Energy Efficiency:

Engine of Economic Growth in Eastern Canada

A Macroeconomic Modeling & Tax Revenue Impact Assessment

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About ENE

ENE (Environment Northeast) is a non-profit organization that researches and advocates innovative policies that tackle our environmental challenges while promoting sustainable economies. ENE is at the forefront of state and regional efforts to combat global warming with solutions that promote clean energy, clean air and healthy forests.

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Table of Contents

Executive Summary

Energy efficiency – an abundant, clean, and low-cost energy resource – is an important component of modern energy systems and has emerged as a key policy tool to help address high energy costs, improve productivity, spur economic growth, and reduce emissions. The Chairman of the International Energy Agency, the Hon. Martin Ferguson, recently called energy efficiency "the 'quiet giant' of clean energy options" and said that "[I]n the near term, energy efficiency and energy savings remain the single most important means of seeking to meet climate and energy security goals in a cost-effective manner."[1]

As investments in energy efficiency programs increase, it is necessary to understand economic effects on individual program participants and on the economy as a whole. Microeconomic benefits to ratepayers and program participants are typically analyzed and verified through public program design processes (see Figure ES-1, on the following page). However, less is known about macroeconomic benefits of efficiency investments and how both costs and benefits impact the economy as a whole.

This study quantifies macroeconomic impacts – economic output, including Gross Domestic Product (GDP) and job growth – of expanded investment to approximately capture all cost-effective energy efficiency (efficiency that is lower cost than supplying additional energy) in the provinces of Québec, New Brunswick, Nova Scotia, and Prince Edward Island. The case-study also provides a high-level assessment of efficiency's impact on government tax collections. This analysis expands and corroborates studies which found – in theory and in practice – that investing in energy efficiency produces significant positive direct and non-direct economic benefits in New England.[2]

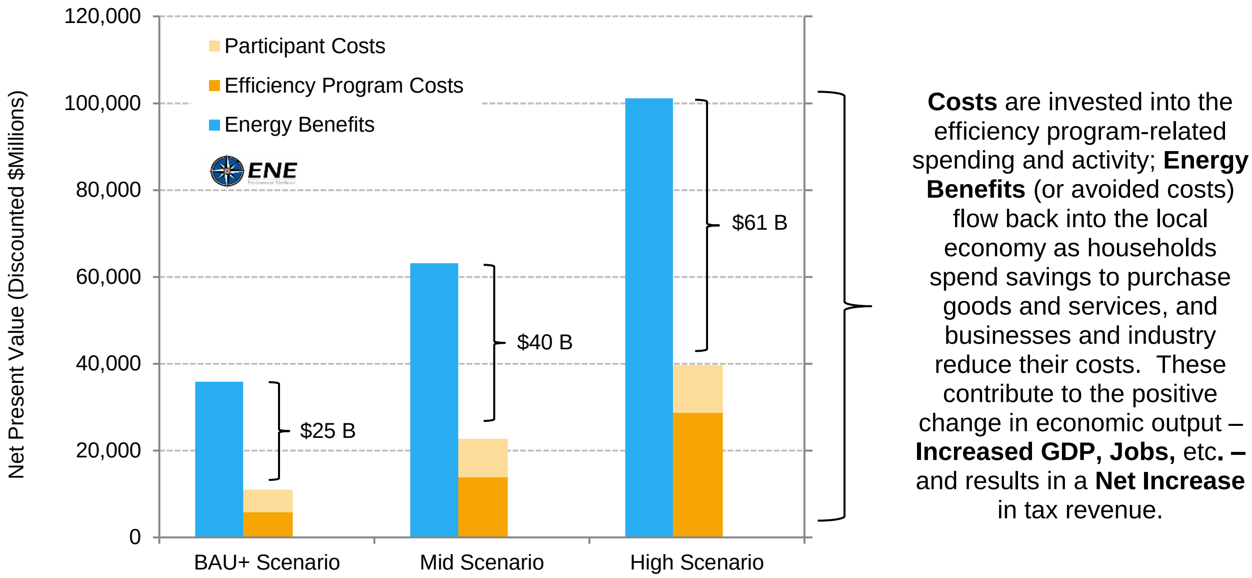
The study uses a multi-province policy forecasting model by Regional Economic Models, Inc. (REMI) to project macroeconomic impacts of expanded efficiency programs in comparison to a scenario where no programs exist. The study analyzes expanded efficiency programs for electricity, natural gas, and liquid fossil fuels – fuel oil, propane, and kerosene. The modeled efficiency investment levels – "Business As Usual+ or BAU+," "Mid," and "High" – were generated using three annual efficiency savings targets for each fuel type (see Table ES-1). The three savings targets reflect: a) an incremental increase in effort over current levels (BAU+); b) a level of effort that approaches all cost-effective efficiency (Mid); and, c) a level of investment that would place the provinces among current leaders (High). This approach overcomes limited up-to-date and public information on the energy efficiency potential in each province, and offers the added value of projecting a range of benefits based on a wider scope of potential investment.

Table ES-1: Annual Efficiency Savings Targets by Fuel Type and Province (% of Annual Consumption)

	BAU+ Target	Mid Target	High Target
Electricity	QC, NB: 0.5% NS, PEI: 1.0%	QC, NB: 1.0% NS, PEI: 1.75%	QC, NB: 1.5% NS, PEI: 2.5%
Natural Gas	0.75%	1.25%	1.75%
Liquid Fossil Fuels	1.3%	1.75%	2.5%

The Mid and High investment levels are significantly higher than current program budgets in the provinces, but all scenarios result in cost-effective energy savings based on the Total Resource Cost Test, the Program Administrator Cost Test, and the Participant Cost Test.[3] From the standpoint of economic resource acquisition, procurement of all cost-effective energy efficiency makes the most sense for ratepayers and consumers because it is the lower-cost resource option. In general, the authors have chosen to present a conservative estimate of the potential energy cost savings and economic impacts from expanded investment in energy efficiency programs. If energy costs rise above the forecasts used in the study, or externalities such as carbon costs are included, savings in the energy systems would further increase (i.e. greater net benefits in Figure ES-1), along with associated economic benefits.

Figure ES-1: Net Present Value of Energy Savings versus Program and Participant Investment – All Fuels



Modeled scenarios relied on representative efficiency programs for each fuel type, using assumptions about costs and savings for program measures in each market segment. Assumptions were based on data from current programs as well as program expansion proposals and cost-effectiveness studies. Efficiency program assumptions were developed by Dunsky Energy Consulting, Inc., and were established after discussions with program administrators and experts in the field of energy efficiency. Expanded efficiency programs were modeled over 15 years, and funding ramp-up periods were incorporated to reflect sustainable program growth rates. The model continues for another 13 years to approximately capture the economic benefits achieved over the life of efficiency measures. In reality, programs would likely continue beyond this 15 year window of investment, and benefits will accrue beyond 2040 (Canadian data for the REMI model was only available to 2040).

In order to investigate the complementary nature of efficiency programs across fuel types and jurisdictions, in addition to modeling scenarios where each province acts alone to implement one fuel type ("independent"), the analysis includes scenarios where a province implements programs for all fuel types at once ("all fuels"); and scenarios where all four provinces implement programs for one or all fuel types simultaneously ("simultaneous"). In all cases, the all fuels and simultaneous, multi-province action resulted in greater economic benefits to a province or the region, due to increased regional competitiveness, intra-provincial trade and other synergistic effects. For example, there is a 14 percent increase in GDP in the region ($73,662 million vs. $83,955 million from 2012 to 2040) and a 12 percent increase in employment (557,040 job-years vs. 625,112 job-years from 2012 to 2040) when provinces move from acting alone to simultaneously implementing all fuels efficiency programs under the Mid investment scenario.

Although sixty scenarios are assessed, for the purposes of an overview, the scenarios where each province acts alone and implements programs for all fuel types are presented below. This provides an understanding of the potential from cases that are administratively feasible in the near- and mid-term.

The following tables show the economic impact of the "all fuels" expanded energy efficiency investments scenarios for each of the four Eastern Canadian provinces. The REMI model outputs include the impact of paying for the programs, participant costs, and decreases in activity in affected sectors, and therefore the results represent the net benefits to the economy. The goal of the analysis is to understand the overall macroeconomic benefits of expanded energy efficiency programs. The study results are applicable even if they do not exactly match planned investments and GDP and jobs indicators can be applied to more specific investment levels to generate estimates of economic benefits for a chosen provincial ramp-up plan.

Table ES-2: Summary of Québec Economic Impacts from Electric, Natural Gas, and Liquid Fossil Fuels Efficiency Programs (2012-2040) – *Cases where province implements all fuel programs simultaneously*

All Fuels – Québec	**BAU+**	**Mid**	**High**
Total Efficiency Program Costs ($2011 Millions)	**4,531**	**11,337**	**23,058**
Increase in GDP ($2011 Millions)	**37,070**	**62,892**	**94,447**
Maximum Annual GDP Increase ($Millions)	2,577	4,480	6,668
Increase in Employment (Job years)	**273,918**	**479,508**	**732,631**
Maximum Annual Employment Increase (Jobs)	20,222	34,402	46,188
Job-Years per $Million of Program Spending	60	42	32
Job-Years per $Million of Program & Participant Spending	32	26	23
Rest of the Four Provinces Economy			
Increase in GDP ($Millions)	*715*	*1,156*	*1,676*
Increase in Employment (Job Years)	*3,385*	*5,613*	*8,392*

Table ES-3: Summary of New Brunswick Economic Impacts from Electric, Natural Gas, and Liquid Fossil Fuels Efficiency Programs (2012-2040) – *Cases where province implements all fuel programs simultaneously*

All Fuels – New Brunswick	**BAU+**	**Mid**	**High**
Total Efficiency Program Costs ($2011 Millions)	**417**	**1,061**	**2,108**
Increase in GDP ($Millions)	**1,502**	**2,189**	**3,046**
Maximum Annual GDP Increase ($Millions)	90	143	218
Increase in Employment (Job years)	**10,714**	**17,032**	**24,819**
Maximum Annual Employment Increase (Jobs)	626	936	1,359
Job-Years per $Million of Program Spending	26	16	12
Job-Years per $Million of Program & Participant Spending	12	10	9
Rest of the Four Provinces Economy			
Increase in GDP ($Millions)	*269*	*378*	*527*
Increase in Employment (Job Years)	*1,896*	*2,741*	*3,879*

Table ES-4: Summary of Nova Scotia Economic Impacts from Electric, Natural Gas, and Liquid Fossil Fuels Efficiency Programs (2012-2040) – *Cases where province implements all fuel programs simultaneously*

All Fuels – Nova Scotia	**BAU+**	**Mid**	**High**
Total Efficiency Program Costs ($2011 Millions)	**739**	**1,675**	**3,089**
Increase in GDP ($Millions)	**4,929**	**8.434**	**11,213**
Maximum Annual GDP Increase ($Millions)	297	509	693
Increase in Employment (Job years)	**34,568**	**58,907**	**81,621**
Maximum Annual Employment Increase (Jobs)	2,524	3,624	4,485
Job-Years per $Million of Program Spending	47	35	26
Job-Years per $Million of Program & Participant Spending	23	22	19
Rest of the Four Provinces Economy			
Increase in GDP ($Millions)	*529*	*885*	*1,296*
Increase in Employment (Job Years)	*3,623*	*6,061*	*8,898*

Table ES-5: Summary of Prince Edward Island Economic Impacts from Electric and Liquid Fossil Fuels Efficiency Programs (2012-2040) – *Cases where province implements all fuel program simultaneously*

All Fuels – Prince Edward Island	**BAU+**	**Mid**	**High**
Total Efficiency Program Costs ($2011 Millions)	**81.3**	**186.7**	**347.1**
Increase in GDP ($Millions)	**135.9**	**354.4**	**475.9**
Maximum Annual GDP Increase ($Millions)	9.8	23.9	34.4
Increase in Employment (Job years)	**1,239**	**2,577**	**3,585**
Maximum Annual Employment Increase (Jobs)	79	153	204
Job-Years per $Million of Program Spending	15	14	10
Job-Years per $Million of Program & Participant Spending	7	9	7
Rest of the Four Provinces Economy			
Increase in GDP ($Millions)	*92*	*191*	*262*
Increase in Employment (Job Years)	*820*	*1,320*	*1,845*

The macroeconomic benefits of efficiency derive from changes in the economy via increased spending on efficiency measures – and the corresponding increase in funding to enable this – and decreased spending on energy. The majority of these impacts (70-90%) result from the energy savings realized by households and business.[4] Lower energy costs increase other forms of consumer spending such as travel/tourism or dining out. Lower energy bills reduce the costs of doing business in the region, bolstering the global competitiveness of local employers and promoting additional growth. Table ES-6 presents the percent of the increased GDP and employment resulting from the efficiency investment versus the energy savings for the scenario where all provinces implement programs for all fuel types at the Mid investment level.

Table ES-6: Percent of Economic Impact Resulting from Efficiency Investment versus Energy Savings – *Scenario where all provinces invest in programs across all fuel types simultaneously at the Mid investment level*

	Region	QC	NB	NS	PEI
GDP					
Percent of GDP Resulting from Efficiency Investment	15%	16%	6%	5%	9%
Percent of GDP Resulting from Energy Savings	85%	84%	94%	95%	91%
Employment					
Percent of Employment Resulting from Efficiency Investment	23%	26%	11%	8%	18%
Percent of Employment Resulting from Energy Savings	77%	74%	89%	92%	82%

While results in Tables ES-2 to ES-5 are informative, they mask the relative contribution of each fuel type to the overall increase in economic output. Figures ES-2 and ES-3 present the total regional increase in GDP ($Millions) and employment (job-years) by fuel type. The figures present aggregate results from the scenarios where all provinces simultaneously implement programs for one fuel type. The totals are greater than the aggregate of the above tables – the individual provinces' all fuels scenario results – due to the fact that, as mentioned above, regional action further increases economic output. Also, the natural gas benefits are relatively low, however, in absolute terms they are high in relation to program investment levels.

Figure ES-2: Total Increase in GDP in QC, NB, NS, and PEI (2012-2040), by Efficiency Investment Scenarios (BAU+, Mid, High), and Fuel Type – *Aggregate of cases where provinces implement each fuel type program simultaneously*

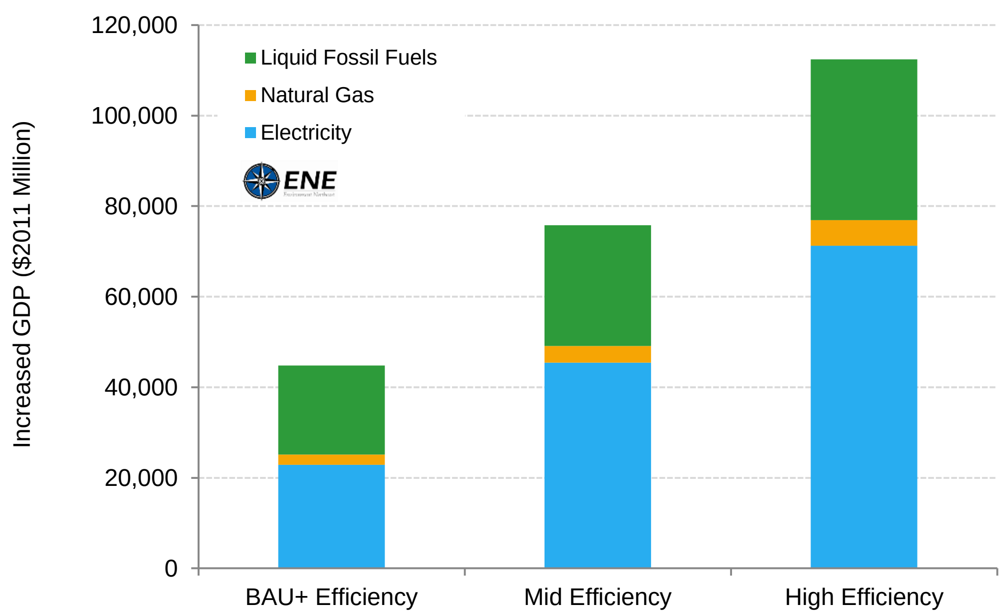
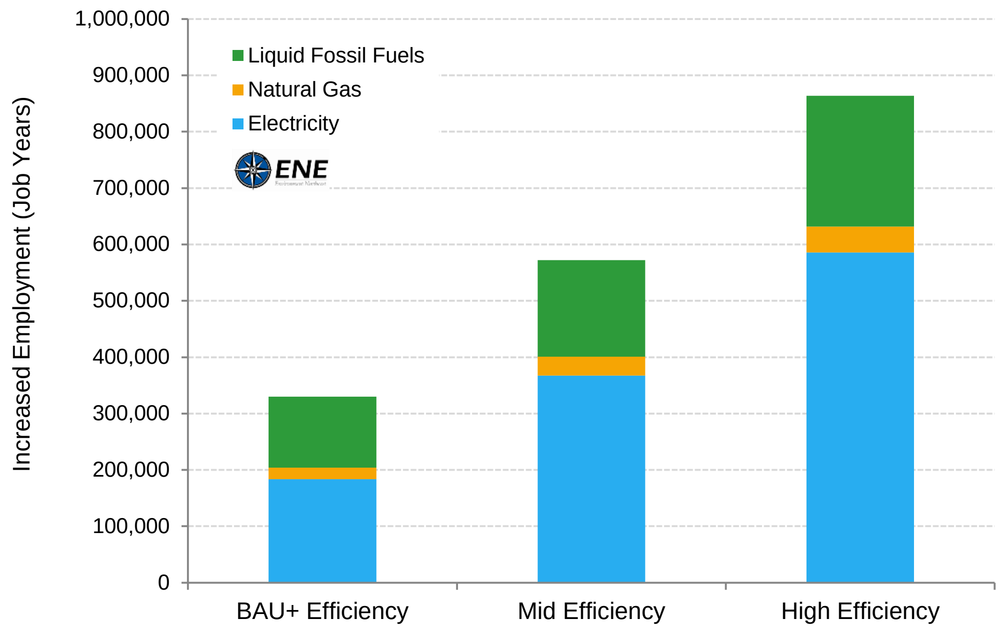


Figure ES-3: Total Increase in Employment in QC, NB, NS, and PEI (2012-2040), by Efficiency Investment Scenarios (BAU+, Mid, High), and Fuel Type – *Aggregate of cases where provinces implement each fuel type program simultaneously*



The modeled results of increased efficiency investments show that efficiency provides significant economy-wide benefits in addition to direct participant savings on which efficiency programs are often justified. Expanding analysis from micro-level, cost-benefit tests to macro-level assessments of the broader economic impacts of efficiency (including losses to electric generators and fuel suppliers) clearly illustrates that investing in energy efficiency is one of the most effective means of improving economic conditions widely, while saving consumers money and reducing emissions.

Another important issue is how the change in energy investment type and level, and the resulting impact on the economy, will affect government revenue streams. This is of particular interest with respect to energy efficiency programs given that they reduce the sale of energy products in a jurisdiction, but also drive economic output in other sectors of the economy. To inform this discussion, a high-level tax revenue impact assessment was conducted to supplement the results of the macroeconomic study. As expected, the results show a loss in provincial and federal sales tax collections from the reduced demand for fuels. However, for the scenarios studied – all fuels at the Mid investment level – the significant increase in economic output generates a net increase in collections of personal income tax, corporate income tax, and sales tax. The net gain in government revenue – including direct sales tax losses – is estimated at $243 million in Québec, $9 million in New Brunswick, $27 million in Nova Scotia, $2 million in PEI, and $312 at the federal level. Thus, the additional tax collections associated with the significant increase in new economic activity more than compensate for the lost sales tax revenue.

The total regional energy savings and reduced greenhouse gas emissions associated with the modeled levels of efficiency investments are also significant. The following table illustrates the possible savings by fuel type at the 'Mid' investment levels.

Table ES-7: Summary of Eastern Canada Energy Saved and Greenhouse Gas (GHG) Emissions Avoided Under Mid Efficiency Investment Level

	Electricity	Natural Gas	Liquid Fossil Fuels
Energy Savings	**(GWh)**	**(Million m3)**	**(PJ)***
Maximum annual savings	**31,125**	**1,050**	**87**
Maximum savings vs. Business as Usual Demand	13%	17%	23%
Lifetime savings (15 years of programs)	448,310	18,900	1,560
Equivalent GHG Emissions Avoided	**(kt CO_2e)**	**(kt CO_2e)**	**(kt CO_2e)**
Maximum annual avoided emissions	9,170	1,990	6,400
Maximum annual avoided emissions vs. 2010 total regional emissions (four provinces)	7.5%	1.6%	5.2%
Lifetime avoided emissions (15 years of programs)	60,390	36,740	115,250

*1PJ = ~ 27,000,000 litres of fuel oil; 39,000,000 litres of propane

Cost-effective efficiency savings can be found in any energy system, and this region is no exception. This study illustrates that the economic benefits exceed the cost of implementing efficiency measures, and that efficiency investments quickly pay for themselves through increased economic activity and job creation. In fact, the analysis shows that the benefits are greater than commonly recognized even by program administrators and proponents, since expanding the assessment beyond traditional benefit/cost tests introduces the impressive impact to the wider economy.

The region is already accruing economic benefits through existing efficiency program, but as show by this study, provinces have significant incentive to move beyond current investment levels. Positioning themselves among the leading jurisdictions with respect to energy efficiency will require policies that include comprehensive efficiency programs and incentives, and market and workforce development strategies, to overcome barriers to efficiency implementation and deliver lasting benefits. By establishing mandates and complementary policy that lead to the procurement of all cost-effective efficiency across all fuel types in the near-term, government will facilitate significant new, local economic growth that is in line with consumer interests and economic and environmental goals. Avoiding expensive upgrades to aging energy infrastructure; facilitating new industry and centers of excellence; reducing the need for energy assistance programs; and, the value of energy security – not quantified or qualified by this study – further increases the attractiveness of this important energy resource.

Table ES-8: Estimate of Current Investment in Electric, Natural Gas, and Liquid Fossil Fuels Efficiency Programs in 2011/2012 Compared to Modeled First Year Expanded Program Investment Levels (Millions$)[5]

All Fuels	2011/12 Efficiency Program Spending (Million$)	1st Year Expanded Efficiency Budget (Million$)
Québec	$279.1	$349.4
New Brunswick	$17.1	$32.5
Nova Scotia	$53.8	$56.0
PEI	$1.5	$5.8

1.0 Introduction

Energy efficiency – an abundant, clean, and low-cost energy resource – is an important component of modern energy systems and has emerged as a key policy tool to help address high energy costs and spur economic growth while reducing greenhouse gas emissions. Cost-effective efficiency programs reduce demand for energy supply, which in turn:

- Reduces the amount of money that leaves jurisdictions to import fossil fuels as well as the energy intensity of processes in a region, increasing energy security;
- Helps individuals and businesses lower their energy bills, which results in savings that are invested in local economies, increasing productivity and competitiveness, and creating jobs;
- Lessens the burden on the existing energy infrastructure, and the need for new and costly upgrades;
- Reduces the energy burden of vulnerable populations, freeing income for other basic needs such as food, housing, and medication; and,
- Helps governments and society cost-effectively reduce greenhouse gas and other air emissions and meet climate and other environmental commitments.

Jurisdictions are regularly assessing the level of funding for energy efficiency programs and are considering legislative and/or regulatory changes to promote adequate and sustained investment in efficiency instead of more expensive traditional supply-side resources. However, before evaluating energy efficiency programs it is necessary to understand why efficiency policy mandates are needed to drive investments that save consumers money. Efficiency programs help correct market failures that inhibit consumers and businesses from investing money in efficiency measures that require an up-front investment to deliver lasting benefits. Examples of these market failures include:

- *Liquidity Constraints* – when a consumer or business has inadequate access to capital to purchase efficient equipment or improve building energy performance;
- *Split Incentives* – when the owner of a piece of equipment or building (the landlord) does not pay the energy bill and is thus unlikely to invest in efficiency improvements that would benefit the resident/renter;
- *Inadequate Information* – when purchasers do not know the future energy costs of a product or property and are thus unlikely to invest in the more efficient option with a higher upfront cost; and,
- *Bounded Rationality* – when the complexity of a decision is beyond the ability of a consumer to make an economically optimal choice.

As investments in energy efficiency programs increase, there is a need to understand economic effects on individual program participants and on the economy as a whole. In other words, in addition to understanding the direct impacts of efficiency programs, it is important to understand the non-direct impacts of efficiency programs on economic activity in aggregate, both from implementation of efficiency programs and the resulting energy savings. Efficiency programs deliver consumer savings, but to what extent do these savings flow through provincial economies to impact overall economic conditions and job growth?

This study seeks to quantify the macroeconomic impacts associated with increased investment in energy efficiency in four eastern Canadian provinces – Québec, New Brunswick, Nova Scotia, and Prince Edward Island. The study analyzes efficiency programs for electricity, natural gas, and "liquid fossil fuels" (fuel oil, propane, and kerosene), using a range of investment scenarios that approach all cost-effective efficiency (efficiency that is lower cost than supplying additional energy) for each province and fuel type. The expanded efficiency investment scenarios use assumptions based on existing and proposed programs, as well as experience from other jurisdictions. The higher efficiency savings targets are considered aggressive yet realistic based on the cost-effective savings potential in the region and experience in other jurisdictions.

The analysis used a detailed, spreadsheet-based model to develop and evaluate efficiency program costs and energy sector benefits. The results were then input into a multi-province policy forecasting model by Regional Economic Models, Inc. (REMI) to project macroeconomic impacts of expanded efficiency programs in comparison to a scenario where no programs exist. The study also quantifies high-level provincial and federal tax revenue impacts from the investment in energy efficiency programs and resulting spending and employment changes for a common scenario in each of the provinces.

The project team consisted of analysts from ENE, Dunsky Energy Consulting (DEC), and Economic Development Research Group (EDRG). The team was assisted by a project steering committee, which consisted of representatives from each of the four provinces and Natural Resources Canada, as well as an informal advisory group of government representatives, utilities and program administrators, and other experts from the region. Steering and advisory committee input was solicited in the development of the input assumptions and the draft final report.

2.0 Energy & Efficiency Trends in Eastern Canada

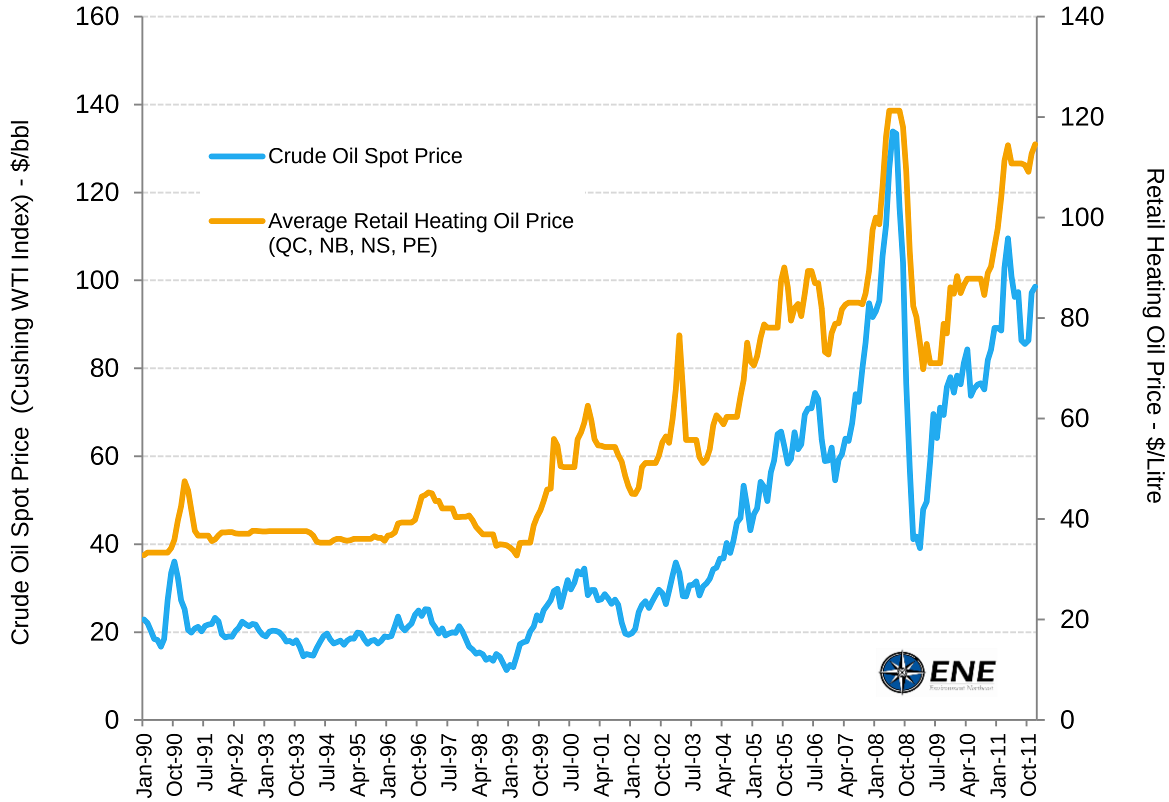
The region of study includes the Canadian provinces of Québec (QC), New Brunswick (NB), Nova Scotia (NS), and Prince Edward Island (PEI). These four provinces, along with the province of Newfoundland and Labrador, comprise the region of "Eastern Canada," and participate in a number of common forums, including the conference of New England Governors and Eastern Canadian Premiers (NEG-ECP). Economic relationships, including energy trade, are strong within the region, as are links to other jurisdictions, in particular Ontario and the northeast U.S.

2.1 Overview of Energy Sector in Eastern Canada

The energy sector is an important component of the economy in Eastern Canada. The natural resource base in the region provides significant primary energy resources, and has also contributed to the development of a relatively energy-intensive industrial sector.[6]

The region is a net exporter of electricity and refined petroleum products.[7] [8] The majority of the electricity consumed in the four provinces is generated in-region, although utilities both sell and purchase power from Ontario and the U.S. Almost all of the refined petroleum products consumed in the region are from refineries in QC, NB, and NS, however, the crude stock is primarily imported from outside Canada. A significant portion of the energy mix is fossil fuel-based – especially in NB, NS, and PEI – which has led to a steady increase in energy prices and bills due to rising oil prices (by way of example, see Figure 1).

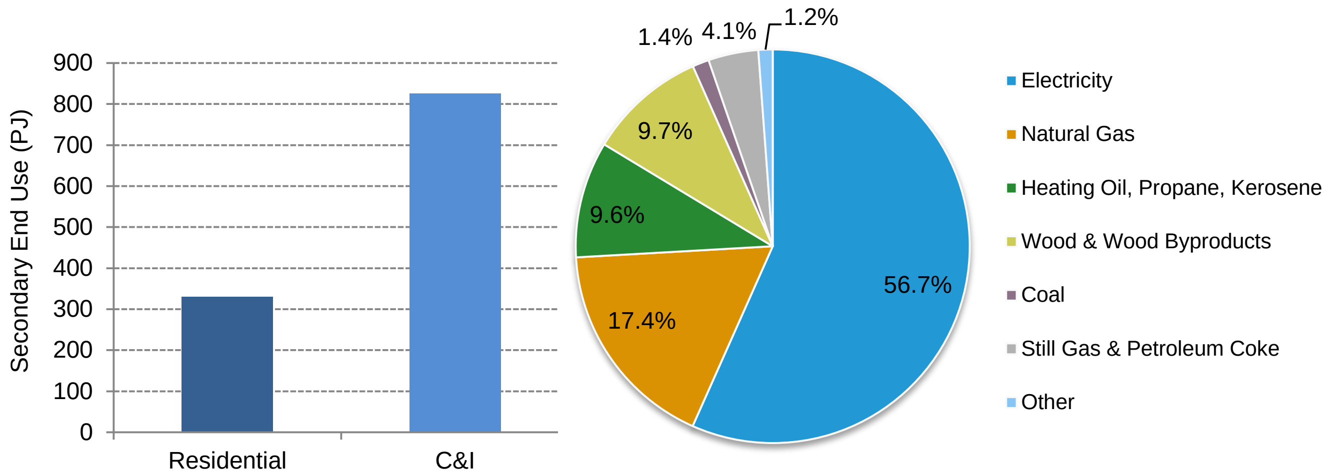
Figure 1: Crude Oil Spot Prices from Cushing WTI Index and Average Retail Heating Oil Prices in Québec, New Brunswick, Nova Scotia, and Prince Edward Island (Jan 1990 to Dec 2011)



Sources: EIA and Statistics Canada (average of Charlottetown, Halifax, Saint John and Quebec retail heating oil prices for period)

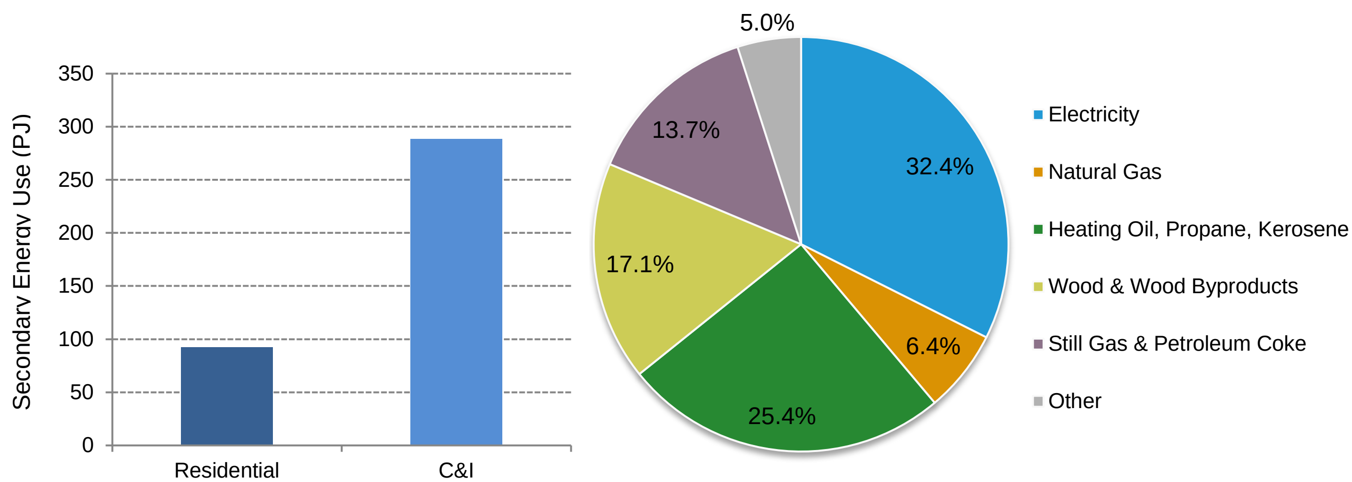
The energy that is produced by the provinces or imported is used by a variety of sectors to generate electricity, run vehicles, and power and heat/cool homes and buildings. In Québec, the Commercial/Institutional and Industrial ("C&I") sectors consume approximately two and a half times more energy than the residential sector, and the majority of the non-transportation end-use demand is met with electricity (see Figure 2). In Atlantic Canada – which includes New Brunswick, Nova Scotia, and Prince Edward Island as well as the province of Newfoundland and Labrador – the C&I sector consumes approximately three times more energy than the residential sector, and relative to other parts of Canada, has a diverse energy supply mix (see Figure 3).

Figure 2: Secondary Energy Use by Sector and Fuel Type in Quebec (2009)



Sources: Office of Energy Efficiency, Natural Resources Canada, Statistics Canada

Figure 3: Secondary Energy Use by Sector and Fuel Type in Atlantic Canada* (2009)



Sources: Office of Energy Efficiency, Natural Resources Canada, Statistics Canada (Note: Statistics Canada C&I data is not disaggregated for Atlantic Canada and therefore the above includes Newfoundland and Labrador, which is not part of the study.)

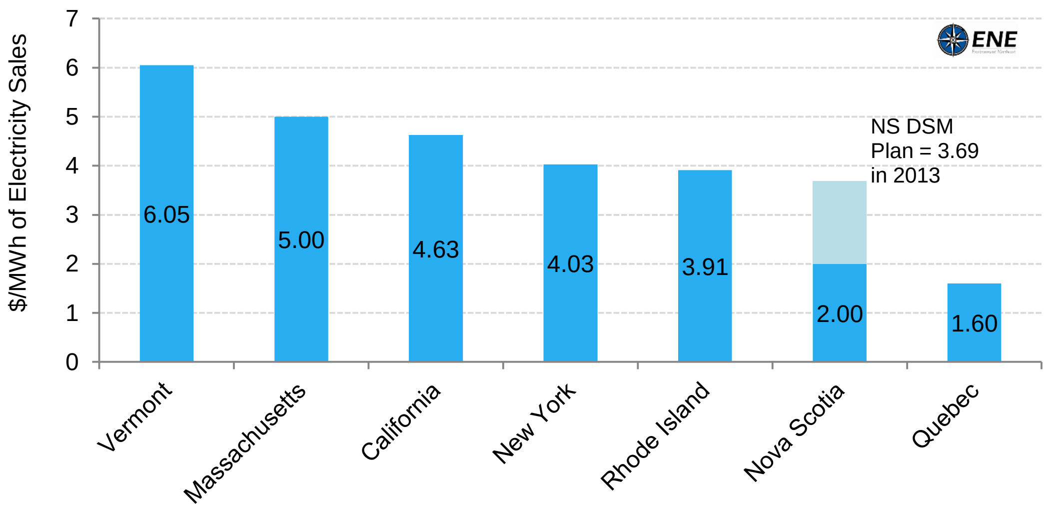
2.2 Energy Efficiency in Eastern Canada

Energy efficiency is increasingly viewed as a bona fide energy resource that allows utilities and regulators to meet consumer energy needs by improving energy usage rather than expanding energy supply. Québec, New Brunswick, Nova Scotia, and Prince Edward Island all have energy efficiency programs in place, however, the scale of programs expansion varies by province.

Efficiency Programs Funding & Administration

Québec and Nova Scotia are considered to be among the leading provinces – along with British Columbia and Manitoba – in terms of electric efficiency program investment. Nova Scotia doubled its electric Demand Side Management effort from 2009 to 2010 and again in 2010 to 2011.[9] In 2011, electric efficiency savings from Efficiency Nova Scotia efforts were approximately 142 GWh of first-year savings or 1.27% of load.[10] Hydro Québec Distribution estimates its investment in efficiency will save approximately 696 GWh in 2012.[11] New Brunswick and Prince Edward Island have established energy efficiency agencies, running programs that are regularly oversubscribed.

Figure 4: Comparison of Nova Scotia and Quebec to Top 5 States by Dollars of Electric Program Spending per MWh of Electricity Sales in 2010[12]



Sources: ENE Analysis of CEE 2010 Industry Report data, Efficiency Nova Scotia Corporation's Demand Side Management Plan 2013-2015 (revised), Emera Annual Report 2011, and NSPI 2011 Load Forecast; Government of Quebec Budget Plan 2010-11, Regie de l'energie Docket No. R-

Hydro-Québec funds and administers electric energy efficiency programs as does Québec's Ministry of Natural Resources and Wildlife, which administers programs across all fuel types. Funding for natural gas programs comes from Gaz Métro and a portion of carbon levy revenues are dedicated to provincial efficiency programs. In Nova Scotia, Efficiency Nova Scotia – an independent, not-for-profit agency – administers electric efficiency programs, which are funded by an electric Societal or Systems Benefit Charge ("SBC"). Efficiency Nova Scotia also administers joint fuel programs that are publicly funded through general revenue. In New Brunswick and PEI, Efficiency New Brunswick – modeled after Efficiency Vermont – and the PEI Office of Energy Efficiency administer efficiency programs that target all fuel types. The agencies and programs in these provinces are currently funded through general revenue, although Maritime Electric contributed funding for electric efficiency initiatives in PEI until 2011.

Codes & Standards

Building codes and appliance and equipment standards are important components of the energy efficiency dialogue as well as the investment scenarios modeled in this study. They are included at increased levels in the higher investment scenarios because they are low-cost options that complement efficiency programs in achieving deep reductions in energy use.

In Canada, the federal government develops model national codes for buildings and houses. Provinces have the jurisdiction to develop and implement a building code and energy standard based on the model national code and/or another benchmark that may exceed the federal standard. Provinces are also responsible for monitoring and enforcement. To date, Nova Scotia and New Brunswick have adopted adapted versions of the National Model Building Code, and Québec's building code is based on the national model. PEI does not have a province-wide building code, although two major municipalities have adopted the model national code.

The Government of Canada sets minimum energy performance standards for some appliances and equipment that cross provincial or territorial borders. Provinces have the jurisdiction to set minimum performance standards on existing or new products not covered by the federal government, and those that are manufactured and sold within a province. Both levels of government can implement labeling programs for products as well as homes and buildings.

Training & Regional Collaboration

Expanded investment in energy efficiency translates into new jobs, both in the efficiency industry and the wider economy. The rapid growth of the efficiency industry will require coordination with trade organizations and training programs. Pooling expertise and resources to develop the industry as well as a workforce training and transition strategy for the region (in addition to collaborating on efficiency policy and program best practices and codes and standards) may prove an effective approach for Québec and the Atlantic provinces. Eastern Canada (and New England) could reasonably position itself as a "Center of Excellence" in energy efficiency and industry hub.

The NEG-ECP has adopted numerous progressive Resolutions with respect to energy efficiency, and the Council of the Federation is committed to "…achieving a 20% increase in energy efficiency by 2020 in their respective jurisdictions" compared to 2010. These forums, among others, offer an opportunity and capacity to advance common initiatives.

2.3 Energy Efficiency Policy Framework in New England

Leading U.S. jurisdictions – many of which are New England states – are ramping up levels of investment in electric efficiency of approximately $4 to $6 per MWh of electricity sales. By comparison, Nova Scotia invested $2.00/MWh of sales in 2010, and is planning to ramp-up investment to approximately $3.69/MWh in 2012. Québec – which had the highest per capita spending on electric efficiency in eastern Canada in 2010[13] – invested approximately $1.60/MWh in 2010 (see Figure 4, above).[14] What leads to the level of investment found in leading jurisdictions? While the details vary, the energy policy reforms adopted tend to follow a consistent framework that requires procurement of cost-effective energy efficiency by utilities on behalf of all their customers. New markets and funding sources have also been developed. The following is an outline of key policy changes that have been implemented in New England:

- ***Efficiency Procurement Mandates:*** A new legislative mandate implemented by utility regulators – often under the oversight of a stakeholder board – that requires electric and/or natural gas utilities to procure all cost-effective energy efficiency – efficiency that is available at lower cost than energy supply options. On the basis of economic evaluations, this requirement is leading utilities and states in the region to plan significant increases in efficiency investments.
- ***Utility Incentive Reform:*** In order to remove the inherent disincentive when utility profits are tied to consumption, legislators and regulators in the region have implemented regulatory approaches that "decouple" or break the link between sales and utility revenue. Policy makers

have also been implementing or updating utility incentives to create business models in which utilities earn money by saving customers money.

- ***Consistent Efficiency Program Funding Sources:*** In the last few years new public policies and newly created markets have diversified sources of efficiency funding, allowing programs to ramp-up quickly. Some of these sources are:
    - ***SBC and Distribution Rates:*** Existing Societal Benefit Charges (SBC) in many cases are no longer fixed, and adjustments to these charges or to distribution rates are fulfilling any additional need for efficiency program funding.
    - ***Regional Greenhouse Gas Initiative (RGGI) Allowance Auction:*** RGGI states are directing the majority of the value of new CO_2 allowances under this carbon cap and trade program to energy efficiency programs as a way to reduce the cost of allowances and keep customers' energy bills low.
    - ***Federal Funds:*** More recently, U.S. federal stimulus funds were used by states to fund expanded energy efficiency programs as federal policy makers understood that efficiency investments are a reliable and effective way to grow the economy and create new green jobs. States incorporate other sources of federal funding into their program budgets.
    - ***Forward Capacity Market (FCM):*** Run by ISO New England (in the deregulated market), the Forward Capacity Market ensures that enough capacity is available to meet peak energy demand. Energy efficiency programs are qualified to participate in this market, bolstering the credibility of efficiency savings and providing additional efficiency program revenue.

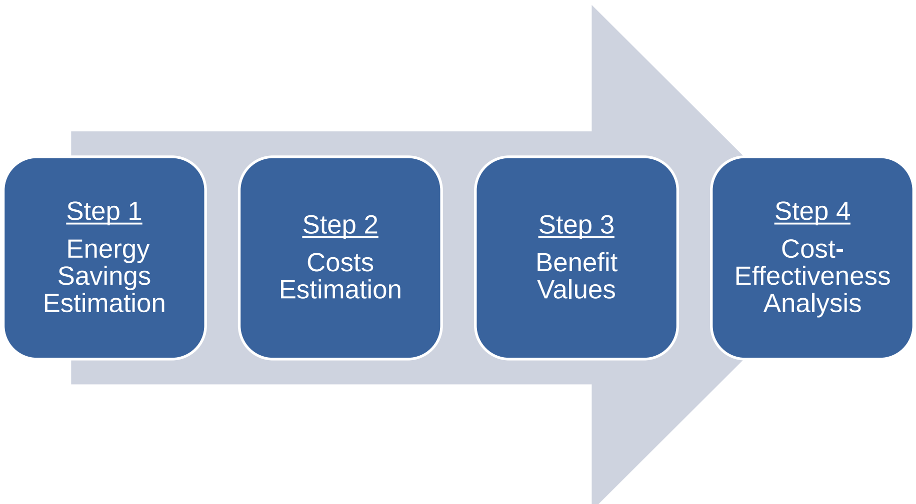
In addition to electric and natural gas efficiency investments, there is an increasing recognition that programs are needed for consumers of energy sources not delivered by regulated electric and natural gas monopolies, such as fuel oil, propane, kerosene, and even wood. While some states have established programs for oil users, for the most part establishing an adequate and sustainable funding stream has been a challenge. Vermont has made the most sustainable commitment to efficiency programs for all fuels, using RGGI allowance value, FCM revenue, and general revenue to help fund new comprehensive programs.

3.0 Energy Efficiency Assumptions Development

In order to evaluate potential impacts of increased investment in energy efficiency in the provinces, assumptions were made about efficiency program budgets, costs to achieve the energy savings, and energy prices and consumption levels during the modeled period. The assumptions, developed by Dunsky Energy Consulting and described in detail below, are based on extrapolations from current and proposed efficiency program data, utility and government projections, and experience in the provinces of study as well as other jurisdictions. The input assumptions, which form the basis of the macroeconomic modeling study, were reviewed by individuals with experiences and expertise in the Canadian energy sector.

The key set of assumptions and inputs was developed in three phases, and the investment scenarios were tested for cost-effectiveness (see Figure 5). Estimates of annual energy savings, based on recommended annual efficiency savings targets (see Table 2) were first established. Unit program and participant costs, disaggregated by residential and commercial/industrial customer classes, were then estimated for each fuel type and efficiency savings target level (see Tables 3-5). The per-unit-of-energy-saved costs were applied to the annual energy savings, generating the annual investment levels that were modeled (see sub-sections 3.2). The benefits values, or avoided costs, are based on the marginal (avoided) source of energy over the study period. These costs were applied to the estimated energy savings to generate annual avoided energy costs (see sub-section 3.3).

Figure 5: Process to Develop Energy Efficiency Modeling Assumptions and Inputs[15]



The investment scenarios are top-down estimates and do not represent a portfolio of discrete cost-effective efficiency measures (i.e. not a traditional efficiency potential study). As a result, the investments and energy savings are high-level estimates. However, the investment scenarios were tested for cost-effectiveness using the Total Resource Cost Test, the Program Administrator Cost Test, and the Participant Costs Test.[16]

Table 1: Illustrative Overview of Strategic Direction that Informed the Development of the Scenarios[17]

	Illustration of Strategic Direction of Scenarios		
	BAU+ Scenario	**Mid Scenario**	**High Scenario**
Summary	Moderately intensify current effort	Put provinces among EE leaders	Put provinces as EE leaders (i.e. No. 1)
Degree to which low cost measures are pursued (e.g. CFLs, Education, etc.)	Aggressive	Very Aggressive	Extremely Aggressive
Degree to which high cost measures are pursued (e.g. building envelope, ground source heat pumps)	Moderate	Aggressive	Extremely Aggressive
Financial support	30-40% of costs	50-60% of costs + Financing	70-80% of costs + Financing
Government policies	BAU (w/consideration for funding mandates)	BAU & Innovative financing (w/consideration for funding mandates)	BAU, Innovative financing, & enhanced building codes & product standards, mandatory building labeling (w/consideration for funding mandates)

3.1 Annual Efficiency Savings Targets

The modeled efficiency investment levels were generated using annual efficiency savings targets (i.e. annual consumption would be reduced by x% per year for each year of investment). Instead of assessing one target per fuel type, a range of three annual efficiency savings targets were established for each fuel type (i.e. BAU+ Target, Mid Target, and High Target). This approach overcomes limited up-to-date and public information on the energy efficiency potential in each province, and offers the added value of projecting a range of benefits based on a wider scope of potential investment. In the case of the electric sector, different savings targets were used for Québec/New Brunswick and Nova Scotia/Prince Edward Island to take into account the higher share of electric heating and of electric industrial processes in Quebec and New Brunswick. The strategic direction of these targets is outlined in Table 1, above.

Table 2: Annual Efficiency Savings Targets by Fuel Type and Province (% of Annual Consumption)

	BAU+ Savings Target	Mid Savings Target	High Savings Target
Electricity	QC, NB: 0.5% NS, PEI: 1.0%	QC, NB: 1.0% NS, PEI: 1.75%	QC, NB: 1.5% NS, PEI: 2.5%
Natural Gas (except PEI)	0.75%	1.25%	1.75%
Liquid Fossil Fuels	1.3%	1.75%	2.5%

For Québec and Nova Scotia, the electric BAU+ target is on par with current energy savings levels from existing efficiency programs. The electric BAU+ target for New Brunswick is an increase over the current annual level of energy savings and PEI's target is a relatively significant increase over the current level of savings. The Mid and High annual savings targets would represent significant increases over current savings targets, except possibly in NS. In all cases, as mentioned above, the investment levels return cost-effective energy savings (i.e. energy savings that cost less that supply) based on the Total Resource Cost Test, the Program Administrator Cost Test, and the Participant Test, and are in-line with savings levels proposed and/or implemented in leading jurisdictions, such as Massachusetts, Rhode Island, and Vermont.

For natural gas, the target savings levels are 0.75%, 1.25%, and 1.75% of annual consumption. No efficiency programs were modeled for PEI, due to very limited consumption of the fuel in that province. The 'Mid' natural gas target level is consistent with the annual savings goal used in ENE's 2009 study for the New England states.[18] Heating oil, propane, and kerosene ("liquid fossil fuels") were analyzed together in the REMI model. The annual savings targets for this fuel type are 1.3%, 1.75%, and 2.5%. The targets were adjusted upward over the course of this study due to advisory committee input with respect to escalating fuel prices and the level of liquid fossil fuel consumption, and thus the significant cost-effective savings potential for this fuel type in the region of study.

The annual energy savings reflect a reduction from a Business As Usual (BAU) load forecasts. The BAU load forecasts do not include energy savings from existing efficiency programs, which avoids double-counting and provides a more conservative estimate of the energy savings, costs, and benefits.[19]

3.2 Program Costs & Investment Levels

Program Costs

The cost of a particular efficiency measure is tallied in the year it occurs, while savings associated with that measure accrue for the duration of the measure's life. For example, a measure installed in 2012 will have its full cost reflected in that year, with per-year energy savings occurring every year over its lifespan. This provides a more accurate model of the measure's real-world economic impacts. Average annual lifespans of measures included in this study range from 10 to 26 years, depending on the fuel and scenario (see Appendix 1).[20]

Values used to calculate the annual and total energy efficiency investment levels are summarized in Tables 3-5.[21]

Table 3: Levelized Unit Electricity Program and Participant Cost (Nominal $/kWh)

Electricity	**Residential**			**C&I**	
	QC / NB	**NS / PEI**		**QC / NB**	**NS / PEI**
BAU+ Scenario					
Unit Program Costs per kWh	0.041	0.052		0.031	0.037
Unit Participant Costs per kWh	0.029	0.034		0.030	0.032
Total Unit Costs per kWh	0.070	0.086		0.061	0.069
Mid Scenario					
Unit Program Costs per kWh	0.053	0.063		0.040	0.046
Unit Participant Costs per kWh	0.027	0.031		0.028	0.030
Total Unit Costs per kWh	0.080	0.094		0.068	0.076
High Scenario					
Unit Program Costs per kWh	0.067	0.071/0.072		0.051	0.055/0.056
Unit Participant Costs per kWh	0.021	0.025		0.023	0.025
Total Unit Costs per kWh	0.088	0.096/0.097		0.074	0.080/0.081

Table 4: Levelized Unit Natural Gas Program and Participant Cost (Nominal $/m^3)

Natural Gas	Residential				C&I		
	QC	NB	NS		QC	NB	NS
BAU+ Scenario							
Unit Program Costs per m3	0.069	0.069	0.068		0.052	0.053	0.052
Unit Participant Costs per m3	0.040	0.040	0.039		0.061	0.062	0.061
Total Unit Costs per m3	0.109	0.109	0.107		0.113	0.115	0.113
Mid Scenario							
Unit Program Costs per m3	0.116	0.117	0.114		0.085	0.085	0.083
Unit Participant Costs per m3	0.034	0.034	0.034		0.051	0.051	0.050
Total Unit Costs per m3	0.150	0.151	0.148		0.136	0.136	0.133
High Scenario							
Unit Program Costs per m3	0.155	0.157	0.151		0.114	0.115	0.111
Unit Participant Costs per m3	0.029	0.029	0.029		0.042	0.042	0.042
Total Unit Costs per m3	0.184	0.186	0.180		0.156	0.157	0.153

Table 5: Levelized Unit Liquid Fossil Fuels Program and Participant Cost (Nominal $/GJ)[22]

Liquid Fossil Fuels	Residential					C&I			
	QC	NB	NS	PE		QC	NB	NS	PE
BAU+ Scenario									
Unit Program Costs per GJ	1.413	1.410	1.407	1.407		1.215	1.212	1.210	1.209
Unit Participant Costs per GJ	1.377	1.374	1.371	1.371		1.196	1.194	1.191	1.191
Total Unit Costs per GJ	2.790	2.784	2.778	2.778		2.411	2.406	2.401	2.400
Mid Scenario									
Unit Program Costs per GJ	2.718	2.706	2.695	2.693		2.263	2.254	2.245	2.243
Unit Participant Costs per GJ	1.384	1.381	1.379	1.379		1.186	1.184	1.181	1.181
Total Unit Costs per GJ	4.102	4.087	4.074	4.072		3.449	3.438	3.426	3.424
High Scenario									
Unit Program Costs per GJ	3.754	3.732	3.711	3.708		3.039	3.020	3.003	3.001
Unit Participant Costs per GJ	0.889	0.889	0.888	0.888		1.055	1.055	1.053	1.053
Total Unit Costs per GJ	4.643	4.621	4.599	4.596		4.094	4.075	4.056	4.054

Funding for energy efficiency measures can be divided into two main categories: program and participant. Program spending derives from government or utility efficiency program budgets. For the purposes of the macroeconomic analysis, funding for the electric and natural gas scenarios is assumed to accrue exclusively from ratepayer funds. For liquid fossil fuels, while funding could come from fuel surcharges for all consumers of those fuels, it is assumed that the scenarios are funded by government. Participant spending consists of the customer co-pays required for most efficiency measures.

Investment Levels

Applying the per unit program and participant costs to the annual energy savings produced the annual and total efficiency investment levels that were input into the model. As an overview, average annual efficiency program investment levels are shown below in Table 6.

Table 6: Modeled Average Annual Efficiency Program Investment Levels over a 15-year Investment Period, Including Ramp-up Period (Million$)

	Electric	Natural Gas	Liquid Fossil Fuels
Québec			
BAU+	345	29	46
Mid	881	81	124
High	1,835	160	247
New Brunswick			
BAU+	27	2	9.5
Mid	70	5	26
High	145	9	51
Nova Scotia			
BAU+	55	0.8	13
Mid	121	2	34
High	225	4	68
Prince Edward Island			
BAU+	6	-	1.9
Mid	13	-	5.1
High	23	-	10

The ramp-up schedule typically results in a 3-5 year expansion period before higher and sustained levels of investment are reached. In cases where no program currently exists, a conservative first year budget is assumed. Efficiency investments are modeled for a total of 15 years, including the ramp-up period. Energy savings and avoided costs (expressed in petajoules and dollars) were generated for an additional 15-20 years, depending on the scenario. However, economic impacts were modeled for a total of 29 years as Canadian data to populate the REMI model was only available until 2040. This will approximately capture the full economic benefits achieved over the life of efficiency measures.

Modeled efficiency programs are further divided into two market segments: (a) commercial and industrial, and (b) residential. Following conventional program evaluation techniques, the commercial and industrial market segments use identical assumptions for efficiency measures and savings. The investment split between residential and commercial and industrial (C&I) market segments is presented in Table 7, and is roughly equal to the split in terms of energy consumption (see Figures 2 and 3). It is also assumed that 10% of C&I spending is on public buildings, which are accounted for differently by the REMI model.

Table 7: Efficiency Program Spending "Split" – Residential and C&I Market Segments

	Residential	C&I
Electric		
QC & NB	35%	65%
NS & PEI	26%	74%
Natural Gas		
QC, NB, & NS	19%	81%
Liquid Fossil Fuels		
All provinces	19%	81%

Table 8 presents estimates of current efficiency program budgets in each of the provinces, across all administrators and agencies (2011/2012). The current levels of investment are compared to the total level of first year investment modeled for the expanded efficiency scenarios in each province (i.e. the starting point of the ramp-up).

Table 8: Current Investment in Electric, Natural Gas, and Liquid Fossil Fuels Efficiency Programs in 2011/2012 Compared to Modeled First Year Expanded Program Investment Levels (Millions$)[23]

All Fuels	2011/12 Efficiency Program Spending (Million$)	1st Year Expanded Efficiency Budget (Million$)
Québec	$279.1	$349.4
New Brunswick	$17.1	$32.5
Nova Scotia	$53.8	$56.0
PEI	$1.5	$5.8

It is important to note that while current or planned efficiency investments in a given province may not exactly match modeled investment levels, the goal of the analysis is to understand the overall macroeconomic benefits of expanded energy efficiency programs. The study results are applicable even if they do not exactly match planned investments and the multipliers for GDP and jobs can be applied to more specific investment levels to generate estimates of economic benefits for a chosen provincial ramp-up plan.

3.3 Avoided Energy Costs

The benefits of avoided spending on electricity are based on the marginal (avoided) costs for electricity (i.e. the electric generation source that is at the margin – the first to be taken offline or not built from a loading order standpoint). Where possible, values for avoided electricity are calculated separately for each province. In Québec, the values are from Hydro Québec Distribution's Electricity Supply Plan 2011-2030, and are based on the short-term market price initially, followed by wind in 2023.[24] In Nova Scotia, the study assumes avoided costs are based on a mix of renewables for the entire period of study.[25] [26] In New Brunswick and Prince Edward Island it is assumed that the marginal (avoided) cost of electricity is the short-term market price until 2029 and 2022, respectively, after which time the cost shifts to the levelized costs of a combined cycle gas turbine.[27] The avoided energy costs for electricity include energy and capacity costs for avoided generation, transmission, and distribution. Marginal greenhouse gas emissions factors for electricity, based on the marginal source of generation, are available in Appendix 2.

Gaz Metro's forecasts have been used to set the marginal (avoided) cost of natural gas for each of the provinces (QC, NB, and NS), which include production and distribution costs.[28] The avoided costs for heating oil, propane, and kerosene in all of the provinces are based on the National Energy Board's 2009 Reference Case Scenario, and include the full delivered cost of energy (production, transportation, and distribution).[29] Avoided costs for select years are available in Appendix 3.

To note, the impacts of reduced electricity consumption on overall energy and capacity prices, or Demand-Reduction-Induced Price Effects (DRIPE), while included in ENE's 2009 report for New England, are not included in this study. These price effects are not relevant in the context of vertically integrated utilities, and are not considered for natural gas and other heating fuels.

3.4 Efficiency Program Labor and Materials

The breakdown of spending on labor, materials, and program administration was assigned to categories in the REMI model in order to create an allocation for efficiency work that more accurately reflects the actual work done in efficiency program implementation.

The contractor materials were further broken down to more accurately represent spending in efficiency programs. Most of this spending falls within the two broad REMI industry segments for general construction and construction trades. However, since the majority of economic activity in these categories is not related to energy efficiency, the REMI model inputs were adjusted to represent the impacts of energy efficiency spending on construction and construction trades. Details are shown in Appendix 4.

4.0 Energy & Emission Benefits of Efficiency Investments

This chapter presents energy and emissions benefits based on the expanded energy efficiency scenarios, which were developed in part as inputs for the REMI model (results from the macroeconomic modeling assessment are presented in Section 6.0). As shown below, the expanded energy efficiency programs would generate substantial reductions in energy consumption and a corresponding reduction in total energy bills for the region. All the expanded efficiency scenarios produce energy savings at a lower cost than supplying the energy.

4.1 Energy Saved

The energy saved in each year of the analysis is the difference between the BAU energy use forecast and the BAU+ scenario, Mid scenario, and High scenario. As mentioned above, BAU consumption is based on the most recent utility or system operator forecasts, or the National Energy Board's 2009 reference case.[30] For all fuel types, where applicable, existing Demand Side Management savings were removed from the BAU scenario.

For each expanded efficiency scenario, reduced consumption in a given year was obtained by adding all annual efficiency savings (or representative bundles of measures) that had not reached the end of their useful life. At the peak, the efficiency investments would result in maximum reductions in projected energy use in the region of 20% for electricity, 22% for natural gas, and 31% for liquid fossil fuels (see Table 9).

4.2 Reduced Energy Spending

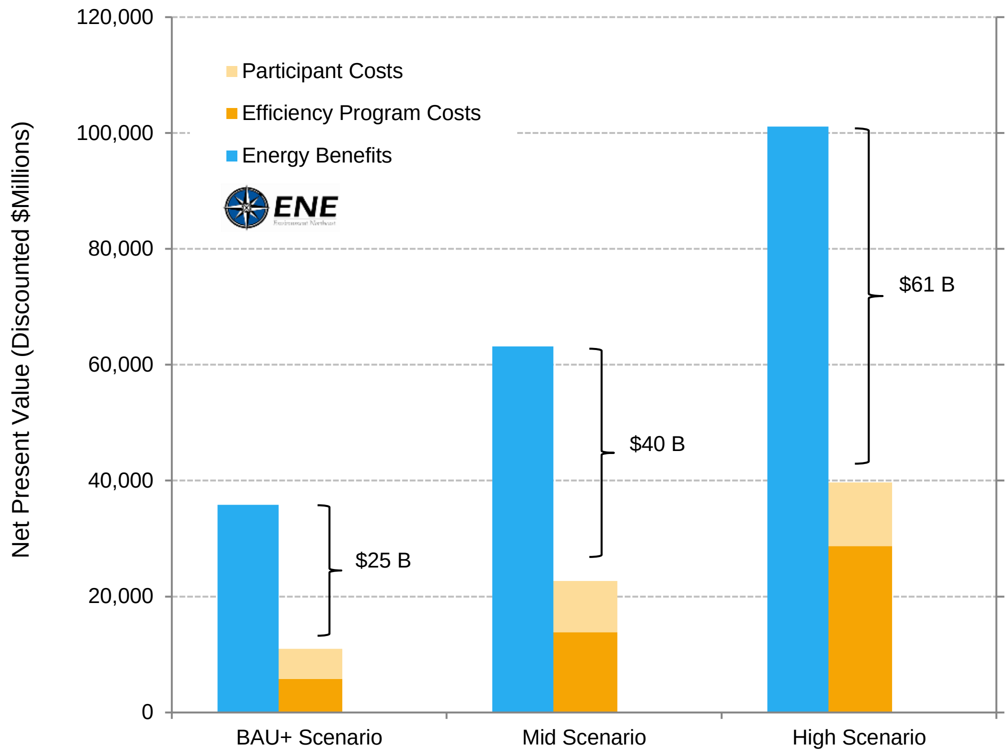
The annual BAU electricity costs were calculated using the marginal price of electricity and the BAU forecasted consumption. BAU natural gas and liquid fuels spending are based on similar calculations.

Net total annual energy cost savings (i.e. avoided costs less efficiency costs) were then subtracted from the BAU energy cost scenario to determine the new energy system cost for each efficiency investment scenario. Savings from existing DSM programs were removed from the forecast and nominal dollars were converted to 2012$.

Over the period of investment (2012-2026), the net decrease in total energy bills in the region would be up to 5% for electricity, 4% for natural gas, and 10% for liquid fossil fuels (all based on Mid efficiency scenario). These energy cost decreases would yield savings of up to $14.4 billion for electricity, $1.3 billion for natural gas, and $11.4 billion for liquid fossil fuels by 2026. As noted above, the electricity and natural gas figures include the increased funding that corresponds with increased spending on efficiency measures. Liquid fossil fuel program costs are also included.

The savings are considered conservative estimates based on current assumptions. The reduced spending on energy does not include externalities such as the future cost of greenhouse gas emissions. Energy cost savings could be even more dramatic if energy prices rise beyond current projections. Figure 6 provides an illustration of the program and participant costs versus regional benefits, which are based on avoided energy costs across all fuel types. For each efficiency scenario, the direct benefit to ratepayers and consumers outweighs the investment to capture the energy savings. At the BAU+ level, the benefit/cost ratio is 3.3 to 1, and ratepayers and consumers save approximately $6 for every program dollar invested. For the Mid and High scenarios, the benefit/cost ratios are 2.7:1 and 2.6:1, respectively. Ratepayers and consumers would save approximately $5 or $4 for every program dollar invested, and higher overall energy benefits.

Figure 6: Total Direct Energy Savings versus Program and Participant Investment – All Fuels, All Provinces (2012-2026)



4.4 Avoided Emissions

Reductions in energy consumption also reduce emissions. Avoided greenhouse gas emissions (Carbon Dioxide Equivalent or "CO_2e") due to energy savings from expanded efficiency programs were calculated by multiplying the energy saved by the appropriate emissions factor for each fuel type and province. Results are shown in Table 8, below, and at the provincial level in Appendix 2.

The avoided emissions factors for electricity are based on the marginal (avoided) source of generation in a given year, which in some cases changes over the period of study. As mentioned above, the marginal sources of generation were determined based on utility plans and input from advisory and steering committee members. The avoided emissions factors for natural gas and liquid fossil fuels are based on Natural Resources Canada's estimates of the carbon content of the fuels.[31]

Reductions in annual emissions of CO_2e for the electricity sector are projected to peak at 5,060 kt CO_2e (BAU+), 9,170 kt CO_2e (Mid), or 12,200 kt CO_2e (High). For natural gas, the maximum annual avoided emissions equal: 1,270 kt CO_2e (BAU+), 1,990 kt CO_2e (Mid), or 2,580 kt CO_2e (High). For liquid fossil fuels, the maximum annual avoided emissions equal: 4,910 kt CO_2e (BAU+), 6,400 kt CO_2e (Mid), or 8,400 kt CO_2e (High). Total lifetime emissions benefits (2012-2040) from expanded efficiency programs for all three fuel types would be up to 133,630 kt CO_2e (BAU+), 212,380 kt CO_2e (Mid), or 311,520 kt CO_2e (High).

Lower emissions not only provide environmental benefits, they also reduce consumer costs in an emissions regulatory framework. Energy efficiency investments decrease demand. Lower demand reduces emissions associated with energy production and/or consumption, which in the case of cap and trade, would reduce demand for emissions allowances, reduce prices for allowances, and reduce cap and trade costs. In general, energy efficiency is seen as an important and effective cost containment mechanism to achieve GHG emission reduction targets.[32]

Table 9: Energy and Emissions Savings in Québec, New Brunswick, Nova Scotia, and Prince Edward Island

Regional Results	**Electric**	**Natural Gas**	**Liquid Fossil Fuels**
Energy Savings	**(GWh)**	**(Million m3)**	**(PJ)**
Maximum Annual Savings			
BAU+ Scenario	15,330	670	67
Mid Scenario	31,125	1,050	87
High Scenario	44,453	1,367	114
Maximum Savings vs. Business as Usual			
BAU+ Scenario	6%	11%	18%
Mid Scenario	13%	17%	23%
High Scenario	20%	22%	31%
Lifetime Savings (15 years of programs)			
BAU+ Scenario	227,270	10,715	1,066
Mid Scenario	448,310	18,900	1,563
High Scenario	719,660	28,700	2,397
Equivalent GHG Emissions Avoided	**kt CO_2e**	**kt CO_2e**	**kt CO_2e**
Maximum Annual Avoided Emissions			
BAU+ Scenario	5,060	1,270	4,910
Mid Scenario	9,170	1,990	6,400
High Scenario	12,240	2,580	8,410
Maximum Annual Avoided Emissions vs. 2010 Total Regional Emissions (122,960 kt CO_2e)[33]			
BAU+ Scenario	4.1%	1.0%	4.0%
Mid Scenario	7.5%	1.6%	5.2%
High Scenario	10.0%	2.1%	6.8%
Lifetime Avoided Emissions			
BAU+ Scenario	34,790	20,260	78,580
Mid Scenario	60,390	36,740	115,250
High Scenario	80,580	54,270	176,670

Energy Efficiency, Economic Growth, and the "Rebound Effect"

The "rebound effect" – the concept that energy savings from improved efficiency are offset by a smaller corresponding increase in energy use (and emissions) – is a real and intuitive phenomenon. However, there is much debate about the magnitude of the effect, and little empirical evidence to support claims that the majority of energy savings, or even a meaningful amount, would be offset by a corresponding increase in demand – either at the micro- or macro-level.[34]

Energy efficiency drives economic growth and it follows that the increased economic output – GDP, income, and jobs – will require energy and result in additional consumption. However, energy spending is only a small portion of GDP (6-8%), which means, on average, less than 10 cents of every dollar saved and re-invested would be spent on energy.[35] In general, the increased demand for energy will be a fraction of the energy saved.

A simplified example: A homeowner in New Brunswick benefits from an efficiency program and reduces heating fuel costs by $2,000, and uses the savings to hire a contractor to build a new deck. Energy costs make up approximately 2% of wood products delivered by sawmills.[36] If the energy used to transport the wood and builder(s) to the job-site, and power the equipment is considered, a conservative estimate of the energy costs embedded in the deck is 5%. Since $1 spend on heating oil is approximately $1 spent on energy,[37] of the $2,000 invested, $100 (or 1/20th) could arguably contribute to the rebound effect.

Further, the additional energy purchased is not necessarily fossil fuels. Using the above example, over 50% of the energy consumed by the forest product sector is renewable fuels and cogeneration is common.[38] The additional economic activity generated by efficiency may result in a relatively small bump in energy use elsewhere, but total energy use and GHG emissions will be significantly reduced.

While increased energy consumption may be the result of increased economic activity, this does not change the fundamental improvement in energy intensity – the amount of energy needed to provide services – which energy efficiency delivered.

5.0 Macroeconomic Modeling Framework

Each proposed energy efficiency future can be segmented into four major components which are relevant to generating an economic impact (positive or negative):

- *Participants' (net) Savings* – the difference between the value of annual energy saved (here termed *avoided cost*) by a participating household/Commercial or Industrial worksite and their cost to add energy-efficiency components to the home/office/factory
- *Investment Spending* – the annual dollars of new demand created through program-related spending and the participants' investment to add energy-efficiency components to the home/office/factory
- *Ratepayer (net) Costs* – the cost to offer the program (residential program costs are assumed to be paid by residential ratepayers; C&I program costs by C&I ratepayers)
- *Local sector off-sets due to Reduced demand for fuels* – depending on the case, this may include some reduction in local (cross province) *Utility* sector sales, some loss in refining production, and fuel retail sales (for unregulated heating fuels)

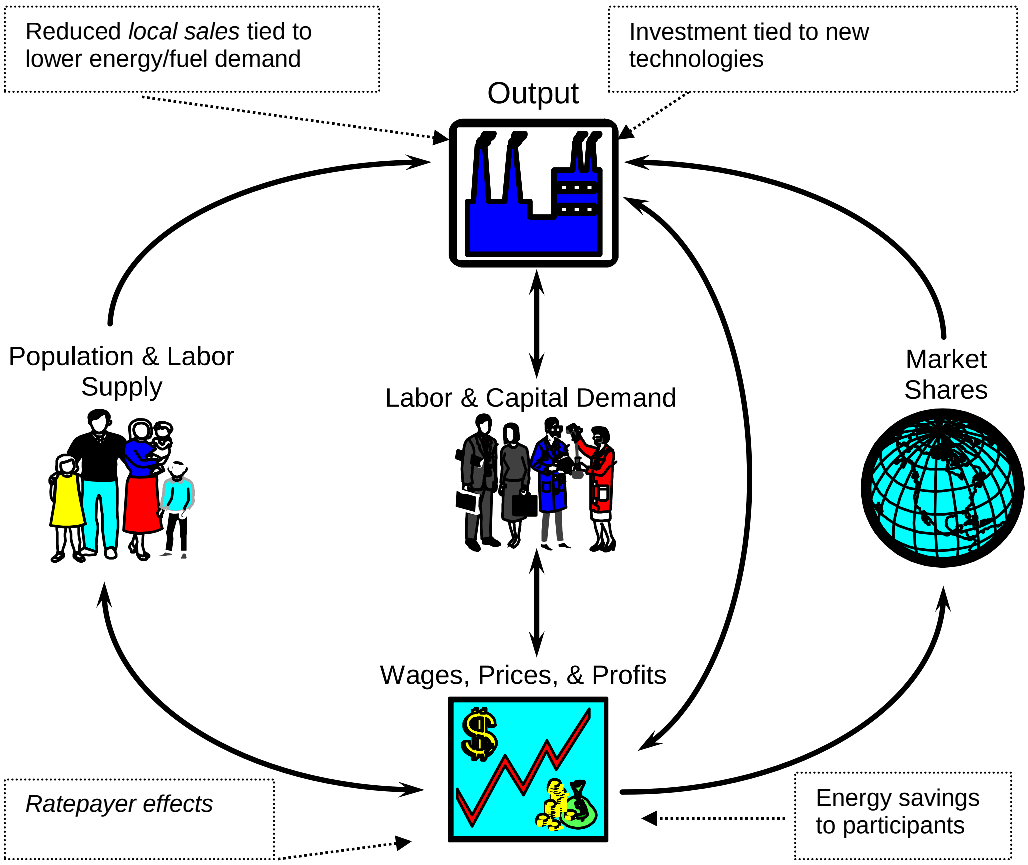
There is an inherent allocation to fuel customer segments (Residential/Commercial/Industrial) for both the net savings and the ratepayer costs, and an allocation to specific industries which fulfill the investment spending on manufactured components and installation services. Therefore it was necessary to use an economic analysis model capable of (a) recognizing these distributive effects of the proposed energy efficiency programs, and (b) forecasting economic change as a result of changes in household cost of living/business costs of doing business. A brief description of the Regional Economic Models, Inc. (REMI) modeling framework applied for the four eastern Canadian provinces follows.

5.1 REMI Economic Impact Policy Insight Forecasting Tool

A multi-region *Policy Insight* forecasting model was calibrated to represent the four provinces. The modeling system allows the analyst to enter province-specific annual changes through select policy levers that pertain to the four components, defined above, and then annually re-solves an economic forecast for the provinces in the model's configuration. The model used forecasts for 58 different industries (approximating 3-digit NAICS definitions of business activity) through the year 2040. The model reports impacts on numerous economic and demographic metrics.

The underlying data that was extracted and built into the REMI model is from Statistics Canada.[39] What is important to qualifying the choice of this model for this study is the model's structure (e.g. internal logic or equation set) and feedbacks among economic stakeholders (households and businesses) when an energy efficiency program is promulgated. Figure 7 portrays the basic concept of what the REMI model is capturing for a region's (province) economy. There are five major "blocks" to a region's economy (*e.g.* output, labor and capital supply, etc.), each block contains numerous equations, and the arrows depict the feedback between different components of an economy. In a multi-region model (of 4 provinces) you can envision four economies such as in Figure 7 and they exhibit feedback between them as well (inter-regional) for labor flows (commuters) and trade in manufactured goods and in services. Unique to the REMI model among the class of 'competing' regional economic impact frameworks available is the linkage to the 'market shares' block. Policies or investments that change the underlying cost-of-doing business for an industry in region **k** will affect that industry's relative competitiveness (relative to the national average for that industry) and its ability to retain/gain sales within its own region, elsewhere in the multi-region marketplace, elsewhere in the Canada and trade outside the country.

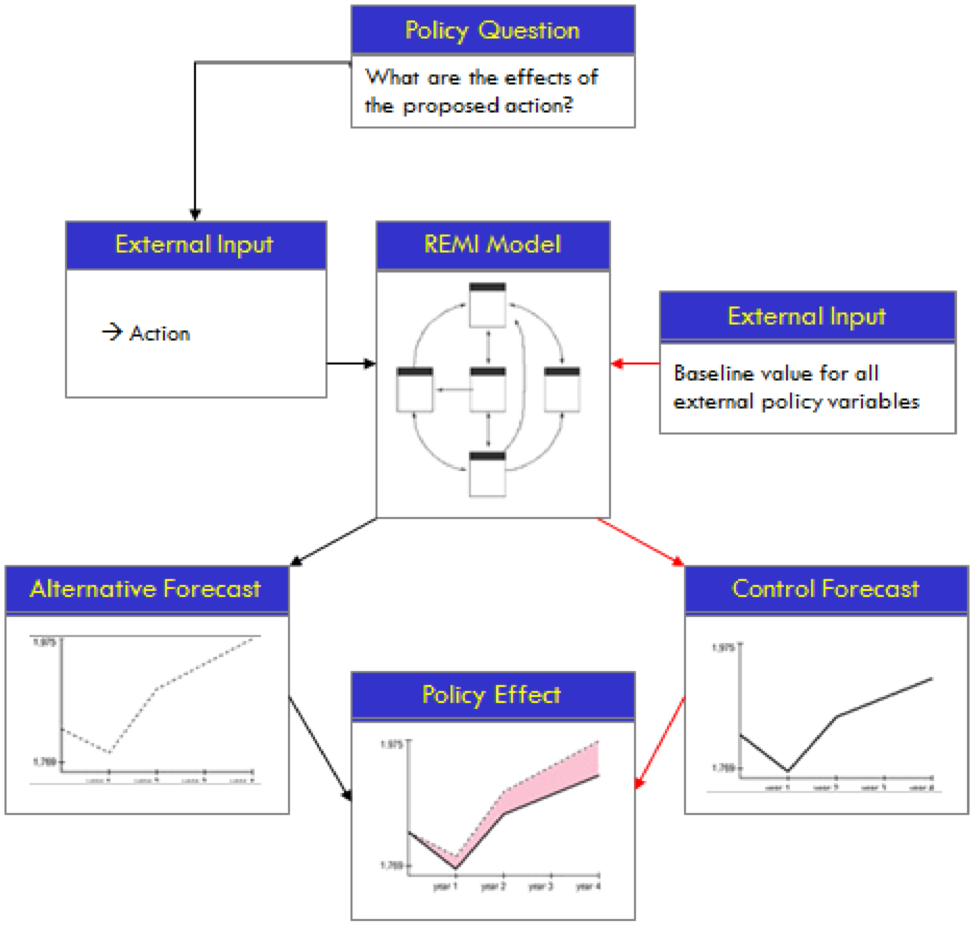
Figure 7: REMI Economic Forecasting Model – Basic Structure and Linkages



Source: EDR Group, Inc.

The REMI model identifies estimates of the economic (and demographic) impacts by comparing the base case[40] annual forecast using the above structure/feedbacks to the annual forecast when energy-related savings/costs or new $ of investment are proposed – the alternative forecast. Figure 8 portrays this relationship.

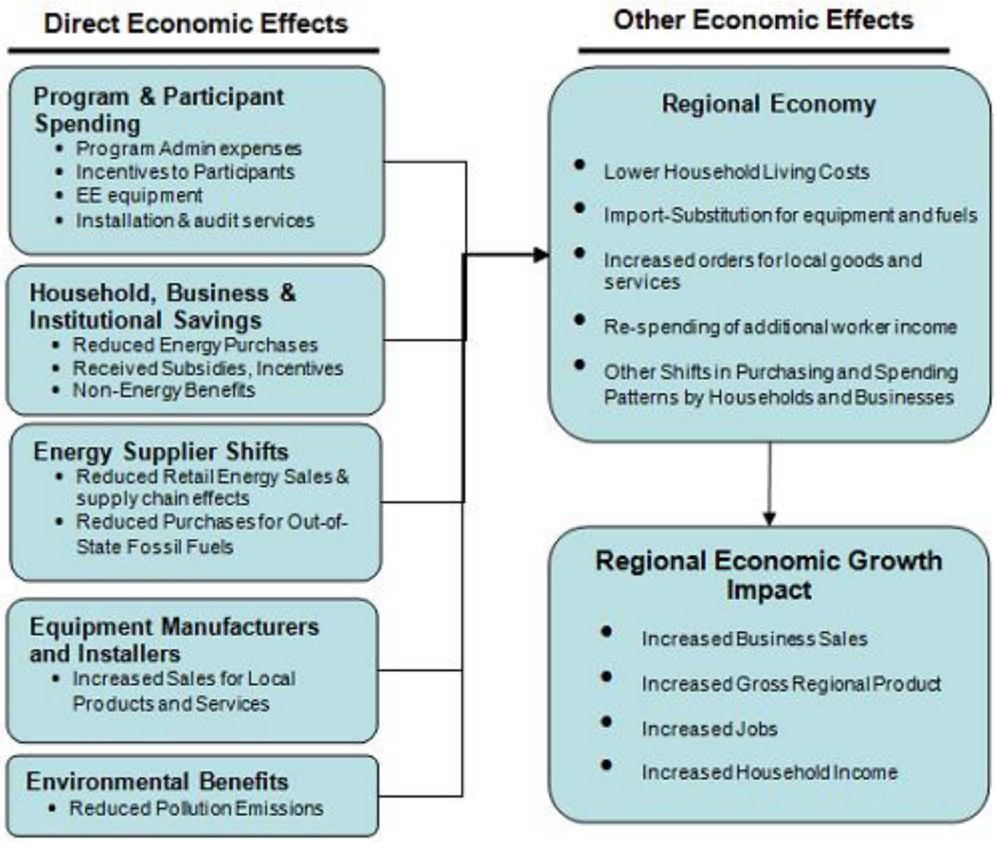
Figure 8: Identifying Economic Impacts in the REMI Framework



Source: EDR Group, Inc.

Translating the ways in which a proposed energy policy/program will affect energy customers (e.g. change in price, consumption or both), a region's economic self-sufficiency (replace imported purchases of energy generating inputs with more locally provided energy conserving devices/services), and the cost to achieve these goals are relevant direct effects that exert an influence on the local economy. Figure 9 below enumerates the set of direct effects that are possible with a broad range of energy policies/programs. Not all of the direct effects shown were applicable to the energy efficiency scenarios analyzed. Excluded from the REMI simulations were monetized environmental benefits, non-energy benefits (not identified), and renewable energy aspects. The forecast of unit avoided generating costs used to value the units of energy conserved, discussed in Section 3, implicitly capture the value of imported fuel inputs.

Figure 9: REMI Model Capabilities to Capture Energy Program Elements in the Regional Economy



Source: EDR Group, Inc.

5.2 REMI Model Assumptions

In addition to fuel-specific assumptions used to frame the expanded energy efficiency scenarios, the following assumptions were necessary to assign scenario-specific direct information into appropriate policy levers in the REMI model:

- Scenario data (investment cost, avoided energy cost, program related costs) pertaining to the "C&I" segment was first allocated to Commercial versus Industrial (23 percent and 77 percent respectively), and then to the underlying (NAICS) industries within each category using Stats Canada 2010 energy consumption data.
- Dunsky Energy Consulting, Inc. and ENE provided estimates of inter-provincial flows specific to each fuel as a basis for isolating the local extent of (within province) reduced industry activity when demand for a fuel is reduced as a result of energy-efficiency.
- New investment demands that arise from energy-efficiency adoption will require *local* contractor labor for the installation share of fuel-specific projects within a customer-segment. All other investment requirements represent dollars of "demand" and the REMI model's industry-specific *regional purchase coefficients* will determine how much of those dollars translate into local sales.
- ENE provided the composition of investment goods and services for program and for participant spending by fuel and by customer-segment (see Appendix 3).

6.0 Economic Impacts of Efficiency Investments – Provincial & Regional Results

This chapter presents the *total* economic benefits (or impacts) for numerous expanded energy-efficiency investment scenarios involving at least one of three fuels – electricity, natural gas, and/or liquid fossil fuels. Energy efficiency deployment is envisioned to occur within the residential customer segment and the Commercial/Industrial (C&I) segment, with varying emphasis depending on the fuel type/geography. Scenarios are examined for the three-levels (targets) of uptake as defined earlier in Section 3. The annual impacts – measured in terms of jobs, output ($CN of business sales), value-added ($CN of Gross Regional Product), and real disposable income represent the change to an economy relative to what would have occurred (that year) without this pathway of energy efficiency adoption.

The annual economic impacts are measured at the province-level for Quebec (QC), New Brunswick (NB), Nova Scotia (NS), and Prince Edward Island (PEI). The reporting of cumulative impacts will vary depending on the scenario – sixty in all – showing impacts on a key province and impacts on rest of the four province region, or as the case may be, impacts for each province. The scenario variants are as follows:

A) A single province adopts a program for one fuel type at a specific target level (36 scenarios);
B) A single province deploys all three fuel programs at a specific target level (12 scenarios);
C) A single fuel program is simultaneously deployed across all four provinces at a specific target level (9 scenarios); and,
D) All three fuel programs are simultaneously deployed across all four provinces at a specific target level (3 scenarios).

Total economic impacts result from direct economic effects of increased efficiency investments. A discussion of how the elements of an energy efficiency deployment scenario become direct economic effects is presented in Appendix 5, along with a summary of the scenario direct effects. A comprehensive region-specific set of multiplier effects in the REMI economic simulation model create additional economic responses once the direct effects have been introduced. In the simplest form of economic impact measurement, this occurs via two economic mechanisms after the direct effects take place: changes in Consumer demand (often labeled '*induced*' effects) and changes in Intermediate demand (often labeled 'indirect' effects). The total impact equals the direct plus non-direct impacts.

The most important feature here is who is changing demand/spending – if it is households (induced) then it is consumer commodity driven. If it is a business (indirect), then it is predicated on the business's production function (which describes what supplies and services the business requires to produce its Output). The REMI model reports a total impact concept, and although it does not report separate induced and indirect contributions, both are accounted for. The total economic impacts (jobs, sales, gross provincial/domestic product or real household income) are expressed as a difference relative to what that value (in year t) would be without the program.

The following four sub-sections (6.1 to 6.4) present the province-by-province results for cases A and B (above). Sub-section 6.5 provides a summary of the aggregate regional impacts from cases C, as well as the cumulate impacts from cases D. Additional provincial and regional results are provided in Appendix 6. Due to the length of analysis intervals (2012-2040), the results are shown summed in constant year 2011$. To note, while energy savings and economic benefits accrue after 2040, availability of data limited the REMI model update for the provinces to 2040. The exclusion of these benefits will not significantly impact the analysis; however the results are accordingly conservative estimates of potential economic impacts.

6.1 Québec (QC)

The Québec-specific analysis includes cases where the province implements a single fuels program in isolation, and cases where all fuel types are implemented simultaneously, at three investment levels.

Tables 10-13 show that over the study interval, all of the cases – regardless of fuel type or target level – deliver net positive impacts to the economy of Québec (i.e. an increase over BAU). The results represent net benefits because outputs from the REMI model include the impact of paying for the programs, participant costs, and decreases in activity that would have gone to the utility and refining sectors, and/or energy distributors.

The significant increase in GDP and employment from expanded investment in energy efficiency derives from changes in the economy that occur as a result of increased spending on efficiency measures and decreased spending on energy. The majority of these impacts (70-90%) result from the energy savings realized by households and business. Lower energy costs cause other forms of consumer spending to increase. Lower energy bills reduce the costs of doing business in the region, bolstering the global competitiveness of local employers and promoting additional growth.

Table 10: Total Economic Impacts in Québec from Investment in Electric Energy Efficiency Programs, at Three Investment Levels (2012-2040)

Electric	BAU+	Mid	High
Total Efficiency Program Costs ($2011 Millions)	**3,769**	**9,376**	**18,892**
Increase in GDP ($2011 Millions)	**18,735**	**37,480**	**60,211**
Maximum Annual GDP Increase ($Millions)	1,470	2,984	4,679
Increase in Employment (Job years)	**151,197**	**306,027**	**496,404**
Maximum Annual Employment Increase (Jobs)	12,385	24,130	31,777
Jobs per $Million of Program Spending	40	33	26
Jobs per $Million of Program & Participant Spending	21	20	19
Rest of the Four-Province Economy			
Increase in GDP ($Millions)	*313*	*605*	*936*
Increase in Employment (Job Years)	*1,496*	*2,950*	*4,704*

Table 11: Total Economic Impacts in Québec from Investment in Natural Gas Energy Efficiency Programs, at Three Investment Levels (2012-2040)

Natural Gas	BAU+	Mid	High
Total Efficiency Program Costs ($2011 Millions)	**268**	**859**	**1,640**
Increase in GDP ($2011 Millions)	**2,473**	**3,957**	**5,318**
Maximum Annual GDP Increase ($Millions)	154	261	373
Increase in Employment (Job years)	**18,855**	**31,125**	**42,583**
Maximum Annual Employment Increase (Jobs)	1,180	1,735	2,369
Jobs per $Million of Program Spending	70	36	26
Jobs per $Million of Program & Participant Spending	28	24	20
Rest of the Four-Province Economy			
Increase in GDP ($Millions)	*55*	*86*	*111*
Increase in Employment (Job Years)	*265*	*438*	*593*

Table 12: Total Economic Impacts in Québec from Investment in Liquid Fossil Fuel (Heating Oil, Propane, Kerosene) Energy Efficiency Programs, at Three Investment Levels (2012-2040)

Liquid Fossil Fuels	BAU+	Mid	High
Total Efficiency Program Costs ($Millions)	**494**	**1,303**	**2,525**
Increase in GDP ($Millions)	**15,795**	**21,274**	**28,535**
Maximum Annual GDP Increase ($Millions)	963	1,233	1,592
Increase in Employment (Job years)	**103,550**	**141,505**	**191,817**
Maximum Annual Employment Increase (Jobs)	6,610	8,425	9,992
Jobs per $Million of Program Spending	210	109	76
Jobs per $Million of Program & Participant Spending	106	71	57
Rest of the Four-Province Economy			
Increase in GDP ($Millions)	*348*	*467*	*634*
Increase in Employment (Job Years)	*1,630*	*2,242*	*3,141*

As Québec implements its energy efficiency program in isolation of the other provinces, the positive economic outcome will nonetheless spill over to the rest of the four province region (as shown in the last two rows of the tables). This is due to: (a) the implementing province with increased economic activity (first from new efficiency investment spending, then from the persistent savings effects particularly on businesses which increase their relative competitiveness in the regional, national, and global marketplace; and (b) cross-province economic interdependencies for labor and other goods and services. The stimulus Québec incurs under the prolonged effects of the simultaneous all fuels scenario (Table 13) creates positive spill-over in the aggregated three province economy worth an additional $1,676 million in GDP and 8,392 associated job-years under the High scenario.

Table 13: Summary of Québec Economic Impacts from Electric, Natural Gas, and Liquid Fossil Fuels Efficiency Programs (2012-2040) – *Cases where province implements all fuel program simultaneously*

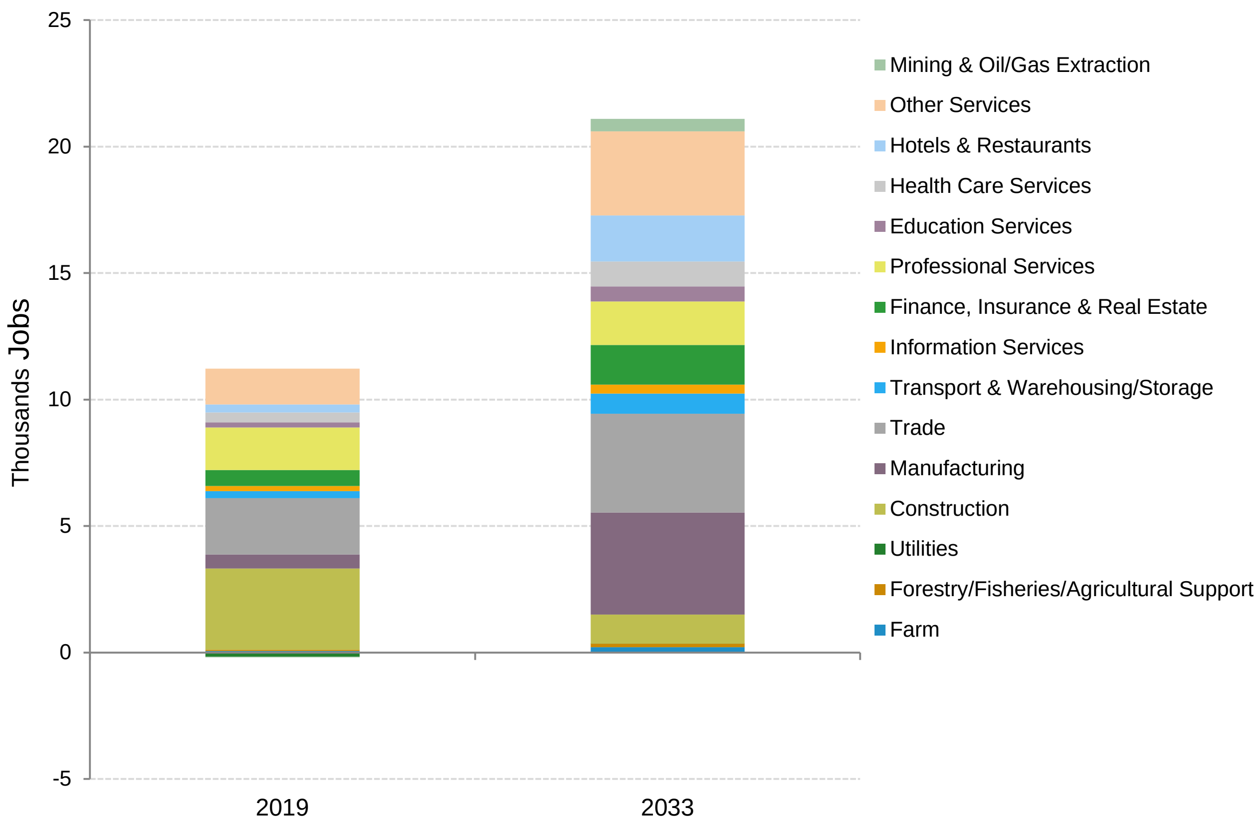
All Fuels – Québec	BAU+	Mid	High
Total Efficiency Program Costs ($2011 Millions)	**4,531**	**11,337**	**23,058**
Increase in GDP ($2011 Millions)	**37,070**	**62,892**	**94,447**
Maximum Annual GDP Increase ($Millions)	2,577	4,480	6,668
Increase in Employment (Job years)	**273,918**	**479,508**	**732,631**
Maximum Annual Employment Increase (Jobs)	20,222	34,402	46,188
Job-Years per $Million of Program Spending	60	42	32
Job-Years per $Million of Program & Participant Spending	32	26	23
Rest of the Four-Provinces Economy			
Increase in GDP ($Millions)	*715*	*1,156*	*1,676*
Increase in Employment (Job Years)	*3,385*	*5,613*	*8,392*

GDP impacts are perhaps the most meaningful economic benefit since GDP leverages "local" labor and local investment (capital). As shown in Table 13, the Québec all fuels scenarios would increase GDP by approximately $37 billion (BAU+ scenario), $63 billion (Mid scenario), or $94 billion (High scenario), as consumers spend energy bill savings in the wider economy. The total increase in employment is equivalent to 273,918 job years (one full-time job for a period of one year), 479,508 job years, or 732,631 job years, respectively. Existing programs are already delivering energy and cost savings and generating some of this economic growth in Québec.

The results in Table 13 are slightly more positive than the sum of results for those 'single fuel' considerations due to the heightened competitiveness created by greater energy savings from fuel programs running in tandem. For example, in Québec, the increase in GDP by coordinated delivery of efficiency programs for all fuel types versus the aggregate of the individual fuel types would add an additional $380 million and 1,827 job-years to the provincial economy over the study period under the High scenarios.

With respect to the employment impacts, for the all fuels implementation case (Mid Scenario), a mid-interval annual snapshot of the job impact allocation is presented for Québec. Two intervals are provided: the mid-point for the investment ramp-up interval (2019), and the mid-point for the post-ramp up interval through 2040 (2033). While the former mid-point also captures the accumulating effects of growing energy-savings, it is meant to distinguish job requirements tied to investment activity compared to (the profile for 2033) job changes under the influence of persistent energy-savings.

Figure 10: Quebec Annual Employment Changes in Select Years under the All Fuels Mid Scenario (2019 & 2033)



6.2 New Brunswick (NB)

The New Brunswick-specific analysis includes cases where the province implements a single fuels program in isolation, as well as cases where all fuel types are implemented simultaneously, at three investment levels.

Tables 14-17 show that over the study interval, all of the cases – regardless of fuel type or target level – deliver net positive impacts to the economy of New Brunswick (i.e. an increase over BAU). The results represent net benefits because outputs from the REMI model include the impact of paying for the programs, participant costs, and decreases in activity that would have gone to the utility and refining sectors, and/or energy distributors.

The significant increase in GDP and employment from expanded investment in energy efficiency derives from changes in the economy that occur as a result of increased spending on efficiency measures and decreased spending on energy. The majority of these impacts (70-90%) result from the energy savings realized by households and business. Lower energy costs cause other forms of consumer spending to increase. Lower energy bills reduce the costs of doing business in the region, bolstering the global competitiveness of local employers and promoting additional growth.

In New Brunswick (and PEI), relatively low electric avoided costs contribute to a lower electric avoided cost benefit per total investment. This, along with smaller electric programs per $GDP and an economy that relies more heavily on imports (i.e. local manufacturing and other businesses supply fewer of the goods and services consumed in the region) explains the impact differentials between NB and PEI and the other provinces.

Table 14: Total Economic Impacts in New Brunswick from Investment in Electric Energy Efficiency Programs, at Three Investment Levels (2012-2040)

Electric	BAU+	Mid	High
Total Efficiency Program Costs ($Millions)	**299**	**742**	**1.492**
Increase in GDP ($Millions)	**370**	**698**	**1,091**
Maximum Annual GDP Increase ($Millions)	26	55	100
Increase in Employment (Job years)	**4,213**	**8,253**	**13,126**
Maximum Annual Employment Increase (Jobs)	240	397	713
Jobs per $Million of Program Spending	14	11	9
Jobs per $Million of Program & Participant Spending	8	7	6
Rest of the Four-Provinces Economy			
Increase in GDP ($Millions)	*29*	*49*	*82*
Increase in Employment (Job Years)	*287*	*527*	*856*

Table 15: Total Economic Impacts in New Brunswick from Investment in Natural Gas Energy Efficiency Programs, at Three Investment Levels (2012-2040)

Natural Gas	**BAU+**	**Mid**	**High**
Total Efficiency Program Costs ($Millions)	**15**	**49**	**94**
Increase in GDP ($Millions)	**69**	**111**	**143**
Maximum Annual GDP Increase ($Millions)	4.4	7.4	10.4
Increase in Employment (Job years)	**608**	**1,007**	**1,361**
Maximum Annual Employment Increase (Jobs)	36	54	74
Jobs per $Million of Program Spending	40	21	14
Jobs per $Million of Program & Participant Spending	17	14	11
Rest of the Four-Provinces Economy			
Increase in GDP ($Millions)	*17*	*26*	*34*
Increase in Employment (Job Years)	*115*	*179*	*236*

Table 16: Total Economic Impacts in New Brunswick from Investment in Liquid Fossil Fuel (Heating Oil, Propane, Kerosene) Energy Efficiency Programs, at Three Investment Levels (2012-2040)

Liquid Fossil Fuels	**BAU+**	**Mid**	**High**
Total Efficiency Program Costs ($Millions)	**103**	**270**	**521**
Increase in GDP ($Millions)	**1,062**	**1,378**	**1,807**
Maximum Annual GDP Increase ($Millions)	64	81	108
Increase in Employment (Job years)	**5,888**	**7,757**	**10,300**
Maximum Annual Employment Increase (Jobs)	351	438	568
Jobs per $Million of Program Spending	57	29	20
Jobs per $Million of Program & Participant Spending	19	18	11
Rest of the Four-Provinces Economy			
Increase in GDP ($Millions)	*225*	*299*	*406*
Increase in Employment (Job Years)	*1,503*	*2,019*	*2,760*

As New Brunswick implements its energy efficiency program in isolation of the other provinces, the positive economic outcome will nonetheless spill over to the rest of the four province region (as shown in the last two rows of the tables). This is due to (a) the implementing province with increased economic activity (first from new efficiency investment spending, then from the persistent savings effects particularly on businesses which increase their relative competitiveness in the regional, national, and global marketplace; and (b) cross-province economic interdependencies for labor and other goods and services. The stimulus New Brunswick incurs under the prolonged effects of the simultaneous all fuels scenario (Table 17) creates positive spill-over in the aggregated three province economy worth an additional $527 million in GDP and 3,879 associated job-years under the High scenario.

Table 17: Summary of New Brunswick Economic Impacts from Electric, Natural Gas, and Liquid Fossil Fuels Efficiency Programs (2012-2040) – *Cases where province implements all fuel program simultaneously*

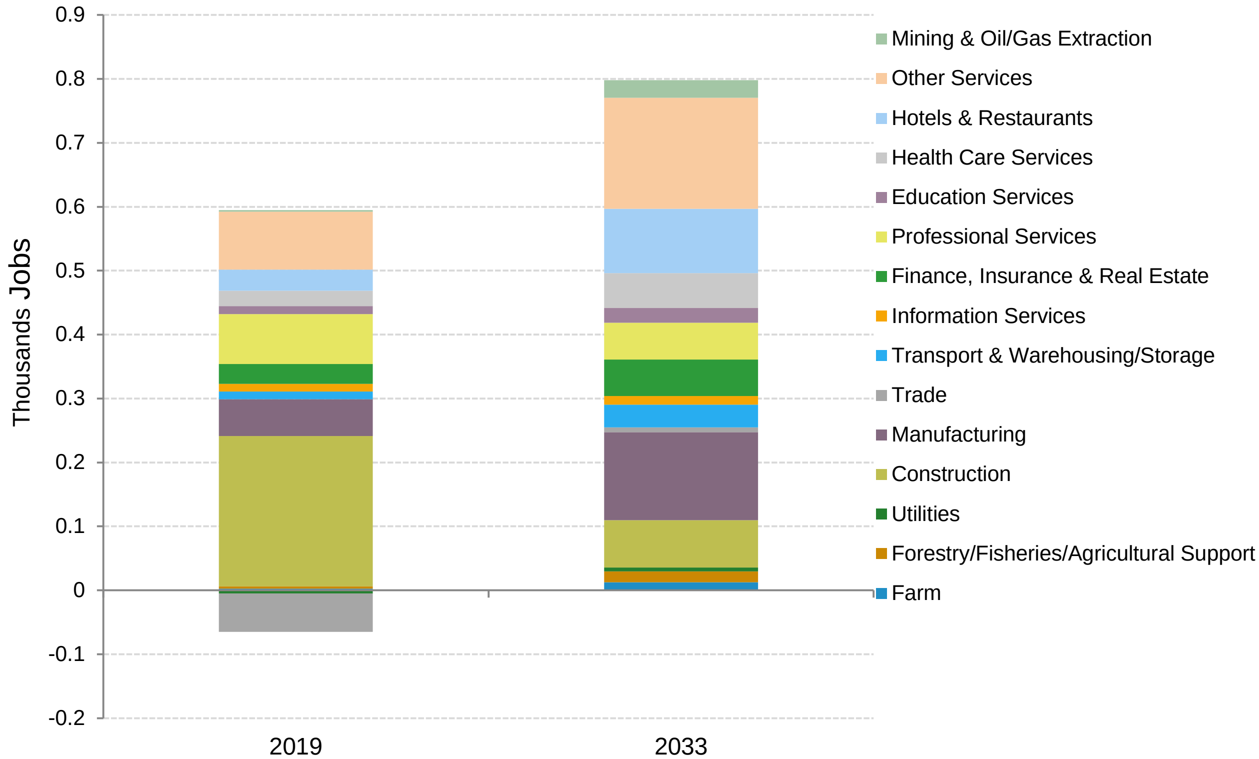
	BAU+	Mid	High
Total Efficiency Program Costs ($Millions)	**417**	**1,061**	**2,108**
Increase in GDP ($Millions)	**1,502**	**2,189**	**3,046**
Maximum Annual GDP Increase ($Millions)	90	143	218
Increase in Employment (Job years)	**10,714**	**17,032**	**24,819**
Maximum Annual Employment Increase (Jobs)	626	936	1,359
Job-Years per $Million of Program Spending	26	16	12
Job-Years per $Million of Program & Participant Spending	12	10	9
Rest of the Four-Provinces Economy			
Increase in GDP ($Millions)	*269*	*378*	*527*
Increase in Employment (Job Years)	*1,896*	*2,741*	*3,879*

GDP impacts are perhaps the most meaningful economic benefit since GDP leverages "local" labor and local investment (capital). As shown in Table 17, the New Brunswick all fuels scenarios would increase GDP by approximately $1.5 billion (BAU+ scenario), $2.2 billion (Mid scenario), or $3.0 billion (High scenario), as consumers spend energy bill savings in the wider economy. The total increase in employment is equivalent to 10,714 job years (one full-time job for a period of one year), 17,032 job years, or 24,819 job years, respectively. Existing programs are already delivering energy and cost savings and generating some of this economic growth in New Brunswick.

The results in Table 17 are slightly more positive than the sum of results for those 'single fuel' considerations due to the heightened competitiveness created by greater energy savings from fuel programs running in tandem. For example, in New Brunswick, the increase in GDP by coordinated delivery of efficiency programs for all fuel types versus the aggregate of the individual fuel types would add an additional $5 million and 32 job-years to the provincial economy over the study period under the High scenarios.

With respect to the employment impacts, for the all fuels implementation case (Mid Scenario), a mid-interval annual snapshot of the job impact allocation is presented for New Brunswick. Two intervals are provided: the mid-point for the investment ramp-up interval (2019), and the mid-point for the post-ramp up interval through 2040 (2033). While the former mid-point also captures the accumulating effects of growing energy-savings, it is meant to distinguish job requirements tied to investment activity compared to (the profile for 2033) job changes under the influence of persistent energy-savings.

Figure 11: New Brunswick Annual Employment Changes in Select Years under the All Fuels Mid Scenario (2019 & 2033)



6.3 Nova Scotia (NS)

The NS-specific analysis includes cases where the province implements a single fuels program in isolation, and cases where all fuel types are implemented simultaneously, at three investment levels.

Tables 18-21 show that over the study interval, all of the cases – regardless of fuel type or target level – deliver net positive impacts to the economy of Nova Scotia (i.e. an increase over BAU). The results represent net benefits because outputs from the REMI model include the impact of paying for the programs, participant costs, and decreases in activity that would have gone to the utility and refining sectors, and/or energy distributors.

The significant increase in GDP and employment from expanded investment in energy efficiency derives from changes in the economy that occur as a result of increased spending on efficiency measures and decreased spending on energy. The majority of these impacts (70-90%) result from the energy savings realized by households and business. Lower energy costs cause other forms of consumer spending to increase. Lower energy bills reduce the costs of doing business in the region, bolstering the global competitiveness of local employers and promoting additional growth.

Table 18: Total Economic Impacts in Nova Scotia from Investment in Electric Energy Efficiency Programs, at Three Investment Levels (2012-2040)

Electric	BAU+	Mid	High
Total Efficiency Program Costs ($Millions)	**592**	**1,287**	**2,345**
Increase in GDP ($Millions)	**3,012**	**5,913**	**7,878**
Maximum Annual GDP Increase ($Millions)	185	359	491
Increase in Employment (Job years)	**23,745**	**44,525**	**62,484**
Maximum Annual Employment Increase (Jobs)	1,500	2,823	3,521
Jobs per $Million of Program Spending	40	35	27
Jobs per $Million of Program & Participant Spending	22	22	19
Rest of the Four-Provinces Economy			
Increase in GDP ($Millions)	*320*	*594*	*890*
Increase in Employment (Job Years)	*2,173*	*4,039*	*6,067*

Table 19: Total Economic Impacts in Nova Scotia from Investment in Natural Gas Energy Efficiency Programs, at Three Investment Levels (2012-2040)

Natural Gas	BAU+	Mid	High
Total Efficiency Program Costs ($Millions)	**7.5**	**24**	**44**
Increase in GDP ($Millions)	**41**	**66**	**86**
Maximum Annual GDP Increase ($Millions)	2.6	4.4	6.1
Increase in Employment (Job years)	**344**	**565**	**749**
Maximum Annual Employment Increase (Jobs)	21	31	41
Jobs per $Million of Program Spending	46	24	17
Jobs per $Million of Program & Participant Spending	20	16	13
Rest of the Four-Provinces Economy			
Increase in GDP ($Millions)	*6.4*	*9.8*	*13.8*
Increase in Employment (Job Years)	*41*	*72*	*96*

Table 20: Total Economic Impacts in Nova Scotia from Investment in Liquid Fossil Fuel (Heating Oil, Propane, Kerosene) Energy Efficiency Programs, at Three Investment Levels (2012-2040)

Liquid Fossil Fuels	BAU+	Mid	High
Total Efficiency Program Costs ($Millions)	**139**	**365**	**700**
Increase in GDP ($Millions)	**1,866**	**2,431**	**3,201**
Maximum Annual GDP Increase ($Millions)	112	145	191
Increase in Employment (Job years)	**10,424**	**13,693**	**18,121**
Maximum Annual Employment Increase (Jobs)	630	774	1,002
Jobs per $Million of Program Spending	75	38	26
Jobs per $Million of Program & Participant Spending	25	25	20
Rest of the Four-Provinces Economy			
Increase in GDP ($Millions)	*205*	*280*	*398*
Increase in Employment (Job Years)	*1,408*	*1,934*	*2,758*

As Nova Scotia implements its energy efficiency program in isolation of the other provinces, the positive economic outcome will nonetheless spill over to the rest of the four province region (as shown in the last two rows of the tables). This is due to (a) the implementing province with increased economic activity (first from new efficiency investment spending, then from the persistent savings effects particularly on businesses which increase their relative competitiveness in the regional, national, and global marketplace; and (b) cross-province economic interdependencies for labor and other goods and services. The stimulus Nova Scotia incurs under the prolonged effects of the simultaneous all fuels scenario (Table 21) creates positive spill-over in the aggregated three province economy worth an additional $1,296 million in GDP and 8,898 associated job-years under the High scenario.

Table 21: Summary of Nova Scotia Economic Impacts from Electric, Natural Gas, and Liquid Fossil Fuels Efficiency Programs (2012-2040) – *Cases where province implements all fuel program simultaneously*

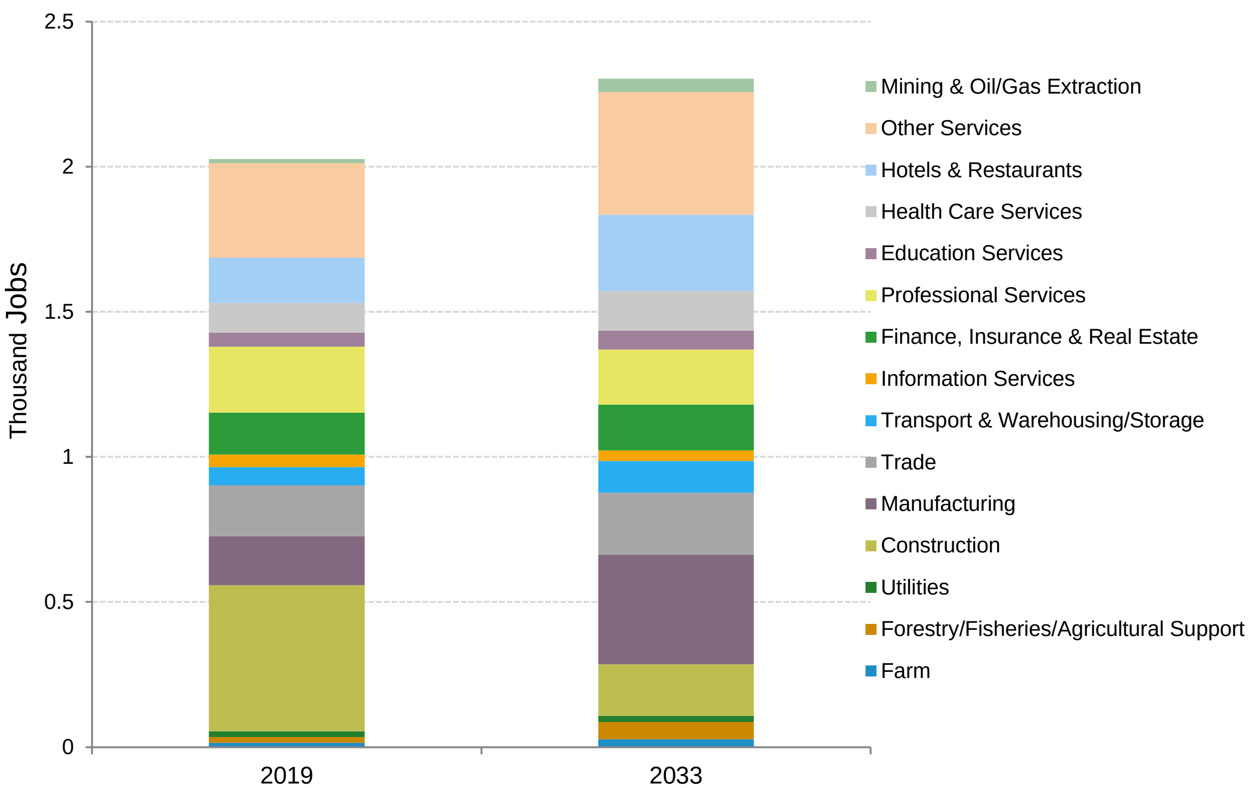
All Fuels – Nova Scotia	BAU+	Mid	High
Total Efficiency Program Costs ($Millions)	**739**	**1,675**	**3,089**
Increase in GDP ($Millions)	**4,929**	**8.434**	**11,213**
Maximum Annual GDP Increase ($Millions)	297	509	693
Increase in Employment (Job years)	**34,568**	**58,907**	**81,621**
Maximum Annual Employment Increase (Jobs)	2,524	3,624	4,485
Job-Years per $Million of Program Spending	47	35	26
Job-Years per $Million of Program & Participant Spending	23	22	19
Rest of the Four Provinces Economy			
Increase in GDP ($Millions)	*529*	*885*	*1,296*
Increase in Employment (Job Years)	*3,623*	*6,061*	*8,898*

GDP impacts are perhaps the most meaningful economic benefit since GDP leverages "local" labor and local investment (capital). As shown in Table 21, the Nova Scotia all fuels scenarios would increase GDP by approximately $4.9 billion (BAU+ scenario), $8.4 billion (Mid scenario), or $11.2 billion (High scenario), as consumers spend energy bill savings in the wider economy. The total increase in employment is equivalent to 34,568 job years (one full-time job for a period of one year), 58,907 job years, or 81,621 job years, respectively. Existing programs are already delivering energy and cost savings and generating some of this economic growth in Nova Scotia.

The results in Table 21 are slightly more positive than the sum of results for those 'single fuel' considerations due to the heightened competitiveness created by greater energy savings from fuel programs running in tandem. For example, in Nova Scotia, the increase in GDP by coordinated delivery of efficiency programs for all fuel types versus the aggregate of the individual fuel types would add an additional $48 million and 267 job-years to the provincial economy over the study period under the High scenarios.

With respect to the employment impacts, for the all fuels implementation case (Mid Scenario), a mid-interval annual snapshot of the job impact allocation is presented for Nova Scotia. Two intervals are provided: the mid-point for the investment ramp-up interval (2019), and the mid-point for the post-ramp up interval through 2040 (2033). While the former mid-point also captures the accumulating effects of growing energy-savings, it is meant to distinguish job requirements tied to investment activity compared to (the profile for 2033) job changes under the influence of persistent energy-savings.

Figure 12: Nova Scotia Annual Employment Changes in Select Years under the All Fuels Mid Scenario (2019 & 2033)



6.4 Prince Edward Island (PEI)

The Prince Edward Island-specific analysis includes cases where the province implements a single fuels program in isolation, and cases where all fuel types are implemented simultaneously, at three investment levels.

Tables 22-24 show that over the study interval, all of the cases – regardless of fuel type or target level – deliver net positive impacts to the economy of PEI (i.e. an increase over BAU). The results represent net benefits because outputs from the REMI model include the impact of paying for the programs, participant costs, and decreases in activity that would have gone to the utility and refining sectors, and/or energy distributors.

The significant increase in GDP and employment from expanded investment in energy efficiency derives from changes in the economy that occur as a result of increased spending on efficiency measures and decreased spending on energy. The majority of these impacts (70-90%) result from the energy savings realized by households and business. Lower energy costs cause other forms of consumer spending to increase. Lower energy bills reduce the costs of doing business in the region, bolstering the global competitiveness of local employers and promoting additional growth.

In PEI (and NB), relatively low electric avoided costs contribute to a lower electric avoided cost benefit per total investment. This, along with smaller electric programs per $GDP explains the impact differentials between PEI and NB and the other provinces. Another contributing factor is that PEI's economy is not as complete as the other provinces – local manufacturing and other businesses supply fewer of the goods and services (not just those related to energy efficiency implementation) consumed in the region. This leads it to be more dependent on imports for goods and services than the other three provinces, in particular Québec and Nova Scotia. The economic benefits of energy savings in PEI are accruing to the other provinces in the studies as well as areas outside of the study region at a much higher rate than for the other provinces in the study.

Table 22: Total Economic Impacts in Prince Edward Island from Investment Electric Energy Efficiency Programs, at Three Investment Levels (2012-2040)

Electric	**BAU+**	**Mid**	**High**
Total Efficiency Program Costs ($Millions)	**61**	**133**	**244**
Increase in GDP ($Millions)	**57**	**95**	**138**
Maximum Annual GDP Increase ($Millions)	4.6	8.3	13.7
Increase in Employment (Job years)	**629**	**1,089**	**1,635**
Maximum Annual Employment Increase (Jobs)	43	71	93
Jobs per $Million of Program Spending	10	8	7
Jobs per $Million of Program & Participant Spending	6	5	5
Rest of the Four-Provinces Economy			
Increase in GDP ($Millions)	*18.8*	*28.8*	*42.5*
Increase in Employment (Job Years)	*171*	*281*	*419*

Table 23: Total Economic Impacts in Prince Edward Island from Investment in Liquid Fossil Fuel (Heating Oil, Propane, Kerosene) Energy Efficiency Programs, at Three Investment Levels (2012-2040)

Liquid Fossil Fuels	**BAU+**	**Mid**	**High**
Total Efficiency Program Costs ($Millions)	**20.5**	**53.7**	**103.1**
Increase in GDP ($Millions)	**78.4**	**259.3**	**336.4**
Maximum Annual GDP Increase ($Millions)	5.3	15.6	20.4
Increase in Employment (Job years)	**609**	**1,494**	**1,945**
Maximum Annual Employment Increase (Jobs)	43	85	109
Jobs per $Million of Program Spending	30	28	19
Jobs per $Million of Program & Participant Spending	10	18	14
Rest of the Four-Provinces Economy			
Increase in GDP ($Millions)	*74*	*162*	*221*
Increase in Employment (Job Years)	*661*	*1,045*	*1,433*

As PEI implements its energy efficiency program in isolation of the other provinces, the positive economic outcome will nonetheless spill over to the rest of the four province region (as shown in the last two rows of the tables). This is due to (a) the implementing province with increased economic activity (first from new efficiency investment spending, then from the persistent savings effects particularly on businesses which increase their relative competitiveness in the regional, national, and global marketplace; and (b) cross-province economic interdependencies for labor and other goods and services. The stimulus PEI incurs under the prolonged effects of the simultaneous all fuels scenario (Table 24) creates positive spill-over in the aggregated three province economy worth an additional $262 million in GDP and 1,845 associated job-years under the High scenario.

Table 24: Summary of Prince Edward Island Economic Impacts from Electric and Liquid Fossil Fuels Efficiency Programs (2012-2040) – *Cases where province implements all fuel program simultaneously*

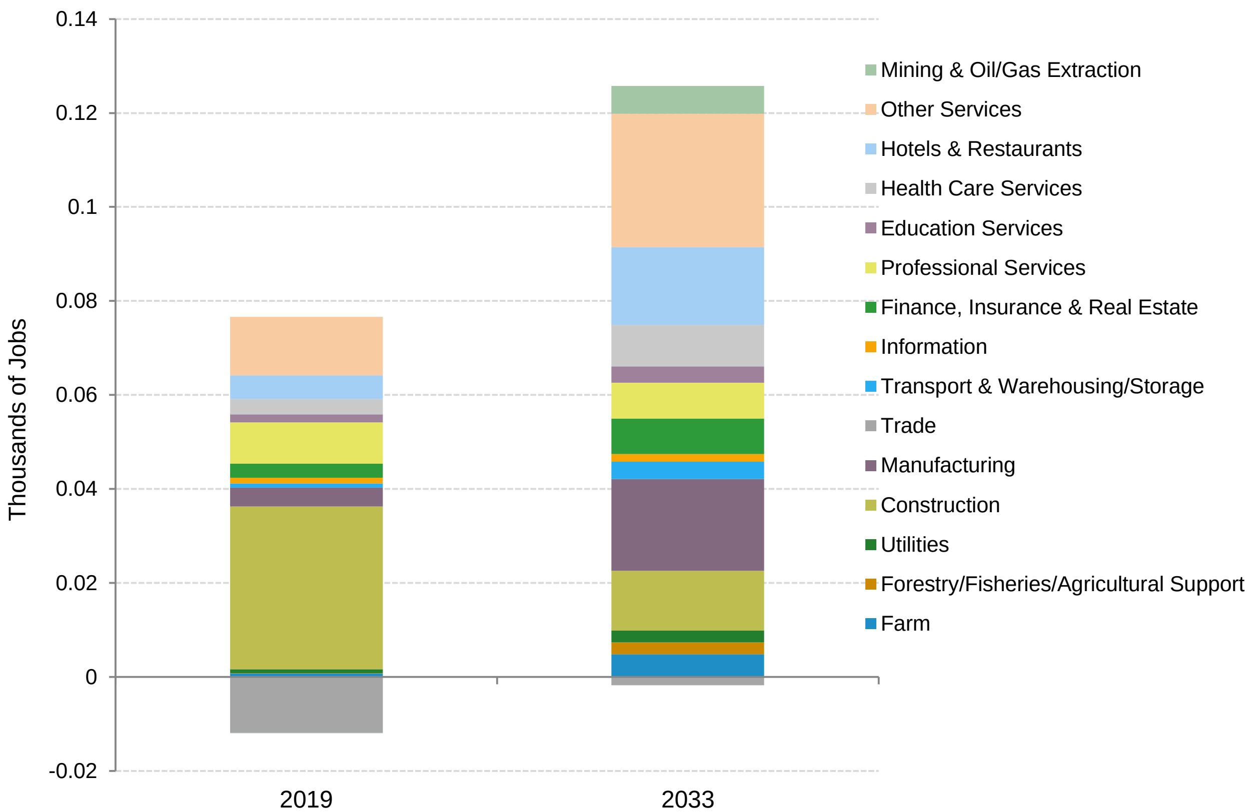
	BAU+	**Mid**	**High**
Total Efficiency Program Costs ($Millions)	**81.3**	**186.7**	**347.1**
Increase in GDP ($Millions)	**135.9**	**354.4**	**475.9**
Maximum Annual GDP Increase ($Millions)	9.8	23.9	34.4
Increase in Employment (Job years)	**1,239**	**2,577**	**3,585**
Maximum Annual Employment Increase (Jobs)	79	153	204
Job-Years per $Million of Program Spending	15	14	10
Jobs per $Million of Program & Participant Spending	7	9	7
Rest of the Four-Provinces Economy			
Increase in GDP ($Millions)	*92*	*191*	*262*
Increase in Employment (Job Years)	*820*	*1,320*	*1,845*

GDP impacts are perhaps the most meaningful economic benefit since GDP leverages "local" labor and local investment (capital). As shown in Table 24, the PEI simultaneous fuels scenario would increase GDP by approximately $136 million (BAU+ scenario), $354 million (Mid scenario), or $476 million (High scenario), as consumers spend energy bill savings in the wider economy. The total increase in employment is equivalent to 1,239 job years (one full-time job for a period of one year), 2,577 job years, or 3,585 job years, respectively. Existing programs are already delivering energy and cost savings and generating some of this economic growth in PEI.

The results in Table 24 are slightly more positive than the sum of results for those 'single fuel' considerations due to the heightened competitiveness created by greater energy savings from fuel programs running in tandem. For example, in PEI, the increase in GDP by coordinated delivery of efficiency programs for all fuel types versus the aggregate of the individual fuel types would add an additional $2 million and 5 job-years to the provincial economy over the study period under the High scenarios.

With respect to the employment impacts, for the all fuels implementation case (Mid Scenario), a mid-interval annual snapshot of the job impact allocation is presented for PEI. Two intervals are provided: the mid-point for the investment ramp-up interval (2019), and the mid-point for the post-ramp up interval through 2040 (2033). While the former mid-point also captures the accumulating effects of growing energy-savings, it is meant to distinguish job requirements tied to investment activity compared to (the profile for 2033) job changes under the influence of persistent energy-savings.

Figure 13: PEI Annual Employment Changes in Select Years under the All Fuels Mid Scenario (2019 & 2033)



6.5 Regional

In addition to the province-by-province results, the analysis included cases where the provinces acted together to: (a) simultaneously implement efficiency programs for a single fuel type – electric, natural gas, or liquid fossil fuels; and (b) simultaneously implement programs for all fuel types (i.e. all provinces and fuel types). Three investment scenarios were assessed in each case.

Province-specific cumulative impacts from provinces simultaneously implementing an efficiency program (regardless of fuel) are slightly more positive when compared with cases where a province acts alone. A straightforward example of this effect is under the case where QC, NB, and NS simultaneously implement natural gas programs. No natural gas programs are modeled for PEI, however PEI nevertheless incurs an increase in GDP of $12.5 million and 72 job-years under the High scenario. PEI's economy is linked to the other three provinces and some of the economic benefits of energy savings in the other provinces spill over into PEI. For example, individuals in other provinces could spend some of their energy savings vacationing on PEI, generating economic activity in retail, hotel and restaurants, and related tourism sectors. Table 25 provides an overview of the individual (Cases A) versus the simultaneous effect (Cases C).

Table 25: Increased GDP from Scenarios when a Province Independently Implements a Program for a Single Fuel Type versus Scenarios where All Provinces Simultaneously Implement a Single Fuel Type (2012-2040)

Increased GDP ($Millions)	Electric		Natural Gas		Liquid Fossil Fuels	
	Individual	Simultaneous	Individual	Simultaneous	Individual	Simultaneous
BAU+ Target						
Québec	18,735	18,924	2,473	2,123	15,795	16,087
New Brunswick	370	555	69	76	1,062	1,239
Nova Scotia	3012	3,236	41	67	1,866	2,170
PEI	57	133	-	5.2	78	155
Mid Target						
Québec	37,480	37,832	3,957	3,400	21,274	21,647
New Brunswick	698	1,052	111	121	1,378	1,689
Nova Scotia	5,913	6,341	66	107	2,431	2,972
PEI	95	234	-	8.2	259	373
High Target						
Québec	60,211	61,056	5,318	5,345	28,575	29,095
New Brunswick	1,090	1,518	143	183	1,807	2,157
Nova Scotia	7,878	8,343	86	161	3,200	3,801
PEI	138	319	-	12.5	336	473

This is the result of heightened competitiveness across the economic bases of all four provinces due to energy savings (hence a reduction in the relative cost of doing business). Each province reaps the benefits of its own fuel efficiency adoption, yet when a province is linked with a surrounding trade area(s) also benefitting from its own program yielding energy-efficiency savings, a larger economic gain occurs. This is because (a) each province experiences growing demand within its border, as well as (b) external (export) demand growth as goods and services within the province become more competitively priced under the savings regime. If a province were to satisfy (a) from its own production, the larger internal demand requires increased supplies, some from outside the provincial border (in the surrounding provinces). Part of (a) is filled by imported goods and services, some from the surrounding provinces (this describes (b)).

Table 26 shows the total regional economic impact when the provinces simultaneously implement programs for each fuel type. Additional province-level impacts from the simultaneous runs are available in Appendix 6.

Table 26: Aggregate Regional Economic Impacts – by Investment Scenario – when all Provinces Simultaneously Implement Efficiency Programs for a Single Fuel Type (2012-2040)

	BAU+	Mid	High
Electric			
Total Efficiency Program Costs ($Millions)	**4,721**	**11,537**	**22,973**
Increase in GDP ($Millions)	**22,848**	**45,459**	**71,237**
Maximum Annual GDP Increase ($Millions)	1,743	3,531	5,456
Increase in Employment (Job years)	**183,876**	**367,633**	**585,940**
Maximum Annual Employment Increase (Jobs)	14,566	28,180	38,373
Jobs per $Millions of Program Spending	39	32	25
Jobs per $Millions of Program & Participant Spending	21	20	18
Natural Gas			
Total Efficiency Program Costs ($Millions)	**291**	**931**	**1,778**
Increase in GDP ($Millions)	**2,271**	**3,636**	**5,701**
Maximum Annual GDP Increase ($Millions)	167	283	404
Increase in Employment (Job years)	**20,200**	**33,367**	**45,590**
Maximum Annual Employment Increase (Jobs)	1,269	1,890	2,579
Jobs per $Millions of Program Spending	69	36	26
Jobs per $Millions of Program & Participant Spending	29	24	19
Liquid Fuels			
Total Efficiency Program Costs ($Millions)	**757**	**1,992**	**3,850**
Increase in GDP ($Millions)	**19,652**	**26,681**	**35,525**
Maximum Annual GDP Increase ($Millions)	1,195	1,921	2,008
Increase in Employment (Job years)	**125,654**	**171,398**	**232,211**
Maximum Annual Employment Increase (Jobs)	7,994	12,485	12,816
Jobs per $Millions of Program Spending	166	86	60
Jobs per $Millions of Program & Participant Spending	71	57	46

Summarized cumulative impact results for the three Case D scenarios where all provinces simultaneous implement efficiency programs for all three fuels with specific penetration targets are shown in Table 27.

Table 27: Cumulative Impacts – All Provinces, All Fuels (2012-2040)

	All Province Implementation							
	Québec		**New Brunswick**		**Nova Scotia**		**Prince Edward Island**	
	GDP	**Job Years**	**GDP**	**Job Years**	**GDP**	**Job Years**	**GDP**	**Job Years**
BAU+	37,565	277,524	1,883	12,868	5,496	37,519	294	2,198
Mid	70,989	535,637	2,884	21,030	9,465	64,297	617	4,148
High	95,884	742,839	3,974	30,289	12,558	88,766	835	5,759

In all cases, each province benefits more through their economic interdependencies with the surrounding three provinces. The incremental benefits associated with this additional level of coordination compared to cases where a province independently implements programs across all fuel types (see Tables 13, 17, 21, and 24) are shown in Table 28 for the Mid scenarios.

Table 28: Comparison of Individual Province's All Fuels Scenario versus All Provinces Implementing All Fuels Simultaneously at the Mid Scenarios

	Single Province		**All Provinces**	
	GDP	**Job Years**	**GDP**	**Job Years**
Québec	62,892	479,508	70,989	535,637
New Brunswick	2,189	17,032	2,884	21,030
Nova Scotia	8,434	58,907	9,465	64,297
PEI	354	2,577	617	4,148
Total	73,869	558,024	83,955	625,112

Regional Employment Effects

In the context of the all fuels, all provinces Mid target implementation case, the time-phasing of job impacts reflects the movement between (a) the investment phase of the proposed policy, (b) the sustained energy-savings phase from useful life of installations, and (c) transactions between the provinces as a result of economic interdependencies especially during periods of new investment demands, and then altered relative competitiveness. That time-path is shown for the "sum of regions" below in the two figures that follow.

In Figure 14 increased consumer demand from net residential (energy) savings and intermediate demand follow a similar trajectory and are the sources of greatest positive job impact. Through 2026 the direct policy effect (in pink) creates the next largest source of positive job impact. After 2026, the investment concludes, and the reason the series shows negative job impacts is due to some (predicated on the flows) "within region" losses for the refining, utility, and fuel retail sectors as energy customers purchase lower amounts of fuel/energy. The policy's effect on the aggregate region's ability to export outside of Canada improves once price pressures abate after the investment period completes by 2026 and energy-savings induces lower price across the region's industries. Within the four-province boundary the aggregate region shows heightened levels of exports amongst themselves (this is driven by relative cost improvements amongst the most proximate trading regions). It is only with respect to exports to rest of Canada (outside the four-province region) that competitiveness has been reduced, but only very slightly.

As outlined in Section 5.0, the overall economic impact of an efficiency scenario can be segmented into four components: (a) investment spending, (b) participant (net) savings, (c) ratepayer (net) costs, and (d) local sector off-sets due to reduced demand for fuels. Each of these components includes direct and non-direct (indirect or induced) effects. In the figures below, 'Direct Jobs from Policy' refers to the net employment impacts from the direct effects of: implementing the efficiency program, the impact of the savings, and any reduction in the economy from making the efficiency changes. 'Local Consumer Demand' refers to the impact of household spending from implicit wages generated under an efficiency scenario (indirect impact). 'Intermediate Demand' refers to rounds of supplier (or business-to-business) transactions under an efficiency scenario (induced impact). 'Investment Demand' explains how an acceleration/de-acceleration of the regional economy under a scenario leads to more (or less) physical plants, equipment, and even housing (above the efficiency investment), which impacts jobs.

Figure 14: "Sum of Regions" Job Impacts (in thousands) by Demand Source and Year under the All Fuels Mid Scenarios (2012-2040)

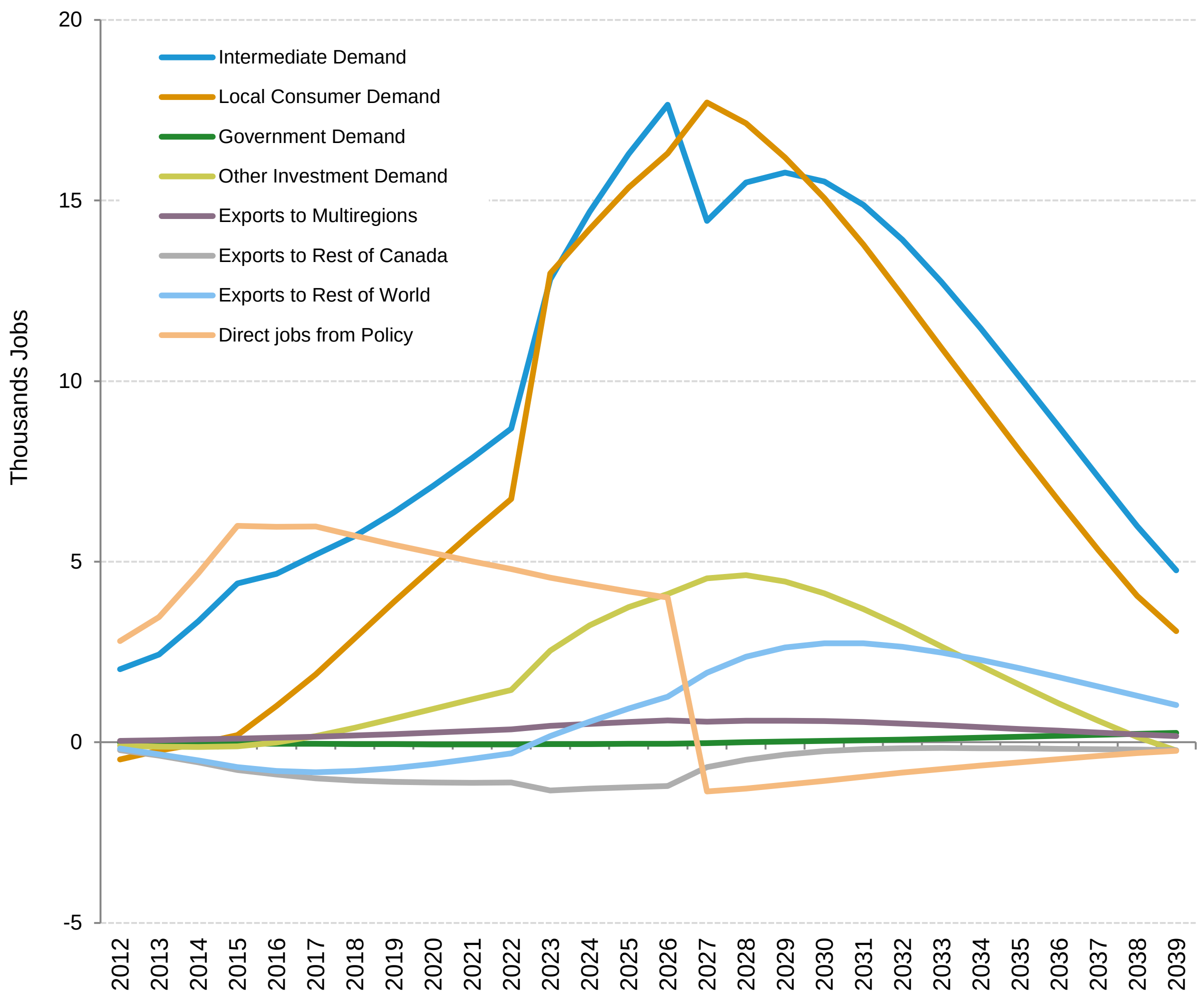
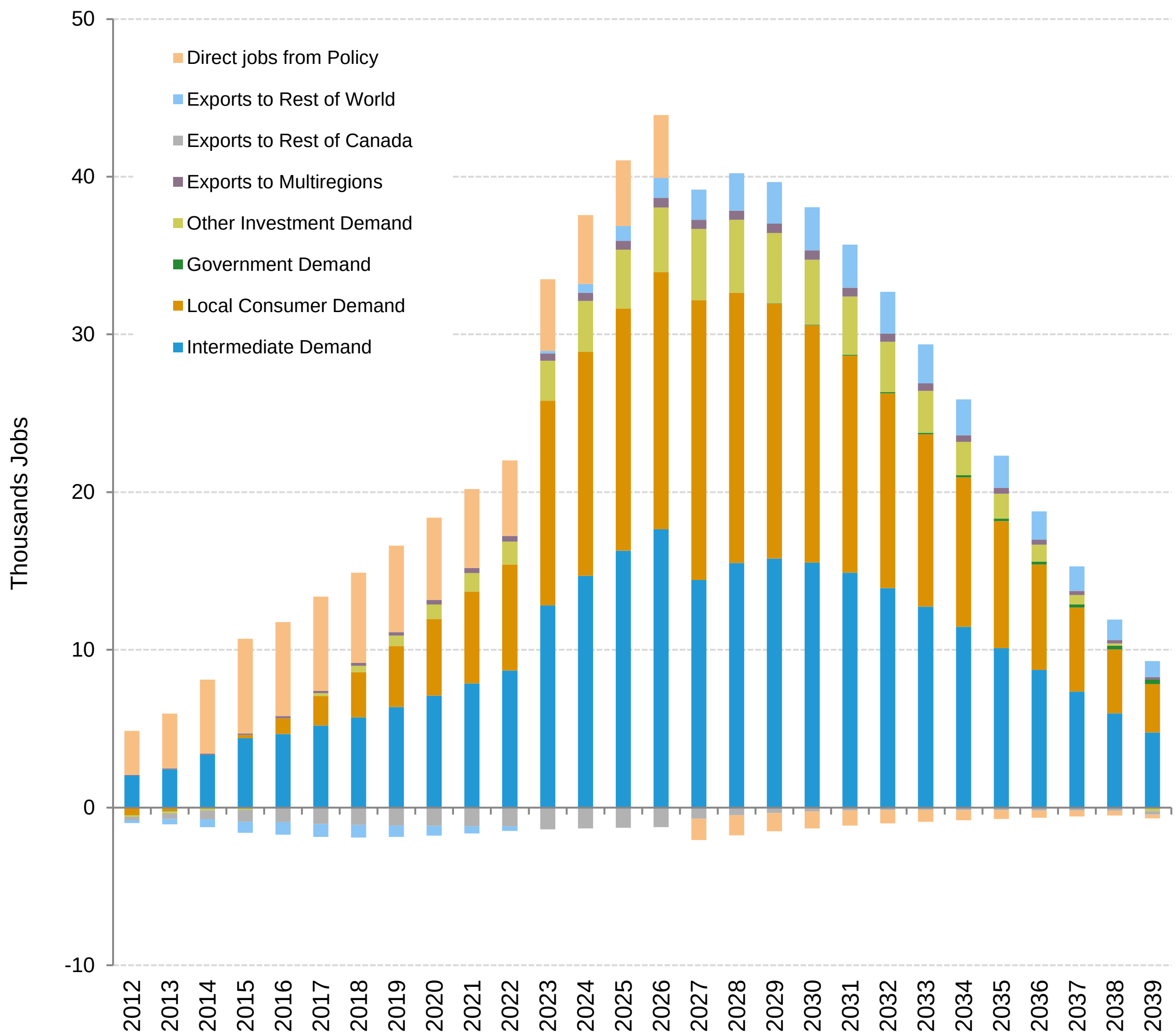


Figure 15 shows for each year, the overall level of job change from all sources, along with the relative contributions. Peak job impact occurs in 2026 as the investment ramp-up completes. It is important to note that the employment impacts taper off only because the study ended the assessment in 2040 due to the availability of data for the REMI model. In actuality, the program and economic benefits would continue beyond this timeframe.

Net job impacts are everywhere "positive" as a result of the surge of investment stimulus, or the persistence of accumulated energy savings which enhances competitiveness and requires more jobs. Increased consumer demand and intermediate demand account for the largest sources of job increases annually.

Figure 15: "Sum of Regions" Job Impacts (in thousands) under the All Fuels Mid Scenarios (2012-2040)



7.0 Tax Revenue Impact Assessment

An important consideration with any new policy is how the change in investment type and level, and the resulting costs and benefits, will impact government revenue streams. This is of particular interest with respect to energy efficiency programs, which reduce demand for energy and thus the sale of energy products in a jurisdiction, but also drive economic output in other sectors of the economy. To inform this discussion, a tax revenue impact assessment was conducted to supplement the results of the macroeconomic impact study.

7.1 Provincial & Federal Tax Revenue Impact

For the "Mid" target presented earlier in Table 26 (all fuels, all provinces) a select set of tax concepts (e.g. sales, personal income, and corporate income) were examined for an estimate of changes to (average) annual collections. These are collections that result from province-level tax policies and federal policies. For these three tax types, changes in tax collections will be based on the total impact annually for relevant tax base proxies that are identified in the REMI scenario result set. The methods used for developing effective tax rates on sales, personal income and corporate income are contained in Appendix 7 along with the schedule of fuel tax rates (by province and federal). Table 29 presents estimates for the net annual gain in provincial and federal tax revenue based on the increased economic output. Direct sales tax losses from lower fuel sales are embedded in the results (see sub-section 7.2).

Table 29: Annual Tax Revenue Change at the Provincial and Federal levels for Select Taxes – All Provinces, All Fuels at the Mid Investment Level (Million 2011$)

	New Revenues, Average Annual[1] (Million 2011$)			
	Sales Tax	Personal Income	Corporate Income	**Sum**
New Brunswick	$4	$4	$1	$9
Nova Scotia	$11	$12	$4	$27
Prince Edward Island	$1	$1	$0	$2
Quebec	$91	$116	$36	$243
Federal[2]	$51	$250	$56	$312

[1] These values should be interpreted as more indicative of revenue changes near 2012, rather than 2040, since the fuel tax rates are current. No projection of tax policy has been attempted.

[2] The federal values are collections of the federal tax across the four provinces and do not include potential effects in provinces outside the region of study.

7.2 Direct Sales Tax Losses from Decreased Fuel Sales

To provide an estimate of the fuel component of sale tax changes that are embedded in the above results, the provincial and federal sales tax rates effective January 1, 2012 were applied (net of exemptions written into each province's tax policy) to the direct scenario data developed by Dunsky Energy Consulting projecting annual bill savings by customer segment. Fuel taxes (e.g. New Brunswick's Gasoline and Motive Fuel Tax) are not considered as they primarily target transportation fuels and there are many exemptions related to the sectors/fuels included in this study. Further, the assessment does not consider the (scenario-induced) altered macroeconomic activity from 2012 to 2040 and the potential changes to fuel consumption that may result.

Since all fuels emphasize the majority of implementation and ensuing energy savings within the C&I segment, the foregone taxes (province or federal) on bill savings are obviously largest from the business base of each province, shown in Table 30.

Table 30: Direct Sales Tax Losses by Fuel Type and Customer-segment under the All Fuels, All Provinces Mid Investment Level (Million 2011$)

Sales Taxes on Fuel Lost (average annual)[1]	NB	NB Federal	NS	NS Federal	PEI	PEI Federal	QC	QC Federal
Residential Electric	1.50	0.94	0	1.29	0	0.13	24.41	12.85
Residential Natural Gas	0.11	0.07	0	0.04	0	0	0	1.26
Residential Liquid Fossil Fuels	1.10	0.68	0	0.99	0	0.15	7.75	4.12
All Residential	**2.71**	**1.70**	**0**	**2.31**	**0**	**0.28**	**32.15**	**18.22**
C&I Electric	3.64	2.27	10.13	5.07	0	0.49	59.26	31.19
C&I Natural Gas	0.06	0.07	0.30	0.15	0	0	0	5.41
C&I Liquid Fossil Fuels	2.70	3.01	8.67	4.33	0	0.68	33.13	18.16
All C&I	**6.4**	**5.4**	**19.1**	**9.5**	**0**	**1.2**	**92.4**	**54.8**

* Nova Scotia and PEI exempt residential fuel consumption across all fuels; Quebec exempts Natural gas purchases from taxation. PEI does not participate in the proposed N Gas efficiency policy.

[1] These values should be interpreted as more indicative of revenue changes near 2012, rather than 2040, since the fuel tax rates are current. No projection of tax policy has been attempted.

Collapsing customer-segment and fuel detail from Table 30 above, Table 31 presents the annual change (loss) in provincial and federal sales tax collections. As mentioned above, the losses are included in the net gain in provincial and federal tax revenue presented in Table 29. To note, the direct annual sales tax losses are over-stated because there is likely to be additional fuel consumption as each province's economy produces more GDP (see page 18 for information on the "rebound effect"), and that incremental fuel consumption cannot be gauged with enough accuracy to attempt basing the figures on total annual fuel consumption changes.

Table 31: Direct Sales Tax Losses under the All Fuels, All Provinces Mid Target (Millions 2011$)

	Direct Sales Tax Losses, Average Annual[1] (Million 2011$)
New Brunswick	$9.1
Nova Scotia	$19.1
Prince Edward Island	-
Quebec	$124.5
Federal	$93.3

[1] These values should be interpreted as more indicative of revenue changes near 2012, rather than 2040, since the fuel tax rates are current. No projection of tax policy has been attempted.

As mentioned above, the direct sales tax losses from reduced fuels sales (Tables 30 and 31) are included in the overall provincial and federal tax revenue change presented in Table 29. Thus, while there will be sales tax losses, the additional economic output should generate a net increase in sales tax as well as personal and corporate income tax revenue. It is important to note that the tax revenue impact results are not based on a comprehensive modeling assessment. The above figures offer a rough sketch of the actual impact. The real value of the tax revenue exercise is in liking the significant increase in economic activity to a meaningful net increase in government revenue, and providing a sense of the magnitude of the effect. The results do support the conclusion that, in addition to driving economic growth, investing in all cost-effective energy efficiency will generate revenue for government, which can be used to fund the efficiency programs and other initiatives.

8.0 Discussion

Increasing investment in energy efficiency program for electricity, natural gas, and liquid fossil fuels (heating oil, propane, and kerosene) in the four provinces would deliver significant economic benefits. Investments in energy efficiency increase Gross Domestic Product, bolster trade, and create local employment. In essence, efficiency programs swap fossil fuel imports for local employment and economic growth.

In all cases, the expanded investment in energy efficiency results in net positive benefits to the local and regional economy. If the provinces expand investment in cost-effective energy efficiency across all fuel types for a 15-year period, the aggregated regional GDP would increase by over $43,600 billion (BAU+ scenario), $73,800 billion (Mid scenario), and $109,100 billion (High scenario) from 2012-2040. The increase in employment over the same period, and under the same scenarios, would be over 320,400 job-years (one full-time job for a period of one year) under the BAU+ scenario, 558,000 job-years (Mid scenario), and 842,600 job-years (High scenario). The "all fuels" and simultaneous, multi-province action results in greater economic benefits to a province or the region, due to increased regional competitiveness, intra-provincial trade and other synergistic effects. For example, there is a 14 percent increase in GDP in the region ($73,800 billion vs. $83, 955 billion from 2012 to 2040) and a 12 percent increase in employment (558,000 job-years vs. 625,112 job-years from 2012 to 2040) when provinces move from acting alone to simultaneously implementing all fuels efficiency programs under the Mid investment scenario.

In New Brunswick and PEI, the relative scale of the macroeconomic benefits is less than in Nova Scotia and Québec. This is due in part to the lower avoided costs for electricity in these two provinces, and the total level of investment relative to $GDP. Another contributing factor is that the structure of PEI's economy (and to a lesser extent NB's). PEI has the least complete economy of the four provinces in the study, leading it to be more dependent on imports for goods and services than the other three provinces. However, the economic benefits of energy savings in PEI are accruing to the other provinces in the study as well as other jurisdictions. In other words, when provinces act alone to implement one or more fuel efficiency programs, there are spill-over effects to the other provinces in the 4-region economy. In the case of PEI, this effect occurs at a much higher rate than for the other provinces in the study. In general, to the extent that the provinces can expand the availability of in-region goods and services related to efficiency programs (e.g. high efficiency equipment and trained professionals) and other local goods and service and industry, the net positive impact in the region will increase.

The results of the tax revenue impacts assessment indicate that the significant increase in economic output would generate a net increase in collections of personal income tax, corporate income tax, and sales tax. Although s more detailed analysis is warranted to determine the actual magnitude of the impacts, the direction of the effect is clear – while efficiency will reduce sales tax collections from the sale of energy, the loss will be more than offset by increased tax collection resulting from the efficiency-driven increase in economic output.

Overall, the modeled results of expanded investments in energy efficiency show that efficiency provides significant economy-wide benefits in addition to the direct participant savings on which efficiency programs are often justified. Expanding analysis from micro-level benefit-cost tests to macro-level assessments of the economic impacts of efficiency (including losses to utilities and fuel suppliers) clearly illustrates that investing in energy efficiency is one of the most effective means of improving economic conditions widely, while lowering energy bills and reducing emissions. While consumer savings are important, the wider economic impacts of expanded efficiency investments must also be a key consideration when evaluating different energy and economic development policy options and in resource planning processes.

APPENDIX 1 – Efficiency Measure Average Lifespan

Table A1: Average Energy Savings Lifespan (Years)

Scenario	Residential	C&I	All Sectors
Electricity			
Electric BAU+	QC, NB: 11 NS, PEI: 10	QC, NB: 14 NS, PEI: 14	QC, NB: 13 NS, PEI: 13
Electric Mid	QC, NB: 12 NS, PEI: 11	QC, NB: 15 NS, PEI: 15	QC, NB: 14 NS, PEI: 14
Electric High	QC, NB: 15 NS, PEI: 14	QC, NB: 18 NS, PEI: 18	QC, NB: 17 NS, PEI: 17
Natural Gas			
NG BAU+	21	15	16
NG Mid	23	17	18
NG High	26	20	21
Liquid Fossil Fuels			
Liquid Fossil Fuels BAU+	21	15	16
Liquid Fossil Fuels Mid	23	17	18
Liquid Fuels High	26	20	21

APPENDIX 2 – Greenhouse Gas Emissions

Table A2-1: Marginal GHG Emissions Factors for electric sector emissions reduced or avoided

	Electric Sector GHG Emissions Factors (tonnes of CO_2e/MWh)
Québec	2012-2022: 0.45 (oil and gas generation)
	2023+: 0.00 (wind generation)
New Brunswick	2012-2029: 0.45 (oil and gas generation)
	2030+: 0.40 (combined cycle gas turbine)
Nova Scotia*	2012+: 0.00 (mix of renewable generation)
Prince Edward Island	2012-2021: 0.45 (oil and gas generation)
	2022+: 0.40 (combined cycle gas turbine)

*See note following Table A2-4 (page 48)

Natural Gas = 1,891 metric ton CO_2e per million m3
Liquid Fossil Fuels = 73,777.65 metric ton CO_2e per PJ

Table A2-2: Québec's Avoided Emissions (2012-2046)

Québec (Mt CO_2e)	BAU+	Mid	High
Electricity	27.7	45.6	56.2
Natural Gas	18.7	33.0	50.1
Liquid Fossil Fuels	51.4	75.4	115.8
Total	**97.8**	**154.0**	**222.1**

Table A2-3: New Brunswick's Avoided Emissions (2012-2046)

New Brunswick (Mt CO_2e)	BAU+	Mid	High
Electricity	6.5	12.9	21.3
Natural Gas	1.1	1.9	2.8
Liquid Fossil Fuels	10.7	15.6	23.9
Total	**18.3**	**30.4**	**48.0**

Table A2-4: Nova Scotia's Avoided Emissions (2012-2046)

Nova Scotia (Mt CO_2e)	BAU+	Mid	High
Electricity*	-	-	-
Natural Gas	0.5	0.9	1.4
Liquid Fossil Fuels	14.4	21.1	32.2
Total	**14.9**	**22.0**	**33.6**

*The study assumes renewables are highest-cost electricity in Nova Scotia during the studied time period, and thus would be the first taken offline or not built if efficiency increases. In the NS policy context, renewable (mostly wind) power will be used when available as NS legislation requires a growing ratio of renewables in NS electricity production (40% by 2020). To meet these targets the utility's contracts with independent wind projects are "must run" when wind is available.

Table A2-5: PEI's Avoided Emissions (2012-2046)

Prince Edward Island (Mt CO_2e)	BAU+	Mid	High
Electricity	1.1	1.9	3.1
Natural Gas	-	-	-
Liquid Fossil Fuels	2.1	3.1	4.7
Total	**3.2**	**5.0**	**7.8**

APPENDIX 3 – Avoided Costs

Table A3-1: Marginal (avoided) costs by fuel and provinces (2012-2050).

	2012	2015	2020	2025	2030	2035	2040	2045	2050
Electricity (nominal $/kWh)									
QC	0.06	0.07	0.08	0.18	0.20	0.22	0.24	0.27	0.29
NB	0.06	0.07	0.08	0.08	0.12	0.13	0.14	0.16	0.18
NS	0.18	0.19	0.21	0.23	0.26	0.28	0.31	0.35	0.38
PEI	0.06	0.07	0.08	0.11	0.12	0.13	0.14	0.16	0.18
Natural Gas (nominal $/m^3)									
All	0.29	0.29	0.32	0.35	0.39	0.43	0.48	0.53	0.58
Unregulated Fuels (nominal $/GJ)									
QC	24.27	24.32	23.78	23.78	23.78	23.78	23.78	23.78	23.78
NB	18.32	18.81	19.03	19.03	19.03	19.03	19.03	19.03	19.03
NS	19.59	20.02	20.19	20.19	20.19	20.19	20.19	20.19	20.19
PEI	21.01	21.30	21.30	21.30	21.30	21.30	21.30	21.30	21.30

APPENDIX 4 – REMI Efficiency Spending Allocations

Table A3: REMI Sector Allocation for Program and Participant Spending by Fuel Type and Sector

	Natural Gas & Unregulated Heating Fuels					
	Program Spending			Participant Spending		
Supplying Industry (Local or not)	Residential	Commercial	Industrial	Residential	Commercial	Industrial
Wood product manufacturing	1%	0%	0%	1%	0%	0%
Nonmetallic mineral product manufacturing	1%	1%	0%	1%	1%	0%
Paper	2%	0%	0%	2%	0%	0%
Machinery manufacturing	5%	13%	25%	6%	14%	28%
Computer, electronic product manufacturing	1%	3%	3%	1%	3%	3%
Electrical equipment, appliance manufacturing	5%	5%	5%	6%	6%	6%
Plastics, rubber product manufacturing	2%	2%	0%	2%	2%	0%
Wholesale trade	1%	2%	2%	1%	2%	2%
Construction	63%	54%	45%	70%	60%	50%
Retail	10%	0%	0%	11%	0%	0%
Professional Services	4%	14%	14%	0%	11%	11%
Utilities	6%	6%	6%	0%	0%	0%

	Electricity					
	Program Spending			Participant Spending		
Supplying Industry (Local or not)	Residential	Commercial	Industrial	Residential	Commercial	Industrial
Wood product manufacturing	1%	0%	0%	1%	0%	0%
Nonmetallic mineral product manufacturing	1%	1%	0%	1%	1%	0%
Paper	2%	0%	0%	2%	0%	0%
Machinery manufacturing	3%	8%	15%	3%	9%	17%
Computer, electronic product manufacturing	1%	3%	3%	1%	3%	3%
Electrical equipment, appliance manufacturing	2%	10%	15%	2%	11%	17%
Plastics, rubber product manufacturing	2%	2%	0%	2%	2%	0%
Wholesale trade	1%	2%	2%	1%	2%	2%
Construction Labor	63%	54%	45%	70%	60%	50%
Retail	15%	0%	0%	17%	0%	0%
Professional Services	4%	14%	14%	0%	11%	11%
Utilities	6%	6%	6%	0%	0%	0%

APPENDIX 5 – Direct Economic Effects from Fuel Policy Design

To understand how the broader economic impacts emerge for an economy (each province), it is important to appreciate the characteristics of the direct changes from deploying more energy-efficiency practices, which include:

- The magnitude and timing of investment expenditures (program or participant, fulfilled by 2025)
- The persistence of energy savings (modeled through 2040)
- The relationship between the investment (cost) required and the ensuing ratepayer benefits (important through 2025)
- The composition of participants (%Residential compared to % C&I)
- The investment scale e.g. % of gross regional product (GRP)

Regarding the magnitude of total investment, the importance of the individual fuel programs within each province is shown in Table A5-1.

Table A5-1: Fuel Efficiency Cumulative Investment Share by Province

		QC	NB	NS	PEI
Total Investment (M 2011$CN)	Electric	7057	560	1079	111
	Natural Gas	634	36	18	0
	Liquid Fuels	979	307	416	61
	sum	**8671**	**902**	**1512**	**172**
Investment share	Electric	81%	62%	71%	64%
	Natural Gas	7%	4%	1%	0%
	Liquid Fuels	11%	34%	27%	36%

The following present by fuel and for the BAU+ target case, the aggregate direct scenario effects that will largely condition the pattern of projected total macroeconomic impacts that can be expected from the REMI forecasting model.

There are two additional sources of information that will also affect the pattern and magnitude of *total* economic impacts, albeit to a lesser degree than the direct scenario effects: (1) assumptions for introducing dollars of new demand into any region of the model; and, (2) the economic interdependencies a province exhibits with each surrounding economy (including rest of Nation and rest of World) in terms of traded goods and services, and in a more immediate perimeter, labor (or commuter) flows. These historical interdependencies (cross-region feedback effects) are captured within the REMI macroeconomic impact forecasting system and are conditional on the relative competitiveness of each province.[41]

Direct Policy Effects: Electric efficiency BAU+

The characteristics of province-level efficiency improvements for electric consumption are shown in Table A5-2. The cumulative investment (through 2026) is largest for Quebec, followed by Nova Scotia, New Brunswick and then PEI. Quebec and New Brunswick will orient a larger share of the efficiency deployment to the residential sector than the other two provinces. Assumed avoided cost benefits per dollar invested into residential efficiency is largest for Nova Scotia (returning $2.55 for every dollar invested) followed by Quebec. The avoided cost benefit for every dollar of C&I invested in efficiency exceeds that from residential investment - for all provinces, with Nova Scotia exhibiting the greatest direct return (of $3.26 dollars) followed by Quebec. In terms of scale of the cumulative avoided cost benefits within the context of a province's economy (measured as % of gross regional product (GRP)), benefits in Nova Scotia represent 0.2% of GRP, Quebec's benefits represent one-half of that, and New Brunswick and PEI's benefits about one-third.

Table A5-2: Cumulative Direct effects from Electric Efficiency Program Design

ELECTRIC	PROVINCE			
	QC	**NB**	**NS**	**PEI**
CUMUL Total Investment$ (B2011CN)	7.057	0.560	1.079	0.111
share as RESID INVST	32%	32%	24%	24%
share as CI invest	68%	68%	76%	76%
RESID Avoided Cost per$ Resid Total INV	1.88	1.18	2.55	1.07
CI Avoided Cost per$ CI Total INV	2.31	1.40	3.26	1.41
Avoided Cost as % of Base GRP	**0.11%**	**0.06%**	**0.21%**	**0.07%**

The Mid and High target cases for electric efficiency alter the above direct program design characteristics as follows: Mid target investment is 2-fold that under the BAU+, so is the scale of the program (measured on the avoided cost benefits). The C&I rates of avoided cost benefit generated per dollar of investment are 10 percent lower than in the BAU+ case for all provinces. The High target program exhibits cumulative investment almost 3 to 4-fold of BAU+ and the program scale is approximately 3-fold. The residential and C&I rates of avoided cost benefit generated per dollar of investment are no lower than 13 percent of those in the BAU+ case for all provinces.

Direct Policy Effects: Natural Gas efficiency BAU+

The characteristics of province-level efficiency improvements for natural gas consumption are shown in Table A5-3. The cumulative investment (through 2026) is largest for Quebec, followed by New Brunswick, and Nova Scotia. There is no program assumed for PEI. All provinces expect 80% of the implementation to be in the C&I customer segment. Assumed avoided cost benefits per dollar invested into residential efficiency is comparable across all three provinces with programs and benefit rates are comparable between residential and C&I programs. In terms of scale of the cumulative avoided cost benefits within the context of a province's economy (measured as % of gross regional product (GRP)), the natural gas efficiency benefits are two orders of magnitude smaller in scale than the electric efficiency program above.

Table A5-3: Cumulative Direct effects from Natural Gas Efficiency Program Design

Natural Gas	PROVINCE			
	QC	NB	NS	PEI
CUMUL Total Investment$ (B2011CN)	0.634	0.036	0.018	0.000
share as RESID INVST	20%	20%	20%	NA
share as CI invest	80%	80%	80%	NA
RESID Avoided Cost per$ Resid Total INV	3.09	3.07	3.11	NA
CI Avoided Cost per$ CI Total INV	3.03	3.03	3.03	NA
Avoided Cost as % of Base GRP	**0.014%**	**0.009%**	**0.003%**	NA

The Mid and High target cases for natural gas efficiency alter the above direct program design characteristics as follows: Mid target investment is 2-fold that under the BAU+, the scale of the program (measured on the avoided cost benefits) is 1.7-fold by comparison. The avoided cost benefit rate per dollar invested for both residential and C&I implementation are approximately 70 and 80 percent respectively of those observed under the BAU+ case. High target program exhibits cumulative investment is 3 to 3.5-fold of BAU+ for the three participating provinces. The residential and C&I rates of avoided cost benefit generated per dollar of investment are lower than for the BAU+ case: residential benefit rates are 50 percent of BAU+ and C&I benefit rates (per dollar invested) are 70 percent by comparison Hence the program scale is a little more than a 2-fold increase compared to BAU+.

Direct Policy Effects: Liquid Fossil Fuels efficiency BAU+

The characteristics of province-level efficiency improvements for liquid fossil fuels consumption are shown in Table A5-4. The cumulative investment (through 2026) is largest for Quebec, followed by Nova Scotia, New Brunswick and PEI. All provinces expect that 77% of its implementation will occur in the C&I customer segment. Assumed avoided cost benefits per dollar invested into residential efficiency varies from $6.24 per $1 residential efficiency invested to $7.80 in Quebec. The avoided cost benefits per dollar of efficiency investment within the C&I segment are 1.2 times greater than the residential segment returns. In terms of scale of the cumulative avoided cost benefits within the context of a province's economy (measured as % of gross regional product (GRP)), the unregulated fuels efficiency benefits are approximately 0.13% of GRP across New Brunswick, Nova Scotia and PEI, and one-half that for Quebec.

Table A5-4: Cumulative Direct Effects from Liquid Fossil Fuels Efficiency Program Design

Liquid Fossil Fuels	**PROVINCE**			
	QC	**NB**	**NS**	**PEI**
CUMUL Total Investment$ (B2011CN)	0.979	0.31	0.42	0.06
share as RESID INVST	0.23	0.23	0.23	0.23
share as CI invest	0.77	0.77	0.77	0.77
RESID Avoided Cost per$ Resid Total INV	7.80	6.24	6.64	7.03
CI Avoided Cost per$ CI Total INV	9.63	7.68	8.17	8.64
Avoided Cost as % of Base GRP	0.06%	0.12%	0.14%	0.15%

The Mid and High target cases for liquid fossil fuels efficiency alter the above direct program design characteristics as follows: Mid target investment is almost 2-fold that under the BAU+, and the scale of the program (measured on the avoided cost benefits) is 1.4-fold that of BAU+, all as a result of the avoided cost benefit rates for residential and C&I at 70 percent. The High target program exhibits cumulative investment almost 1.4 to 2.7-fold of BAU+. The residential and C&I rates of avoided cost benefit generated per dollar of investment vary significantly compared to the BAU+ case. Residential benefit rates drop to 50 percent of those under BAU+, Quebec's C&I benefit rate is 36 percent lower, while PEI will return $18.65 of avoided cost benefit per dollar invested (up 116 percent), Nova Scotia $15.02 (up 84 percent) and New Brunswick $11.03 (up 44 percent).

APPENDIX 6 – Detailed Provincial Results

Simultaneous Implementation (All Provinces) of Expanded Efficiency Programs – Electricity Results (2012-2040)

Table A6-1: Simultaneous Electric – BAU+ Scenarios

ALL $ are 2011CN	QC	NB	NS	PEI
Total Program Costs($Millions)	3,768.8	299.1	592.2	60.8
Increase in GDP($Millions)	18,924.0	554.8	3,235.8	133.4
GDP/Program$(Millions)	5.02	1.85	5.46	2.19
Total Job Years	152,605	5,305	24,876	1,090
Jobs/Program$Million	40	18	42	18

Table A6-2: Simultaneous Electric – Mid Scenarios

ALL $ are 2011CN	QC	NB	NS	PEI
Total Program Costs($Millions)	9,375.7	741.9	1,286.8	133.0
Increase in GDP($Millions)	37,831.8	1,051.5	6,341.7	233.8
GDP/Program$(Millions)	4.04	1.42	4.93	1.76
Total Job Years	308659	10345	46712	1917
Jobs/Program$Million	33	14	36	14

Table A6-3: Simultaneous Electric – High Scenarios

ALL $ are 2011CN	QC	NB	NS	PEI
Total Program Costs($Millions)	18,892.1	1,492.3	2,344.8	244.0
Increase in GDP($Millions)	61,056.2	1,518.1	8,342.9	319.9
GDP/Program$(Millions)	3.23	1.02	3.56	1.31
Total Job Years	502542	15762	64895	2741
Jobs/Program$Million	27	11	28	11

<u>Simultaneous Implementation (All Provinces) of Expanded Efficiency Programs – Natural Gas Results (2012-2040)</u>

Table A6-4: Simultaneous Natural Gas – BAU+ Scenarios

ALL $ are 2011CN	QC	NB	NS	PEI
Total Program Costs($Millions)	268.2	15.1	7.5	0.0
Increase in GDP($Millions)	2,123.2	75.5	66.9	5.2
GDP/Program$(Millions)	7.92	5.02	8.97	0.00
Total Job Years	18932	704	532	33
Jobs/Program$Million	71	47	71	0

Table A6-5: Simultaneous Natural Gas – Mid Scenarios

ALL $ are 2011CN	QC	NB	NS	PEI
Total Program Costs($Millions)	858.6	48.8	23.5	0.0
Increase in GDP($Millions)	3,400.3	120.8	106.7	8.2
GDP/Program$(Millions)	3.96	2.48	4.55	0.00
Total Job Years	31273	1168	871	54
Jobs/Program$Million	36	24	37	0

Table A6-6: Simultaneous Natural Gas – High Scenarios

ALL $ are 2011CN	QC	NB	NS	PEI
Total Program Costs($Millions)	1,640.2	94.0	43.8	0.0
Increase in GDP($Millions)	5,345.2	183.0	160.7	12.5
GDP/Program$(Millions)	3.26	1.95	3.67	0.00
Total Job Years	42776	1584	1158	72
Jobs/Program$Million	26	17	26	0

Simultaneous Implementation (All Provinces) of Expanded Efficiency Programs – Liquid Fossil Fuels Results (2012-2040)

Table A6-7: Simultaneous Liquid Fossil Fuels – BAU+ Scenarios

ALL $ are 2011CN	Quebec	NB	NS	PEI
Total Program Costs($Millions)	494.0	102.8	139.2	20.5
Increase in GDP($Millions)	16,087.3	1,238.7	2,170.4	155.3
GDP/Program$(Millions)	32.57	12.05	15.59	7.57
Total Job Years	105,663	6,854	12,056	1,081
Jobs/Program$Million	214	67	87	53

Table A6-8: Simultaneous Liquid Fossil Fuels – Mid Scenarios

ALL $ are 2011CN	QC	NB	NS	PEI
Total Program Costs($Millions)	1,303.3	270.4	364.9	53.7
Increase in GDP($Millions)	28,939.5	1,688.6	2,971.9	372.5
GDP/Program$(Millions)	22.21	6.25	8.15	6.93
Total Job Years	194,596	9,510	16,593	2,179
Jobs/Program$Million	149	35	45	41

Table A6-9: Simultaneous Liquid Fossil Fuels – High Scenarios

ALL $ are 2011CN	QC	NB	NS	PEI
Total Program Costs($Millions)	2,525.2	521.3	700.4	103.1
Increase in GDP($Millions)	29,095.1	2,156.5	3,801.0	472.9
GDP/Program$(Millions)	11.52	4.14	5.43	4.58
Total Job Years	195,697	12,324	21,399	2,790
Jobs/Program$Million	77	24	31	27

Simultaneous Implementation (All Provinces) of Expanded Efficiency Programs – All Fuels Results (2012-2040)

Table A6-10: Simultaneous All Fuels – BAU+ Scenarios

ALL $ are 2011CN	**QC**	**NB**	**NS**	**PEI**
Increased GDP ($Millions)	37565.3	1883.2	5495.6	294.2
Job Years	277524	12868	37519	2198

Table A6-11: Simultaneous All Fuels – Mid Scenarios

ALL $ are 2011CN	**QC**	**NB**	**NS**	**PEI**
Increased GDP ($Millions)	70989.4	2883.8	9465.1	616.8
Job Years	535637	21030	64297	4148

Table A6-12: Simultaneous All Fuels – High Scenarios

ALL $ are 2011CN	**QC**	**NB**	**NS**	**PEI**
GRP$ Mil (2011CN)	95883.9	3974.3	12558.0	835.2
Job Years	742839	30289	88766	5759

APPENDIX 7 – Methodology for Effective Tax Rate Determination – Select Taxes

Tax revenue impacts will result from changes in business and consumer spending patterns resulting from the direct effects of and subsequent effects from energy efficiency investments. Due to the complexities of tax policies (deductions, exemptions, brackets etc.), it is not possible to simply apply the prevailing tax rate to the change in the relevant 'tax base' since this would greatly overstate impacts. Instead it is necessary to determine the *effective tax rate*[42] for a specific type of tax using recent data and for it to be constructed using a tax base concept, or a close proxy for that concept. The need for the proxy is a result of the fact that the REMI model is the basis for identifying the changes in a select (not infinite) set of macroeconomic activities under the investment scenarios, and the model's outputs do not include changes in corporate income for instance. The model does however track changes in industry-specific annual value-added (gross regional product or gross domestic product) which is a proxy for movements in corporate income.

The estimates of tax revenue impacts will be driven by results from the REMI model, using a per unit impact factor method.[43] Under this method, the economic activity driving each tax revenue source (personal income tax, corporate income tax, and sales/consumption tax) is identified. For example, personal income tax collections are driven by personal income, sales/consumption taxes collections are largely driven by personal income (the disposable portion), and corporate income taxes are largely driven by value added. Actual tax revenues for the most recent year for which data is consistently available are compared to the annual level of the tax base activity to determine the per-unit relationship.

The results are to be interpreted as one-year impacts based on current tax policy and macroeconomic conditions. In reality tax policies will change over time (rates will vary, new types of taxes will be implemented, some might be abolished) but the tax impact factors used here are static. The REMI scenario impacts however will show yearly changes in the tax base (proxy) concepts, and as a result we collapse that time-series of impacts into an average annual impact.

Personal Income Tax

To calculate the personal income tax generation factors, the amount of total personal income in the nation and in each province were obtained from the Canada Revenue Agency Final Tax Return Statistics 2011 Edition. This document contains data based on the 2009 tax year. These figures were then adjusted for inflation to 2011 dollars using the Consumer Price Index (Statistics Canada). The amount of personal income tax revenue was also obtained from the federal and provincial budgets. Though more recent data on collections were available, for consistency with the personal income data, it was necessary to use budget figures from the 2009-10 fiscal year, adjusted to 2011 dollars.

Personal income tax revenue was then divided by personal income to determine personal income tax revenues per $ of personal income. The per unit factor for each province will be applied to the change in personal income time-series from the REMI model to provide an estimate of personal income tax revenue impacts.

Corporate Income Tax

To calculate corporate income tax factors, real Gross Domestic Product (GDP) data for the nation and each province was used. For consistency with personal and income tax factors, we used GDP for 2009 expressed in 2011 dollars. The amount of corporate income tax revenue was then obtained from the federal and provincial budgets (FY2009-10, adjusted to 2011 dollars).

Corporate income tax revenue (in millions) was then divided by GDP (in millions) to determine corporate income tax revenues per $ of GDP. The per unit factor for each province will be applied to the change in GDP from the REMI model to provide an estimate of corporate income tax revenue impacts under the desired scenario.

Note: the Federal Corporate Income effective tax rate was further adjusted (downward) to reflect a 9 percent reduction effective 2012.

Sales/Consumption Tax

The sales tax revenue generation factor was calculated by dividing personal income (described above) by the amount of sales/consumption tax revenue reported in the federal and provincial budgets (FY2009-10, adjusted to 2011 dollars). One caveat is that the federal government and each province report sales and consumption taxes differently, in part since the policies are not uniform across the provinces. For example, some report a single figure for all sales and consumption taxes, while others report tobacco, alcohol, and fuel taxes separately from goods and services tax/harmonized sales tax (GST/HST), and some report these in different combinations. To deal with the variation, the aggregated sales/consumption tax line items for each province was used to ensure that all taxable activity was reflected, therefore, the resulting sales tax generation factor represents an aggregation of all types of consumption taxes within a province.

Sales/consumption tax revenue (in millions) was then divided by personal income (in millions) to determine sales tax revenues per $ of income. The per-unit factor for each province was applied to the change in personal income from the REMI model to provide an estimate of sales tax revenue.

Note: The Quebec effective rate on Sales Tax was adjusted (upward) to reflect an 11.7 percent increase effective 2012.

Table A7-1: Effective Tax Factors by Jurisdiction

CALCULATED TAX IMPACT FACTORS (2011$)

Personal Income Tax Generation Factor (See Note 1)			
	Personal Income (millions)	**Personal Income Tax Revenues (millions)**	**Personal Income Tax Revenues per $ of Income**
Canada	$1,059,808	$119,817	$0.113
New Brunswick	$20,972	$1,345	$0.06
Nova Scotia	$27,082	$1,916	$0.07
Prince Edward Island	$3,772	$261	$0.07
Quebec	$232,294	$17,251	$0.07

Corporate Income Tax Generation Factor (See Note 2)			
	Real Gross Domestic Product (GDP) (millions)	**Corporate Income Tax Revenue (millions)**	**Corporate Income Tax Revenues per $ of GDP**
Canada	$1,602,494	$32,777	$0.021
New Brunswick	$23,484	$190	$0.01
Nova Scotia	$29,390	$324	$0.01

Prince Edward Island	$4,189	$37	$0.01
Quebec	$267,290	$3,774	$0.01

Sales Tax Generation Factor (See Notes 1 and 3)

	Personal Income (millions)	Sales Tax Revenues (millions)	Sales Tax Revenues per $ of Income
Canada	$1,059,808	$30,053	$0.028
New Brunswick	$20,972	$1,310	$0.06
Nova Scotia	$27,082	$1,641	$0.06
Prince Edward Island	$3,772	$262	$0.07
Quebec	$232,294	$12,144	$0.06

Notes:

Note 1 - 2009 personal income and fiscal revenues in the 2009-10 Fiscal Year, expressed in 2011 dollars.

Note 2 - 2009 personal income and 2009 GDP, expressed in 2011 dollars.

Note 3 - Include sales tax, plus fuel consumption tax, alcohol tax and tobacco tax as reported by each government unit (as noted on their respective budget assumption tables).

Sources: Federal and individual province budgets for 2009-10, Canada Revenue Agency Final Tax Return Statistics 2011 Edition (based on 2009 tax year), and Statistics Canada.

Sales Tax Schedule Applied to Fuel Sales

The schedule below is segmented into fuel and customer-segment combination to best attempt estimating the direct sales taxes lost under increased energy-efficiency. An entry of *"0"* is interpreted as either "an exemption" or no sales tax exists at that jurisdictional level for one or more of the fuel types. The bolded entries account for degree of exempt purchases based on the specific province's list of exempt industries purchasing fuel, or for Quebec, how much propane comprises of liquid fossil fuel consumption for either the residential or the C&I segments.

Table A7-2: Sales Tax Schedule Applied to Fuel Sales

		Taxable?					
	Sales Tax rate	ELEC RESID	ELEC C/I	NGAS RESID	NGAS C/I	UNREG RESID	UNREG C/I
PEI_Federal	5%	1	1	1	1	1	1
PEI_PROV	0	0	0	0	0	0	0
QUE_Federal	5%	1	1	1	1	1	1
QUE_PROV	9.5%	1	1	0	0	**0.99**	**0.96**
NB_Federal	5%	1	1	1	1	1	1
NB_PROV	8%	1	1	1	**0.56**	1	**0.56**
NS_Federal	5%	1	1	1	1	1	1
NS_PROV	10.0%	0	1	0	1	0	1

References & End Notes

[1] Closing remarks of Hon. Martin Ferguson, Chairman, International Energy Agency at the 2011 IEA Ministerial Meeting "*Our Energy Future: Secure, Sustainable and Together*" (October 19, 2011).

[2] *See e.g.* Howland, J., D. Murrow (2009). *Energy Efficiency: Engine of Economic Growth*, ENE (www.env-ne.org/resources/open/p/id/964); Hibbard, P., S. Tierney, A. Okie, and P. Darling (2011). *The Economic Impacts of the Regional Greenhouse Gas Initiative on Ten Northeast and Mid-Atlantic States*, The Analysis Group (www.analysisgroup.com/uploadedFiles/Publishing/Articles/Economic_Impact_RGGI_Report.pdf)

[3] The Total Resource Cost Test (TRC) is the ratio of *total benefits* i.e., the benefits to the program participants, the utility, and all utility consumers at large (including non-participants) to *total costs* i.e. the program costs such as rebates consumer incentives, administrative costs, and customer contributions to the efficiency measures. If the ratio of total benefits to total costs is greater than 1.0, then an efficiency program is deemed to be cost-effective according to the TRC. The Program Administrators Cost Test (PACT) examines cost-effectiveness from the point of view of the energy sector. PACT is the ratio of the *energy (and water) benefits* generated by the efficiency program in terms of avoided supply costs (i.e. transmission, distribution, and generation and savings) to the *energy efficiency program costs* such as rebates/consumer incentives and administrative costs. The Participant Cost Test (PCT) examines cost-effectiveness from the point of view of the program participant, and is the ratio of the *energy benefits* in terms of avoided supply costs to the *program participant costs* (i.e. participant co-pay).

[4] See Table 11 (page 29) in ENE's *Energy Efficiency: Engine of Economic Growth* (2009). Available on-line at: www.env-ne.org/resources/open/p/id/964

[5] Estimate for Québec based on: Government of Québec's 2012-2013 *Budget Plan*, pp. C.68 and D.95. Available on-line at: http://www.budget.finances.gouv.qc.ca/Budget/2012-2013/en/documents/budgetplan.pdf. Estimate for New Brunswick is based on: Budget 2011-2012 *Main Estimates* (www.gnb.ca/0160/budget/buddoc2011/ME2011-12.pdf). Estimate for Nova Scotia is based on: Efficiency Nova Scotia Corporation's revised *Electricity Demand Side Management Plan 2013-2015* (www.nsuarb.ca/index.php?option=com_content&task=view&id=73&Itemid=82), and Budget 2012-2013 *Estimates and Supplementary Detail for the Fiscal Year 2012-2013* (www.novascotia.ca/finance/site-finance/media/finance/budget2012/Estimates_And_Supplementary_Detail.pdf). Estimate for PEI based on personal correspondence with the PEI Office of Energy Efficiency.

[6] Office of Energy Efficiency, Natural Resources Canada – Comprehensive Energy Use Database, 1990 to 2009. Tables available on-line at: http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/comprehensive_tables/list.cfm?attr=0.

[7] National Energy Board Electricity Import Export Statistics (Jan-Dec 2011). Available on-line at: http://www.neb-one.gc.ca/clf-nsi/rnrgynfmtn/sttstc/lctrctyxprtmprt/2011/lctrctyxprtmprt2011_12-eng.pdf

[8] Based on SC 57-003-X *Report on Energy Supply and Demand in Canada – 2009 Preliminary*, and provincial documents (e.g. *Final Report – New Brunswick Energy Commission 2010-2011*).

[9] Presentation by Allan Crandlemire, Efficiency Nova Scotia to Climate Action Network Canada Provincial and Territorial Climate Change Leadership in Canada Conference (November 2, 2011). Available on-line at: http://can.cdn.hstd.org/wp-content/uploads/2011/11/Allan-Crandlemires-Presentation-Workshop-8.pdf.

[10] Efficiency savings level from NS UARB Docket No. M04819 – E-ENSC-R-12 Efficiency Nova Scotia Corporation Application for Approval of its *Electricity Demand Side Management Plan for 2013-2015*, Evidence of ENSC (revised) filed on April 18, 2012: http://www.nsuarb.ca/index.php?option=com_content&task=view&id=73&Itemid=82. Annual electricity sales from Emera's *Financial Report 2011*: http://www.snl.com/Cache/1001166584.PDF?D=&O=PDF&iid=4072693&Y=&T=&fid=1001166584.

[11] See Régie de l'énergie Order D-2012-024, R-3776-2011 (Demand relative a l'etablissement des tariffs d'electricity de l'annee tarifaire 2012-2013) on March 8, 2012. Available on-line at: http://internet.regie-energie.qc.ca/Depot/Projets/117/Documents/R-3776-2011-A-0058-DEC-DEC-2012_03_08.pdf

[12] State results are based on ENE analysis of CEE's *2010 Annual Industry Report* (electricity program budgets) and ENE's database of electricity sales in the states. Figures for NS are based on Efficiency Nova Scotia Corporation's *Electricity Demand Side Management Plan 2013-2015* (Revised), Emera's *Financial Report 2011*, and NSPI's 2011 Load Forecast. The figure for Québec is based on the Government of Québec's 2011-2012 *Budget Plan*, Régie de l'énergie Order D-2010-153 in Docket No. R-3709-2009 – *Demand relative a l'approbation annuelle du budget 2010-2011 des programmes et des interventions de*

l'Agence de l'efficacité de énergetique (http://www.regie-energie.qc.ca/audiences/decisions/D-2010-153.pdf), and Hydro Québec's *Annual Report 2011*. New Brunswick and Prince Edward Island do not report electricity-only efficiency program budgets, and are therefore not included in the $/MWh comparison.

[13] Per capita dollars of program investment is a common metric for comparing the level of effort between jurisdictions, however, given the dominance of the Commercial & Industrial (C&I) sectors, a more appropriate comparison for the region is $ per MWh (or $ per PJ or MMBtu) delivered.

[14] See endnote 10, above.

[15] Figure from Dunsky Energy Consulting's presentation to ENE and the project Steering Committee in November, 2011.

[16] See endnote 3, above.

[17] Table adapted from Dunsky Energy Consulting's presentation to ENE and the project Steering Committee in November 2011.

[18] Howland, J., D. Murrow (2009). *Energy Efficiency: Engine of Economic Growth*, ENE. Available on-line at: www.env-ne.org/resources/open/p/id/964

[19] BAU demand forecasts were developed by Dunsky Energy Consulting. Electricity forecasts are based on: Hydro Québec's *Electricity Supply Plan 2011-2030* (http://www.hydroquebec.com/distribution/en/marchequebecois/planification.html); NBSO's *10-Year Outlook: An Assessment of the Adequacy of Generation and Transmission Facilities in New Brunswick 2011-2021* http://www.nbso.ca/Public/_Private/NBSO%2010%20Year%20Outlook%202011-12.pdf; Nova Scotia Power's *2011 Load Forecast* (https://cleaner.nspower.ca/site-nsp/media/nspower/2011.10.Year.System.Outlook.Report.as.revised.Mar.2012.pdf); and personal correspondence with Maritime Electric. Natural gas and liquid fossil fuels forecasts are based on Gaz Metro's forecasts (Québec) and the National Energy Board's *2009 Reference Case Scenario: Canadian Energy Demand and Supply to 2020 – An Energy Market Assessment July 2009* (www.neb-one.gc.ca/clf-nsi/rnrgynfmtn/nrgyrprt/nrgyftr/2009/rfrnccsscnr2009-eng.pdf).

[20] Average energy savings lifespans for each customer class, fuel type, and efficiency target were provided by Dunsky Energy Consulting, Inc.

[21] The levelized unit program and participant costs for each customer class, fuel type, and efficiency target were developed by Dunsky Energy Consulting, Inc.

[22] 1 GJ = ~ 27 litres of fuel oil; 39 litres of propane

[23] See footnote 5, above.

[24] Hydro Québec's *Electricity Supply Plan 2011-2020*. Available on-line at: http://www.hydroquebec.com/distribution/en/marchequebecois/planification.html

[25] Nova Scotia Power's *2011 Load Forecast*. Available on-line at: https://cleaner.nspower.ca/site-nsp/media/nspower/2011.10.Year.System.Outlook.Report.as.revised.Mar.2012.pdf

[26] The study assumes renewables are highest-cost electricity in Nova Scotia during the studied time period, and thus would be the first taken offline or not built if efficiency increases. In reality, renewable (mostly wind) power will be used when available as NS legislation requires a growing ratio of renewable power in NS electricity production (40% by 2020). To meet these targets the utility's contracts with independent wind projects are "must run" when wind is available. The 20 year fixed price in the renewables contracts help stabilize electricity costs if fossil fuel prices rise during that time.

[27] No publicly available information on avoided costs for electricity were available for New Brunswick and PEI. The avoided costs used in the study were provided by Dunsky Energy Consulting, and adjusted based on conversations with New Brunswick Power, Efficiency New Brunswick, and Maritime Electric.

[28] Gaz Métro filing R-3752-2011 (http://internet.regie-energie.qc.ca/Depot/Projets/91/Documents/R-3752-2011-B-0244-DEMAMEND-PIECEREV-2011_08_31.pdf; http://internet.regie-energie.qc.ca/Depot/Projets/91/Documents/R-3752-2011-B-0061-PREUVE-AUTRE-2011_04_29.pdf; http://internet.regie-energie.qc.ca/Depot/Projets/91/Documents/R-3752-2011-B-0351-DEMANDE-PIECEREV-

2011_09_29.pdf) and R-3662-2008 (http://www.regie-energie.qc.ca/audiences/3662-08/Phase-2/PiecesPEN_3662-02/B-38_GM-10doc03_3662-2_13juin08.pdf)

[29] National Energy Board's *2009 Reference Case Scenario: Canadian Energy Demand and Supply to 2020 – An Energy Market Assessment July 2009*. Available on-line at: www.neb-one.gc.ca/clf-nsi/rnrgynfmtn/nrgyrprt/nrgyftr/2009/rfrnccsscnr2009-eng.pdf

[30] An average rate of load growth over the last five years of a published forecast was applied to extend electricity forecasts. For natural gas and liquid fossil, demand remained constant beyond published forecasts by Gaz Métro (Québec) and the National Energy Board (natural gas in NB and NS; liquid fossil fuels for all provinces) – i.e. zero annual load growth applied to the last year of forecasted demand.

[31] Conversion factors are based on Aube, F. (2001) *Guide for computing CO2 emissions related to energy use*, CANMET Energy Diversification Research Laboratory. Available on-line at: http://www.marcobresci.it/docs/guida_co2.pdf.

[32] RGGI precedent – get RGGI Inc. article

[33] *National Inventory Report 1990-2009: Greenhouse Gas Sources and Sinks in Canada*, Part 3, Annex 15 – Provincial/Territorial Greenhouse Gas Emissions Tables, 1990-2009. Figure represents total GHGs for QC, NB, NS, PEI.

[34] Goldstein, D. (2010, December 17). Some Dilemma: Efficiency Appliances Use Less Energy, Produce the Same Level of Service with Less Pollution and Provide Consumers with Greater Savings. What's Not to Like? Message posted to NRDC Switchboard: http://switchboard.nrdc.org/blogs/dgoldstein/some_dilemma_efficient_applian_1.html

[35] Levi, M. (2010, December 14). Mangling Energy Efficiency Economics. Message posted to Council on Foreign Relations' Energy, Security, and Climate blog: http://blogs.cfr.org/levi/2010/12/14/mangling-energy-efficiency-economics/

[36] Based on information from the following: Nyboer, J. (2011). *A Review of Energy Consumption and Related Data in the Canadian Wood Products Industry: 1990, 1995 to 2009*. Available on-line at: http://www2.cieedac.sfu.ca/media/publications/Wood%20Products%20Report%202010%20_2009%20data_%20Final.pdf; U.S. EPA's *Energy Trends in Selected Manufacturing Sectors: Opportunities and Challenges for Environmentally Preferable Energy Outcomes*. Prepared by ICF International, March 2007, Available on-line at: www.epa.gov/sectors/pdf/energy/ch3-5.pdf

[37] In reality, distribution and marketing are also included in the per-unit cost of heating fuels (equal to 10-20%).

[38] See e.g. Statistics Canada CANSIM Table 128-0006 – *Energy fuel consumption of manufacturing industries in gigajoules, by North American Industry Classification System (NAICS*); or Natural Resources Canada (2010*), Status of Energy Use in Canadian Wood Product Sector*. Prepared in collaboration with FPInnovations – Forintek Division Western Region. Available on-line at: www.forintek.ca/public/pdf/Public_Information/technical_rpt/Status%20on%20Energy%20use%20in%20Canadian%20Wood%20Products%20sector%20-%202010.pdf

[39] All underlying economic data sources are from Statistics Canada's National Economic Accounts. Available on-line at: http://cansim2.statcan.gc.ca/cgi-win/cnsmcgi.exe?Lang=E&C2Fmt=HTML2D&CIITpl=SNA___&ResultTemplate=THEMSNA2&CORCmd=GetPRel&CORId=3764. All underlying demographic data sources are from Statistics Canada catalogue numbers: 91-215-X, 71-001-X, 84F0211X, 84F0210X, and 84-537-XIE; Population Projections for Canada, Provinces and Territories; 2006 Census: Data Products (migration and labour force activity); and Actuarial Report Canada Pension Plan as at 31 December 2009.

[40] The regionally-calibrated software model is delivered with a *standard Regional Control* forecast out to 2040. This analysis has assumed that forecast is a sufficient long-term representation of the base case economies.

[41] *Relative* competitiveness is defined against the national average.

[42] The effective rate is defined as dividing total reported collections by the aggregate value of the tax base for the same year.

[43] Also called a per capita method, however, since population is not used for this model, the term "per unit" is used.