as the highest use category with 25% of total electricity use. Indoor lighting is the second highest category with 20% of the total electricity consumption, ventilation with 16% of total consumption, cooling and refrigeration each with 11%, miscellaneous items with 8%, space heating with 7% and water heating with 1%.

Figure 5: Distribution of C&I Electricity Consumption, Year 2004, By End Use



Residential Sector

In 2004, the population of PEI was 138,000 as referenced in "Canada's Energy Outlook". This represents a modest annual increase in population at rate of .27% from 1995 to 2004. Population growth estimates are expected to increase at an annual rate of .10% through 2010 and continue to increase at a slower annual rate of .04% from 2010 to 2015.

In 2004, the number of households in PEI was 54,400, as referenced by Natural Resources Canada. Households grew at steady annual rate of 1% from 1995-2004 and are expected to continue increasing at the same rate over 2008-2017. By 2015, the number of households is expected to be 59,300. The mix of housing stock has been very consistent over the years. Since 1990, the breakdown has followed a similar pattern: 71% of homes are single detached, 5% are single attached, 19% are apartments and 5% are mobile homes. Similarly, energy use data reported by NRCan shows that during 1990 to 2004 there has been a consistent distribution of energy use by housing type; 85.5% of energy use is attributable to single

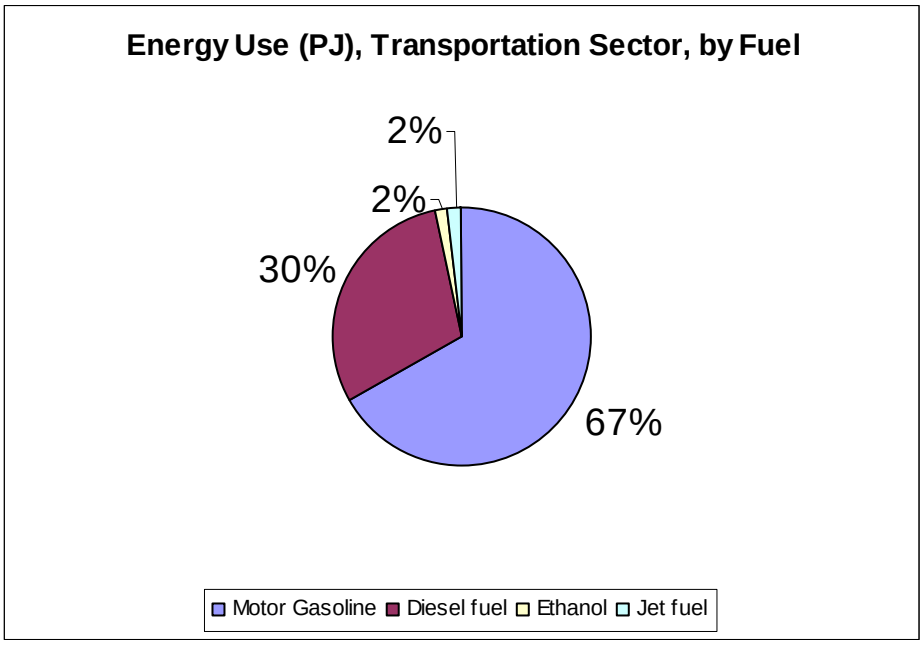
detached homes, 4% is attributable to single attached homes, 6% attributable to apartments and 5% to mobile homes.

The PEI labour force increased from 1995-2004 at an annual rate of 2% totaling 78,000 in 2004. Labour force growth rates are expected to decrease to an annual rate of 1%. By 2015, the labour force is expected to be 80,400. Non-agriculture employment was 69,000 in 2004 with a comparable annual growth rate of 2% from 1995-2004

Transportation Sector

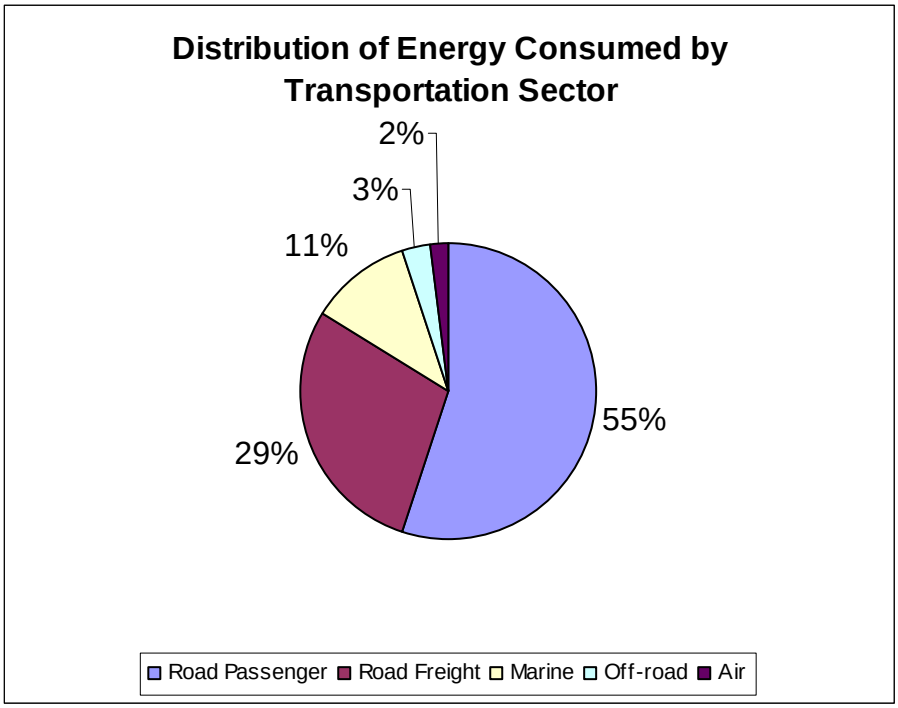
The distribution of energy consumed in the transportation sector (Figure 6) is heavily weighted towards motor gasoline at 67% of total consumption. Diesel fuel comprises 30% of the total, jet fuel 1.5% and ethanol 1.5% of the total transportation fuel consumed on PEI.

Figure 6: Distribution of Transportation Energy Consumption (PJ), Year 2008, By Fuel Type



The transportation mode with the highest energy use (Figure 7) in 2004 was road passengers with 55% of total demand, then road freight with 29%, marine with 11%, off-road with 3% and air transportation with 2% of the total energy demand.

Figure 7: Distribution of Transportation Energy Consumption, Year 2008, By Transportation Mode



C. Energy Use and Carbon Emissions – All Sectors

Based on the data presented below (Table 5), energy demand for the three sectors combined is forecasted to grow at a rate of 1% annually for 2008 through 2017. The growth rate of electricity is estimated at 2% annually for the same time frame. Oil is estimated to grow at an annual rate of 1%. The rate of growth for propane is forecasted to remain unchanged for 2011 to 2015, however, a slight increase is forecasted for 2016 and 2017. Energy demand for biomass is expected to remain unchanged for 2008-2017.

Note that presentation of electricity use and savings in petajoules (PJ) is as primary energy at generation. These values account for line losses and are calculated based on a 10,000 Btuh/kWh heat rate.

In the Transportation Sector, no growth is forecasted for demand of gasoline, ethanol and jet fuel for 2008 through 2017. For diesel fuel however, a growth rate of 1% is forecasted for 2008 through 2015 and no growth for 2016 and 2017.

Table 5: Projected Energy Demand, All Sectors Combined, By Fuel Type

All Sectors Energy Demand:	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
C&I and Residential Energy Demand:										
Oil (PJ)	6.4	6.5	6.5	6.6	6.6	6.7	6.7	6.8	6.9	7.0
Propane (PJ)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Biomass (PJ)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Sub-Total C&I and Res Fossil Fuel (PJ)	9.6	9.7	9.7	9.8	9.8	9.9	9.9	10.0	10.1	10.2
Sub-Total C&I and Res Fossil Fuel (mm litres #2 fuel oil)	250	252	252	254	255	257	258	260	263	265
Electricity (PJ)	11.4	11.6	11.8	12.0	12.3	12.5	12.8	13.0	13.3	13.6
Sub-Total C&I/Residential (PJ)	21.0	21.3	21.5	21.8	22.1	22.4	22.7	23.0	23.4	23.8
Sub-Total C&I/Residential (in million litres #2 fuel oil)	547	554	559	566	574	582	591	599	609	619
Transportation Energy Demand:										
Motor Gasoline (PJ)	8.2	8.3	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Ethanol (PJ)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Diesel fuel (PJ)	3.7	3.8	3.8	3.8	3.8	3.9	3.9	3.9	3.9	3.9
Jet fuel (PJ)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Sub-Total Transportation Fossil Fuel (PJ)	12.3	12.5	12.6	12.6	12.6	12.7	12.7	12.7	12.7	12.7
Sub-Total Fossil Fuels (in million litres #2 fuel oil)	320	325	328	328	328	330	330	330	330	330
Total Energy Demand (PJ)	33.3	33.8	34.1	34.4	34.7	35.1	35.4	35.7	36.1	36.5
Total Fossil Fuel (PJ)	21.9	22.2	22.3	22.4	22.4	22.6	22.6	22.7	22.8	22.9
Total Fossil Fuel (in million litres #2 fuel oil)	569	577	580	581	583	587	589	590	593	595

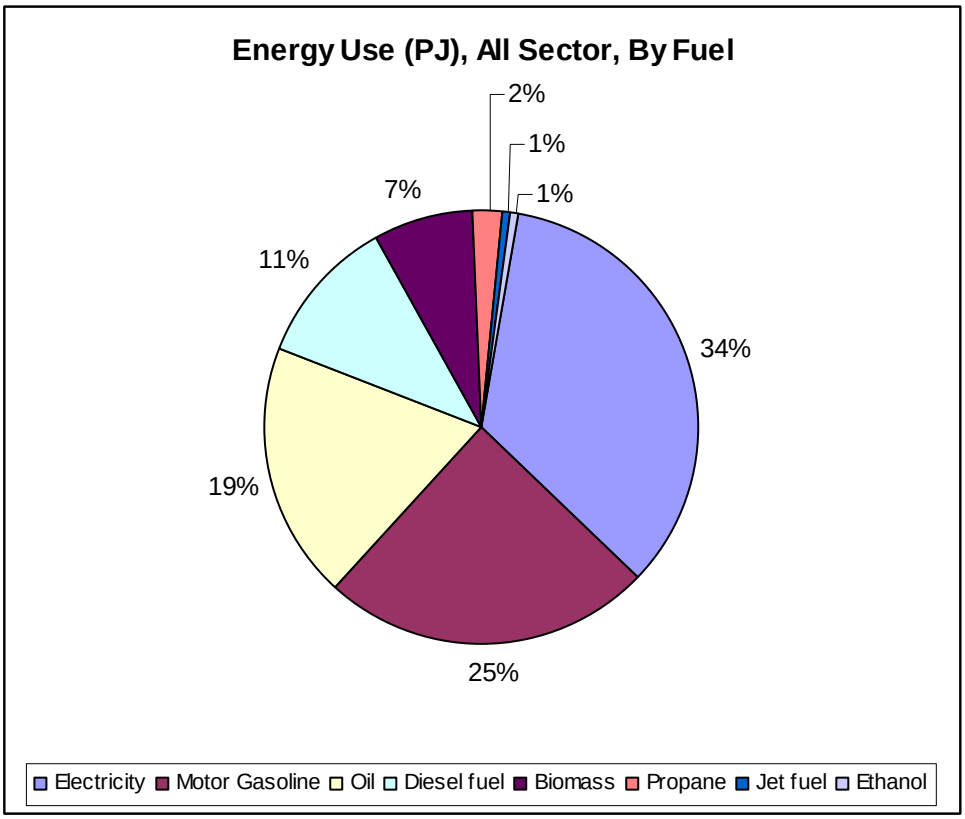
The growth rate for greenhouse gas carbon emissions (Table 6) for all sectors combined is forecasted to increase approximately 1% annually.

Table 6: Projected Carbon Emissions, All Sectors Combined

All Sectors Greenhouse Gas Emissions	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GHG emissions (Megatons CO2 equivalent)	1.3	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4

Energy demand for all sectors combined is forecast to be 33 petajoules in 2008. Total energy use in 2008 (Figure 8) is allocated by fuel type as follows: 34% of energy demand is attributable to electricity, 25% to gasoline, 19% to oil, 11% to diesel fuel, 7% to biomass, 2% to propane, 1% to ethanol and 1% jet fuel.

Figure 8: Energy Use (PJ), Year 2008, All Sectors Combined, By Fuel Type



D. Energy Use and Carbon Emissions – Commercial & Institutional Sector

Energy demand for the C&I Sector is forecasted to grow at a rate of 2% annually for 2008 through 2017. Electricity growth of 2-3%, year-over-year leads the fuel types in growth rate followed by oil averaging 2% annually and growth in propane unchanged from 2008-2017.

Table 7: Projected Energy Demand, C&I Sector, By Fuel Type

Commercial & Institutional:	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Energy Demand										
Oil (PJ)	3.3	3.4	3.4	3.5	3.5	3.6	3.6	3.7	3.8	3.9
Propane (PJ)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Biomass (PJ)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Sub-Total Fossil Fuel (PJ)	4.4	4.5	4.5	4.6	4.6	4.7	4.7	4.8	4.9	5.0
Sub-Total Fossil Fuel (in million litres #2 fuel oil)	114	117	117	119	120	122	123	125	127	130
Electricity (PJ)	5.9	6.0	6.2	6.3	6.5	6.6	6.8	7.0	7.2	7.3
Total C&I Sector (PJ)	10.3	10.5	10.7	10.9	11.1	11.3	11.5	11.8	12.1	12.3
Total C&I Sector (in million litres #2 fuel oil)	268	274	277	283	288	294	300	306	313	321

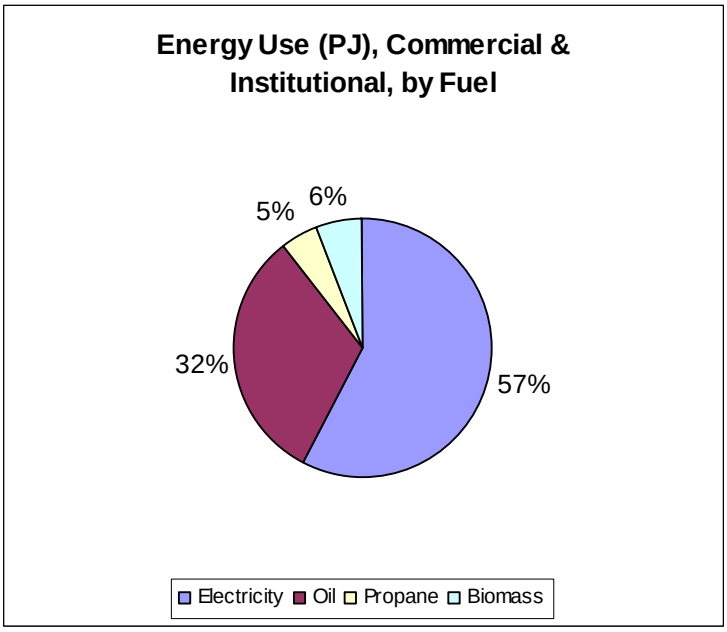
Table 8 shows the C&I sector GHG emissions. Unfortunately, the source for these data – Canada's Energy Outlook - does not appear to report PEI level emissions beyond one significant digit, so annual changes, or lack thereof, should be evaluated carefully.

Table 8: Projected Carbon Emissions, C&I Sector

Greenhouse Gas Emissions	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GHG emissions (Megatons CO2 equivalent)	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

Energy demand for the C&I sector is expected to increase from 10.3 petajoules in 2008 to 12.3 petajoules in 2017. Total energy use in 2008 (Figure 9) allocated by fuel type is: 57% for electricity, 32% for oil, 6% for biomass and 5% for propane.

Figure 9: Energy Use (PJ), Year 2008, C&I Sector, By Fuel Type



E. Energy Use and Carbon Emissions – Residential Sector

Energy demand for the Residential Sector is forecasted to grow less than 1% from 2008 through 2017, with all growth in electricity use.

Table 9: Projected Energy Demand, Residential Sector, By Fuel Type

Residential:	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Energy Demand										
Oil (PJ)	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Propane (PJ)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Biomass (PJ)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Sub-Total Fossil Fuel (PJ)	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Sub-Total Fossil Fuel (in million litres #2 fuel oil)	135	135	135	135	135	135	135	135	135	135
Electricity (PJ)	5.5	5.6	5.6	5.7	5.8	5.9	6.0	6.1	6.2	6.2
Total Residential Sector (PJ)	10.7	10.8	10.8	10.9	11.0	11.1	11.2	11.3	11.4	11.4
Total Residential Sector (in million litres #2 fuel oil)	279	280	281	284	286	289	291	293	295	298

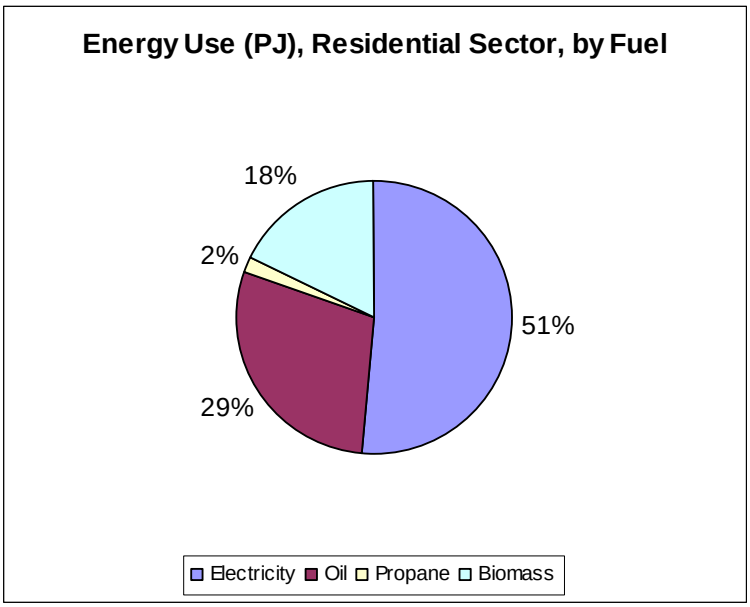
Residential Sector carbon emissions are also level across the forecast period, 2008-2017. As noted above, this may be a partially an artifact of the reporting precision of the data.

Table 10: Projected Carbon Emissions, Residential Sector

Greenhouse Gas Emissions	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GHG emissions (Megatons CO2 equivalent)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

Total residential energy use (Figure 10) in 2008 is allocated by fuel type as follows: 51% of energy demand is attributable to electricity, 29% to oil, 18% to biomass and 2% to propane.

Figure 10: Energy Use (PJ), Year 2008, Residential Sector, By Fuel Type



F. Energy Use and Carbon Emissions – Transportation Sector

Energy demand for the Transportation Sector is forecast to grow at 1% annually for 2009 and 2013 and levels off after 2013. Motor gasoline grows steadily for the first two years and then growth levels off. Diesel fuel is forecast to grow at an annual rate of 1% for 2008-2013 and levels off from 2014 to 2017. There is no change in demand for jet fuel or ethanol for 2008-2017.

Table 11: Projected Energy Demand, Transportation Sector, By Fuel Type

Transportation Energy Demand:	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Motor Gasoline (PJ)	8.2	8.3	8.4	8.4	8.4	8.4	8.4	8.4	8.4	8.4
Ethanol (PJ)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Diesel fuel (PJ)	3.7	3.8	3.8	3.8	3.8	3.9	3.9	3.9	3.9	3.9
Jet fuel (PJ)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Sub-Total Transportation Fossil Fuel (PJ)	12.3	12.5	12.6	12.6	12.6	12.7	12.7	12.7	12.7	12.7
Sub-Total Fossil Fuels (in million litres #2 fuel oil)	320	325	328	328	328	330	330	330	330	330

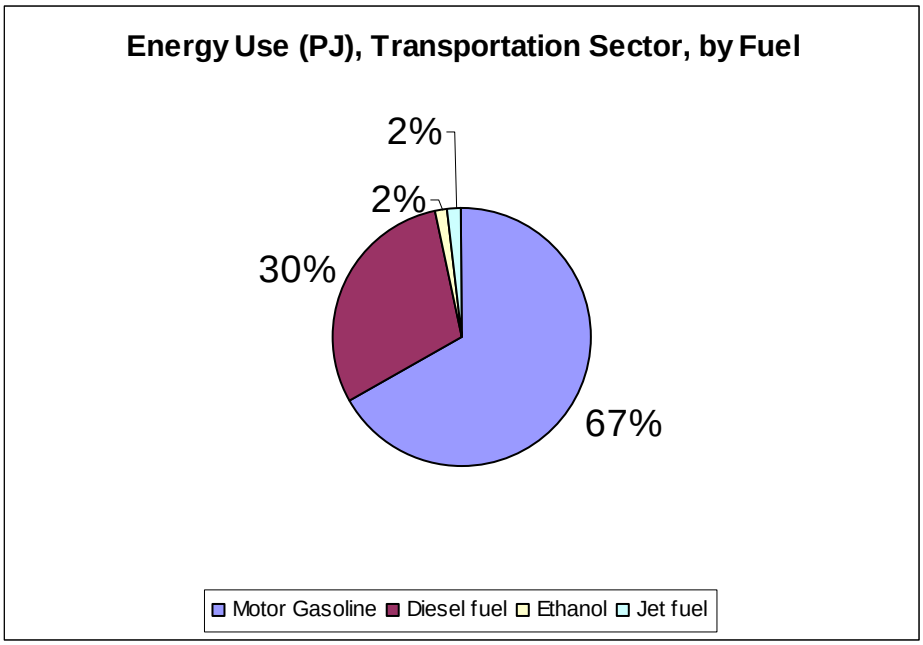
Transportation Sector carbon emissions growth rate increases slightly at an annual rate of 1% for 2009 and 2010 and is unchanged for 2011-2017.

Table 12: Projected Carbon Emissions, Transportation Sector

Greenhouse Gas Emissions	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
GHG emissions (Megatons CO2 equivalent)	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900

Total energy use in 2008 (Figure 11) is allocated by fuel type as follows: 67% of energy demand is attributable to motor gasoline, 30% to diesel fuel, 1.5% to jet fuel and 1.5% to ethanol.

Figure 11: Energy Use (PJ), Year 2008, Transportation Sector, By Fuel Type



III. Technical and Economic Potential for the Residential and C&I Sectors

While achievable potential - that amount of cost-effective energy efficiency potential that could be attained through aggressive, but realistic, initiative efforts – was the primary analytical objective of this study, estimates of both technical and economic potential were made. A review of previous potential studies yielded estimate of likely percentage reductions in energy use in the residential and C&I sectors. These percentage multipliers were then applied to the reference case energy use projections to develop estimates of technical and economic potential for Prince Edward Island.

Technical potential is an estimate of the maximum savings potential that can be attained if ALL efficiency opportunities are pursued, regardless of cost, normal equipment replacement cycles, or other barriers to full implementation. This figure represents a theoretical upper limit to savings potential. Economic potential is a subset of technical potential and is that portion of the technical potential which is cost-effective. Cost-effectiveness is typically determined through the use of either the total resource cost test or societal test. As discussed in the following section, both total resource cost and societal cost effectiveness tests were used to estimate the PEI achievable potential.

As similar studies have not been completed for the transportation sector, technical and economic potential were not estimated for this sector.

A. Findings from Previous Potential Studies

Results from several electric and gas potential studies completed over the past ten years are summarized in Tables 13 and 14. As potential studies have almost always been performed for regulated fuels, similar studies are not available to estimate fuel oil savings potential. Given the similarity in their principal end-use applications – heating and hot water – we have used the gas potential study results to estimate the technical and economic potential savings for all PEI fossil fuel use – oil, biomass and propane.

Table 13: Summary of Electricity Potential Studies

				Estimated Consumption Savings as % of Sales					
Area (s) Covered	Author(s)	Year Complete	Type of Savings Potential	Res.	Com	Ind	Total	Est Summer Pk Demand Savings as % of Total Capacity	Years to Achieve Estimated Savings Potential
New Brunswick	Énergie NB Power	2004	Technical Economic Max. Achievable	32% 7% 3%	32% 14% 6%	13% 12% 1%	24% 10% 3%	N.A.	17
British Columbia	BC Hydro	2002	Economic Max. Achievable	17% 4%	17% 4%	27% 11%	N.A.	N.A.	9
California	Xenergy	2002	Technical Economic Max. Achievable Budget Constrained	21% 15% 10% 8%	17% 13% 10% 7%	13% 12% 11% 4%	19% 14% 10% 6%	25% 16% 10% 6%	10
Manitoba	Manitoba Hydro	2002	Economic Max. Achievable	19% 4%	19% 6%	5% 1%	N.A.	N.A.	9
Midwest	ACEEE	2003	Max. Achievable	N.A.	N.A.	N.A.	11%	N.A.	20
New Mexico	Itron	2006	Max. Achievable	N.A.	N.A.	N.A.	8%	8.90%	10
Connecticut	GDS Associates/ Quantum Consulting	2003	Technical Max. Achievable	24% 13%	25% 14%	20% 13%	24% 13%	24% 13%	10
Georgia	ICF	2005	Technical Economic Max. Achievable	N.A.	N.A.	N.A.	29% 20% 2.3%-8.7%	33% 18% 1.8%-5.5%	5
Illinois	ACEEE	1998	Achievable	N.A.	N.A.	N.A.	43%	N.A.	20
Iowa	ORNL	2001	Max. Achievable	5.3%	5.1%	6%	5.4%	N.A.	15
Mass.	RLW Analytics / SFMC	2001	Economic Budget Constrained	31% 5%	21%	N.A.	24% 5%	N.A.	5
New York	OEI / VEIC / ACEEE	2002	Technical Economic	37% 26%	41% 38%	22% 16%	37% 30%	N.A.	10
Ontario	ICF	2005	Technical Economic	N.A.	N.A.	N.A.	26% 21%	33% 21%	20
Oregon	Technical	2003	Ecotope / ACEEE / Tellus	28%	32%	35%	31%	N.A.	10
Puget Sound Region	Puget Sound Energy	2003	Max. Technically Achievable Max. Economically Achievable	17% 7%	7% 6%	0% 0%	12% 6%	33% 11%	20
Quebec	OEI / VEIC	2004	Max. Technically Achievable Max. Economically Achievable	8% 2%	19% 6%	1% 1%	7% 3%	N.A.	8
Texas	OEI	2007	Max. Achievable	N.A.	N.A.	N.A.	20%	22%	15
Utah	Tellus Institute	2001	Max. Achievable	N.A.	N.A.	N.A.	9%	N.A.	6
Vermont	OEI / VEIC	2002	Max. Technically Achievable	30%	32%		31%	37%	10
VELCO	OEI / VEIC	2002	Max. Achievable	18%	17%		17%	23%	10
AZ,CO,NV, NM,UT,WY	SWEEP/ ACEEE/Tellus	2002	Max. Achievable	14%	20%	19%	18%	N.A.	8
NJ, NY, PA	ACEEE	1997	Max. Achievable	35%	35%	41%	N.A.	N.A.	14

Table 14: Summary of Gas Potential Studies

Area(s) Covered	Author(s)	Year Completed	Type of Savings Potential	Total Gas Reduction as a % of Sales	Years to Achieve Estimated Savings Potential
California	ACEEE	2003	Technical Economic Max. Achievable	35% 21% 9%	20
Georgia	ICF	2000	Technical Economic Max. Achievable	19% 11% 1.8-5.5%	5
Iowa	ORNL	2001	Max. Achievable	3.7%	15
Midwest	ACEEE	2003	Max. Achievable	9.30%	20
Midwest	Quantec	2005	Technical Max. Achievable	46.6% 25.2%	20
New York	OEI/VEIC/ACEEE	2002	Economic Max Achievable	28% 1.5%	5
Utah	GDS/ Quantum	2004	Technical Max. Achievable	38% 20%	10

A review of the two tables highlights differences in the referenced studies' vintages and implementation timeframes, though differences in implementation timelines should only affect estimates of achievable potential. Further, some studies include measures such as fuel switching (not considered as part of the PEI analysis). The studies have publication dates ranging from 1998 to 2007 and implementation timeframes of five to 20 years. Table 15 presents our estimates for the ten year timeframe of the PEI analysis of the percentage reduction in energy use for electricity and fossil fuels.

Table 15: PEI Technical and Economic Potential Percentage Use Reductions

	Percent Reduction in Energy Use	
Sector/Fuel	Technical	Economic
Electricity		
Residential and C&I	30%	25%
Fossil Fuel		
Residential and C&I	35%	25%

B. Estimates of PEI Technical and Economic Potential

Table 16 shows the estimated PEI technical and economic potential energy savings using 2017 as the reference year. Across all fuels, the residential and C&I savings are both

estimated as 32% for technical potential and 25% for economic potential. Similarly, for the combined buildings sector (residential and C&I), savings are estimated as 32% for technical potential and 25% for economic potential.

Table 16: PEI Technical and Economic Potential Estimates- 2017 Reference Year

	Consumption/Reduction in Energy Use	
Sector/Fuel	Technical	Economic
Electricity		
Residential Base Consumption (2017 PJ)	6.20	6.20
Residential Savings	1.86	1.55
C&I Base Consumption (2017 PJ)	7.35	7.35
C&I Savings	2.21	1.84
Total Electricity Consumption (2017 PJ)	13.55	13.55
Total Electricity Savings	4.07	3.39
Percent Savings	30%	25%
Fossil Fuel		
Residential Base Consumption (2017 PJ)	5.20	5.20
Residential Savings	1.82	1.30
C&I Base Consumption (2017 PJ)	5.00	5.00
C&I Savings	1.75	1.25
Total Fossil Fuel Consumption (2017 PJ)	10.20	10.20
Total Fossil Fuel Savings (2017 PJ)	3.57	2.55
Percent Savings	35%	25%
Total Combined Fuel Consumption (2017 PJ)	23.75	23.75
Total Combined Fuel Savings	7.64	5.94
Percent Savings	32%	25%

IV. Achievable Potential - Residential and Commercial & Institutional Sectors

This section presents the energy and demand savings results from the analysis of the proposed residential and C&I initiatives. Summary results are presented cumulatively for all of the proposed initiatives and separately for each individual residential and C&I initiative. Prior to the presentation of the results is a discussion on the measure and initiative screening methodology used. As noted in the previous section, achievable potential is defined as that amount of cost-effective energy efficiency potential that could be attained through aggressive, but realistic, initiative efforts.

A. Measure and Initiative Achievable Potential Methodology

This achievable potential analysis built on measure characterizations and initiative designs developed by the project team for similar studies, including recent work that supported the establishment of Efficiency New Brunswick. The project team staff did spend some time on PEI assessing efficient product availability at retail and interviewing C&I facility managers, though the amount of primary data collection conducted for this study was limited.

The measure and initiative screening and achievable potential methodology are described in more detail below.

Markets, Measures, and Initiatives

The analytical methodology employed in this study makes distinctions between markets, measures, and initiatives. Energy efficiency measures are the technology options themselves, e.g., efficient T8 lighting or air infiltration control in homes, although measure characteristics (*i.e.*, costs and savings) often depend upon the market in which the technology is applied. Initiatives are implementation efforts with strategies tailored to specific markets and measure packages. This section defines measure, market, and initiative to structure the methodology discussions that follow.

From the perspective of this report, markets are the arenas in which decisions are made affecting energy use. Broadly, there are two different markets – existing buildings (whether homes, offices, retail stores, or industrial facilities) and new construction. Owners of existing homes or business facilities are faced with different decisions than potential owners of new homes or business facilities, particularly when evaluating costs of different options that would affect energy use.

Further, the existing building market can be subdivided into two "submarkets" – retrofit and lost opportunity:

Retrofit Opportunities: In this "market," home or business owners have existing equipment that provides needed lighting, heating, cooling, refrigeration, or other services. While this equipment may not use energy efficiently or may have other disadvantages (*e.g.*, age, reliability, or product quality), the owner has the option of

continuing to use this equipment. When considering energy efficiency, a home or building owner must compare the benefits of new equipment against the full cost of installation. Retrofit opportunities to improve efficiency are not time dependent. In this analysis, most retrofit opportunities in the C&I sector are acquired through a proposed direct install initiative. In the residential sector, they are acquired through the proposed Homes initiative, which is principally focused on improvements to existing residences.

Lost Opportunity: In this case, the home or business owner makes a decision to install new equipment, due to equipment failure, expansion, performance concerns, or other drivers. In the case of a home owner, this could be the replacement of a failed refrigerator, boiler or clothes washer. For a business, this could be the replacement of a failed motor or purchase of new production equipment to expand plant capacity. Similarly, new construction savings opportunities are also classified as lost opportunities. The costs associated with efficiency improvements in this market reflect the *incremental* cost over and above what purchase and installation of standard efficiency equipment would cost.

Typically, the window of opportunity (in terms of time) to influence these energy efficiency decisions is very narrow, much narrower than in the retrofit market. If this window is missed, it can be said that this opportunity has been lost. While the savings can still be realized in the future, it can typically be done so only at a higher cost as a retrofit measure. Success in this market relies heavily upon the efforts of retailers (for retail products), design professionals (particularly engineers), and trade allies (*e.g.*, contractors, vendors, suppliers) to influence these time dependent decisions.

A given energy efficiency measure may have very different characteristics depending upon the market. In the residential sector, a homeowner would evaluate the full cost of a new ENERGY STAR® refrigerator when considering the replacement of an old, inefficient, but serviceable unit; for a new home or someone in the market to replace a failing refrigerator, the cost of the ENERGY STAR unit is only the additional or "incremental" cost above a standard-efficiency unit. The energy and demand savings also differ – the savings for a retrofit measure are compared to the old, inefficient unit (at least until the homeowner would have needed to replace the unit at the end of its life), while the savings for new construction or replacement lost opportunity measure are compared to a new, standard unit.

Appendix C lists the residential and Appendix D lists the C&I measures examined in this report.

We use the term "Initiatives" to describe strategies that affect energy-related decisions in each of these markets. Sometimes there is a clear mapping of initiative to market – for example, the Commercial Direct Install initiative deals exclusively with retrofit opportunities in the C&I sector. However, there can be overlapping initiative and markets, as in the case of the residential Efficient Products and Homes initiatives. The analysis takes into account these potentially "competing" initiatives by adjusting the number of participants or measure penetration in each.

Measure Characteristics – Residential vs. C&I

The evaluation of energy efficiency measures is not only a function of market but of methodology. There are two basic approaches to determining the energy efficiency (or generation) potential of an efficiency measure: "bottom-up" or "top-down."

A **bottom-up approach** first starts with the savings and costs associated with replacing one piece of equipment with its efficient counterpart, and then multiplies these values by the number of measures expected to be installed throughout the life of the initiative. The key factor in the energy savings calculation is the number of kilowatt-hours or joules saved annually from the installation of a more efficient unit such as a dishwasher, air conditioner, or boiler. A bottom-up approach was used for the residential sector analysis in this study.

A **top-down approach** begins with a disaggregated energy sales forecast over the time period under study and then determines what percentage of these sales a given efficiency measure will save. For this study, the sales data were further broken down by end use and building type before the savings percent is applied. Savings are then calculated, for example, as the percentage of all energy used for interior lighting in an office building that would be saved by switching to high performance lighting fixtures. The C&I sector analysis was conducted using a top-down approach.

Avoided Cost and Other Key Inputs

Investment in energy efficiency generates a variety of benefits and costs. Benefits include the avoided cost of generating electricity or supplying a fuel in the amount saved by the investment; reduced need for transmission and distribution capacity; avoided water costs; avoided pollutant emissions, whether from electric generation or fuel end-use; savings in maintenance costs; and other non-resource benefits. For most efficiency measures, the largest benefit accrues from the avoided costs of electricity generation and fossil fuel consumption. Therefore, these avoided costs represent a critical input to a potential study.

To develop the avoided electricity costs for this study, we consulted with Maritime Electric regarding PEI's energy supply. As a result of these discussions, we determined that electricity efficiency savings would typically offset energy purchased from New Brunswick and brought to PEI by submarine transmission cable. We also assumed that the relative load in PEI as compared to New Brunswick indicates that energy savings would typically offset energy generated by the Coleson Cove oil-fired generating plant. Therefore, the avoided cost of electricity on PEI for this analysis was determined from the cost of fuel necessary to generate the electricity at Coleson Cove, adjusted for transmission losses. Appendix F presents the avoided electricity costs used in the analysis.

Avoided costs of fuel oil for residential and commercial use were based on forecasts of retail prices presented in Energy Outlook 2006.[4] These are also included in Appendix F.

[4] Natural Resources Canada (2006). *Canada's Energy Outlook: The Reference Case 2006.*

The avoided cost of energy from the district heating system is an average of the avoided purchase price of the various fuels used, weighted by their annual average contribution to the total energy consumption of the plant on an energy content basis. Fuel oil avoided costs were also developed from the Energy Outlook, the cost of wood chips was estimated as C$135/cord, and municipal waste was assumed to be free.

The economic calculations included two additional components: avoided capacity costs and avoided carbon emissions. The reduced need for generation capacity as a result of demand reductions from the efficiency measures is captured through a per-kW avoided cost. This cost is based on an estimate for a large combustion turbine provided by Maritime Electric and was set at $56 per kW-year. The avoided carbon emissions were valued at $20 per ton of CO_2, which is approximately $0.015 per kWh.

Currently, a market for carbon has not been firmly established in Canada. However, emissions trading is anticipated as a compliance option under Canada's new Clean Air Act. According to the Regulatory Framework for Air Emissions, the Government of Canada will not distort the emissions trading market by placing a cap on the cost of compliance. Rather carbon will trade at market driven prices. Carbon is currently[5] selling for $25 ($18 EUR) on the European Climate Exchange, the only marketplace integrating mandatory, legally binding emissions reductions with emissions trading and offsets.

Under the Regulatory Framework, the regulated sector can also achieve compliance through contributions to the Climate Change Technology Fund. Contributions will cost $15 per tonne from 2010 to 2012 and $20 per tonne in 2013. Thereafter, the rate will escalate yearly at the rate of growth of nominal GDP. The Climate Change Technology Fund will no longer be a compliance option post 2017.

B. Measure Characterization and Screening

The process of assessing the economic effects of efficiency investments is typically referred to as "cost-effectiveness screening." This refers to the comparison of the benefits of the investment to its cost. Efficiency measures should pass the "cost-effectiveness screen" of having positive net benefits (*i.e.*, benefits greater than costs), based on whatever economic tests are applied.

A primary consideration in cost-effectiveness analysis is choosing the cost and benefit components that are included within the boundary of the comparison, whether at the measure or initiative level. A particular boundary definition is referred to as a "test." The test used depends upon the perspective of the decision-makers and where their concern lies: overall societal impact, utility system impact, or customer-level impact. Although there exists a wide range of economic tests, one of the most common tests used is the Societal Cost Test (SCT) because it provides an understanding of the overall effect of efficiency investments on society. The SCT assesses the impacts of a portfolio of energy efficiency initiatives on the economy at large. It does not concern itself with distributional equity between different

[5] As of Fall 2007.

segments of society. The test compares the present value of costs of efficiency for all members of society (including costs to participants and initiative administrators) compared to the present value of benefits, including avoided energy supply and demand costs. The assessment of participant costs extends beyond the energy source in question to increases or decreases in operations and maintenance costs and costs for other resources (*e.g.*, water), as well as non-resource cost impacts. It also includes monetized effects of externalities (*e.g.*, emissions impacts). Results are typically expressed as either net benefits or a benefit-to-cost ratio.[6]

For this study, we first screen individual measures using a modified SCT. The key difference between the SCT as applied to individual measures and the description above is that initiative administration costs are not included at the measure level. The results of measure screening for this analysis show that some of the measures initially included in our initiative design are not cost-effective. Most are C&I measures. These include some advanced HVAC control strategies and equipment, graywater heat exchangers, retrofit of higher efficiency heating units, and integrated building design in commercial new construction. In many cases, these measures are cost-effective in some, but not all, building types due to differences in operating hours. For example, the graywater heat exchanger is cost-effective in building types with substantial hot water use such as lodging, health care, and restaurants, but not in retail establishments. Further, due to differences in retail electricity retail prices and avoided costs – avoided costs are typically lower than retail rates - some measures may be cost-effective from a customer, but not a societal, perspective.

Only three residential measures were found to be not cost-effective and excluded: "Super" windows, solar hot water systems, and the R2000-bundle of multifamily new construction measures. These measures were removed from the final set of initiatives; they are not included in the initiative-level results presented in this report. The single-family bundle of new construction measures was found to be slightly non-cost-effective, with a benefit-cost ratio of approximately 0.9. Given the uncertainties in the input data, we decided to retain this measure.

While measure screening was performed using the societal test, final initiative screening was done using both the societal test and the total resource cost test. For this analysis, the only difference between the two tests was the exclusion of the avoided carbon benefit in the total resource cost test.

C. Proposed Initiatives and Initiative Screening

The following initiatives were screened as part of this analysis. Note that the proposed initiative designs in Appendix A collapse several of these initiatives to provide a more streamlined, and cost-efficient, administrative and implementation structure.

Residential Sector

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

- Efficient Products Initiative – appliances, lighting, windows, and potentially consumer electronics
- Homes Initiative – principally focused on existing homes, leveraging ecoEnergy/EnerGuide audits.
- New Construction - Also proposed to have a modest new construction component.

Commercial & Institutional Sector

- Direct Install for small/medium customers
- Retrofit for larger C&I customers
- Lost Opportunity for both equipment replacement and New Construction

Once the measures that are not cost-effective are removed from the analysis, initiative budgets are developed based in part on assumptions made about initiative ramp-up and annual measure penetration rates. For this study we assumed fairly aggressive levels of initiative implementation, while recognizing that several years would be needed to fully ramp the initiatives given the lack of an efficiency contractor infrastructure. These budgets (Appendix F) include the costs of Initiative Administrator staff (fully loaded), contractors, marketing efforts, and monitoring, verification, and evaluation efforts. This spending adds to the costs of the efficiency investments without generating any additional benefits. As such, it is possible that an initiative made up of measures that are individually cost-effective may not be cost-effective overall. In the case of the residential new construction initiative, which includes one measure bundle with borderline cost-effectiveness, the overall net benefits are negative (total societal BCR of 0.86). However, these are far outweighed by the positive net benefits of the other residential initiatives. As a result, we believe that the new construction initiative should be tentatively included in the overall portfolio to present a comprehensive set of approaches to efficiency on PEI. AS discussed in Section 6, we recommend further research to characterize the residential new construction opportunity on PEI.

Proposed incentives for the residential and C&I initiatives consist primarily of consumer rebates, as well as some limited financing offerings. While tax credits could also be implemented to support these proposed initiatives, they are unlikely to have a similar impact and what savings they do generate will often be at a higher cost. Further, it is usually much easier to adjust initiative rebates to reflect changing market conditions and initiative objectives. Modifications to tax credits typically require legislative action, involve longer lead times, and may often be difficult to change once in place.

In developing these proposed initiative designs no presumption was made regarding initiative administration. There are a number of possible administrative models that could be pursued including oversight and implementation by a PEI provincial agency, Maritime Electric, or a newly created efficiency utility.

D. Summary of Achievable Savings Potential

Figures 12, 14 and 16 show how the achievable annual energy savings from efficiency investments grow over time and give a graphical representation of the contribution of each initiative. The growth is due to two factors. First, we assume a gradual increase in the number of measures installed in each year as the efficiency initiatives ramp up and reach a wider customer base. Second, efficiency measures save energy for multiple years – these impacts are cumulative, so the annual savings attributable to the initiative in any year come from measures installed over all of the previous years.

The largest achievable electricity savings (Figure 12) comes from the Efficient Products initiative, primarily from CFLs. The Homes initiative generates the greatest non-electric savings (Figure 14). Across all fuels, the largest achievable savings is from Efficient Products, followed closely by the C&I Direct Install initiative (Figure 16).

Figure 12: Annual Electricity Savings by Initiative (2008-2017)

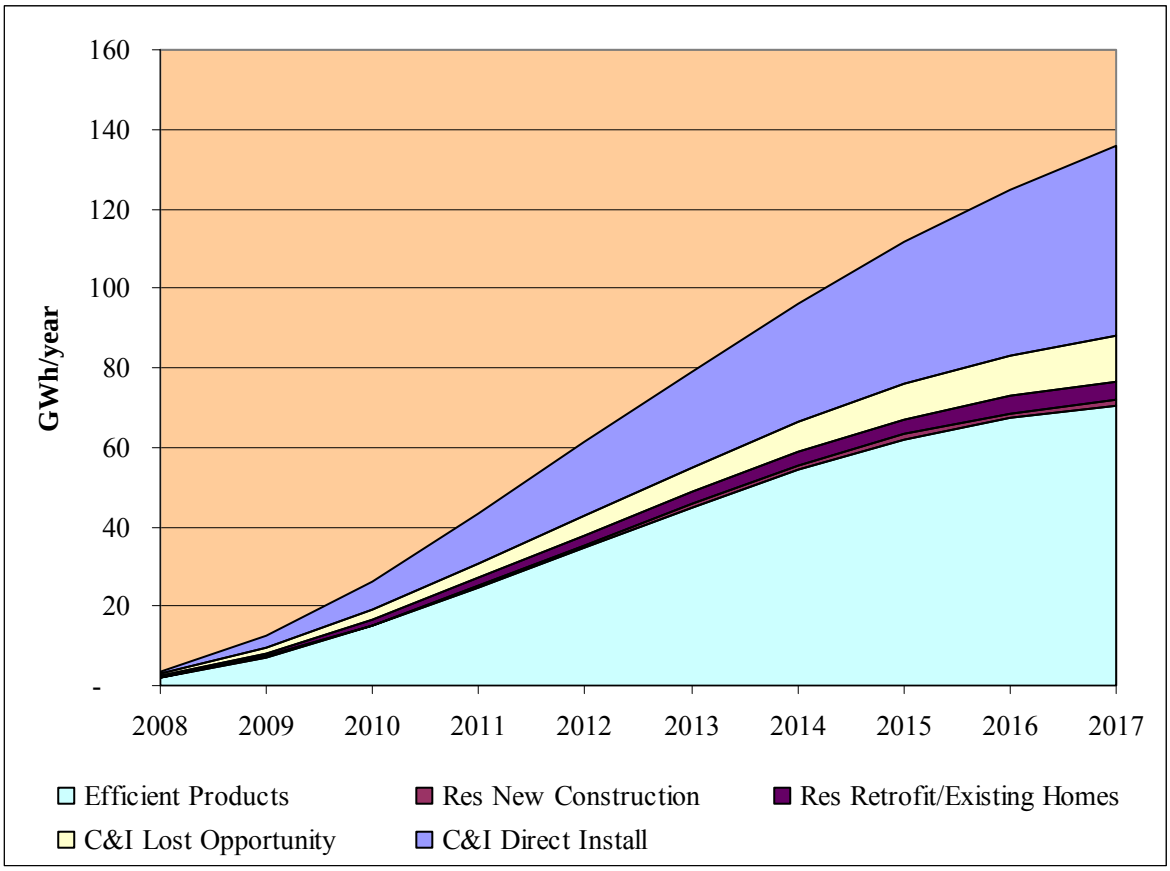


Figure 13 below shows how the recommended C&I and residential efficiency initiatives could offset all of the projected 2017 electricity growth for these sectors. The top line in the graph represents the forecasted load growth from 2008 to 2017. There is also a flat line projection of 2008 estimated electricity use. The other lines represent the reduction in forecasted electricity use from the successive implementation of the two sets of recommended initiatives – C&I, then residential. The two sets of building initiatives lower the projected electricity use in 2017 to a level less than 2008 estimated energy use.

Figure 13: Annual Electricity Savings by Sector versus Forecasted Consumption and 2008 baseline consumption, (PJ/year)

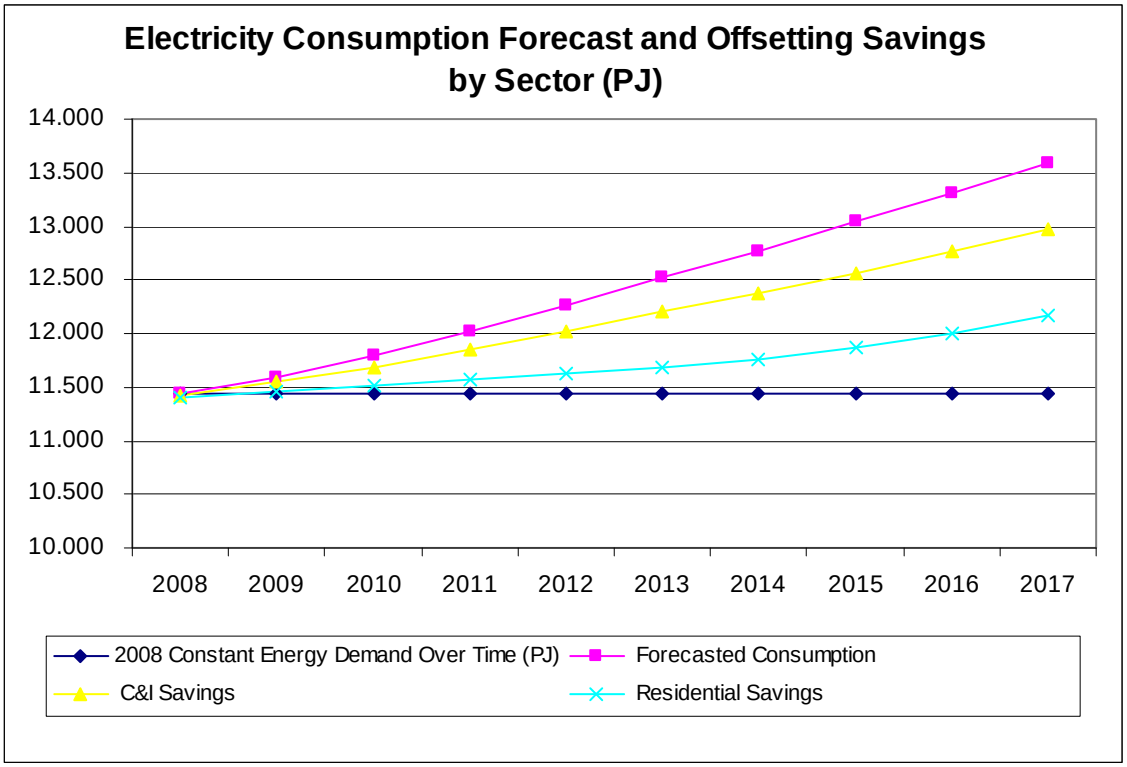


Figure 14: Annual Non-Electric Fuel Savings by Initiative (2008-2017)

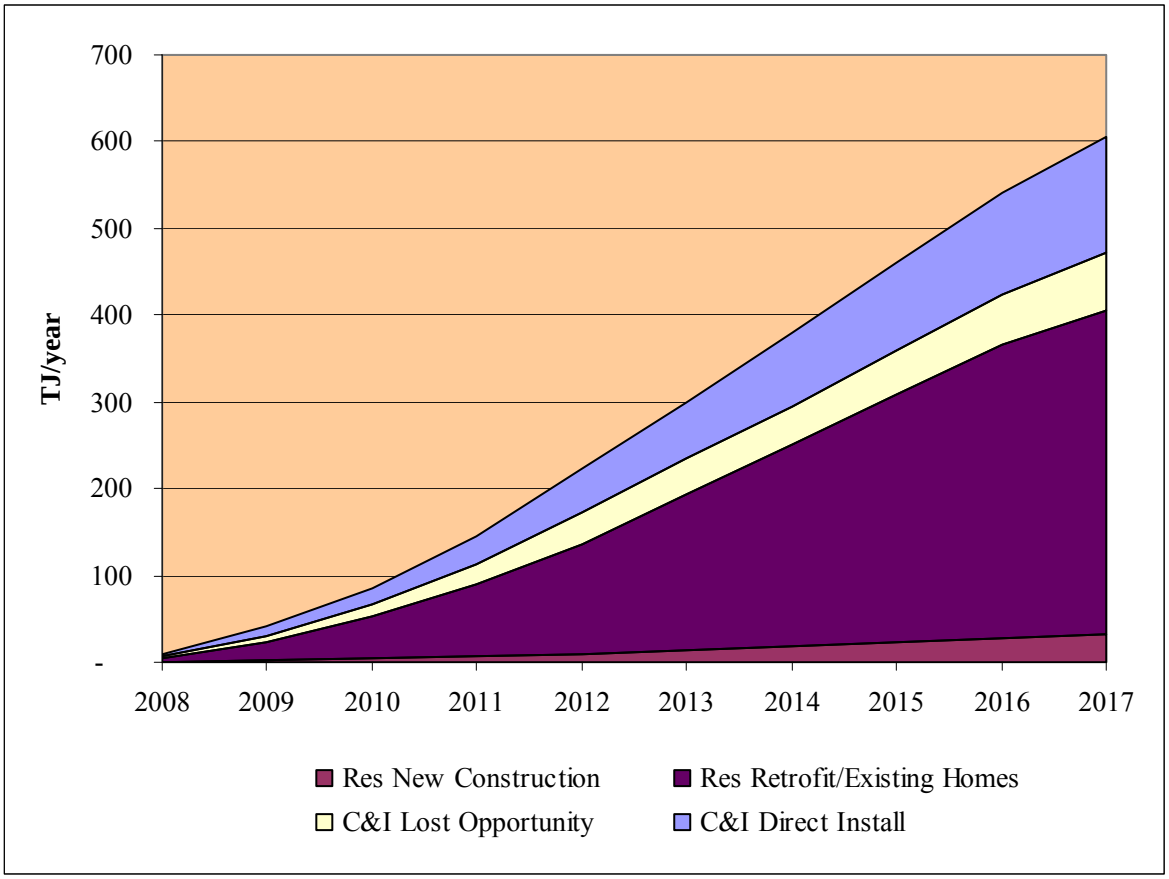


Figure 15 (below) is similar to Figure 13, but examines fossil fuel energy use and includes the impacts of the recommended transportation strategies. Note that while the savings from the two sets of building sector (C&I and residential) initiatives does not completely offset load growth compared to a projection of 2008 usage, the inclusion of transportation savings does[7].

[7] The methodology used to estimate transportation savings estimated savings in 2017, but did not directly estimate annual savings. However, for Figure 1 a reasonable extrapolation of annual savings was made.

Figure 15: Annual Non- Electric Fuel Savings by Sector versus Forecasted Consumption and 2008 baseline consumption, (PJ/year)

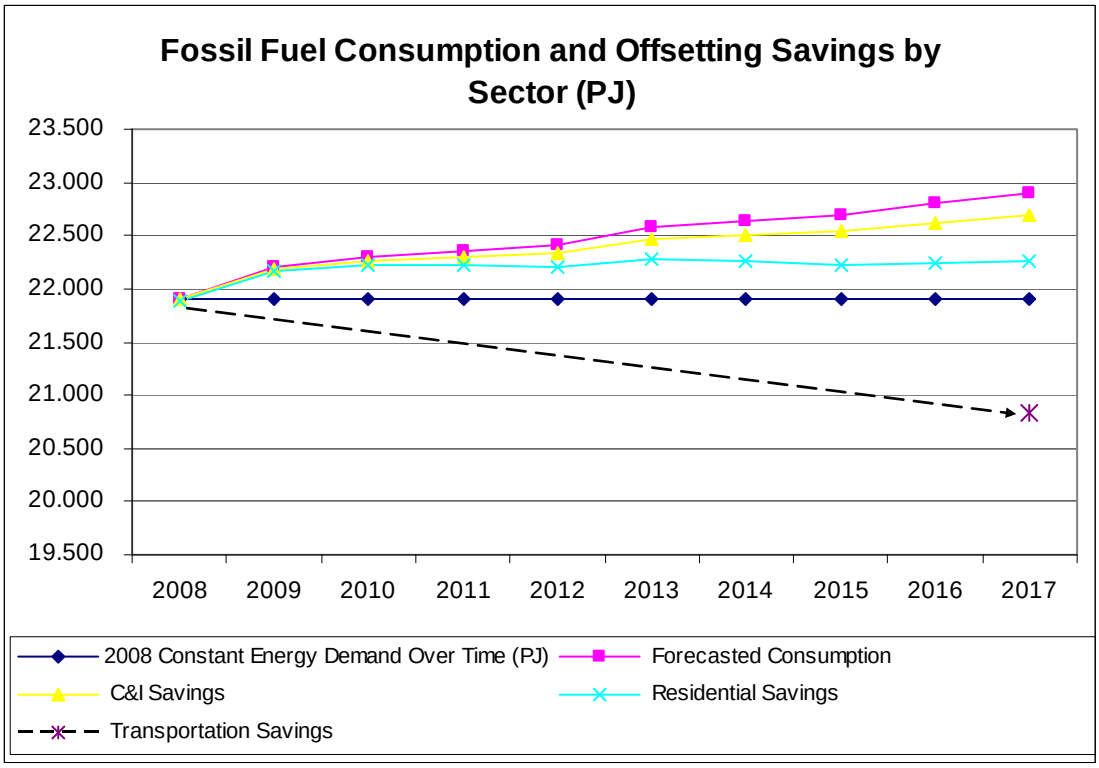
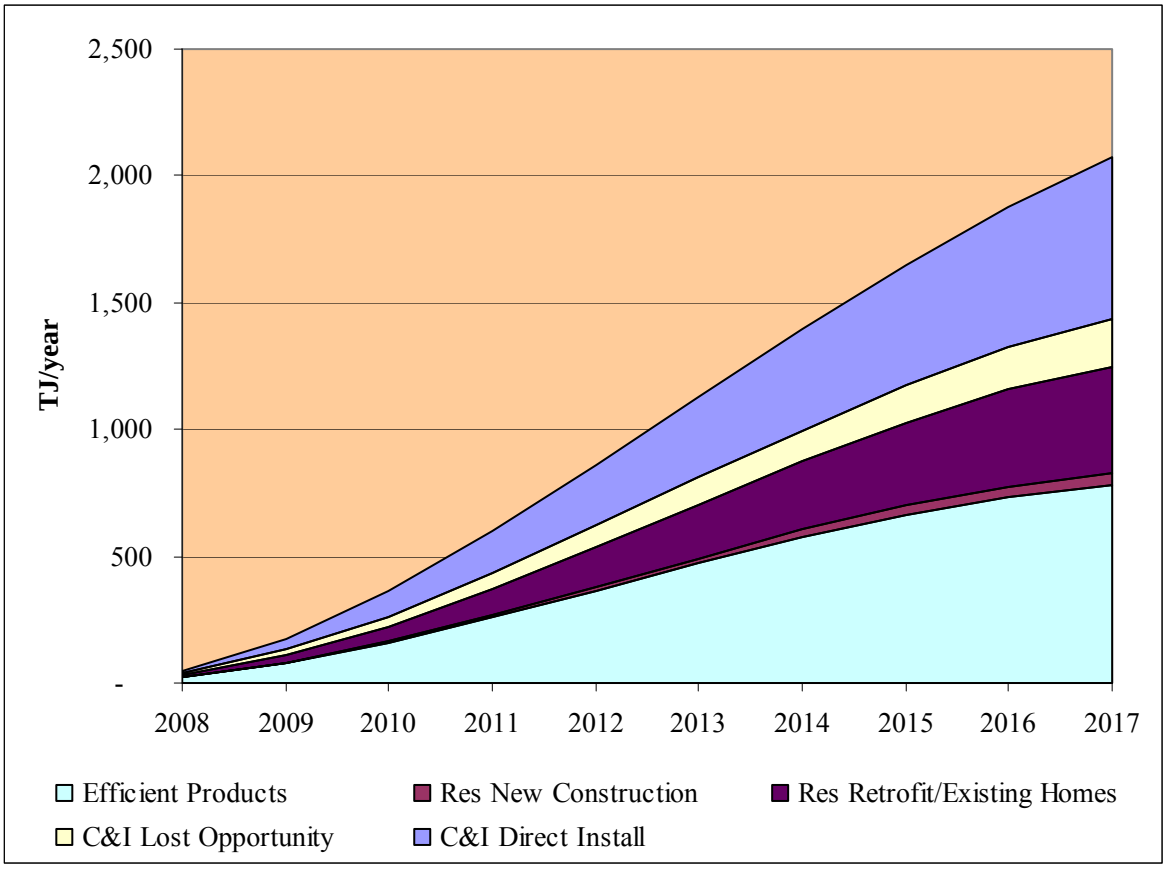


Figure 16: Annual Energy Savings by Initiative, All energy types (TJ/year- 2008-2017)



Two significant differences between the pattern of electricity (Figure 12) and fossil energy savings (Figure 14) are evident. First, the Efficient Products Initiative is responsible for over half of the electric energy savings, but is not even shown on the non-electric energy savings graph. This Initiative generates most of its savings from lighting measures, which save a substantial amount of energy, but actually result in a small *increase* in fossil energy consumption due to decreased internal gains. Because they generate less waste heat, more fuel is needed for space heating. This increased fossil use is small - the additional fossil fuel required as a result of the Efficient Products Initiative is less than that saved by the Residential New Construction Initiative. Second, the Residential Retrofit Initiative has a far greater impact on fossil energy savings. Again, this is driven by the measures included, which emphasize building shell performance and domestic how water savings.

Figure 17, like Figures 13 and 15, shows he impact of the C&I, residential, and transportation initiatives relative to projected consumption, but for all fuels. The two sets of building initiatives (C&I and residential) lower the projected energy use in 2017 to a level nearly equivalent to 2008 estimated energy use. The addition of the transportation initiatives lowers energy use in 2017 to less than 2008 estimates.

Figure 17: Annual Energy Savings by Sector versus Forecasted Consumption and 2008 baseline consumption, All energy types (PJ/year)

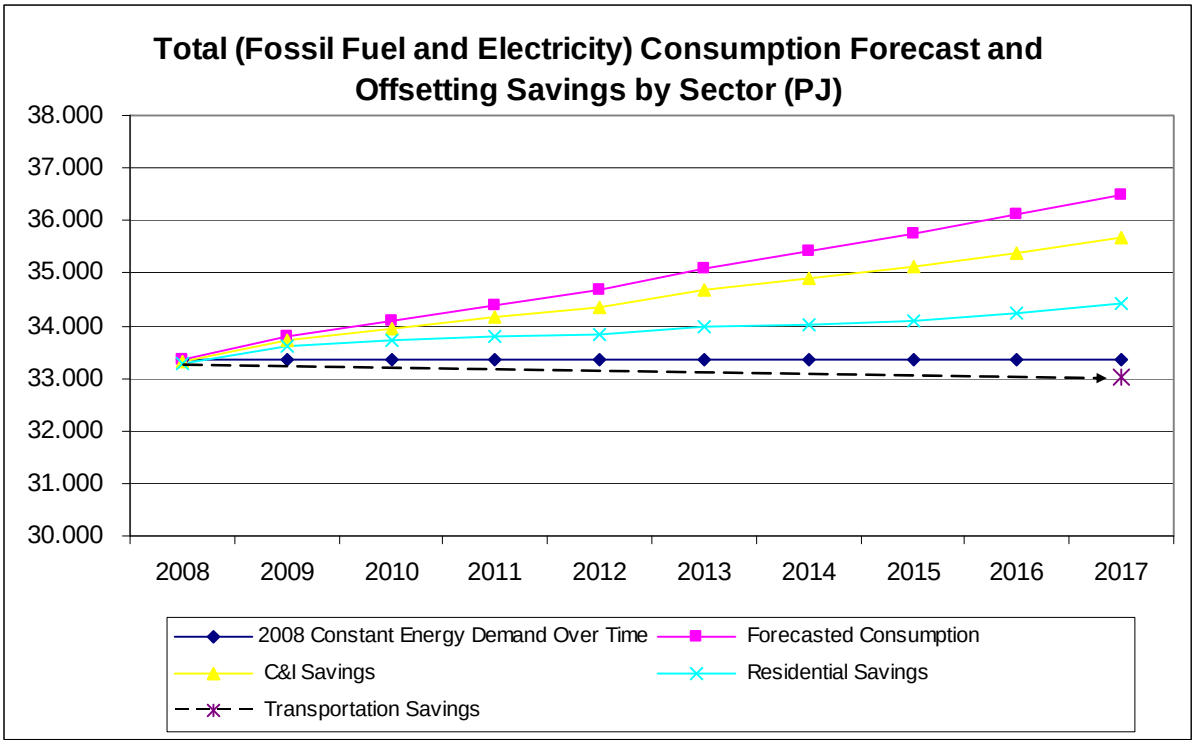


Table 17 below shows the energy, demand, and CO_2 emission reductions in 2017 (the tenth and final year of the Initiatives) from all measures installed up to and including that year. The Residential Sector is responsible for the majority of the savings; within that, the Retrofit/Existing Homes and Efficient Products Initiatives together are responsible for most of the savings. "Other Energy" includes all other non-electricity energy use: natural gas, oil, propane, fuel oil, ethanol, wood and biomass.

Table 17: Cumulative Annual Savings from Efficiency Initiatives in 2017, by sector

	Winter Peak Demand (MW)	Electricity (GWh)	Other Energy (TJ)	CO_2 (tons)
Residential	13.7	76	444	92,939
C&I	4.1	59	199	55,409
Total	17.8	136	643	148,348

To understand the relative effect of the recommended efficiency initiatives on projected energy consumption on PEI, Table 18 shows the annual energy savings as compared to the forecast energy consumption for each year. Again, the savings grow over time, reaching a total of 11% of annual electricity and 6% of annual other energy use.

Table 18: Annual Energy Savings Compared to Forecast, by year

	Electricity (GWh)			Other Energy (TJ)		
Year	Forecast	Savings	Percent Savings	Forecast	Savings	Percent Savings
2008	1,003	4	0.4%	9,600	11	0.1%
2009	1,017	12	1%	9,700	41	0%
2010	1,034	26	3%	9,700	84	1%
2011	1,054	43	4%	9,760	142	1%
2012	1,075	61	6%	9,820	220	2%
2013	1,097	79	7%	9,880	298	3%
2014	1,120	96	9%	9,940	382	4%
2015	1,143	112	10%	10,000	472	5%
2016	1,167	125	11%	10,100	566	6%
2017	1,192	136	11%	10,200	643	6%

Table 19 presents the results of the economic analysis of the Initiatives as measured by the Societal Cost Test (SCT), by sector. The SCT includes the value of carbon reductions as benefits, valued at C$20 per metric ton of CO_2. The Initiatives generate C$151 million in net benefits. As with the energy results, the Residential Sector is responsible for the majority of the net monetary benefits, although the C&I Initiatives have relatively higher net benefits as demonstrated by the higher Benefit-Cost Ratio (BCR). Table 20 presents the same information as Table 19, but from a total resource cost test (TRC) perspective. The TRC test does not include the economic benefits of carbon reduction. Using the TRC test, the Initiatives still provide nearly C$127 million of net benefits at BCRs of over 2.3 for each sector.

Table 19: Economic Effects as Measured by Societal Cost Test (millions 2007 C$)

	Costs	Benefits	Net Benefits	BCR
Residential	59.1	152.3	93.2	2.6
C&I	26.2	84.3	58.1	3.2
Total	85.3	236.6	151.3	2.8
Note: All values are total "present value" dollars over 10-year program life				

Table 20: Economic Effects as Measured by Total Resource Cost Test (millions 2007 C$)

	Costs	Benefits	Net Benefits	BCR
Residential	59.1	137.2	78.1	2.3
C&I	26.2	75.0	48.8	2.9
Total	85.3	212.2	127.0	2.5
Note: All values are total "present value" dollars over 10-year program life				

Table 21 provides a detailed look at the energy impacts and economic costs of each initiative. The energy and emissions impacts are the annual impacts in 2017 (as in Table 19 above). The costs are the total present value of spending by all parties in all years of the Initiatives.

Table 21: Cumulative Annual Savings in 2017 and Total Present Value Costs, by Initiative

Initiative	Measure Costs (millions 2007 C$)	Total Costs (millions 2007 C$)	Electricity (GWh)	Other Energy (TJ)	Total Energy (TJ)	CO_2 (tons)
Res New Construction	8.3	9.3	1.7	33	50	3,494
Res Retrofit/Existing Homes	31.5	34.5	4.3	374	419	29,169
Efficient Products	13.6	15.3	70	37	779	60,276
C&I Direct Install	15.1	20.9	48	133	635	42,690
C&I Lost Opportunity	3.7	5.3	12	66	189	12,719
Total	72.1	85.3	136	643	2,073	148,348

Note that the achievable potential analysis represents an estimate of savings based on the current status of efficiency efforts on PEI. These estimates may be affected by the outcomes of several on-going or proposed efficiency activities being pursued at the provincial and federal level. These efforts include, but are not limited to:

- Implementation of DSM initiatives by Maritime Electric in response to the Renewables Energy Act. Maritime has recently filed a proposed plan with the Island Regulatory and Appeals Commission. The proposed plan addresses a subset of the measures analyzed in this study.
- Proposed CFL distribution plans on PEI – up to four CFLs per household may be made available to residential customers.
- Proposed incandescent bulb ban and/or lighting efficiency standards. These would not likely be implemented until the middle of this study's proposed implementation timeframe.

Implementation of any of the above activities would affect the results derived from this study's analysis.

V. Achievable Potential – Transportation Sector

A. Approach

This analysis is a high-level assessment of potential measures to reduce energy consumption and greenhouse gas (GHG) emissions from transportation sources on Prince Edward Island. An initial list of potential transportation strategies was first created and then reduced to nine measures based on a qualitative assessment of potential benefits, costs, and feasibility. These nine measures were then analyzed quantitatively, at a sketch-level, to estimate benefits, costs, and cost-effectiveness in the year 2017. The estimates of benefits are based on the population and characteristics of the vehicle fleet on Prince Edward Island. GHG benefits are reported for the full fuel-cycle, considering GHG emitted in fuel production as well as in the operation of the vehicle.

The cost estimates represent total societal costs, including government costs and monetary (e.g., initiative administration, reduced tax revenue, fuel savings) as well as costs and benefits to individuals and the private sector (e.g., reduced fuel consumption, increased vehicle purchase costs, monetized value of time). The cost estimates include only costs that could be easily monetized and do not include costs that are difficult to quantify such as consumer welfare benefits or impacts, although these were discussed qualitatively.

B. Initiatives Analyzed

Nine initiatives to reduce energy use and GHG emissions from the transportation sector were selected for further analysis. These include:

1. Alternative fuel initiative;
2. Vehicle fuel economy incentives;
3. Government fleet purchase;
4. GHG emission standards;
5. Transit service enhancement;
6. Telecommuting/compressed work week;
7. Signal synchronization;
8. Anti-idling campaign; and
9. Education and outreach.

A general description of each initiative as well as the specific proposed action is provided in Table 22.

Table 22: Transportation Initiatives Analyzed

Initiative	Description	Proposed Action
1. Alternative Fuel Initiative	Regulations, incentives, or initiatives to promote the availability and use of alternative fuels that can be used by existing vehicles, such as an ethanol blend of 10 percent (E10) or less, or biodiesel for diesel-fuelled vehicles.	Provide a 50 cents per litre subsidy for pure renewable ethanol (i.e., five cents per litre for E10R) to enable production and/or importation and a driver incentive for use.
2. Vehicle Fuel Economy Incentives	Incentives promoting the purchase of more fuel efficient vehicles and/or alternative fuel vehicles, in the form of subsidies or feebates/rebates tied to fuel economy, energy efficiency or GHG emissions.	Implement a revenue neutral feebate/rebate with target fuel economy of five percent below baseline in 2009 to 15 percent below baseline in 2017. Feebates/rebates would be adjusted annually or quarterly to insure achieving GHG emissions target and revenue neutrality.
3. Government Fleet Purchases	Purchase of more fuel efficient or alternative fuel vehicles by a governmental organization or private organization.	Accelerating current efforts, improve the average fuel economy of new Provincial government and City of Charlottetown vehicle purchases, ranging from four percent better than baseline in 2010 to 33 percent

		better in 2016 and later, through best-in-class purchase, right-sizing of the fleet, and shared vehicles.
4. Greenhouse Gas Emission Regulations	Adoption of fleet-wide light-duty vehicle greenhouse gas emissions standards similar to those imposed by the State of California.	GHG emission standards are assumed to be phased in beginning in 2010, to allow manufacturers a two-year lead time to comply. The GHG standards apply to the full fuel-cycle, not just tailpipe emissions.
5. Transit Service Enhancement	New or improved transit services, such as downtown circulators, commuter routes, or visitor shuttles among key tourist/resort areas.	This action is defined as introducing 12 new vehicles (22-passenger minibuses), providing 200 new route-km, with eight trips/day/route, resulting in an additional 3,500 vehicle-km of service daily.
6. Telecommuting / Compressed Work Week	Telecommuting refers to an employee who otherwise works at a workplace working some days from home. Compressed work week refers to the shifting of worker hours so that the employee works more hours per day on fewer days per week.	Implement an outreach and awareness campaign to encourage both of these options. This may include direct outreach to employers and/or development of goals/standards with a corresponding employer recognition

		campaign.
7. Traffic Signal Synchronization	Improving traffic flow through coordinated signal timing.	The Charlottetown Perimeter Highway Initiative is used as an illustrative example. This project, which is being undertaken by the PEI Department of Transportation Planning and Public Works, would synchronize traffic signals along this 22-km highway.
8. Anti-idling Campaign	Reduce vehicle idling, and therefore fuel consumption and emissions, through a combination of regulations, outreach, and supportive technologies (e.g., cab heaters).	Continue with aggressive implementation of the Fleet Challenge initiative and additionally make efforts to increase awareness among both medium and heavy duty truck operators and the general public (light duty vehicles).
9. Education and Outreach	Outreach and public awareness/education campaigns regarding fuel-saving measures such as reduced driving speeds/speed limits, eco-driving, tire inflation and low-viscosity oil.	Conduct an information campaign increasing awareness of the fuel saving benefits of decreasing driving speeds, shifting sooner, maintaining steadier speeds, driving more smoothly with fewer rapid starts, keeping tires properly inflated, and

	using lower viscosity motor oil. Increase enforcement for speed limits and lower speed limits where feasible.

Several strategies were additionally considered, but ruled out through the preliminary screening process:

- Land use and non-motorized transport, due to long lead times and low cost-effectiveness over a 20-year time frame. [8]
- Marine emissions, due to limited absolute benefits and very limited fleet turnover.
- Cap-and-trade, due to implementation difficulties and potential conflict with future federal action.
- Carbon taxes, due to overlap with fuel economy measures, fewer absolute CO2 reductions (consensus forecast price of $40 per tonne is approximately equal to 10 cents per litre) than the other fuel economy measures, and potential equity impacts.

C. Key Findings and Recommendations

Table 23 summarizes the findings of the analysis, including effectiveness (fuel saved and tonnes of GHG reduced), total social cost, and cost-effectiveness (dollars per litre of fuel saved and tonne of GHG reduced). Negative cost and cost-effectiveness results (shown in red text in parentheses) indicate that there is a net social benefit, e.g., due to fuel savings. The results are presented as annual savings in the year 2017.

Table 23: Transportation Sector Analysis Results (year 2017)

[8] An assessment of the longer-term GHG impacts of "sustainable community design" (integrated land use, transit, and pedestrian design strategies) would still be valuable, along with an assessment of existing land use policies and potential policy changes to reduce GHG emissions and energy consumption.

Strategy	Effectiveness		Cost	Cost-Effectiveness	
	Fuel saved (milllion L)	GHG tonnes reduced	Total Social Cost	Cost per litre	Cost per tonne
1 - Alternative Fuel Subsidy	13.35	31,036	$ 3,437,218	$ 0.26	$ 111
2 - Fuel Economy Feebates	13.17	30,614	$(10,128,937)	$ (0.77)	$ (331)
3 - Gov't Fleet Purchase	0.13	306	$ (83,621)	$ (0.64)	$ (274)
4 - GHG Emission Standards	22.81	53,041	$(14,967,794)	$ (0.66)	$ (282)
5 - Transit Enhancement	0.19	435	$ 1,754,998	$ 9.37	$ 4,032
6-Telecommuting	0.88	2,049	$ (1,268,923)	$ (1.44)	$ (619)
7 - Signal Synchronization	0.33	763	$ (2,459,527)	$ (7.50)	$ (3,224)
8 - Anti-idling campaign	0.08	185	$ 50,272	$ 0.63	$ 272
9 - Education and Outreach	3.46	8,035	$ (1,588,887)	$ (0.46)	$ (198)

Six of the nine strategies are recommended due to high cost-effectiveness and no significant adverse impacts, with the exception that fuel economy feebate/rebates and GHG emission standards need to be carefully analyzed before being jointly implemented due to substantial overlap:

- Fuel economy feebates/rebates;
- Government fleet purchases;
- GHG emission standards;
- Telecommuting/compressed work week;
- Traffic signal synchronization; and
- Education/awareness campaigns for non-speed measures.

Two analyzed strategies with low cost-effectiveness were recommended:

- Anti-idling campaign, due to high public health benefits and good potential for achieving improved cost-effectiveness.
- Speed reductions (a component of the education/awareness campaign strategy) are recommended due to substantial safety co-benefits that may justify the initiative even by themselves.

Of the analyzed strategies, two were recommended to not be implemented:

- Alternative fuel subsidies, due to the ineffectiveness of corn/grain ethanol, the limited feasibility (supply availability) of renewable (sugar, cellulosic) ethanol, the likely substantial leakages from the measure (fuel displacement resulting in offsetting emission increases elsewhere due to renewable ethanol shifting to PEI), and poor cost-effectiveness.

- Transit service enhancements were not recommended due to very poor cost-effectiveness and low absolute reductions.

All of the strategies that are implemented should have a monitoring and evaluation component (which is included in the administrative cost element of the analysis), to track and verify initiative effectiveness, especially for strategies that have greater uncertainty regarding how effective they will be (e.g., anti-idling, telecommuting, education and outreach). These strategies could be implemented on a one-year pilot basis w/evaluation after the first year to determine whether they should be continued. Initiatives should also include initial data-gathering before full implementation, e.g., collecting data on where and how much bus and truck idling occurs in order to focus outreach and technical assistance efforts, or conducting employer surveys on the existing extent of telecommuting and the extent to which it might be expanded.

While detailed annual budgets were not developed as part of the transportation initiative analysis, Appendix E contains estimated annual budgets for the first three years of the proposed initiative efforts, 2008-2010.

D. Limitations of the Analysis

The results presented in Table 23 should be sufficient for assessing the approximate order of magnitude of the benefits and costs of each strategy. However, they are based on a screening-level analysis, rather than an in-depth evaluation of any particular strategy. Without performing more detailed studies, there is significant uncertainly in some of the results. Some particular areas of uncertainly include:

- The benefits of transit service enhancement are highly dependent upon the level of ridership achieved with the service. This cannot be assessed without a detailed study of the particular services to be provided and the potential market for these services.
- The telecommuting, anti-idling campaign, and education and outreach strategies may result in widely varying effectiveness depending upon existing conditions (e.g., extent to which workers already telecommute), markets/sectors targeted (e.g., private vehicles, fleets, tour buses, or trucks), and level of effort put into outreach for each strategy. Costs will also vary depending upon the level of resources allocated. Existing quantitative data on the potential effectiveness of these strategies are not very reliable and therefore the results should be viewed as having considerable uncertainty.
- Table 23 does not indicate any non-quantifiable co-benefits (other social benefits) or "leakages" (offsetting negative impacts) that might result from each strategy. For example, although transit service is not a cost-effective GHG reduction strategy, it can provide other important social benefits. Feebates and fuel economy regulations, while resulting in net savings to consumers through reduced fuel costs, also may have the impact of reducing consumer choice and therefore consumer welfare.
- Table 23 presents results for only a "snapshot" of the future, i.e., the year 2017. The benefits of some strategies – notably, those affecting emissions from new vehicles –

will start slowly but increase over time as vehicles are phased in. In particular, feebates and GHG emissions standards will result in benefits that continue to increase substantially in future years.

VI. Recommendations

A. Summary of Program & Initiative Recommendations

There is considerable cost-effective energy savings potential that could be pursued on Prince Edward Island. The following initiatives are proposed for implementation on PEI.

Residential Sector

- Efficient Products Initiative – appliances, lighting, windows, and potentially consumer electronics
- Homes Initiative – principally focused on existing homes, leveraging ecoEnergy/EnerGuide audits. Also proposed to have a modest new construction component, though further research on this initiative component is recommended.

Commercial & Institutional Sector

- C&I buildings – a single C&I umbrella initiative that offers multiple participation tracks:
  - Direct install for small/medium customers
  - Retrofit for larger C&I customers
  - Lost opportunity for both equipment replacement and new construction

Transportation Sector

- Vehicle fuel economy incentives;
- Government fleet purchase;
- GHG emission standards;
- Telecommuting/compressed work week;
- Signal synchronization;
- Anti-idling campaign; and
- Education and outreach.

As noted previously, there is no presumption on how these proposed initiative designs would be administered. There are a number of possible administrative models that could be pursued including oversight and implementation by a PEI provincial agency, Maritime Electric, or a newly created efficiency utility.

B. Additional Initiative Needs and Possible Regulatory Activities

The project team recommends that the above proposed efficiency and GHG mitigation initiatives be pursued. We also note that successful initiative implementation would benefit

from both further analysis and research and from more detailed initiative designs. In particular, efforts should be expended to assess:

- The availability of the both residential and small C&I contractors to provide the services outlined in the Homes initiative and in the direct install component of the C&I initiative.
- Current residential new construction practices – the single family bundled set of new homes measures marginally fails the societal cost-effective screening (0.9) and the multifamily new home measures fails more noticeably (0.56). Efforts should be made to better quantify baseline new construction practices on PEI and to develop PEI specific incremental costs.
- A determination of whether more detailed and up to date appliance and other end use saturation and efficiency data are needed for both the residential and C&I sectors.
- Opportunities to coordinate initiative delivery efforts with other neighboring provinces. For example, Efficiency New Brunswick has expressed interest in working with others in implementing their upstream incentive efforts for high performance T8 lighting.

Further, successful initiative implementation will require the development and implementation of an initiative tracking and reporting database. While we have assigned costs to the development and maintenance of such a database, a more formal scoping of this need should be pursued. It is possible that some economies could be attained through joint efforts with neighboring provinces.

As PEI more fully develops its initiative designs it will be critical that it anticipates and plans for evaluation efforts to measure the success of its initiatives. On-going initiative evaluation is a key, and sometimes overlooked, component of any robust efficiency effort. An evaluation plan should be developed that provides a detailed near-term (Years one through three) evaluation schedule. The proposed residential and C&I Initiative budgets include a line item for evaluation.

On a longer-term basis, additional research could be expended to assess:

- An assessment of the longer-term GHG impacts of "sustainable community design" (integrated land use, transit, and pedestrian design strategies), along with an assessment of existing land use policies and potential policy changes to reduce GHG emissions and energy consumption
- Development and promulgation of a provincial Energy Code. Currently, only the two largest municipalities on PEI have building codes but no energy codes are enforced in the Province. The proposed residential and C&I new construction initiative efforts will help builders, architects and engineers familiarize themselves with efficient building practices. A provincial energy code could build on the success of these initiative efforts. If a provincial code is implemented, thought should be given to supporting code officials with training, technical assistance and other resources to support code enforcement.

- Hook-up fees or requirements. A limited number of jurisdictions have instituted minimum building efficiency requirements as a condition of electric service. Alternatively, hook-up fees could vary as a function of a building's efficiency. Typically, utilities have been reluctant to pursue these options without being directed to do so by their regulators. Hook-up fees have been a viable policy consideration where energy codes are non-existent, infrequently updated, or inadequately enforced.

List of Appendices

Appendix A: Full Residential and C&I Initiative Descriptions

Draft
Residential Efficiency Initiatives for Prince Edward Island

The residential initiatives are designed to achieve aggressive market penetrations of high-efficiency technologies in existing and new homes. The residential initiatives would deploy distinct but integrated market approaches to existing and new construction efficiency opportunities to fully procure comprehensive and lasting savings.

The recommended residential efficiency initiatives were developed with the following considerations:

- Provide an opportunity for all residential customers to participate
- Recognize the small customer population and the resulting lack of significant economies of scale in initiative implementation. Implementation of residential efficiency efforts on PEI would likely benefit from coordination and possible joint implementation with initiative administrators in New Brunswick and Nova Scotia.
- Leverage relationships with the small number of on island product retailers, builders, and contractors
- Minimize barriers to participation for low income customers
- Address all fuels – electricity, oil, biomass and propane – recognizing that oil and biomass use constitutes over three-quarters of all residential energy use on PEI

In performing the residential achievable potential analysis, including the development of the annual initiative budgets in Appendix E, we assumed a steady ramp-up of initiative activity in the first few years. For the Homes initiative the initiative ramp-up recognized the lack of an existing contractor infrastructure to provide all of the required efficiency services.

I. Efficient Products Initiative

A. Introduction and Eligible Products

This initiative promotes the purchase of efficient (ENERGY STAR®) lighting, appliances and windows sold through "retail" channels. While the large majority of participants are expected to be residential customers, non-residential customers would not be excluded from participation.

The PEI initiative administrator would work with retailers and manufacturers to stock, promote and sell ENERGY STAR lighting products, appliances and building products including, but not limited to:

- CFLs

- Fixtures - hard-wired fixtures, ceiling and ventilation fans, torchieres, etc.
- Clothes Washers
- Refrigerators and freezers
- Dishwashers
- Dehumidifiers
- Windows

Additional products could be added to (or removed from) this list as new ENERGY STAR specifications are developed and existing ones revised. For example, ENERGY STAR is completing the development of a specification for solid state lighting (SSL). Labeled SSL luminaires should be available at retail in mid-2008 and should be considered for initiative inclusion. Note that removal of second refrigerators is addressed in the Existing Homes initiative

The initiative would place great emphasis on leveraging of the ENERGY STAR program – relying wherever possible on the ENERGY STAR standard as the initiative's definition of efficiency and basis for determining eligibility for initiative offerings. Energy efficient versions of all of the products listed above currently participate in the ENERGY STAR program. For some products, e.g.; clothes washers and dishwashers, incentives may be tiered to promote products that exceed ENERGY STAR requirements. Use of the Consortium for Energy Efficiency (CEE) tiers (www.cee1.org) is recommended. While the ENERGY STAR specifications and label should serve as the underpinning for this initiative, promotion of certain non-ENERGY STAR products may be pursued on a limited basis.

It is expected that most of the initiative's savings would come from lighting (primarily CFLs). In the past, most CFLs sold through efficiency initiatives used instant rebates. More recently, initiative administrators in many North American jurisdictions have been implementing joint negotiated cooperative promotions ("NCPs") – effectively product buy downs or markdowns - with manufacturers and retailers to obtain either wholesale or retail price reductions. These efforts have both increased the number of efficient lighting products sold and reduced the costs to do so. It is expected that the proposed Efficient Products Initiative would use both instant rebates and NCPs to increase the sales of efficient lighting on Prince Edward Island.

Clothes washers and dishwashers save energy mostly from reduced hot water and, for clothes washers, reduced dryer energy use. Most of the hot water use will be oil-fired. Given the current high saturation of ENERGY STAR dishwashers we would recommend setting minimum initiative criteria at a level above ENERGY STAR; potentially at one of the higher CEE tiers. This will limit initiative free-ridership and increase per unit energy savings.

B. Market Barriers

The barriers to investments in efficiency for these consumer products can be numerous. While they vary somewhat from product to product, there can be a number of common problems:

- Consumers lack of information or misinformation – most consumers are unaware of the differences in energy consumption and other performance characteristics of efficient and inefficient products;

- Uninformed retail sales staff – many sales people also do not understand the differences in efficiency between different products;
- Poor sales skills – many retail sales people are not skilled at "selling up" to higher priced, higher quality products (a problem exacerbated by high turnover in sales staff);
- Poor past experience with the product – some consumers' initial experience with efficient lighting products may make them reluctant to purchase them again;
- Limited availability of some efficient products (e.g. airtight, insulation contact (IC)-rated fluorescent recessed cans and other types of ENERGY STAR fluorescent fixtures that are considered aesthetically appealing);
- Small magnitude of savings for many consumer products makes it hard to get consumers attention – although the absolute magnitude of savings available from many products is modest (40-200 kWh/year for all but a few), the percentage savings are often large and the cumulative effect of numerous purchases is substantial; and
- High incremental costs for some products (e.g., clothes washers).

C. Initiative Strategies

This initiative would employ several different strategies to overcome the above market barriers.

Financial Incentives

Financial incentives will be offered to overcome the first cost barrier that is common to all of the above efficient products. Depending on where the planned market intervention occurs, the proposed incentive may vary for a given product.

Possible promotional and incentive strategies could include:

In-store instant rebate coupons for lighting products. Note that not all national retail chains will participate in coupon-based initiatives. For example, Wal-Mart has typically been reluctant to participate in coupon initiatives. The volume of instant coupons may require the hiring of a coupon processing and fulfillment contractor.

Proposed incentive levels for this initiative component are:

Product	**Proposed Incentive**	**Comment**
Bare/spiral CFLs	$1/bulb	Higher incentives for higher wattage bulbs (≥ 23 watts) may be considered.
Specialty CFLs – globe, A-lamps, reflectors dimmable, etc.	$2.50/bulb	Proposed revisions to ENERGY STAR CFL spec will require elevated temperature testing of reflector CFLs. If these requirements are not in place at initiative start, restrict reflector incentive to PNNL tested lamps. See: http://www.pnl.gov/rlamps/
CFL Fixtures	$15/fixture	As SSL fixtures become available, may need to differentiate rebate levels – possibly lower

		CFL fixture rebate and set high SSL incentive to partially account for higher cost.

Higher incentives for low mercury bulbs may also be considered.

Mail-in rebate coupon for efficient appliances. Consumers would complete a mail-in rebate form that would be available at the retailer and would require proof of purchase. Proposed incentive levels for this initiative component are:

Product	**Proposed Incentive**	**Comment**
Clothes washer	$50	Higher incentives for higher CEE tiers should be considered. Depending on retailer stocking and initial rebate activity, consider eliminating rebates for the least efficient ENERGY STAR models after the first six months to a year of initiative implementation.
Dishwasher	$20	Set minimum eligibility above current ENERGY STAR level
Refrigerator/freezer	$25	New ENERGY STAR specification to be effective in April 2008
Dehumidifier	$15	
Window	$25	"Super" window did not pass screening

Manufacturer/retailer sales-based markdowns. Payment to the retailer or manufacturer is based on documented sales of eligible products. Incentive amounts can be pre-determined and distributed as a "standard offer" or subject to bid or negotiation through an RFP-based process. This "upstream" market intervention approach eliminates coupon redemption costs, but does require timely review and processing of participating trade ally invoices. Historically, these upstream incentive approaches have worked best with lighting products, specifically CFLs. Incentive amounts are usually equal to or less than that offered through consumer based rebates.

Consumer Marketing

The initiative would use a wide variety of tools to market to and educate consumers. These may include, but not be limited to:

- Point-of-purchase ("POP") materials;
- Utility bill inserts;
- Direct mail;
- A central web-site;
- Booths at home shows;
- Public relations events;

- Outreach to media;
- 800 number consumers can call for expert advice; and
- Limited media advertising.

The initiative would develop and implement a cooperative marketing offer to co-fund retailer or manufacturer initiated ad development and placements. The initiative would also encourage participating NCP retailers and manufacturers to include marketing as part of their proposals.

To supplement these efforts, community-based outreach activities such as Project Porchlight may also be considered. Other "special events" used to market the initiative could include torchiere turn-ins and December holiday events using LED holiday strings, e.g., Christmas tree lightings and incandescent holiday light turn-ins.

Trade Ally Marketing

The initiative would conduct regular "outreach" visits to all retail stores likely to sell eligible products to consumers on PEI to keep them informed of initiative developments, answer questions, provide rebate coupons and point-of-purchase marketing materials, etc. The initiative would also periodically provide sales training to sales staff of key trade allies. The initiative would develop a retailer participation agreement that would detail the responsibilities and benefits from participation in the Efficient Products Initiative.

II. Homes Initiative

A. Introduction and General Initiative Description

This initiative will address space and water heating efficiency opportunities in both existing and new homes, with the principal initiative focus on existing homes. Typically residential new construction initiatives have separate and dedicated implementation, marketing and technical services. However, the small number of new home starts (estimated at approximately 800 per year) on PEI may not provide a sufficient critical mass to justify a stand-alone new homes initiative. We would suggest limited new construction services delivery in the first year to allow initiative staff to better assess the actual savings opportunities and initiative needs in the new homes market.

For both the existing homes and new construction initiative components we recommend that the ecoEnergy (formerly EnerGuide) audit tool and general initiative structure serve as the basis for the planned PEI Homes Initiative. This entails the use of an initial home assessment (D audit) and a post-installation audit (E audit). While the initiative goal will be to comprehensively address all cost-effective savings opportunities in each participating existing residence through the audit process, incentives will be provided for select individual measures without first having had an audit. This initiative feature is critical to address time dependent space or water heating equipment replacement-at-failure opportunities. We also recommend that early refrigerator retirement be offered through this initiative.

Currently, the ecoEnergy program provides grants for:

- Insulation
- High performance windows
- Efficient heating and cooling systems, including efficient distribution fans and wood stoves
- Efficient water heating, including drain water heat recovery
- Blower door directed air sealing

The proposed incentive structure builds on these current ecoEnergy grants.

A rating of 80 will be a requirement for the new homes component. However, the R-2000 program will be considered as a future compliance option if it is determined that there is sufficient builder and contractor interest to support the required R-2000 training and certification on PEI.

As noted below, first costs are a critical barrier for potential initiative participants to overcome in upgrading the efficiency of their homes. For low income customers these costs are insurmountable. Low income customers would participate in this initiative along with all other residential customers, but their incentives would cover the full costs of measure implementation.

B. Market Barriers

There can be a number of barriers to investments in efficiency in residential retrofit markets. These include:

- Consumers lack of knowledge of the nature of the energy and non-energy benefits (e.g. reduced fire hazards, better indoor air quality, greater durability of the home) of comprehensive efficiency improvements;
- Limited infrastructure of quality contractors who can address efficiency opportunities;
- Consumers inability to identify quality contractors who can address efficiency opportunities;
- Limited availability for some efficient products (e.g. fluorescent fixtures that are considered aesthetically appealing);
- Split incentives between building owners who make investment decisions and renters who pay energy bills; and
- Consumer reluctance to incur debt to finance efficiency improvements.

Additional new construction barriers include:

- Builders lack of knowledge or skill regarding both efficient practices and efficient products;

- Mistaken perceptions that some efficient products (e.g. fluorescent light fixtures) are necessarily prone to operating problems or aesthetically unappealing;
- Split incentives – builders have little incentive to focus on energy efficiency since they will not ultimately be paying the energy bills; and
- Consumers' inability to differentiate between efficient and inefficient homes and products.

C. Initiative Strategies

This initiative would employ several different strategies to overcome these barriers, including financial incentives, consumer marketing, and trade ally marketing.

Financial Incentives

Incentives would cover one-third of the installed measure costs for existing homes, in addition to any federal ecoEnergy grants. For new homes, one-quarter of the estimated measure cost would be covered. Existing homes customers would be required to pay half the cost of the home audit (half of $300) if they do not install at least $150 in recommended measures. The initiative administrator should also consider offering free CFL installation and low cost water conservation measures, e.g., tank wraps, pipe insulation, showerheads, and faucet aerators as part of the initial home assessment. This will help to get contractors "in the door" and will insure that all assessments generate some amount of energy savings.

Consumer Marketing and Recruitment

There would be limited direct marketing to consumers through newspaper and radio ads. Point-of purchase materials would be placed in home stores. It is anticipated that a substantial amount of customer outreach would be performed by participating contractors seeking homeowners' business and the initiative will develop initiative materials, e.g., brochures, for contractors to distribute. The initiative administrator will work with the appropriate provincial and community-based organizations to help identify and recruit low income customers.

The initiative would offer to cost-share consumer advertising conducted by contractors and builders who participate in the initiative.

This initiative could also "mine" participants in past provincial or federal audit initiatives to generate leads.

Trade Ally Marketing

Contractor recruitment and participation is critical to the success of this initiative and the initiative administrator should begin outreach to these trade allies once a "go-ahead" is received for this initiative. Contractors would be actively recruited and would be informed of

the incentives and materials distributed to them via mail, e-mail and any regularly scheduled PEI initiative activities for contractors.

One initiative consideration is whether there should be any training or certification requirements as a condition for contractor participation in the initiative (note that the R-2000 initiative has a number of training and/or certification requirements). These efforts would benefit from coordination with neighboring provinces.

Other Key Strategies

Some limited outreach, staff training and point of purchase development and placement would be directed to appliance retailers, home improvement centers, and plumbing supply showrooms to help capture kitchen remodeling activity.

The PEI initiative administrator will provide sufficient project oversight to insure quality of measure installations and that the home assessments provide a complete and accurate identification of savings opportunities.

Draft Commercial and Institutional Efficiency Initiative Designs for Prince Edward Island

Introduction

Preliminary initiative designs for the Commercial and Institutional (C&I) sector were developed based on experience with C&I initiatives in other jurisdictions and the specific nature of the C&I market on PEI. Current practice is moving towards limiting the number of distinct initiatives that each require staff, branding and marketing efforts, and other resources. Therefore, we recommend that all C&I efficiency activities occur as part of one initiative. This simplifies customer's interactions with efficiency programming by providing a single point-of-contact for their needs.

Within the initiative there are two main initiatives corresponding to two separate market segments. The Direct Install Initiative is focused on cost-effective retrofit projects for small and medium-sized customers. The Lost Opportunity Initiative focuses on increasing the frequency with which high efficiency equipment is selected during equipment replacement, renovation and new construction events. We also recommend providing large customers with additional support through an Account Management system.

As with the Homes initiative the lack of an existing contractor infrastructure to provide all of the required efficiency services will present a challenge to successful initiative implementation. Recruitment and growth of this infrastructure will be a critical initiative activity.

a) Small and Medium C&I Direct Install

As with most jurisdictions, a large majority of commercial entities on PEI are small to medium-sized, with electric demand less than 100 kW. Below, we discuss the market barriers facing these customers and the key strategies that this initiative will use to address these barriers.

Market Barriers

Numerous market barriers exist that inhibit the selection and purchase of energy efficiency technologies by smaller C&I customers, and some are unique to this smaller class of customers. These barriers include:

- Lack of Information or search costs: Small customers are especially prone to this barrier. They have little time and work with smaller contractors who themselves face barriers in gathering information. Many customers do not hire someone to address energy issues for their facility. This poses significant challenges for distinguishing energy-efficient products or services from those that are not.
- Hassle or transaction costs: Small businesses do not want to invest the time required to research and evaluate multiple options.

- Performance Uncertainties/Perceived Risk/Hidden Costs: C&I customers have high discount rates when introducing new technologies in production facilities, as "down time" has significant impacts on profitability and performance. Additionally, design professionals and contractors may be unwilling to change standard practice due to concerns about supporting new equipment after installation.
- Split Incentives: For those small C&I customers where landlords pay for equipment, but tenants pay the bills, there is little incentive for landlords to invest in improvements.
- Access to capital: Concerns about debt burdens push businesses to focus on first costs, rather than life-cycle costs, as do the practices of lending institutions to fail to account for the unique features of energy-saving products. Smaller customers often have difficulty obtaining credit in general.
- Lack of availability: Energy-efficient equipment may not be stocked by distributors or vendors, and longer lead times might prevent companies from selecting this equipment to minimize downtime.
- Organization Practices or Customs: Businesses may establish procurement policies requiring purchase of least-first-cost equipment, rather than lowest life-cycle cost.
- Competition for resources: Businesses are inundated with salespeople offering money-saving equipment and services. Energy efficiency must compete.

Initiative Strategies

Direct Install (DI) initiatives offer turnkey services, combining project analysis, financial incentives, and installation into a unified package to reduce the time and effort required on the part of the customer, thus overcoming many of the barriers noted above. The objective of this initiative would be to provide an aggressive approach to obtaining savings in the small and medium C&I sector over a limited timeframe. The DI initiative focuses mainly on overcoming the hassle and transactions cost barrier and reduces the need for capital investment by providing high incentive payments. It will use special incentive offers, financing and, eventually, an alliance of contractors to promote the retrofit of inefficient equipment with higher efficiency units where this is cost-effective. The initiative will primarily focus on:

- lighting
- HVAC control measures, system tune-ups, and VFDs
- water heating measures such as pipe insulation and flow reduction
- space heating measures such as air sealing and pipe and shell insulation
- high efficiency refrigeration

Initially, this initiative would be delivered Island-wide by a single DI contractor who is selected through an open-bid process. The contract would specify preferred pricing on a set of energy efficiency measures and goals for comprehensiveness in project completion in exchange for promotional assistance and referrals. All customers interested in participating in the initiative would be referred to the DI contractor. The DI contractor might do installations themselves or subcontract the work to local mechanical and electrical contractors. If the latter, the DI contractor would be responsible for selecting and training the installers to ensure that the equipment is installed properly.

While vesting one entity with the contract for all DI work on the Island may be appealing from an administrative perspective, it may not meet other objectives such as building the capacity of the contractor community to facilitate higher efficiency installations in the absence of an initiative. Therefore, the initiative should also include recruiting and training for local contractors to serve as market-based providers of DI projects. Over time, local contractors who meet training and performance criteria would be able to work directly with customers to identify, initiate, and complete projects and receive incentives from the Initiative Administrator without working through the DI contractor. This two-pronged approach provides both immediate acquisition of efficiency savings and long-term market transformation to generate on-going savings with less market intervention.

Financial Incentives

This initiative would initially include high incentives (we assumed 75 percent of full retrofit costs in the portfolio screening) to induce high levels of participation. Financial incentives would be paid directly to the DI contractor to cover a significant portion of project costs, with the remaining amount coming from the customer.

Customer costs remaining after the incentives would be paid in full by customers or financed through a financing initiative to be established specifically for this effort. The contract would limit prices charged to the customer by the DI contractor. Financing initiatives typically include arrangements with specific lenders for low-interest loans and simplified application processes. In return for the favorable loan terms, the lender receives direct referrals from the initiative, bringing in business with relatively little sales and marketing effort. Depending on the selection of Initiative Administrator, on-bill financing has proven to be popular with customers where the utility is willing to support it and has the technical capability to integrate it with their existing billing and accounting systems.

Trade Ally Marketing

The DI contractor would be selected by an open RFP process. Installation firms would be identified by the DI contractor. The initiative would be marketed among the contractor community by both initiative staff and the DI contractor. Eventually, a limited number of firms would be selected as qualified DI installation contractors.

Consumer Marketing

The initiative will require marketing by both initiative staff and the DI contractor. The Initiative Administrator's efforts would focus on making local businesses aware of this effort and providing referrals to the DI contractor (or other qualified contractors once they are part of the initiative). The DI contractor would be responsible for marketing to individual customers or customer classes and may have contractual goals for number of leads generated or projects initiated. The initiative would eventually provide marketing materials that qualified contractors could use with their customers to promote the DI incentives.

The DI Initiative also provides an opportunity to inform customers of the incentives and assistance available from the Lost Opportunity Initiative. For example, an audit might identify a piece of equipment that, while not cost-effective to replace immediately, is nearing the end of its useful life. In such a case, the DI contractor should be trained to notify the customer of the incentives available when new equipment is purchased. Because the DI retrofit incentives

will typically be much higher than the lost opportunity incentives (described below) care must be taken to structure these incentives such that customers and contractors are prevented from receiving the higher retrofit incentive amount for lost opportunity projects that would have been undertaken even absent the retrofit initiative.

b) Lost Opportunity

This initiative complements the Direct Install initiative, aggressively targeting equipment replacement opportunities for all C&I customers. This initiative would promote high-efficiency equipment replacement choices at the time these events naturally occur, including equipment replacement upon failure, building remodeling and renovation activities. Because new construction activity is predicted to be relatively slow, we include those events in this initiative as well, rather than separate them into a distinct new construction initiative. The term "Lost Opportunity" covers all of these equipment replacement events.

Market Barriers

Most of the same Market Barriers described under the DI initiative also apply to Lost Opportunity measures, although factors related to the availability of time and equipment selection are more important in this case. Whereas DI targets the replacement of inefficient but functional equipment, Lost Opportunity upgrades by their very nature are time-sensitive. The window to effectively influence the purchase of a piece of equipment that is replacing a failed unit is typically very short, potentially on the order of days or even hours. Therefore, different strategies are necessary to capture these opportunities and generate a higher efficiency installation.

Initiative Strategies

The initiative will aggressively target equipment replacement opportunities for all C&I customers. The primary strategy will target Trade Allies – electrical and mechanical contractors and distributors – to promote stocking and sales of high-efficiency equipment in place of standard equipment.

Upstream Financial Incentives

To adequately capture these "lost opportunities," the initiative would include both "upstream" and customer financial incentives as well as substantial upstream marketing efforts.

The upstream incentives are structured to result in end-user purchase prices for high-efficiency equipment that is equal to the price of standard-efficiency equipment. The New Brunswick Upstream Lighting Initiative is an example of this approach that has worked well in smaller geographic areas such as PEI with a limited number of distributors for a particular equipment class. Collaborating with this existing initiative could result in overall savings in initiative costs. Even if no direct collaboration occurs, the initiative model can be the same or nearly so.

Initiative staff determine the incremental costs to the distributor for equipment with fairly predictable high-efficiency alternatives: lighting (e.g., Super T8s in place of T8s or T12s), air conditioning (e.g., Tier II model efficiencies), and premium efficiency motors. Based on this, they would develop an upstream incentive amount – paid directly to distributors – that would

offset the entire cost difference between the standard- and high-efficiency equipment. The distributor passes the incentive payment on to the customer by charging the same amount for the high-efficiency equipment as for the standard-efficiency equipment.

The incentive payment to the distributor would also include a "hassle factor" payment to compensate for changes in distributor's record-keeping systems to comply with reporting requirements as well as the extra work required in transactions. The Initiative Administrator would pay incentives to distributors in response to invoices demonstrating sales of eligible products.

Customer Financial Incentives

For other types of equipment, prescriptive rebates may be offered directly to the customer to defray the incremental cost of higher-efficiency models. Customers would fill out simple forms to claim the rebate. In the U.S., this type of approach has typically been used for equipment such as off-the-shelf HVAC equipment (e.g., RTUs, split-systems, boilers), lighting, and motors.

This initiative should also have the ability to handle "custom" projects not covered by a prescriptive rebate. This requires staff or contractors who can conduct technical analysis on the project and negotiate an incentive level with the customer based upon the project's financial returns and the customer's cash flow requirements.[9] Another component of custom project work is to provide technical assistance to customers interested in installing efficiency measures but without the necessary in-house technical capabilities to understand the available options. Again, technical assistance could be provided by in-house staff or by contracted consultants with expertise in various technologies and systems (*e.g.,* compressed air, refrigeration).

Note that this initiative does not distinguish between replacement, renovation, and new construction markets for these products. All of these represent Lost Opportunities are therefore subject to the same incentives and approach. Different approaches to reaching these different markets are described below.

Last, we have assumed that large customers who are not eligible for the Direct Install initiative could propose retrofit projects as a custom project under this Initiative. In our experience, such projects are fairly uncommon. To ensure adequate participation of larger customers, the Initiative Administrator could consider providing large customer retrofit projects incentives, depending on available funding and other criteria.

Trade Ally Marketing

A key component in this market is the development of effective working relationships with trade allies, particularly mechanical contractors, electrical contractors, and distributors or vendors. Because of the narrow window of time within which customers make decisions to replace equipment, these trade allies need to be positioned to offer high-efficiency alternatives *first*, rather than provide energy efficiency as an option to their "standard" offering.

[9] At this point in initiative design, we have not specified which, if any, services might be cost-effectively contracted for by the Initiative Administrator.

Initiative staff would be responsible for contacting these entities to inform them of the initiative and encourage them to participate where appropriate. For the upstream incentives, staff would be responsible for marketing the initiative to the distributors, enrolling them, and supporting their participation with assistance on consumer marketing, technology specifications, and the administrative processes necessary to receive payment for qualifying products.

Initiative staff could also host training sessions with contractors to highlight the benefits of high-efficiency equipment and to highlight the availability of both upstream and end-user incentives.

Marketing to trade allies would also include attention to the role of high efficiency in new construction. Emphasis would be on building awareness within the community of the opportunities and benefits of high efficiency systems and construction standards and on gathering "leads" on plans for significant new projects to facilitate early collaboration by Initiative staff with the owners and designers. The Account Managers (see Considerations for Large Customers, below) will also play a role in these activities.

Consumer Marketing
The initiative would use community events – possibly integrated with those promoted by the residential initiatives – to raise awareness among smaller business owners of the opportunities available to this customer class. C&I customers would be encouraged to contact initiative staff when considering equipment replacement projects. However, the key method of reaching customers is through the trade allies. As in the DI Initiative, trade allies would be provided with promotional materials to assist with their customer education and information efforts.

c) Considerations for Larger Customers

The differences between large and small-to-medium C&I customers – in terms of management, expertise, and capacity for undertaking capital projects – and the substantial savings potential at larger facilities indicate a need for additional efforts for large customers. According to Maritime Electric Data, the largest 100 customers (not including the four largest industrial customers or the University) have average peak monthly loads in excess of 200 kW and are responsible for approximately one-third of all C&I energy consumption.

We recommend having one or more Initiative staff responsible for establishing direct relationships with each of these customers to maximize the capture of both retrofit and lost opportunity projects. This is similar to an "Account Management" approach taken by many businesses (including utilities) with their largest customers. The goal of these relationships would be to integrate initiative staff into capital planning activities at each Large C&I customer. Being invited to participate at that level with each customer may and likely will require demonstrating value to each Large C&I customer beyond the scope of just obtaining electricity savings (e.g., finding resources to assist with power factor correction, demand management, and other resource impacts).

Other initiatives that have implemented an Account Management approach have assumed that each Manager can handle approximately 20 accounts. In order to serve the largest 100

customers, this would require 5 Account Managers, which may be more than is warranted for the PEI initiative. One mitigating factor is that the "large" customers on PEI may in fact be medium-sized as compared to large customer elsewhere. According to the Maritime data, 15 of the largest 100 customers are food stores. In most jurisdictions, this percentage would be lower. For example, a recent study in Southern Vermont found only six food stores out of the largest 130 customers. Therefore, it may be possible to serve the largest customers on PEI with fewer Account Managers. In setting up this part of the initiative, the Initiative Administrator will need to balance the number of Managers with the number of customers that can be served and the level of attention that can be provided to each.

Where appropriate, technical and design assistance services would be provided either by initiative staff, outside contractors hired by the initiative, the consumer's design team, or some combination of the three, depending on customer needs, and expertise. The initiative would assist in: determining efficiency opportunities; analyzing efficiency opportunities in terms of costs and savings; identifying available products and vendors; and contributing to design and specification documents.

Financial incentives for large customers and their projects would be custom tailored to the specifics of the project. Overall, the goal is to provide incentives at a level which defrays some portion of the cost of efficiency measures and addresses the financial needs of the customer. Ideally, the incentive results in a project cash flow with a better rate of return than other business investments typically made by the customer.

Appendix B: Full Transportation Initiative Descriptions

I. P.E.I. Energy Efficiency Analysis: Transportation Strategies

RECOMMENDED:

I. Vehicle Fuel Economy Incentives

A. Description

Incentives promoting the purchase of more fuel efficient vehicles and/or alternative fuel vehicles, in the form of subsidies or feebates/rebates tied to fuel economy, energy efficiency or GHG emissions. This strategy represents an alternative to fixed fuel economy standards, although their objectives are the same.[10]

Existing Programs or Initiatives

Provincial hybrid tax incentive of $3,000 since 2004 – PEI issued 63 in 2006

Federal initiative proposed for feebate/ rebate system based on efficiency (offer rebates of $1,000 to $2,000)[11] – details and enactment of federal strategy still uncertain.

Proposed Action

Implement a revenue neutral feebate/rebate with target fuel economy (expressed in CO2 grams/km) of 312 (five percent below baseline) in 2009 to 279 g/km (15 percent below baseline) in 2017. Feebates/rebates would be adjusted annually to best achieve and maintain GHG emissions targets and revenue neutrality.

B. Assumptions

[10] Both incentives (subsidies or feebates) and mandates/standards aim to achieve a given fleet-wide level of fuel economy. There are trade-offs in that mandates effectively insure the achievement of the fuel economy outcome, but cause greater market distortions and cost uncertainties for both manufacturers and consumers (these are much more substantial in smaller markets and less so at the national level). Incentives allow greater consumer preference and decrease costs and uncertainties somewhat, but the fuel economy outcome is not guaranteed. The two mechanisms are not mutually exclusive, however, as a federal fuel economy standard of 30 mpg for example, could be supplemented by a Provincial feebate initiative that imposed a fee for vehicles below 35 mpg and gave a rebate to vehicles above 35 mpg. The amounts of these feebates/rebates could be adjusted to provide sufficient incentives that average fuel economy actually does achieve 35 mpg in the Province, and/or to aim for the initiative to achieve revenue neutrality, depending on decided policy goals.

[11] Following the completion of the analysis for this report, the details of the Federal initiative were released. Details are available at: http://ecoaction.gc.ca/ecotransport/index-eng.cfm

Reference Case

We assume that baseline fuel economy projections hold and that the current hybrid incentive is phased out/replaced by this measure, since it is more directly outcome-oriented and technology-neutral. For the baseline, vehicle fuel economy and vkt are assumed equal to that provided in the Reference case.

Fuel is considered to cost $1.10 per litre for all strategies. Also for all strategies, past and future benefits and costs may be determined from the underlying calculations and spreadsheets, but the figures provided refer only to costs incurred and benefits received in 2017. These figures should be representative of longer time periods as well.

Effectiveness Rates

The policy is flexible in that it can theoretically achieve whatever level of effectiveness is desired through the definition and operationalization of the feebates rebates. We believe a phased in target of a 15 percent fuel economy improvement would be in practice very reasonable and achievable.

C. Results

Cost

The governmental cost of administering and evaluating the initiative is estimated to be equivalent to two full-time equivalents, or $200,000 (this, and FTE costs for all strategies, include the salary and fringe and benefits agreed earlier, and the fully allocated office and equipment overhead and general, managerial and administrative support – such as from senior managers, IT support, administrative assistance, payroll, human resources, etc. staff). Fuel tax revenue of $0.158 per litre will be lost for each litre of fuel saved, totalling $2.1 million annually by full effectiveness in 2017.

Drivers will pay about $1.4 million extra in 2017 to purchase vehicles (6,200 new vehicles purchased) with the incrementally higher fuel economy the initiative achieves.

Benefits

Drivers will save about $14.5 million in fuel costs due to the improved fuel economy of the fleet in 2017.

Cost-Effectiveness

The initiative is extremely cost-effective as revenue neutral economic incentives provide strong incentives with minimal cost. For 2017 there is expected to be a net societal benefit of about $10.1 million, a figure derived predominantly from

driver fuel savings, and therefore a savings of $0.77 per litre or $331 per tonne of CO2.

If fully implemented, the strategy is estimated to reduce CO2 by 30,600 tonnes annually in 2017. With its positive ("no regrets") cost effectiveness and a substantial CO2 reduction, we recommend that this strategy be aggressively pursued if the GHG emission standards, which have a mostly overlapping effect, are not.

D. Other Considerations

Feasibility

The initiative has minimal obstacles to implementation, and many analogues already exist (e.g., gas guzzler taxes, hybrid/alternative fuel incentives) in less comprehensive forms.

Leakages

It is likely in the short-term and somewhat into the medium-term (approximately five years) that the market incentives will result in more poor fuel economy vehicles being sold elsewhere in Canada as the initiative merely displaces vehicle purchases rather than shifting manufacturer production. However, manufacturer are sensitive to shifts in consumer preference and based on sales data will shift their production mix in the medium- to long-term in response.

Co-benefits and Externalities

Reduced fuel consumption will reduce local air pollutants from vehicles. There may be some reduction in vehicle safety from the shift towards more fuel efficient (typically smaller) vehicles, although this effect is usually overstated. Consumer choice is reduced somewhat.

Federal implementation of a similar feebate system, would likely yield some additional benefits:

- decrease or elimination of Provincial initiative administration costs ($200,000 annually);
- increased initiative local effectiveness, due to the greater market power of a nationwide initiative increasing the availability of better fuel economy vehicles; and,
- better global emission reductions, due to decreased leakages from the displacement of poor fuel economy vehicles (i.e., the North American fleet manufacturing mix will change much more significantly with a nationwide initiative, decreasing the shifting of poor fuel economy vehicles to other locations).

Timing and Durability

The strategy will likely need to be phased in for political acceptability and to develop awareness before consumers are

making their purchase decisions. (We selected a fairly slow phase in period.) Once implemented, the initiative will also take time for fleet turnover to increase its effectiveness.

II. Government Fleet Purchases

A. Description

This strategy involves the purchase of more fuel efficient or alternative fuel vehicles by a governmental organization or private organization (the latter often under a governmental mandate).

Existing Programs or Initiatives

Some hybrids and more efficient vehicles have been purchased by the Province to date (no alternative fuels yet). These are considered to be in the baseline forecast. The PEI business plan includes objectives for "right-sizing" the fleet as well as selecting "best in class" vehicles for purchase.[12]

Proposed Action

Improve the average fuel economy of new Provincial government and City of Charlottetown vehicle purchases, ranging from four percent better than baseline in 2010 to 33 percent better in 2016 and later. This strategy would be a more aggressive and extensive version of the initiative described in the PEI Business Plan. It would include purchasing best-in-class vehicles for all purchases and more aggressive right-sizing of the fleet, including through the use of shared vehicles.

B. Assumptions

Reference Case

While the calculations represent the shift from the baseline, the true baseline for these fleets is not known, as efforts are already underway to improve fleet fuel economy. This strategy would significantly accelerate that trend by 2012.

Effectiveness Rates

The additional fleet fuel economy improvements range from four percent better than baseline in 2010 to 33 percent better in 2016 and later. It is assumed that the government fleets do not pay fuel taxes.

[12] "Best in class" is a term of art in the automotive sector, used to describe the highest performance level (in fuel economy, horse power, acceleration, etc.) of any vehicle in a regulatory-defined classification. These classes are, for example, jointly defined by US DOE and US EPA as part of their fuel economy standards and certification and every make and model for each year is accordingly classified. These agencies define market classes (viz., small cars, family sedans, upscale sedans, luxury sedans, large sedans, hatchbacks, coupes, etc.) and EPA size classes (viz., mini-compact, compact, mid-size cars, large cars, mid-size station wagons, etc.). See www.fueleconomy.gov. The Province could set its standards by reference to these or other defined classes, and require that the average for all vehicles purchased be within 5 or 10 percent of the very best available within its class.

C. Results

Cost

The purchases of more fuel efficient vehicles (including hybrids) is estimated to cost the governments just over $30,000 more in 2017 than in the baseline case. Incremental staff costs of around $10,000 are also important. These are spread over the approximately 36 new vehicles purchased that (and other) years.

Benefits

The strategy is estimated to provide about $124,000 in fuel savings by 2017 (and increasing thereafter until full fleet turnover occurs).

Cost-Effectiveness

The strategy is extremely cost effective, with net social savings of $84,000 in 2017, with savings of $0.64 for each litre of fuel saved and of $274 for each tonne of CO2 abated.

If fully implemented, the strategy is estimated to reduce CO2 by 306 tonnes annually in 2017. The strategy has positive ("no regrets") cost effectiveness, although it results in a small absolute reduction in emissions. The action is a maximum ratcheting up of an existing strategy, facilitating implementation. Further, there is very important symbolic "lead by example" value in the Province and municipalities adopting such a strategy (or conversely, not adopting such a strategy).

D. Other Considerations

Feasibility

There may be a challenge to find more fuel-efficient models of certain heavy duty vehicles, but right-sizing across the fleet may compensate for this.

Leakages

Although the scale is very small, it is likely in the short-term and somewhat into the medium-term (approximately five years) that the fleet purchases will result in more poor fuel economy vehicles being sold elsewhere in Canada as the initiative displaces vehicle purchases rather than shifting manufacturer production. However, manufacturer are sensitive to shifts in consumer preference and based on sales data will shift their production mix in the medium- to long-term in response.

Co-benefits and Externalities

Reduced fuel consumption will reduce local air pollutants from vehicles. There may be some reduction in vehicle safety from the shift towards more fuel efficient (typically smaller) vehicles, although this effect is usually overstated.

Timing and Durability

The strategy can begin nearly immediately, however, the initiative will take time for fleet turnover to increase its effectiveness.

III. Greenhouse Gas Emission Regulations

A. Description

This strategy includes adoption of fleet-wide light-duty vehicle greenhouse gas emissions standards similar to those imposed by the State of California. These standards take effect in California beginning in 2009 and are phased in through 2016. While GHG emissions can be reduced through various means, the vast majority of such reductions are expected to result from reductions in CO2 emissions as a result of improved fuel economy.

Existing Programs or Initiatives

None identified

Proposed Action

For the purposes of this analysis, the GHG emission standards are assumed to be phased in beginning in 2010, to allow manufacturers a two-year lead time to comply. The standard would reach 220g/km by 2016. The GHG standards apply to the full fuel-cycle, not just tailpipe emissions, so overall GHG emissions are assumed to be reduced in proportion to the standards.

B. Assumptions

Reference Case

Base case fuel economy of light-duty vehicles: Fuel efficiency of new vehicles under the base case is assumed to remain essentially constant over the analysis period (consistent with the Reference Case). Under the alternative case, average fuel efficiency is assumed to improve in proportion to the reduction in GHG emissions – i.e., most GHG savings will result from reductions in fuel consumption. Baseline energy use from affected light-duty vehicles is assumed to be the "road passenger energy demand" referenced in the Natural Resources Canada transportation sector tables (as cited in the Reference Case).

Mix of vehicle types: Per the Reference Case, passenger cars are estimated to make up 60 percent of new light-duty vehicle sales, and light-duty trucks 40 percent. The split between LDT1 and LDT2 is estimated at 75%/25%, consistent with U.S. assumptions embedded in the U.S. Environmental Protection Agency (EPA) MOBILE6 emission factor model. This assumption holds across strategies.

Activity fractions: To calculate the net GHG reductions from the light-duty vehicle fleet in 2017, the activity fraction (%VKT) of each affected previous model year needed to be calculated. This fraction is a function of age distributions (% of vehicles by age) and mileage accumulation rates (km/year). These parameters were taken from default values embedded in the EPA's MOBILE6 model. About 63 percent of LDV travel on the road in 2017 is made up of model year 2010 or later vehicles affected by the GHG standards. This assumption holds across strategies.

Fuel type: All fuel consumed by light-duty vehicles is assumed to be gasoline. Given that only a small percentage of such vehicles use diesel fuel and the GHG emissions from gasoline and diesel differ by a relatively small amount, this assumption will not substantially affect the calculations of benefits and cost-effectiveness.

Effectiveness Rates

The emission standards apply to the full fuel cycle and will result in a 34 percent reduction in GHG emissions from passenger cars (PC) and light-duty trucks 1 (LDT1) and a 25 percent reduction in emissions from light-duty trucks 2 (LDT2).

C. Results

Cost

Public sector costs for initiative administration and enforcement, $100,000, are extremely small compared to the net savings to consumers. For the public sector, minor costs may be occurred in the administration and enforcement of the initiative. These costs could be reduced through joint implementation with neighbouring provinces. For this analysis, an annual initiative administration cost of one full-time staff person is assumed. Lost fuel tax revenue totals $3.6 million.

The other major cost impacts would be to private vehicle owner-operators, in the form of increased vehicle purchase costs. Private-sector cost-effectiveness estimates for the GHG standards are taken from analysis by the State of California.[13] Drivers are estimated to pay approximately an additional $5.2 million in 2017 to purchase vehicles meeting the standard.

Benefits

Drivers are estimated to save $25.1 million in 2017 in reduced fuel costs.

Cost-Effectiveness

The initiative is extremely cost-effective due to the high fuel savings. For 2017 there is expected to be a net societal benefit of about $15.0 million, a figure derived predominantly from driver fuel savings, and therefore a savings of approximately $0.66 per litre of fuel saved or $282 per tonne of CO2.

By directly addressing CO2 emissions, this strategy is extremely effective, with an estimated reduction of CO2 by 53,000 tonnes annually in 2017. The strategy has positive ("no regrets") cost effectiveness, further recommending it for option. Significant overlap with the feebate/rebate strategy implies that they should not be jointly adopted.

[13] California Air Resources Board. Staff Proposal Regarding the Maximum Feasible and Cost-Effective Reduction of Greenhouse Gas Emissions from Motor Vehicles, Draft, June 14, 2004.

D. Other Considerations

Feasibility

Since this strategy is standards-based, there is relatively little uncertainty regarding the emissions and fuel savings benefits that are expected to occur. It is possible that there could be a reduction in benefits if the higher prices of new vehicles is significant enough to discourage consumers from purchasing these vehicles and instead to keep older, less efficient vehicles longer. However, operating cost savings over the life of the vehicle are expected to benefit consumers, and their magnitude will increase if gasoline prices continue to rise. Also, as technology advances, the cost differential for new vehicles may be expected to fall.

Leakages

It is likely in the short-term and somewhat into the medium-term (approximately five years) that the market incentives will result in more poor fuel economy vehicles being sold elsewhere in Canada as the initiative merely displaces vehicle purchases rather than shifting manufacturer production. However, manufacturer are sensitive to shifts in consumer preference and based on sales data will shift their production mix in the medium- to long-term in response.

Co-benefits and Externalities

Emissions of local air pollutants would be reduced. Unquantified costs would include impacts on consumer welfare and safety to the extent that the standards require the sales of smaller and/or less powerful vehicles.

Timing and Durability

The initiative will be phased and its effects will be delayed by the rate of fleet turnover, meaning less than half the very long-term benefits will be occurring by 2017.

IV. Telecommuting / Compressed Work Week

A. Description

Telecommuting generally refers to an employee who otherwise works at a workplace working some days from home, typically with good telecommunications connections. Compressed work week refers to the shifting of worker hours so that the employee works more hours per day on fewer days per week (e.g., four 10-hour days in a week eight nine-hour and one-eight-hour day per biweekly period), thus commuting fewer days.

Existing Programs or Initiatives

No formal initiatives have been identified.

Proposed Action

Implement an outreach and awareness campaign to encourage both of these options. This may include direct outreach to employers, development of goals/standards with a corresponding employer recognition campaign. The estimated penetration rate is for two percent (above current rates) of employees to participate in each initiative.

B. Assumptions

Reference Case

The Reference Case was utilized to provide the total vkt and help estimate the percent of vkt undertaken for commuting.

Effectiveness Rates

Conservatively, the amount of vkt reduced by telecommuting was placed at 75 percent of the commute distance avoided. Some studies have indicated that telecommuters increase their non-commute vkt when telecommuting, due to either new discretionary trips, or due to the division into two trips (say one on the telecommute day and the other on the weekend) what otherwise would have been a single combined trip with two stops (say on the weekend). Similarly, the compressed work week effectiveness was conservatively put at 50 percent of the commute distance avoided, as this represents a day off from work rather than a day working from home as per telecommuters.

C. Results

Cost

The combined cost for education and outreach for telecommuting and compressed work weeks was set at $250,000, including staff time and materials. This represents the intention that the effort would be focused on outreach to employers to implement

the strategy, rather than a broad (and less targeted) campaign to the general public. Including foregone tax revenues due to the project's success raises the cost to $389,000.

Benefits

Quantified benefits are primarily fuel cost savings and travel time savings for commuters. For the two elements combined this is approximately a $1 million savings in fuel costs and $750,000 in avoided (non-productive) commute time. Other benefits not quantified include incremental maintenance and depreciation avoided on the commute vehicle and, some studies indicate, lower employee stress and greater productivity.

Cost-Effectiveness

Because of the relatively low costs of an employer outreach initiative, this measure has a high level of cost-effectiveness, with net societal benefits of almost $1.3 million. This translates to an additional $1.44 per litre for each litre of gasoline saved and a benefit of $619 per tonne of CO2 abated.

Telecommuting and compressed work weeks are estimated to together reduce CO2 emissions by 2,000 tonnes annually in 2017. These strategies have a negative ("no regrets") cost per tonne, supporting their case for implementation. We recommend this related pair of strategies be pursued.

D. Other Considerations

Feasibility

Similar initiatives have been introduced in a number of North American cities and shown some success through employer outreach. Penetration rates will be constrained by the number of "knowledge workers" for telecommuting, and by shift schedules, business hours, etc. for compressed work weeks

Leakages

The rebound effect of additional non-commute trips being undertaken when an employee is at home, whether for telecommuting of compressed work weeks, during business hours was discussed above.

Co-benefits and Externalities

The reductions in vkt from this strategy will proportionally reduce local air pollutant emissions and decrease crashes, incidents and congestion.

Timing and Durability

Implementation can begin nearly immediately, but there is likely to be lag time in employer uptake and willingness to change workplace culture.

V. Traffic Signal Synchronization

A. Description

This strategy involves improving traffic flow through coordinated signal timing, reducing vehicle idling and improving acceleration/deceleration profiles for vehicles through selected corridors.

Existing Programs or Initiatives

The PEI Department of Transportation Public Works is already pursuing this effort, and it is included to provide a first order estimate of what its CO2 emission reduction benefits will be.

Proposed Action

For this analysis, the Charlottetown Perimeter Highway Initiative is used as an illustrative example. The objective of this project, which is being undertaken by the PEI Department of Transportation Planning and Public Works, is to synchronize traffic signals along this 22-km highway. While other opportunities for signal synchronization on provincial roads are limited, there may be additional opportunities within the City of Charlottetown.

B. Assumptions

A number of the key assumptions are based on communication with Stephen Yeo in the Department of Transportation and Public Works (T&PW). A simulation study of the corridor is in progress, but results will not be ready in time for this analysis.

Total number of traffic signals affected: 20
Total corridor length: 22 km
Daily vehicle-traffic affected: 17,500 (average daily traffic ranges from 10,000 to 25,000 vehicles at different points along the corridor)
It is assumed that the project will be implemented solely through synchronization, and not by lengthening the green portion of the signal cycle. Therefore, perpendicular roads (cross-traffic) would not be adversely affected.
It is assumed that there will be half as much reverse-peak traffic as peak direction traffic, and that there will be an adverse effect (delay) equal to one-half the number of seconds per cycle that the peak direction saves.

Effectiveness Rate

The strategy was analyzed for a range of 5 – 15 seconds of reduced idle time per signal cycle. This would result in a travel time savings of between 1.7 and 5.0 minutes over the length of the entire corridor). This reduced idling time will directly reduce fuel consumption and CO2 emissions. The midpoint of this range, 10 seconds, was used for the calculations presented here.

C. Results

Cost

A one-time project implementation cost of $100,000 is assumed, to be annualized over five years. This assumes a cost of approximately $5,000 per intersection to conduct traffic counts, run simulation software to optimize timing, and retime signals. $51,483 in foregone fuel tax revenues is also incurred. If more significant hardware or software investments are required (e.g., to physically connect unconnected signals, or upgrade out-of-date hardware), costs would be greater. The project cost is assumed to be spread over a five-year period, which is the lifetime typically assumed for signal retiming projects (to maintain optimal traffic flow, signals need to be retimed every few years to account for changing traffic patterns).

Benefits

Project costs will be offset by reduced fuel costs to vehicle owner-operators, and more extensively by the benefits of reduced travel time to travelers.

Cost-Effectiveness

This strategy has the highest cost-effectiveness rate of the evaluated strategies, with net societal benefits of $2.5 million (versus annualized costs of $20,000). This converts to social benefit of $7.50 per litre of fuel saved and $3,224 per tonne of CO2 abated.

The signal synchronization project is estimated as potentially reducing up to 750 tonnes of CO2 emissions annually. It should be noted that this strategy's estimate in particular involves a high degree of uncertainty, due to the difficulty in predicting traffic flow changes without a micro-simulation. Additionally, there is uncertainty regarding project costs and the extent to which there will be negative impacts on cross-traffic.

D. Other Considerations

The most important unknown parameter is the average savings in idle time per signal. This cannot be determined without a simulation study. However, the estimates of up to 5 minutes travel time savings over the 22-km length of the corridor appear consistent with what might be achieved through signal synchronization initiatives.

Additional delays due to cross-traffic could offset some of the benefits. These delays are not considered in this analysis and cannot be estimated without a detailed assessment of corridor conditions and the signal synchronization plan.

Signal synchronization may also yield the greatest benefits during peak hours and lesser benefits at other times of the day. This could reduce the overall benefits of the strategy. However, cost-effectiveness is still likely to be over $1.00 per litre of fuel saved even under very conservative assumptions.

The co-benefits of this strategy are significant, and are likely to more than offset public-sector costs. The primary co-benefits include reduced delay to travelers (estimated at over $700,000/year under the more conservative scenario of 5 sec/signal and a conservative value of time of $5/hour) and reduced fuel costs for vehicle owner-operators (estimated at approximately $150,000 per year under the same scenario). Consideration of either or both of these benefits would result in a net negative cost-effectiveness (i.e., benefits outweigh costs to society as a whole).

Feasibility

Signal synchronization is a common transportation measure and should face no political opposition.

Leakages

Potential adverse effects on reverse-peak and cross-traffic are addressed above. There is a minimal amount of induced traffic that may be generated due to improved traffic flow.

Co-benefits and Externalities

Fuel reductions will reduce local air pollutant emissions. Increased travel speeds may have minor negative safety implications.

Timing and Durability

The project should be able to be implemented in approximately a year and have long-lasting benefits if periodic adjustments are made.

VI. Anti-idling Campaign

A. Description

The objective of an anti-idling initiative is to reduce idling, and therefore fuel consumption and emissions from idling, from motor vehicles through a combination of regulations, outreach, and supportive technologies (e.g., cab heaters). Anti-idling initiatives can target a number of sectors:

- Heavy trucks, which may idle for extended periods of time at rest areas or staging areas (probably not a significant issue on Prince Edward Island);
- Local delivery and service trucks;
- Tour buses (e.g., at restaurants and scenic stops);
- School buses, especially when dropping off or picking up students at the school;
- Public transit vehicles, at layovers; and
- Personal vehicles.

Existing Programs or Initiatives

The Government of Prince Edward Island has applied for funding for an anti-idling initiative that would primarily target fleet vehicles, including school buses, transit buses, and municipal fleets.[14] However, federal funding for this initiative does not appear likely. Natural Resources Canada has an Idle-Free Zone initiative that includes informational and outreach materials designed to encourage people to reduce idling on a voluntary basis.

Proposed Action

Implementation of activities similar to the Fleet Challenge initiative and additionally make efforts to increase awareness among both medium and heavy duty trucks and the general public (light duty vehicles).

B. Assumptions

Potential fuel consumption and GHG reductions from anti-idling initiatives were developed for each sector listed above. Key parameters include the total number of vehicles in the sector, the increase in compliance (i.e., the change in percent of drivers not idling as a result of the campaign), the average minutes of idling reduced per day per vehicle, the number of days per year for which idling is reduced, and the cost of

[14] Prince Edward Island Department of Environment, Energy & Forestry: *Prince Edward Island Fleet Challenge*, Version 3.0.

targeting the particular sector. The following table shows the various key assumptions.

Anti-Idling Target Populations	Vehicle type	Est. Total Vehicles	Increase in % compliance*	Min/Day Reduced	Days/ Year	Annual cost of targeting sector	
School buses	HDT	280	25 - 50%	15	180	$	35,200
Local buses	HDT	6	50 - 80%	15	300	**	
Municipal utility/ service vehicles	MDT	357	25 - 50%	5	250	**	
Tour buses	HDT	60	10 - 30%	30	100	$	7,543
Heavy-duty trucks, private	HDT	2,684	3 - 10%	15	250	$	17,600
Med-duty trucks, private	MDT	1,590	3 - 10%	5	250	$	17,600
All light-duty vehicles	LDV	75,929	2 - 5%	5	365	$	35,200

*Range represents range of values tested for sensitivity purposes ("conservative" vs. "optimistic" assumptions)
**Included with school bus costs as part of Fleet Challenge initiative

Total vehicles by sector: Estimates of school buses (280), the Charlottetown municipal fleet, and the public transit vehicle fleet (6) were taken from the *Prince Edward Island Fleet Challenge* proposal. The estimate of the number of municipal utility/service vehicles for the Island as a whole (357) is based on the Charlottetown fleet (168), factored by the ratio of total Provincial population to Charlottetown population, and assuming that 50 percent of the municipal fleet vehicles are trucks (MDT). Tour buses, private medium-duty trucks, heavy-duty trucks (HDT), and light-duty vehicles (LDV) were estimated from vehicle registrations for the Province as obtained from Statistics Canada.

Increase in compliance: "Increase in compliance" is the difference in the percentage of drivers in each sector shutting off their engines during idle after the initiative is implemented, vs. before the initiative is implemented. The estimates of increase in compliance are based on professional judgment for most sectors. A report by Natural Resources Canada[15] found that over 50 percent of motorists idled their vehicle at various locations surveyed before implementation of an anti-idling campaign that included both signage and commitments. The combination of signage and commitments to reduce idling resulted in reductions of idling duration of 72 percent at school sites and 78 percent at commuter parking lot drop-off/pick-up sites (signage alone did not have a significant impact). However, this was for initiatives directed at a very specific target audience. The estimates shown above are more conservative. Large fleets (e.g., municipal fleet vehicles) are assumed to be

[15] *Turn It Off: Reducing Vehicle Engine Idling.* Final Report, Prepared by McKenzie-Mohr Associates and Lura Consulting for Natural Resources Canada, January 2001.
http://www.oee.nrcan.gc.ca/transportation/idling/material/reports-research/turn-it-off-exec-summary.cfm?attr=16

the easiest target, with private truck operators and car drivers harder to reach on a widespread basis.

Minutes/day reduced: The estimates of idle time reduced are also based on professional judgment for most sectors. A report by Natural Resources Canada suggests that Canadian motorists idle their vehicles 7.7 minutes per day, on average. The 5-minute savings assumes that not all idling can be eliminated. Studies of school bus idle reduction initiatives suggest that 15 minutes per day might be reduced. The amount of idling that might be reduced by tour buses, municipal service vehicles, and privately-operated trucks is more speculative.

Days/year: The number of days/year of idling reduced is based on the approximate length of the school year (180 days), summer tourist season for tour buses (100 days), local buses operating six days per week, trucks in service five days per week, and private vehicles used seven days per week.

C. Results

Cost

The total budget proposed for the PEI Fleet Challenge initiative is $176,000. This was spread over a five-year period (assuming that is approximately how long the effects of the initiative would last) and applied to school buses, local buses, and municipal service vehicles (the primary target populations). Tour bus costs were estimated based on the number of vehicles, in the same proportion (cost per vehicle) as the Fleet Challenge initiative. For the remaining sectors, it was assumed that additional costs equivalent to the Fleet Challenge costs would be required to target the private truck sectors, and further costs of the same amount required to target private light-duty vehicle drivers. These costs total $113,000 annually, and include initiative staffing as well as outreach and educational materials, activities, etc. These costs should be considered quite speculative. Foregone fuel tax revenues from the program amount to an additional $13,000 annually.

Benefits

Fuel savings are a net benefit to vehicle operators. For public vehicle fleets, these cost savings are balanced against the cost of running the initiative. For private vehicle fleets, owner-operator cost savings are accounted for separately from public sector initiative costs.

There are considerable uncertainties associated with the estimates shown above that may affect the benefits and cost-effectiveness of the initiatives. Significant uncertainties are related to the potential increase in compliance with anti-idling goals, especially under the private vehicle fleet

initiative, and the potential reduction in daily vehicle idling time. The impact of these factors on is especially large for the private vehicle fleets, given the large number of vehicles in these fleets. In other words, the potential benefits of reaching private vehicle operators is much greater than for the public sector – but on the other hand, it is much more difficult to do so comprehensively.

The other key issue of uncertainty is the cost associated with implementing an effective private-sector anti-idling campaign. It is likely that initiative impacts will vary as a function of the level of resources directed at each initiative. However, reliable information on initiative effectiveness as a function of cost/ level of resources is not available.

Cost-Effectiveness

This strategy has an annualized net societal cost of $33,500. This converts to a social cost of $0.42 per litre of fuel saved and $181 per tonne of CO2 abated. There is significant uncertainty, however, and a higher effectiveness rate could readily reverse these costs to net social savings.

The anti-idling campaign is estimated as potentially reducing about 180 tonnes of CO2 emissions annually. This could be as much as doubled with a higher rate of effectiveness. Although costs are estimated here as higher than a benchmark of $40 per tonne, the low absolute cost, potential for high effectiveness and co-benefits imply that this campaign may be worth implementing despite our conservative estimate of net social costs exceeding the recommended benchmark.

D. Other Considerations

Feasibility

As an extension of existing campaign proposal, the strategy should not have significant obstacles.

Leakages

None identified.

Co-benefits and Externalities

Fuel reductions will reduce local air pollutant emissions. This should be significantly more beneficial than for other strategies, as idling vehicles create the phenomenon of carbon monoxide hot spots, which are much less likely with moving traffic. Additionally, there is typically greater exposure to the population because of the location of idling and the population exposed (children with regard to school buses).

Timing and Durability

The complete initiative should be able to be implemented within a year. Benefits may gradually erode over time, but renewed

investment over time could instead result in gradual increases in effectiveness.

VII. Education and Outreach

A. Description

This strategy involves outreach (e.g., to fleet operators) and public awareness/education campaigns regarding a number of fuel-saving measures. The measures evaluated here include reduced driving speeds/speed limits, eco-driving (better shifting patterns, smoother acceleration/deceleration cycles), tire inflation and low-viscosity oil.

Existing Programs or Initiatives

No initiatives have been identified.

Proposed Action

Conduct an information campaign increasing awareness of the fuel saving benefits of decreasing driving speeds, shifting sooner, maintaining steadier speeds, driving more smoothly with fewer rapid starts, keeping tires properly inflated, and using lower viscosity motor oil. Include increased enforcement for speed limits and lower speed limits where feasible.

B. Assumptions

Reference Case

Vkt and fuel consumption are taken directly from the Reference Case.

Effectiveness Rates

Reducing actual speeds from 110 kph to 90 kph (the top speed limit on PEI) results in a 22.3% savings in fuel consumption for passenger cars. We assume five percent of travel is at greater than 90 kph, and that 50 percent of those vehicles will reduce their speed. We do not include any speed reductions for vehicles less than 90 kph, although the education campaign may influence these drivers as well.

Eco-driving campaigns have been estimated to have a 5 to 14 percent reduction in fuel consumption (IEA 2004) for vehicles changing from more aggressive driving styles, with some studies reporting even higher results. We use a 10 percent fuel reduction with 10 percent of drivers changing their style.

Improved tire inflation is estimated to have a 2.9 percent reduction in fuel consumption with 10 percent of drivers participating.

Using lower viscosity motor oil, e.g., shifting from 10W-30 or 10W-40 to 5W-30, is reported to have a 1.2 percent fuel reduction (IEA 2005), with 10 percent of vehicles assumed here to adopt this measure.

C. Results

Cost

The initiative cost is estimated at $200,000 for increased speed limit enforcement and a combined $250,000 for the education campaign across the four measures. The reduced speed limit is calculated as having a $1.2 million cost to drivers from increased travel time.

Benefits

Combined fuel savings are estimated at $3.8 million: $1.0 million for speed reduction; $1.9 million for eco-driving; $560,000 for tire inflation; and, $230,000 from low-viscosity oil.

Cost-Effectiveness

The overall campaign is estimated to have a net societal benefit of $2.1 million, with savings of $0.62 per litre reduced and $266 per tonne of CO2 abated. While the three non-speed measures all have better cost-effectiveness than the above overall campaign figures, speed reduction has a cost of $0.35/litre and $149 per tonne for its reductions.

The three non-speed measures show high cost-effectiveness and are recommended for implementation. Speed reductions have been shown in some other studies (e.g., ICF 2004) to be cost-effective based solely on their safety benefits, and so are also recommended based on their combined CO2, local air pollutant and safety benefits.

D. Other Considerations

Feasibility

The campaign should be relatively easy to implement, based on the introduction of similar initiatives elsewhere.

Leakages

At the margin, there theoretically should be a small rebound effect of increased vkt due to the reduction in driving cost.

Co-benefits and Externalities

Reductions in fuel consumption will reduce local air pollutant emissions. Speed reductions will result in noticeable safety improvement.

Timing and Durability

The full campaign should be able to be implemented within a year. With campaign continuation at the $450,000 annual level

utilized for this analysis, there should be gradual increases in effectiveness due to shifts in driver norms.

NOT RECOMMENDED:

VIII. Alternative Fuel Initiative

A. Description

Regulations, incentives, or initiatives to promote the availability and use of alternative fuels that can be used by existing vehicles, such as an ethanol blend of 10 percent (E10) or less, or biodiesel for diesel-fuelled vehicles. This includes gasoline blending requirements, tax credits, and public-private partnerships to establish fuelling stations. Alternative fuel initiatives also include parallel initiatives for flex-fuel or pure ethanol (E-85 or "neat ethanol") vehicles. Initiatives (such as selected here) can also emphasize more truly renewable alternative fuels (designated here as E10R) with significantly better life cycle emission savings, such as cane, cellulosic, or sugar beet ethanol.

Existing Programs or Initiatives

Federal renewable fuels mandate – E5 (2010), B2 (2012) – already included in base case.

Federal interest in E10, biofuels (B5, B10): details and enactment of the federal initiative are still uncertain.

Proposed Action

Provide a 50 cents per litre subsidy for pure renewable ethanol (i.e, the equivalent of five cents per litre for E10R)[16] to enable production and/or importation and a strong driver incentive for use.[17] This subsidy would likely supplement other

[16] Note that this subsidy was selected to approximate the financial incentive needed to shift to 95 percent uptake of E10R fuel by light duty vehicles (or the equivalent total ethanol content in E5 and E85, etc.). The actual subsidy would of course be selected as part of the pre-regulatory analysis, but this level was felt to be the aggressive level necessary to achieve a high market penetration rate over a short time period for a product that is only a small portion of the total current ethanol market.

[17] While governments have typically also used alternative fuel content mandates to achieve usage targets, this scenario assumes that existing mandates stay roughly the same and that economic incentives supplement these. This was done in large part because of the greater uncertainty and difficulty in modeling the economic costs of the market distortions, trade impacts, food prices, etc. required by mandates. These overall results are consistent with other studies which do include those costs, and which put the effectiveness of this strategy sometimes at $500 or higher per tonne of CO2 abated. All of these results will be very sensitive to changes in the production costs and available supply of renewable ethanol, which is still in the nascent market stages in North America. Significantly lower figures are projected by many (not all) for longer timeframes, and thus this

ethanol tax incentives/tax credits/subsidies in order to encourage the shift to renewable ethanol with less impact on existing initiatives and production (e.g., sunk capital investments). Renewable ethanol will be defined as achieving an average life-cycle GHG emission reduction of 80 percent (eight percent for E10R). Biodiesel was not included here due to the very low usage of diesel technology in light duty vehicles, but its inclusion (especially for heavy-duty vehicles) would likely represent a measurable improvement in cost-effectiveness although not sufficient to alter the overall conclusions.

B. Assumptions

Reference Case

The reference case includes the existing federal renewable fuels mandate, which is assumed to attract only corn- or wheat-based ethanol. Vehicle fuel economy and vkt are assumed equal to the Reference case. Fuel is considered to cost $1.10 per litre for all strategies. Also for all strategies, past and future benefits and costs may be determined from the underlying calculations and spreadsheets, but the figures provided refer only to costs incurred and benefits received in 2017. These figures should be representative of longer time periods as well.

Effectiveness

The subsidized ethanol is assumed to achieve its defined target of reducing life-cycle emissions by 80 percent compared to gasoline (thus, eight percent for E10). The subsidy is assumed to include two cents per litre of E10 for the fuel cost subsidy and three cents per litre to attract consumers without any new mandates on ethanol use. (The latter is an income transfer that does not affect the societal cost, but does enable a high uptake rate.) The uptake rate by 2017 is assumed to reach and plateau at 95 percent due to the subsidy affecting uptake at wholesale (possible extra profit margin) as well as retail (reduced consumer price) markets.

C. Results

Cost

The total cost of the subsidy in 2017 will be $8.34 million with an additional $100,000 annually in administrative costs (one full-time equivalent, "FTE," fully loaded with fringe

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strategy may be worth consideration in order to help develop this market. Cynically, given the high costs of this strategy and the limited market effect it would have (unless targeted solely at Provincial production, for example), matching other Provincial efforts and otherwise "coat-riding" on federal and or U.S. programs to encourage the renewable ethanol market is recommended above being an early entrant.

benefits, office overhead and general, managerial and administrative costs).

Benefits

Consumers and/or wholesalers will benefit at three cents per litre, or $5,005,827, from the uptake attraction portion of the subsidy.

Cost-Effectiveness

The measure overall in 2017 will result in a net societal cost of $3.4 million, or $0.26 per litre of gasoline equivalent saved or $111 per tonne of CO2 abated. This is roughly three to six times the expected cost ($20-$40 per tonne) of alternative abatement options needed to reach the national Kyoto target.

If fully implemented, the strategy is estimated to reduce CO2 by 31,000 tonnes annually in 2017. However, because of the poor cost effectiveness, we recommend that this strategy not be pursued at this time.

D. Other Considerations

Feasibility

While technologically feasible from the fuel existence perspective, the availability of E10R in the Atlantic Provinces market at these levels is questionable. Further, as this would likely mostly be displacing the use of E10R from elsewhere, the global benefits may be questionable (however, the subsidy would not only cover transportation costs, but would likely increase world supply on the margin as well).

The political acceptance of a high subsidy is also questionable, especially since some portion of the private sector subsidy may be embodied in the form of windfall profits for wholesale distributors, and not solely passed on as price reductions to attract consumers.

Leakages

Given limited local production potential (from sugar beets, though this may increase in the mid-term), much of the fuel will need to be transported significant distances. The subsidy may thus serve to increase global emissions due to the E10R long-distance transport rather than local consumption, with geographic fuel displacement outweighing the supply incentive of the subsidy (minus its transport cost component). As ethanol is corrosive to petroleum pipelines, greater use of more GHG-intensive trucking for importation and distribution will likely be necessary.

Co-benefits and Externalities

Like all forms of ethanol, this will reduce or break-even on local air pollutants. Ethanol will displace oil consumption,

potentially improving energy security (depending on the E10R source). Because of ethanol's greater flammability as well as the need for transport by truck rather than pipeline, there may be small negative safety impacts.

Timing and Durability

The initiative can see immediate effects, with uptake having few technical (only cultural/behavioural) constraints beyond supply availability. There is no need to wait for fleet turnover or other lagged effectiveness so long as ethanol blends remain at or below 10 percent.

Life-cycle emissions

As described above, the initiative is focused on a defined renewable ethanol fuel at 80 percent life-cycle emission reductions, thus fully addressing the life-cycle issue.

IX. Transit Service & Parking Management

A. Description

This strategy includes new or improved transit services, such as downtown circulators, commuter routes, or visitor shuttles among key tourist/resort areas. The strategy can also be designed in conjunction with parking management initiatives and/or an incentive such as subsidized transit passes.

Existing Programs or Initiatives

None identified.

Proposed Action

This action is defined as introducing 12 new vehicles (22-passenger minibus), providing 200 new route-km, with eight trips/day/route, resulting in an additional 3,500 vehicle km of service daily. An average operating speed of 25 km/hr was assumed (Massachusetts speeds range from 18 to 35 km/hr).

B. Assumptions

Fuel consumption and emissions: The analysis assumes 22-passenger transit vehicles using diesel fuel, with an average efficiency of 33.6 L/100 km (7.0 miles per gallon). This compares to an average private vehicle fuel efficiency of 9.0 L/100 km.

Ridership: Average transit vehicle occupancy (ATVO) values were tested ranging from 6 to 10 persons/vehicle. These are relatively optimistic, as Massachusetts occupancies for rural and small city transit systems range from 2.7 to 11.6, with 3.7 on Cape Cod. However, below a range of 6 to 8 persons per vehicle, net fuel savings and emissions reductions were negative, so values lower than this were not tested.

Prior mode use of transit travelers: Fifty percent is considered typical based on surveys in the U.S. but it is likely to be higher in a rural/small city environment such as PEI, so a value of 70 percent was used for the results shown below. Average private vehicle occupancy of 1.1 is typical for commuting while 1.6 is considered typical as an average for all trip purposes.

Reference Case

As this action represents the introduction of a new transit service, its impacts are estimated independent of existing conditions, and thus does not use a baseline or the Reference Case.

Effectiveness Rates

A number of key parameters are estimated based on a review of Massachusetts small community/rural transit systems (e.g., Cape Cod, a rural/small town tourist environment similar to PEI).

C. Results

Cost

Substantial net costs ($2.35 million) for this strategy would accrue to the public sector due to capital investment in buses as well as operating costs. The parameters used for this analysis include operating costs of $75/vehicle revenue-hour (Massachusetts system costs range from $56 – 93); capital costs of $150,000/vehicle, annualized based on a 15-year lifespan. Other capital investment costs (e.g., maintenance/operations facilities) are not considered as it is assumed that existing facilities would be sufficient. There is a transfer of almost $1 million of fares paid to the transit agency by riders, although as an income transfer this does not result in net costs to society.

Benefits

Riders will save about $600,000 in fuel costs, and approximately double that amount in avoided vehicle maintenance costs (e.g., oil, tires, and unscheduled maintenance) and depreciation. Consumer welfare impacts are also significant but (e.g., the benefits of improved mobility) are not quantified. Other long-term benefits, such as land use and vehicle ownership, are also not quantifiable here.

Cost-Effectiveness

With a $1.5 million net societal cost, this measure is not a cost-effective strategy for greenhouse gas reductions, although there are many other reasons to increase transit service. This action results in an $8.01 cost per litre of fuel saved, or almost $3,500 per tonne of CO2 abated.

Transit service enhancements are estimated to reduce CO2 emissions by only 435 tonnes. Further, introducing increased transit service for the primary purpose of reducing greenhouse gases is an extremely expensive and ineffective strategy for doing so. (There are many other good reasons for improving transit service, thus any GHG emission reductions should be viewed as an incidental co-benefit of transit strategies advanced for other reasons.) We recommend that transit enhancements should not be pursued for the purpose of reducing CO2 emissions.

D. Other Considerations

Feasibility

Given funding availability and political support, this measure can be implemented easily.

Leakages

There is the possibility that some of the vehicles previously used by new transit riders will now be available to other household members who did not have vehicle access, resulting in some offsetting personal vehicle trips.

Co-benefits and Externalities

As described previously, transit provides substantial benefits to public welfare by providing additional mobility, especially for those too young to drive, without access to a vehicle, or otherwise not able to drive. Land use impacts may also occur, but are not quantified here.

Timing and Durability

This measure can be implemented relatively quickly, requiring perhaps a year for route planning and bus procurement. New transit services typically start slowly but steadily increase in ridership over the years.

Methodology Discussion

The most important uncertain parameter for this analysis is the average ridership or vehicle occupancy of the transit service (ATVO). This will depend upon the details of the service and the market served and cannot be determined without local market research. Therefore, a range of values was tested. The values tested here are considered relatively optimistic. However, values in this range are required to break even or achieve net fuel savings, even under relatively optimistic assumptions regarding other parameters. If average ridership is less than a critical value, the fuel consumption of the transit vehicle (which gets lower mileage than a passenger car) more than offsets the savings in reduced private vehicle travel. While ridership on peak-period transit service can be significantly higher, *average* ridership values reflect the operations of the bus over the entire day, including "deadheading" to and from routes, reverse-direction trips that may carry few passengers, and mid-day, evening, and weekend service that may be less productive than peak-period service.

Different assumptions regarding prior mode use of transit travelers and private vehicle occupancy were also tested. The assumptions of 70% prior private vehicle use and 1.1 average vehicle occupancy (typical for commuting but low for all trips) are considered optimistic, but again are required in order to break even or achieve a net fuel savings given feasible/realistic assumptions regarding other inputs. Assuming a higher average private vehicle occupancy (1.6 is typical across all trips) means that higher transit ridership would be needed to break even on fuel savings, since the

private vehicle is relatively more efficient when it carries more people.

The additional benefits of parking management or fare incentives when applied in conjunction with transit were not estimated directly, because of the low cost-effectiveness of transit service overall and the need for more locally-specific data to properly evaluate these strategies. However, parking management strategies (e.g., parking pricing, remote lots, time limitations) and fare incentives would make it more likely that the higher ATVO ranges tested here could be achieved.

Assumptions regarding service provision and efficiency, including total route-km of service and runs/day, will affect the total costs and benefits, but will not significantly affect the cost-effectiveness estimates. Given the considerable uncertainty in these estimates, therefore, further sensitivity testing on different levels of transit service was not performed.

The benefits of transit could be increased through the use of advanced vehicles such as hybrids or natural gas buses. However, these benefits could also be offset by increases in private vehicle fuel efficiency, if fuel efficiency is increased in the future with/by either nationwide fuel efficiency standards or GHG regulations. It is assumed for this analysis that the relative efficiency of buses and private vehicles will remain the same (i.e., technology evolves at the same rate in both sectors).

X. Summary and Recommendations

Several strategies were additionally considered, but ruled out through the preliminary screening process:

- Land use and non-motorized transport, due to long lead times and low cost-effectiveness over a 20-year time frame.
- Marine emissions, due to limited absolute benefits and very limited fleet turnover.
- Cap-and-trade, due to implementation difficulties and possible conflict with potential federal action.
- Carbon taxes, due to overlap with fuel economy measures, fewer absolute CO2 reductions (consensus forecast price of $40 per tonne is approximately equal to 10 cents per litre) than the other fuel economy measures, and potential equity impacts.

Of the analyzed strategies, two were recommended to not be implemented:

- Alternative fuel subsidies, due to the ineffectiveness of corn/grain ethanol, the limited feasibility (supply availability) of renewable (sugar, cellulosic) ethanol, the likely substantial leakages from the measure (fuel displacement resulting in offsetting increases elsewhere due to renewable ethanol shifting to PEI) and poor cost-effectiveness.
- Transit service enhancements were not recommended due to very poor cost-effectiveness and low absolute reductions.

Two analyzed strategies with low cost-effectiveness were recommended:

- Anti-idling campaign, due to high public health benefits and good potential for achieving improved cost-effectiveness.
- Speed reductions are recommended due to substantial safety co-benefits that may justify the initiative even by themselves.

The remaining six strategies are recommended due to high cost-effectiveness and no significant adverse impacts, with the exception that fuel economy feebate/rebates and GHG emission standards need to be carefully analyzed before being jointly implemented due to substantial overlap:

- Fuel economy feebates/rebates;
- Government fleet purchases;
- GHG emission standards;
- Telecommuting/compressed work week;

Traffic signal synchronization;

Education/awareness campaigns for non-speed measures.

Appendix C: Residential Measures Screened for Achievable Potential

Measure Name	Initiative Type	Initiative
Clothes Washer (1.8 MEF) - electric/electric	Lost Opportunity	Residential Retail Products
Clothes Washer (1.8 MEF) - oil/electric	Lost Opportunity	Residential Retail Products
Dishwasher (E-Star) - electric	Lost Opportunity	Residential Retail Products
Dishwasher (E-Star) - oil	Lost Opportunity	Residential Retail Products
Refrigerator (E-Star)	Lost Opportunity	Residential Retail Products
Freezer (E-Star)	Lost Opportunity	Residential Retail Products
Window (E-Star) - oil heat	Lost Opportunity	Residential Retail Products
Window (Super E-Star) - oil heat	Lost Opportunity	Residential Retail Products
CF Lamp - (Res E-Star)	Lost Opportunity	Residential Retail Products
CF Fixture Interior - (Res E-Star)	Lost Opportunity	Residential Retail Products
CF Fixture Exterior - (Res E-Star)	Lost Opportunity	Residential Retail Products
comprehensive shell package	Retrofit	Residential Existing Homes
comprehensive shell package	Retrofit	Residential Existing Homes
comprehensive shell package	Retrofit	Residential Existing Homes
comprehensive shell package	Retrofit	Residential Existing Homes
comprehensive shell package	Retrofit	Residential Existing Homes
comprehensive shell package	Retrofit	Residential Existing Homes
comprehensive shell package	Retrofit	Residential Existing Homes
comprehensive shell package	Retrofit	Residential Existing Homes
comprehensive shell pkg Low Income	Retrofit	Residential Existing Homes
comprehensive shell pkg Low Income	Retrofit	Residential Existing Homes
comprehensive shell pkg Low Income	Retrofit	Residential Existing Homes
comprehensive shell pkg Low Income	Retrofit	Residential Existing Homes
comprehensive shell pkg Low Income	Retrofit	Residential Existing Homes
comprehensive shell pkg Low Income	Retrofit	Residential Existing Homes
comprehensive shell pkg Low Income	Retrofit	Residential Existing Homes
comprehensive shell pkg - refrig replace	Retrofit	Residential Existing Homes
second refrigerator	Retrofit	Residential Existing Homes

removal/dispose		
low-income freezer early retirement	Retrofit	Residential Existing Homes
R-2000 SF Oil	Lost Opportunity	Residential New Construction
R-2000 MF Oil	Lost Opportunity	Residential New Construction
CFLs RNC SF	Lost Opportunity	Residential New Construction
Oil Furnace	Lost Opportunity	Residential Retail Products
Oil Boilers	Lost Opportunity	Residential Retail Products
ECM Fans	Lost Opportunity	Residential Retail Products
Dehumidifiers	Lost Opportunity	Residential Retail Products
comp shell package - refrigerator replace Low Income	Retrofit	Residential Existing Homes
Drain water heat recovery - electric DHW	Lost Opportunity	Residential Retail Products
Drain water heat recovery - oil DHW	Lost Opportunity	Residential Retail Products
Solar DHW – electric DHW	Retrofit	Residential Existing Homes
Solar DHW – oil DHW	Retrofit	Residential Existing Homes

Appendix D: C&I Measures Screened for Achievable Potential

Measure Name	Initiative Type	Initiative
Super T8 Retrofit	Retrofit	Direct Install/Retrofit
HE Metal Halide - interior	Retrofit	Direct Install/Retrofit
CFL - interior	Retrofit	Direct Install/Retrofit
Occupancy on/off	Retrofit	Direct Install/Retrofit
LED exit sign	Retrofit	Direct Install/Retrofit
Pulse Start MH v. MV - exterior	Retrofit	Direct Install/Retrofit
Premium Efficiency Motors	Retrofit	Direct Install/Retrofit
VFD	Retrofit	Direct Install/Retrofit
HE Refrigeration	Retrofit	Direct Install/Retrofit
HE AC Tier II	Retrofit	Direct Install/Retrofit
EMS/Controls - COOL	Retrofit	Direct Install/Retrofit
EMS/Controls - HEAT	Retrofit	Direct Install/Retrofit
EMS/Controls - VENT	Retrofit	Direct Install/Retrofit
Dual enthalpy control	Retrofit	Direct Install/Retrofit
Super T8 Fixture	Lost Opportunity	Remodel/Replacement
Pulse Start MH - interior	Lost Opportunity	Remodel/Replacement
CFL - interior	Lost Opportunity	Remodel/Replacement
Occupancy on/off	Lost Opportunity	Remodel/Replacement
LED exit sign	Lost Opportunity	Remodel/Replacement
Pulse Start MH v. std MH - exterior	Lost Opportunity	Remodel/Replacement
Premium Efficiency Motors	Lost Opportunity	Remodel/Replacement
VFD	Lost Opportunity	Remodel/Replacement
HE Refrigeration	Lost Opportunity	Remodel/Replacement
HE AC Tier II	Lost Opportunity	Remodel/Replacement
Optimized unitary HVAC distribution/control system — Cool	Lost Opportunity	Remodel/Replacement
Optimized unitary HVAC distribution/control system — Heat	Lost Opportunity	Remodel/Replacement
Dual enthalpy control	Lost Opportunity	Remodel/Replacement
Super T8 Fixture	Lost Opportunity	New construction
Pulse Start MH - interior	Lost Opportunity	New construction

CFL - interior	Lost Opportunity	New construction
Occupancy on/off	Lost Opportunity	New construction
LED exit sign	Lost Opportunity	New construction
Improved exterior lighting design	Lost Opportunity	New construction
Premium Efficiency Motors	Lost Opportunity	New construction
VFD	Lost Opportunity	New construction
HE Refrigeration	Lost Opportunity	New construction
HE AC Tier II	Lost Opportunity	New construction
Optimized unitary HVAC distribution/control system — Cool	Lost Opportunity	New construction
Optimized unitary HVAC distribution/control system — Heat	Lost Opportunity	New construction
Dual enthalpy control	Lost Opportunity	New construction
HE fixtures/design Tier I	Lost Opportunity	New construction
Heat Fuel Switch -- Resistance	Retrofit	Direct Install/Retrofit
WH Fuel Switch	Lost Opportunity	New construction
Integrated Building Design - Small Bldg	Lost Opportunity	New construction
Integrated Building Design - Large Bldg	Lost Opportunity	New construction
Pre-Rinse Spray Valve	Retrofit	Direct Install/Retrofit
Faucet aerator	Retrofit	Direct Install/Retrofit
Graywater heat exchanger/GFX	Retrofit	Direct Install/Retrofit
Graywater heat exchanger/GFX	Lost Opportunity	New construction
Graywater heat exchanger/GFX	Lost Opportunity	Remodel/Replacement
Indirect-fired DHW off space htg boiler	Retrofit	Direct Install/Retrofit
Indirect-fired DHW off space htg boiler	Lost Opportunity	New construction
Indirect-fired DHW off space htg boiler	Lost Opportunity	Remodel/Replacement
Low-flow shower heads	Retrofit	Direct Install/Retrofit
Low-flow shower heads	Lost Opportunity	New construction
Low-flow shower heads	Lost Opportunity	Remodel/Replacement
Pipe insulation - water heating	Retrofit	Direct Install/Retrofit
Pipe insulation - water heating	Lost Opportunity	New construction
Pipe insulation - water heating	Lost Opportunity	Renovation
Tank insulation	Retrofit	Direct Install/Retrofit
Tank insulation	Lost Opportunity	New construction
Tank insulation	Lost Opportunity	Remodel/Replacement
Air Sealing	Retrofit	Direct Install/Retrofit
Air Sealing	Lost Opportunity	New construction
Air Sealing	Lost Opportunity	Renovation
Improved heating system high efficiency unit - Tier 1	Retrofit	Direct Install/Retrofit
Improved heating system high efficiency unit - Tier 1	Lost Opportunity	New construction
Improved heating system high efficiency unit - Tier 1	Lost Opportunity	Remodel/Replacement
Demand-Controlled Ventilation (controller, sensor)	Retrofit	Direct Install/Retrofit

Demand-Controlled Ventilation (controller, sensor)	Lost Opportunity	New construction
Demand-Controlled Ventilation (controller, sensor)	Lost Opportunity	Remodel/Replacement
Outdoor Air Reset	Retrofit	Direct Install/Retrofit
Outdoor Air Reset	Lost Opportunity	New construction
Outdoor Air Reset	Lost Opportunity	Remodel/Replacement
High Performance Glazing double pane, low-E, low conductivity frame - Tier 1	Lost Opportunity	Remodel/Replacement
Sensible Heat Recovery	Retrofit	Direct Install/Retrofit
Sensible Heat Recovery	Lost Opportunity	New construction
Sensible Heat Recovery	Lost Opportunity	Remodel/Replacement
Pipe insulation - space heating	Retrofit	Direct Install/Retrofit
Pipe insulation - space heating	Lost Opportunity	New construction
Pipe insulation - space heating	Lost Opportunity	Renovation
Integrated Design - High Performance (30% > codes) - Tier 1	Lost Opportunity	New construction

Appendix E: Initiative Budgets

Total for All Initiatives	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Staff (fully loaded)	$502,896	$566,120	$539,795	$539,795	$539,795	$539,795	$539,795	$539,795	$539,795	$539,795
Customer Incentives	$1,420,963	$2,351,420	$3,607,920	$4,630,641	$5,479,876	$5,804,349	$6,047,934	$6,169,424	$6,228,375	$5,298,238
Contractors	$220,988	$251,867	$346,177	$396,287	$430,966	$440,174	$444,017	$441,456	$438,691	$415,573
General Admin Expenses	$94,140	$79,140	$79,140	$79,140	$79,140	$79,140	$79,140	$79,140	$79,140	$79,140
Marketing	$355,000	$380,000	$320,000	$295,000	$295,000	$295,000	$295,000	$295,000	$295,000	$295,000
Other	$116,344	$74,493	$84,665	$100,280	$108,434	$110,002	$111,552	$113,250	$114,865	$116,599
Evaluation	$26,308	$256,548	$87,557	$263,325	$104,034	$264,170	$104,305	$264,452	$104,593	$264,744
Miscellaneous	$55,000	$30,000	$12,500	$12,500	$12,500	$12,500	$12,500	$12,500	$12,500	$12,500
Total	**$2,791,640**	**$3,989,588**	**$5,077,754**	**$6,316,968**	**$7,049,746**	**$7,545,129**	**$7,634,243**	**$7,915,017**	**$7,812,959**	**$7,021,588**
Utility Costs minus Customer Incentives	$1,370,676	$1,638,168	$1,469,833	$1,686,327	$1,569,869	$1,740,781	$1,586,309	$1,745,593	$1,584,584	$1,723,351

Initiative #1: C&I Direct Install/Retrofit	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Staff (fully loaded)	$205,967	$269,190	$269,190	$269,190	$269,190	$269,190	$269,190	$269,190	$269,190	$269,190
Customer Incentives	$675,555	$641,141	$1,109,041	$1,399,291	$1,550,865	$1,580,000	$1,608,822	$1,640,373	$1,670,399	$1,702,618
Contractors	$90,074	$85,485	$147,872	$186,572	$206,782	$210,667	$214,510	$218,716	$222,720	$227,016
General Admin Expenses	$40,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
Marketing	$50,000	$50,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000	$40,000
Other	$36,344	$34,493	$59,665	$75,280	$83,434	$85,002	$86,552	$88,250	$89,865	$91,599
Evaluation	$22,720	$52,959	$83,968	$99,736	$100,445	$100,581	$100,716	$100,864	$101,004	$101,155
Miscellaneous										
Total Utility Costs	**$1,120,660**	**$1,158,269**	**$1,734,737**	**$2,095,069**	**$2,275,717**	**$2,310,440**	**$2,344,791**	**$2,382,394**	**$2,418,179**	**$2,456,578**
minus Customer Incentives	$445,104	$517,128	$625,696	$695,779	$724,852	$730,440	$735,969	$742,021	$747,780	$753,960

Initiative #2: C&I New Construction	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Staff (fully loaded)	$16,787	$17,633	$17,795	$17,694	$18,041	$20,420	$21,884	$23,100	$24,132	$25,425
Customer Incentives	$14,754	$23,127	$32,001	$41,582	$52,612	$43,408	$50,829	$58,536	$66,014	$75,276
Contractors	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
General Admin Expenses	$585	$614	$620	$616	$628	$711	$762	$805	$841	$886
Marketing	$5,847	$6,142	$3,719	$3,698	$3,771	$4,268	$4,574	$4,828	$5,044	$5,314
Other	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Evaluation	$420	$441	$445	$442	$451	$510	$547	$577	$603	$636
Miscellaneous	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total	**$38,393**	**$47,957**	**$54,579**	**$64,033**	**$75,503**	**$69,317**	**$78,595**	**$87,845**	**$96,634**	**$107,536**
Utility Costs minus Customer Incentives	$23,639	$24,830	$22,578	$22,451	$22,891	$25,909	$27,767	$29,310	$30,620	$32,260

Initiative #3: C&I Renovation	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Staff (fully loaded)	$10,613	$15,049	$16,822	$17,600	$18,010	$11,759	$12,318	$12,792	$13,173	$13,443
Customer Incentives	$9,328	$19,738	$30,252	$41,361	$52,521	$24,998	$28,612	$32,415	$36,035	$39,800
Contractors	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
General Admin Expenses	$370	$524	$586	$613	$627	$410	$429	$446	$459	$468
Marketing	$3,697	$5,242	$3,516	$3,678	$3,764	$2,458	$2,575	$2,673	$2,753	$2,809
Other	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Evaluation	$265	$376	$421	$440	$450	$294	$308	$320	$329	$336
Miscellaneous	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total	**$24,273**	**$40,929**	**$51,596**	**$63,692**	**$75,372**	**$39,918**	**$44,242**	**$48,645**	**$52,750**	**$56,856**
Utility Costs minus Customer Incentives	$14,945	$21,192	$21,344	$22,331	$22,852	$14,921	$15,630	$16,231	$16,714	$17,056

Initiative #4: C&I Remodel/Replacement	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Staff (fully loaded)	$116,142	$110,860	$108,926	$108,248	$107,491	$111,363	$109,340	$107,651	$106,237	$104,675
Customer Incentives	$102,076	$145,397	$195,885	$254,386	$313,465	$236,734	$253,962	$272,791	$290,617	$309,911
Contractors	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
General Admin Expenses	$4,046	$3,862	$3,794	$3,771	$3,744	$3,879	$3,809	$3,750	$3,701	$3,646
Marketing	$40,456	$38,616	$22,765	$22,624	$22,465	$23,275	$22,852	$22,499	$22,203	$21,877
Other	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Evaluation	$2,904	$2,772	$2,723	$2,706	$2,687	$2,784	$2,734	$2,691	$2,656	$2,617
Miscellaneous	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Total	**$265,622**	**$301,506**	**$334,093**	**$391,735**	**$449,853**	**$378,035**	**$392,697**	**$409,382**	**$425,414**	**$442,725**
Utility Costs minus Customer Incentives	$163,547	$156,109	$138,208	$137,349	$136,388	$141,301	$138,734	$136,591	$134,797	$132,814

Initiative #5: Residential Retail Products	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Staff (fully loaded)	$48,555	$48,555	$35,393	$35,393	$35,393	$35,393	$35,393	$35,393	$35,393	$35,393
Customer Incentives	$258,014	$450,349	$675,584	$835,376	$958,281	$958,281	$1,085,181	$1,085,181	$1,085,181	$958,281
Contractors	$20,877	$29,939	$39,048	$46,352	$48,731	$48,731	$48,731	$48,731	$48,731	$48,731
General Admin Expenses	$10,238	$10,238	$10,238	$10,238	$10,238	$10,238	$10,238	$10,238	$10,238	$10,238
Marketing	$100,000	$100,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000	$75,000
Other	$20,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
Evaluation	$0	$75,000	$0	$60,000	$0	$60,000	$0	$60,000	$0	$60,000
Miscellaneous	$20,000	$10,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Total	**$477,683**	**$734,080**	**$850,262**	**$1,077,358**	**$1,142,641**	**$1,202,641**	**$1,269,541**	**$1,329,541**	**$1,269,541**	**$1,202,641**
Utility Costs minus Customer Incentives	$219,669	$283,731	$174,678	$241,982	$184,361	$244,361	$184,361	$244,361	$184,361	$244,361

Initiative #6: Residential New Construction	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Staff (fully loaded)	$29,952	$29,952	$16,790	$16,790	$16,790	$16,790	$16,790	$16,790	$16,790	$16,790
Customer Incentives	$59,600	$119,200	$178,800	$238,400	$298,000	$357,600	$417,200	$476,800	$476,800	$476,800
Contractors	$28,384	$40,152	$60,304	$67,072	$73,840	$73,840	$73,840	$67,072	$60,304	$43,536
General Admin Expenses	$8,190	$8,190	$8,190	$8,190	$8,190	$8,190	$8,190	$8,190	$8,190	$8,190
Marketing	$30,000	$30,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
Other	$30,000	$10,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Evaluation	$0	$25,000	$0	$25,000	$0	$25,000	$0	$25,000	$0	$25,000
Miscellaneous	$10,000	$5,000	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500
Total	**$196,126**	**$267,494**	**$296,584**	**$387,952**	**$429,320**	**$513,920**	**$548,520**	**$626,352**	**$594,584**	**$602,816**
Utility Costs minus Customer Incentives	$136,526	$148,294	$117,784	$149,552	$131,320	$156,320	$131,320	$149,552	$117,784	$126,016

Initiative #7: Residential Existing Homes	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Staff (fully loaded)	$74,880	$74,880	$74,880	$74,880	$74,880	$74,880	$74,880	$74,880	$74,880	$74,880
Customer Incentives	$301,637	$952,469	$1,386,357	$1,820,246	$2,254,134	$2,603,329	$2,603,329	$2,603,329	$2,603,329	$1,735,552
Contractors	$81,653	$96,291	$98,952	$96,291	$101,614	$106,937	$106,937	$106,937	$106,937	$96,291
General Admin Expenses	$30,713	$30,713	$30,713	$30,713	$30,713	$30,713	$30,713	$30,713	$30,713	$30,713
Marketing	$125,000	$150,000	$150,000	$125,000	$125,000	$125,000	$125,000	$125,000	$125,000	$125,000
Other	$30,000	$20,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
Evaluation	$0	$100,000	$0	$75,000	$0	$75,000	$0	$75,000	$0	$75,000
Miscellaneous	$25,000	$15,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Total	**$668,883**	**$1,439,353**	**$1,755,902**	**$2,237,129**	**$2,601,340**	**$3,030,858**	**$2,955,858**	**$3,030,858**	**$2,955,858**	**$2,152,436**
Utility Costs minus Customer Incentives	$367,246	$486,884	$369,545	$416,884	$347,206	$427,529	$352,529	$427,529	$352,529	$416,884

Transportation Budget

All Transportation Initiatives	Year 2008	Year 2009	Year 2010	. . . . .	Year 2017
Staff (fully loaded)	$808,000	$730,000	$708,000	. . . . .	$716,000
Contractors	$50,000	$0	$0	. . . . .	$10,000
Marketing	$0	$150,000	$150,000	. . . . .	$150,000
Other - vehicle purchases (marginal cost)	$0	$0	$3,422	. . . . .	$30,160
Evaluation	$2,000	$45,143	$67,143	. . . . .	$67,143
Miscellaneous - fuel savings	$0	$0	($14,043)	. . . . .	($123,781)
Miscellaneous - foregone fuel tax	$51,843	$148,091	$954,962	. . . . .	$6,279,966
Total	**$911,843**	**$1,073,234**	**$1,869,484**	**. . . . . .**	**$7,129,488**

Appendix F: Avoided Costs

Year	Electric Energy C$/kWh	Electric Capacity C$/kW-yr	Electric Externalities C$/kWh	Residential Fuel Oil C$/GJ	Commercial Fuel Oil C$/GJ	District Heat C$/GJ	Wood C$/GJ
2008	0.108	56	0.015	16.64	15.86	4.93	6.40
2009	0.104	56	0.015	15.98	15.24	4.82	6.40
2010	0.098	56	0.015	15.32	14.61	4.72	6.40
2011	0.093	56	0.015	15.30	14.59	4.71	6.40
2012	0.089	56	0.015	15.28	14.57	4.71	6.40
2013	0.083	56	0.015	15.26	14.55	4.71	6.40
2014	0.083	56	0.015	15.25	14.52	4.71	6.40
2015	0.085	56	0.015	15.23	14.50	4.71	6.40
2016	0.085	56	0.015	15.07	14.36	4.68	6.40
2017	0.087	56	0.015	14.91	14.21	4.66	6.40
2018	0.088	56	0.015	14.75	14.06	4.64	6.40
2019	0.091	56	0.015	14.59	13.91	4.62	6.40
2020	0.092	56	0.015	14.44	13.77	4.60	6.40
2021	0.094	56	0.015	14.44	13.77	4.60	6.40
2022	0.096	56	0.015	14.44	13.77	4.60	6.40
2023	0.095	56	0.015	14.44	13.77	4.60	6.40
2024	0.098	56	0.015	14.44	13.77	4.60	6.40
2025	0.098	56	0.015	14.44	13.77	4.60	6.40
2026	0.099	56	0.015	14.44	13.77	4.60	6.40
2027	0.100	56	0.015	14.44	13.77	4.60	6.40