SECTION 2 –
CASE STUDIES OF BEST PRACTICES

CASE STUDY 1: HISTORICAL NARRATIVE OF NATURAL RESOURCES CANADA'S OFFICE OF ENERGY EFFICIENCY INITIATIVES

This narrative was based on a series of interviews with former employees of the Office of Energy Efficiency as well as its precursor organizations within NRCan. It was not designed to be comprehensive but illustrative, drawing out lesson learned where possible. It was undertaken by Peter Love who knew personally those who were interviewed for this project.

The preproduction of this narrative in this textbook was approved by Natural Resources Canada

HISTORICAL NARRATIVE OF NATURAL RESOURCE CANADA'S

OFFICE OF ENERGY EFFICIENCY'S INITIATIVES

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1. BACKGROUND

"If you don't know where you've been, you don't know where you are going"

Introduction

Natural Resources Canada (NRCan's) Office of Energy Efficiency – OEE (and its predecessors the Office of Energy Conservation – OEC, and the Conservation and Renewable Energy Branch – CREB) have been developing, delivering and improving energy efficiency programs and tools for the housing, building, equipment, community, industry and transportation sectors since 1973. They have undertaken these projects because energy efficiency has proven to be a reliable way to reduce greenhouse gas emissions, lower energy costs for Canadians and provide stimulus to the economy through increased employment.

The Canadian energy efficiency landscape is constantly evolving through action by various levels of government, energy utilities and consumers. OEE continues to play a key role in this evolution and has embarked on a strategic planning exercise to align its initiatives accordingly. In this context, a clear understanding of federal energy efficiency initiatives – past and present – will help chart a future that builds on successful initiatives.

The objective of this narrative is to document a **selection** of OEE's energy efficiency initiatives since its creation. This research will help inform NRCan's strategic planning, as well as policy development and stakeholder engagement, in the context of the Government's efforts to support Canada's transition to a low-carbon economy. Throughout this narrative, the term OEE will be used to also include OEC, CREB and its other predecessors.

Scope of Narrative

Aside from the temporary campaigns and rationing during the last two world wars, the Department of Energy, Mines and Resources (EM&R), the predecessor to NRCan, began developing and delivering energy efficiency programs and tools before any other government or utility in Canada in 1973. Other early programs were launched by Ontario Hydro and BC Hydro in the mid 1980's, which were then followed by other provincial and utility programs. With over 45 years of continuous program delivery, this narrative will not attempt to document every program or change made to these programs. Instead, it will focus on a selection of a few of the initiatives that occurred over this period that illustrate the key features of other similar initiatives.

It is also important to note that this narrative will be limited to past initiatives of OEE and its predecessors. It thus does not include the work currently being done at OEE or the energy efficiency activities that have been undertaken by other groups within NRCan (such as CanmetENERGY) or other departments (such as Environment & Climate Change, National Defense, Agriculture, etc) and agencies (such as the National Research Council or Canada Mortgage and Housing Corporation).

Structure of Narrative

This narrative could have been organized in a number of different ways.

A. **Sectoral:** One way would be to categorize by economic sector (the five major sectors of the economy being homes, removed equipment as it is not a sector,buildings, industry and transportation). Although OEE has been active in each of these five sectors since its inception and the organization was often structured to reflect sectoral activities, the types of initiatives taken to each sector are similar and thus organizing by type of initiative would is more appropriate.

B. **Chronological:** The most obvious and straightforward way to organize this narrative would be chronologically, noting the different major periods. Although never clearly documented in the past, there would appear to be four major periods:

- ***Launch – 1973-1987*** – This initial period started with the launch of the Office of Energy Conservation which specifically included conservation as this was thought to be a broader term that encompassed sustainability. During this period, many programs including the Canadian Home Insulation Program (CHIP), the Canadian Oil Substitution Program (COSP) and the R-2000 Program. The EnerGuide rating system for energy products was also developed during this timeframe, as well as a wide range of very popular consumer 'How To' booklets.

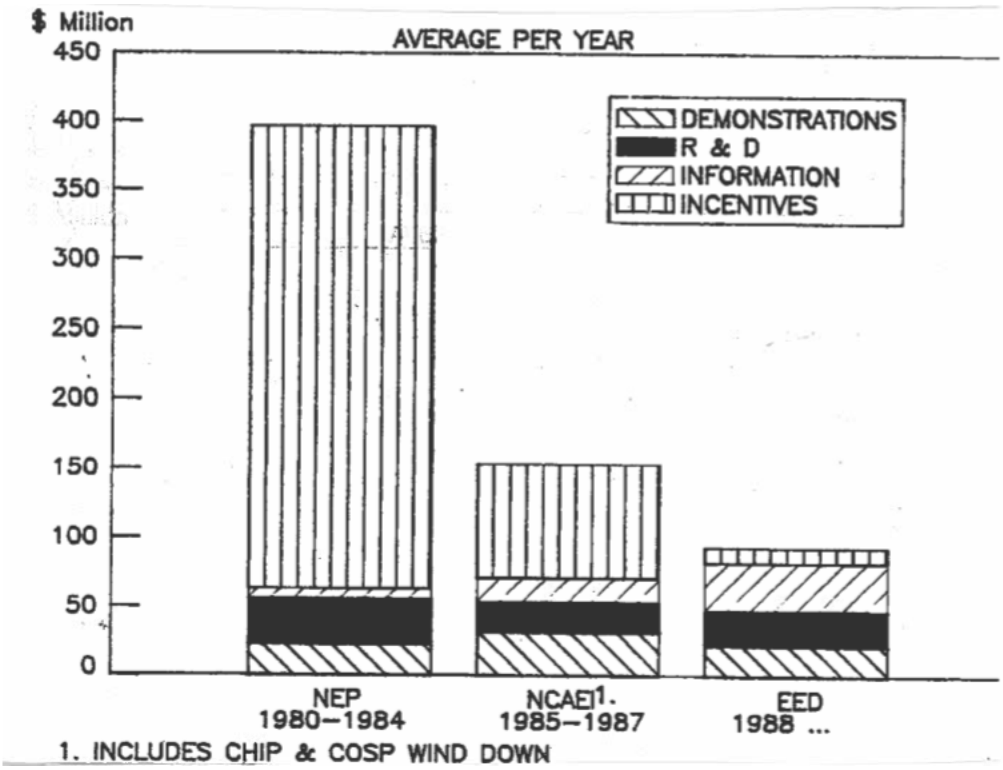
- ***Consolidation – 1988-1997*** – This is the period of rapid change, when all the incentive programs launched during the previous period were cancelled as part of the decision to move away from the National Energy Program and OEE staff fell from over 100 to about 50. Those who experienced it first-hand refer to the meeting when these changes were announced as the "Buffalo Jump". Although this era was challenging, it was also a period of time that saw the launch of important new initiatives, including the Energy Efficiency Act in 1992 which allowed the government to set Minimum Energy Performance Standards (MEPS) for energy consuming products; and a Model National Energy Code for Buildings (MNECB) in 1997 which was developed as a model code for adoption by authorities having jurisdiction.

- ***Expansion – 1998-2011*** – This is the period when various new incentive programs were reintroduced in response to growing concerns and commitments by the Canadian public and various Canadian governments to reduce greenhouse gas (GHG emissions). One of the most prominent of these new programs was the EnerGuide Home Incentive Program which was launched in 1998 removed ecoENERGY as it did not offer incentives. Also launched that year was the Commercial Building Incentive Program (CBIP).

- ***Ambition – 2011-present*** – During this period, previous incentive programs were cancelled but OEE has been able to retain its core non-incentive initiatives. Key activities have included the Pan-Canadian Framework on Clean Growth and Climate Change, commitment to developing model net-zero energy ready code for new buildings, model code for existing buildings, labelling and benchmarking activities, stringent equipment standards via regulations, joining the UN General Assembly's Global Alliance for Buildings and Construction (ABC) in 2015 and subsequently hosting a meeting, and Build Smart: Canada's Building Strategy. These more recent initiatives are not included in this narrative, which focuses on previous initiatives.

An indication of the size of past funding changes can be seen from Figure 1 which shows average annual program expenditures between 1980 and 1988 [1].

FIGURE 1
AVERAGE ANNUAL PROGRAM EXPENDITURES BY OEE 1980-1988



Source: Energy Mines & Resources [1]

C. **Key Drivers**: A third way to organize this narrative would be based on the key driver that informed OEE activities at the time. The three core drivers named below line up fairly well with the chronological periods previously identified. This was likely because it was the change in these drivers which defined the different periods. The three drivers were:

- ***Energy Price/Security – 1973-1987*** – The creation of the Office of Energy Conservation (OEC) was one of the Canadian government's responses to the 1973 Oil Crisis, when the OPEC (Organization of the Petroleum Exporting Countries) imposed an embargo on the export of oil to five countries, including Canada. The average price of oil subsequently increased more than four times, from $2.70 to $11/barrel[2] with growing concerns regarding energy security. While many, including a prominent Premier, called for federal subsidies to reduce oil import costs, the decision was made to at least partially offset the policies and funding for the supply side of the energy equation with money for an office to promote the demand side by encouraging energy conservation. Also in 1973, the Science Council of Canada published the first of many forthcoming Canadian reports calling for a more sustainable future including the call for a "Conserver Society."[3] Two years earlier, the Club of Rome had commissioned a study on the world's future, which became the subject of the subsequent book The Limits to Growth[4] which included rebeen shown to be boith more effeccommendations on improving energy and resource efficiency. This was also the recommendation of a number of environmental organizations who were active in various energy project reviews at the time. A few years later in 1979, the Second Oil Crisis - caused by the Iranian Revolution- saw oil prices more than doubling to $29.19/barrel[2]. The 1980 National Energy Program (NEP) was one of Canada's main responses to this second oil crisis. Although the NEP is most remembered by its "made-in-Canada" oil price, one of its seven main elements was to offer financial incentive to promote energy conservation and oil substitution. By 1986, oil prices had gone down to $13.51/barrel, and remained below $30 until 2004.[2]

- ***Economy – 1988-2000*** – With lower oil prices and growing concerns over government debt levels, it became more difficult to justify investing federal general revenue funds on energy efficiency incentive programs. Instead, the OEE was able to retain its core non-incentive activities based on the savings that energy efficiency would create for homes, organizations, businesses and drivers. These initiatives supported Canada's 1990 Green Plan and the signing of the 1992 Rio Declaration

- ***Environment/Climate Change – 2000-present*** – Following Canada's agreement to join 159 other countries that signed onto the Kyoto Protocol in 1997, the Canadian government launched "Action Plan 2000 on Climate Change." Energy efficiency was featured prominently in the sections of this plan that covered the transportation, energy, industrial, and buildings sectors. After 2011 OEE refocused its efforts into further leadership on codes and standards as well as various tools and engagements with other levels of government as these initiatives had been found to be more cost effective than incentives.

D. **Initiative Types***.* A further way to organize this narrative is by types of initiatives. While expressed in different ways at different times over the last 45 years, they can be categorized around four main areas:
   - Leadership;
   - Codes & standards;
   - Information/tools/training; and
   - Incentives.

As the first three – Leadership, Codes and Standards, and Information/Tools/Training have remained the core elements of OEE activities since its inception, this is the approach used to organize this narrative.

The following four sections summarize the key elements of each and how they have evolved. The scope of this project does not permit a detailed description of individual programs, their budgets, targets, or results; this could be the subject of a subsequent project.

The final section of this narrative summarizes lessons learned by former OEE staff who were interviewed regarding future OEE initiatives.

Methodology

Over the past 45 years, OEE has published hundreds of reports, with the more recent ones made available on its website. While these reports provide useful details regarding each of the four major types of initiatives, this narrative relies mainly on one-on-one and group interviews with former senior staff at OEE and its predecessor organizations. Their comments form the basis of this narrative, but there is no attribution to any one individual. Appendix A contains the names and last title of those who agreed to provide their insights for this narrative. The author would like to personally thank David Brooks and Carol Buckley (former Director General), Brian Kelly, Barbara Mullally Pauly, Phil Jago, John Cockburn, Louis Marmen and Anne Auger (all former Directors) for their time and cooperation on this project. And finally, a special thank you to Jerome Bilodeau, Chief, Strategic Policy (Buildings and Industry Division at OEE) for all of his support and guidance on this project.

2. LEADERSHIP

Active and consistent leadership at the international, interprovincial and interdepartmental levels is perhaps the most important -but often unrecognized- asset brought forth by the OEE.

International

At the international level, this has included the OEE's Director General serving as chair of the International Partnership for Energy Efficiency Cooperation (IPEEC). The creation of this organization, which remains active today, grew out of work tasked by the G8 Energy Ministers' meeting in Heiligendamn in 2007. More recently, OEE has worked closely with the Asia Pacific Economic Cooperation (APEC) and the International Energy Agency in various areas particularly in collaborating on the development of globally traded products.

Alignment with energy efficiency initiatives in the US has been a significant preoccupation with OEE. This has extended to aligned equipment standards and labelling programs and ENERGYSTAR housing and building programs with the recognition of the economies that seamless trading borders can bring.

Interprovincial

At the interprovincial level, both Assistant Deputy Ministers (ADMs) and Director Generals (DGs) played leading roles at the ADM Steering Committee on Energy Efficiency and its various subcommittees. For many years, OEE prepared and delivered reports at the annual meetings of the Energy and Mines Ministers Conference (EMMC) and its predecessor, the Council of Energy Ministers. One example of this leadership is the report "Build Smart: Canada's Buildings Strategy," which was adopted by First Ministers at the 2017 edition of the EMMC conference. [5]

Interdepartmental

At the interdepartmental level, OEE has been a consistent source of information and advice on energy efficiency policy and programs to other departments. Following the signing of the Kyoto Protocol, OEE staff played key leadership roles in many of the climate change panels that were formed and met over a period of 2-3 years and produced a number of useful and insightful reports.

OEE leadership in this area has also included supporting more than 80 energy efficiency retrofits of federal facilities since the inception of the Federal Buildings Initiative (FBI) in 1991. Over the last three decades, custodial federal organizations have often used guaranteed Energy Performance Contacts (EPCs) as a tool to fund energy efficiency improvements. The 2015 Evaluation of the Office of Energy Efficiency noted the FBI has shown that 82 energy efficiency retrofits between 1994 and 2014, paid for through $329 million in energy performance contracts, have saved the federal government $45.5 million in annual operating costs[6]. More broadly within the Canadian economy, the EPC industry is worth $450 million/year, generating annual energy savings of about $45 million/year. It is estimated that this industry is currently responsible for over 4,000 direct jobs and 5,000 indirect jobs. Up to 80% of the labour associated with these projects is local[7]. Experience has also proven the importance of training and capacity building activities to support federal building retrofit decision-making.

The precursor to the FBI Program was the Canadian Federal Energy Management Program (C-FEMP) which reduced federal energy use by 28% and avoided $1 billion in cumulative energy costs.[6] C-FEMP's information and training activities were highly rated by users and had a high rate of incrementality. The evaluation of C-FEMP determined that most projects were cost-effective. After the program was terminated in 1986, there was no central federal program to coordinate and facilitate energy efficiency investments. Consequently, lack of available capital investment, lack of available personnel with technical expertise to select energy efficient technologies and failure to ensure correct operation after installation, prevented departments from realizing energy efficiency opportunities. Consequently, the program was reinstated as the Federal Buildings Initiative in 1991. This program was a direct response to the 1990 "Green Plan" which included a section on "Starting in our Own House." The first FBI project was the Harry Hayes federal government building in Calgary. The first NRCan building was the Geological Survey of Canada building, also in Calgary; interestingly, an earlier audit had indicated limited savings potential for this building but the OEE person who visited the site saw opportunities and the project ended up reducing energy consumption by 35%.

As part of the Action Plan 2000, the OEE also delivered, jointly with Department of Indian and Northern Affairs, a program to promote improved energy efficiency in First Nations communities.

Public Outreach

In its early years, OEE also developed and managed a series of public outreach organizations. The first were Community Conservation Centres, which were created in 1978 to increase community knowledge and understanding of energy conservation and encourage activity in this area. The next were Conservation and Renewable Energy Offices (CREOS), which were set up in each province and territory to assist in the delivery of OEE programs, in particular the Canadian Oil Substitution Program (COSP), discussed later in this narrative. A third initiative in this area was the Energy Pathways Program, a community outreach program. Removed ref to Ficner and Lyons otherwise would have had to mention other directors

External Panels and Conferences

Another initiative in this area was the creation of the National Advisory Committee on Energy Efficiency (NACEE), which was convened by OEE and consisted of energy efficiency experts from all sectors of the economy. It was one of the outcomes of the rebranding of the former Efficiency and Alternative Energy Branch. NACEE provided an opportunity for leaders from across Canada to meet and learn from each other and keep up to date with what was going on in the sector. This group met several times annually from the late 1990s and played a valuable role in assisting OEE in the development and improvement of their programs and policies.

In the late 1990s/early 2000s, OEE was also active in setting up and delivering national conferences that focused on various aspects of energy efficiency. These included the Energy Summit which is a biennial conference, first held in 2003. It is one of several tools that contribute to the objective of NRCan's Industry Energy Management Program: *accelerate the uptake of energy management to help companies save money and reduce greenhouse gas emissions by reducing energy per unit of production.*

The not-for-profit Excellence in Manufacturing Consortium (EMC) has partnered with NRCan on the last three events (2018, 2016 and 2014); prior to that, the Canadian Manufacturers and Exporters (CME) was the co-host. EMC has been responsible for logistics, registration and securing exhibitors, while NRCan has handled the conference content, i.e., developing the program and finding speakers. The co-hosts jointly share responsibility for marketing and promotion.

The conference has also been the venue for presentation of the biennial Canadian Industry Partnership for Energy Conservation (CIPEC) Awards.

Recognition

OEE also launched a full suite of awards, including the ENERGY STAR Canada Awards Program. Beginning in 2003, the ENERGY STAR Canada Awards Program has been celebrating energy efficiency leaders ever since, at an annual award ceremony where the awards are highly coveted by winners. Other awards include the ENERGY STAR Market Transformation awards, the CIPEC Leadership awards (referenced in the previous paragraph) and the SmartWay Excellence awards.

Previous Leaders

On an organizational level, OEE has been fortunate to have had a remarkable series of exceptional leaders, some of whom were interviewed as part of this narrative.

David Brooks was the first Director General and set up the Office of Energy Conservation. Donald MacDonald was the Minister at that time and Ian Stewart, his Deputy Minister, was a strong proponent of ensuring that the entire focus of energy policy was not just on the supply side. Ian Efford took over as Director General in 1978 and oversaw much of the early growth of the office. He was succeeded by Charles Marriot who was succeeded by Doug Patriquin and Guy McKenzie who had the removed unenviable as it was his job task of cancelling the incentive programs and reducing staff to 40% of its former size in 1987 after having expanded it initially. Bill Jarvis, the next Director General, was charged with the establishment of a new non-incentive focused organization; at the end of his term, he started the process to rename the office to its current Office of Energy Efficiency and launching the National Advisory Committee on Energy Efficiency (NACEE). The next leader was Neil MacLeod who oversaw the launch of many new programs including the very successful ENERGYSTAR for Houses Program. Carol Buckley, who had been with OEE since 1983 (for all but 2 years), served as Director General from 2006 to 2015 and played a vital role in keeping OEEs core activities funded during a period when most other departments were facing massive cuts to programs and staff.

Beyond these leaders, there were also periods when Ministers played a very active role in advancing energy efficiency. In 1976, then Minister of Energy Mines & Resources, Alastair Gillespie, opened the first national conference on industrial energy efficiency which was attended by many of the leaders in industry. Out of this conference and future discussions, the Canadian Industry Program for Energy Conservation (CIPEC) was born. When this program began to lose momentum after a few years, it was Minister Anne McLelland who worked with Chuck Hantho, CEO of Dofasco, to reinvigorate it. Other early strong supporters of energy conservation were Tommy Douglas, the first leader of the New Democratic Party, John Fraser, the Progressive Conservative Minister of the Environment and Speaker of the House,with his strong support for the FBI Program, Ralph Goodale who was there for the launches of the EnerGuide for Houses and Commercial Building Incentive Program when he was Minister and Lisa Raitt when she was Minister, ably supported by Cassie Doyle who was a particularly strong advocate for energy efficiency.

3. CODES & STANDARDS

The OEE have actively used Codes and Standards to help reduce energy consumption since its inception using a multi-level approach to transforming the market for most energy consuming products. This has consisted of the following three core elements:

- ***Eliminate the Worst -*** Mandatory Minimum Energy Performance Standards (MEPS): set minimum energy performance requirements for specified energy consuming products. They eliminate the worst, most energy- inefficient products from being imported or sold across borders in Canada.

- ***Inform Choices -*** Energy consumption labels such as EnerGuide help consumers make informed purchasing choices by identifying and comparing the energy consumption information of various product brands and models.

- ***Promote the Best*** - Labels such as ENERGY STAR and R-2000 help promote the most energy efficient brands and models.

Figure 2 illustrates these three main approaches to using codes and standards currently in use in Canada.

FIGURE 2

THREE MAIN APPROACHES TO USING STANDARDS IN CANADA

Source: OEE [8]

One indication of the impact of codes and standards on energy consumption is the fact that, since 1992, energy consumed by household appliances has been reduced by 32%.[7]

Eliminate the Worst

In 1992, Canada passed the Energy Efficiency Act which gave it the authority to regulate Mandatory Minimum Energy Performance Standards (MEPS) for identified products that were shipped across international or provincial borders for the purpose of lease or sale. Regulations are now in place for 80% of the products and equipment used in residential, commercial and industrial sectors.[9] In 2008, it was estimated that new measures would have the potential to reduce energy demand in Canada by an amount equal to almost 25% by 2030.[9] It has also been estimated that almost $5 billion in cumulative present value energy savings will be realized by 2030.[10]

Since the late 1980s, OEE worked with a consortium of provinces, utilities, industry stakeholders and the National Research Council to develop the Model National Energy Code for Buildings (MNECB) which was released in 1997. It was Canada's first national voluntary standard for building energy performance and influenced the level of energy efficiency incorporated into one provincial and one municipal building code. Its largest impact on construction practices was that it was required in order to receive incentives under the CBIP Program practices.

In 2011, the MNECB was updated and renamed the National Energy Code for Buildings (NECB); this renaming made it more consistent with other model national construction codes. It included an average 25% performance improvement over the MNECB. The new code outlines the minimum energy performance levels for all new buildings; it also offers more flexibility for achieving compliance. The NECB was last updated in 2015 and included 90 new changes that further increase the minimum energy efficiency of new buildings. OEE is currently in the process of developing model codes for existing buildings as well as a Net Zero Energy Ready requirement for new buildings by 2030.

Inform Choices

Canada developed the EnerGuide label in the mid 1970's that has formed the basis for energy consumption labelling ever since. It is required on most smaller household appliances with related voluntary applications for most residential HVAC (Heating, Ventilating and Air Conditioning) products.

One of OEE's first publications, "The Mileage Book", listed the fuel economy of all makes and models of cars and light duty trucks sold in Canada. The publication of this booklet along with other related publications led to the development of the government's own corporate fuel efficiency program which got off to a very promising start. The OEE web site and app offers the means to compare vehicle efficiency across the various types of vehicles available in Canada. EnerGuide rating labels are now required on every new car and light truck sold in Canada.

Promote the Best

In 1982, OEE, in partnership with the Canadian Home Builders Association, launched the R-2000 Program which established very high minimum energy performance standards that houses were required to meet in order to receive certification. This program was based on the success of a series of highly efficient homes that were built in Saskatchewan in the late 70's, and on NRCan's Super Energy Efficient Housing Demonstration Program which was managed with CanmetENERGY.

In 1992, the US launched the voluntary ENERGY STAR program that identifies the most energy efficient brands or models. Ten years later, NRCan gained the rights to use this symbol in Canada. There are now more than 75 different product categories for equipment, new houses, commercial buildings and industrial plants that can be certified. In the US, it has been estimated that ENERGY STAR and its partners have helped save American families and businesses $430 billion on their energy bills.[11] Applying the 10:1 rule of thumb, this would imply savings of about $40 billion in Canada. The Energy Star program for New Houses program has now been used to certify 100,000 homes in Ontario alone[12], and a 2012 survey of Canadian consumers judged ENERGY STAR the best energy efficiency tool available.

4. INFORMATION/TOOLS/TRAINING

Information

One of OEE's first activities was to develop and publish booklets in both English and French that would assist consumers to save energy in their homes. These included "100 Ways to Save Energy, Money and the Environment," "The Furnace Book," "The Mileage Book," "Keeping the Heat In," "The Garbage Book" and many more. As an indication of the popularity of these publications, more than 3 million copies of "Keeping the Heat In" were distributed.

OEE has always been known for the unbiased reliability of the information they provide and the quality of their publications. While initially only available in printed versions, most are now available on the OEE web site.

As this was many years before the internet, the OEE set up the Ener$ave Heatline, which fielded calls from consumers across Canada on the best way to choose energy saving products and install energy saving technology in their homes. Three future Directors at OEE began their careers with this program.

In addition to providing information to assist residential end users, OEE has also been a leader in collecting key energy data that can be used by governments as well as the private sector. In 1991, the OEE launched the National Energy Use Database (NEUD) initiative to help the department improve its knowledge of energy consumption and energy efficiency at the end use level. The development of this formalized approach to documenting energy efficiency impacts is perhaps the most important legacy left by Bill Jarvis. The NEUD's most important ongoing role is to secure the development of a base of reliable national information on energy consumption for all sectors. This information was particularly important for use by the CIPEC sector panels and gave them confidence in the baseline data. This data is also summarized in the Comprehensive Energy Use Database which provides an overview of sectoral energy markets in Canada and in each region of the country.

Tools

In addition to general publications, OEE has also played a leading role in the development and promotion of a wide range of tools used by the public and private sector across Canada. This included, with sibling organization CanmetENERGY, HOT2000, a home energy simulation tool that is used to certify homes to meet the R-2000 and the EnergyStar for New Homes Standards, as well as the EnerGuide labels for both new and existing homes.

More recently, the OEE developed the CAN-QUEST software, based on a US version, which models energy use in buildings and ensures that new buildings comply with NECB 2011 and that new buildings and additions comply with the NECB 2017.

Another tool actively promoted by OEE is ENERGY STAR Portfolio Manager, which has become an industry standard for benchmarking many different types of buildings. Initially developed in 1999 in the US, OEE negotiated the rights adopt it to the Canadian context and for NRCan to use it in Canada in 2011.

An international tool that OEE has brought into Canada is the ISO 50001 Energy Management Systems Standard, which provides commercial and industrial facilities with a structured framework to manage their energy use. First introduced in 2011, it has been estimated that such systems have the potential to save up to 30% of the total energy use in industry and up to 40% in commercial buildings.[13]

Training

OEE has been offering the Dollar to $ense Energy Management training workshops since 1997. More than 5,000 of these workshops have trained more than 75,000 energy professionals. These workshops are now being delivered by the Canadian Institute for Energy Training (CIET) through a licensing agreement from the OEE.

5. INCENTIVE PROGRAMS

As noted in the background section of this report, OEE has gone through two periods when incentives were a prominent part of their activities (1973-87 and 1998-2011), both of which were followed by two periods where the other three initiatives (leadership, codes & standards and information/tools) were the focus. This was due in large part to changing global economic circumstances which impacted the drivers behind energy efficiency. Another factor was the impact of debt reduction as a federal priority by both Conservative and Liberal governments, which forced all department to reduce expenditures. Various reports have noted that energy efficiency programs funded by general government revenue, such as OEE's programs, are much easier to cancel than those funded by energy consumers through regulated revenues recovered from rate payers. The first such study was done for the ACEEE (American Council for an Energy Efficient Economy) in 1998, which concluded that the funding levels of energy efficiency programs funded by rate payers are much more consistent than those funded by general government revenue.[14] This was due to the relative difficulty of unwinding the regulatory processes related to rate-payer based funds, compared to the relatively easy cancellation of programs funded by general revenues.

It is far beyond the scope of this narrative to summarize the key features of the many incentive programs successfully managed by OEE over the past 45 years. Instead, the following is a summary of the key features and lessons learned from four of the biggest and most prominent of these programs: Canadian Home Insulation Program (CHIP) which was initially called the Home Insulation Program (HIP), Canada Oil Substitution Program (COSP), ecoENERGY Retrofit - Homes Program (initially called the EnerGuide for Houses Program) and the Commercial Building Incentive Program (CBIP).

Home Insulation Program (HIP) and Canadian Home Insulation Program (CHIP)

HIP was the first incentive program launched after the formation of the OEE. It was originally administered by CMHC and initially focused on providing incentives to the three Maritime provinces (New Brunswick, Nova Scotia and P.E.I.) as they were particularly dependent on imported oil for space heating. The program was soon expanded across Canada and was renamed CHIP. The program initially provided up to 40% of the cost of home insulation, later increased to 50% and then 60% up to a maximum of $500.

At its peak, it was spending about $250 million/year and it is estimated that over 900,000 homes participated in the program. As homes that participated in the program had little or no attic insulation, the addition of R20 had a huge impact. The program was successful by most standards, but it did have a number of challenges. Although urea formaldehyde foam insulation (UFFI) had been successfully used for many years in the UK to insulate the hollow area between exterior brick walls and indoor walls, this technique was relatively new to Canada. As initially there were no industry standards for training or performance, some installations caused problems, including the incorrect mixtures of the components, application when weather was not suitable, overfilling of cavities, etc. There were also issues associated with ensuring that the work was done correctly and would lead to expected energy savings. These problems became widely reported in the media and led to the eventual banning of UFFI and thus removal of UFFI from the program. Lawsuits to recover the cost of removing UFFI followed and a program was set up in Consumer and Corporate Affairs to provide funding to remove UFFI from walls.

A number of valuable lessons were learned from this experience. One was a much stronger focus on Evaluation, Measurement and Verification (EM&V) of programs. Another was a commitment to ensuring sufficient understanding of the building science associated with new products before they get included in government incentive programs. The industry's response was the creation of associations that provide installer training and certification courses for various types of insulation.

Canada Oil Substitution Program (COSP)
COSP was launched in 1980 as part of the National Energy Program. It provided incentives for the replacement of oil fired heating systems with non-oil systems such as natural gas, electricity (resistance and heat pumps) and wood. This replacement market stimulated the development for more efficient systems. At its peak, incentives totaled over $300 million/year. Although the prime focus of this program was to reduce Canadian dependence on imported oil, it also specified that only more energy efficient modes of natural gas furnaces could be used.

EnerGuide for Houses
The EnerGuide for Houses Program was launched in 1998. It provided homeowners with incentives for prescribed home energy retrofits that require an initial EnerGuide audit (to identify opportunities) and a subsequent audit (to confirm that the upgrades were made). The use of before-and-after audits was based on the lessons learned from the CHIP and COSP programs, as well as the availability of the HOT2000 audit tool. When a new government was elected in 2006, the program was re-visted and renamed the ecoENERGY Home Program. By 2012, the target of retrofitting 250,000 homes had been reached and the program was terminated.

As noted earlier, one of the lasting impacts of this program was the commercialization of very high efficiency condensing gas furnaces which went from a market share of 40% in 1998 to 80% in 2008.[15] During this time, the price also dropped by 30% and production home builders realized that they did not need to install brick chimneys for these furnaces, saving both costs and time. Regulations under the Energy Efficiency Act in 2008 made high efficiency condensing gas furnaces mandatory. Removed ref to knowing that future budget $ would be required

Canadian Building Incentive Program (CBIP)

The Minister of Natural Resources Canada (NRCan) introduced the Commercial Building Incentive Program (CBIP) in 1998. Removed 2 sentences re intent as repetitive The purpose of CBIP was to reduce the energy consumed in new commercial/institutional buildings by encouraging energy-efficient design practices that were 25% more energy efficient than similar buildings constructed under the Model National Energy Code for Buildings (MNECB) of 1997. Commercial and institutional buildings are responsible for about 11% of Canada's secondary energy use.

Until May 18, 2001, CBIP provided a one-time financial incentive equal to up to three times the value of the estimated annual energy savings of the building when compared to a similar building constructed under the MNECB. The maximum contribution was the lower of $80,000 per building or the design cost of the building. After May 18, 2001, the maximum contribution was reduced from three times to two times the value of the estimated annual energy saving up to a maximum of $60,000 per building. For owners with more than one building, the maximum was 12 buildings or $500,000. It offset the incremental design costs associated with designing energy efficient buildings. CBIP supported training in energy efficient design and the energy performance labelling of buildings. CBIP was delivered by the federal government in Ottawa but with some informal partnering arrangements with the private sector.

CBIP had three main activities:

- Develop technical tools and provide training by workshops to building design professionals to be more energy efficient;
- Promote the concept and aims of the program through trade shows and conferences, and;
- Provide financial assistance to promote energy efficient design.

The program covered both large and small buildings. For large buildings, applicants were required to run their proposed design through CBIP approved energy performance simulation software. This software was accessible from the NRCan website. For builders of small commercial buildings, the OEE provided prescriptive packages of energy efficiency improvements for specific types of buildings. When these improvements were included in the design, the OEE considered the design to meet the efficiency specified for the measure set (all of these exceed 25 percent). An evaluation of CBIP was completed in 2001, covering the period of April 1, 1998 to October 31, 2000.

This program was so successful that it led the Canadian Green Building Council (CaGBC) to use CBIP as an assessment tool to confirm a buildings energy score and thus contribute to its overall Leadership in Energy and Environmental Design (LEED) certification. Even after CBIP was wound up, CaGBC has continued to use it as a compliance tool. Like the ecoENERGY program, OEE were aware that their initial budget requests to Treasury Board would require them to return to seek further funding as the program was expected to be very popular with building owners.

A related incentive program was the Energy Retrofit Program for Existing Buildings which provided incentives for energy efficiency upgrades to existing commercial and institutional buildings. Like the EcoENERGY program, it also underwent various name changes over the years.

6. LESSONS LEARNED FROM PAST LEADERS

All of the past leaders who were interviewed for this narrative were pleased to have the opportunity to share lessons learned from their time as OEE leaders.

Many shared very similar views but there was one disagreement, particularly on the role of the OEE in using general government revenue to fund incentive programs. The following is a short summary of the main lessons learned:

- ***Consistency*** – One of the most important lessons from the past 45 years seems to have been the **importance of having a consistent voice in the federal government on the importance and role of energy efficiency.** Like the public dialogue on energy, almost all the focus in government on energy is on the supply side – oil sands, pipelines, LGN, coal plants, nuclear, renewables, transmission lines, etc. with very limited mention of the importance of the demand side of the energy equation.

- ***Understand the Client –*** Although it is recognized that with travel restrictions, it is hard for OEE staff to get out of their offices to meet industry experts and visit sites, this is a fundamental requirement that should not be overlooked. One of the examples here is holding CIPEC meetings at manufacturing sites across Canada so OEE staff as well as other members of CIPEC can see for themselves the initiatives that have been taken and the further ones that are being planned.

- ***Insist on Good Data –*** One of the key successes to previous OEE programs has been insistence on ensuring that there is **reliable and accurate energy data** and that this data is updated on a regular basis and used to track and assess progress. One example of such data is benchmarking data which includes company or sector level tracking.

- ***Partnerships –*** OEE's programs can maximize their impact when they are developed and implemented in partnership with other levels of government (building codes), utilities (incentive programs) and recognition programs (R-2000 and ENERGY STAR). While this results in OEE's role being less visible, the benefits outweigh this consideration. The Federal Government was often the only organization having the critical mass necessary to develop data, tools, standards, and codes but private and government sector partners were usually better positioned to deliver information and programs to end users.

- Removed section of support of minister – serving the Minister was always front & centre

- ***Codes & Standards*** – Development and enforcement of codes and standards has proven to be one of the most cost-effective ways of making large improvements in energy efficiency. They are the most effective means to truly lock-in the benefits of market transformation. It is also important to recognize that almost all industries have agreed that they would far prefer one national (or even North American) standard to 10 or 60 different provincial/state standards. The compliance infrastructure (through market surveillance) already in place to ensure compliance with these regulations may also be useful to ensure that claims made by manufacturers re GHG emission reductions associated with their products are justified.

- ***Information & Tools*** – OEE has built a strong reputation over its 45 years history of providing unbiased and useful information and tools that assist Canadians in making wise energy choices. With the transformations underway with electric vehicles and the intent of things, it might be timely for OEE to consider updating its potential study that was done a few years ago with the IEA.

- ***Environmental Benefits –*** Emphasizing the environmental benefits is at least as good a way to promote energy efficiency as dollar savings. One of the unusual features of OEE leadership since the 1980's is that many stayed with the office for most of their careers as they were committed to the environmental objectives of the office.

- ***Incentives –*** As noted earlier, the one area where there was disagreement over the role of the OEE was with respect to incentives. As OEE currently relies solely on general government revenue for all its funding, this means that any incentive program would be funded by this general revenue. While most of those interviewed did agree with the importance of having financial incentive programs as a way to draw attention to energy efficiency opportunities, most thought that a better source of such funding would be from utility rate payers as is common in most provinces as well carbon pricing which OEE, at this time, is not able to fully access.

APPENDIX A – PAST LEADERS INTERVIEWED FOR THIS PROJECT

The following are the names, years associated with OEE and last position of those interviewed for this narrative.

David Brooks	1973-1978	Director General
Brian Kelly	1973-1985	Director, Information Programs
Barbara Mullally	1977-2008	Acting Director, Housing Programs
John Cockburn	1980 – 2014	Director, Equipment Division
Phil Jago	1980 – 2016	Director, Buildings
Carol Buckley	1983 – 2015	Director General
Louis Marmen	1997-2007	Director, Residential & Equipment
Anne Auger	2003-2007	Director, Buildings

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CASE STUDY 2: BRITISH COLUMBIA

The original case study for BC was written by Andrew Pape-Salmon and Tom Berkhout, both of whom worked for the BC government when this was prepared in 2018. It was reproduced with the permission of Pierre Langlois of Econoler who published it in Canadian Energy Efficiency Outlook: A national Effort for Tracking Climate Change [1].

This Case Study was updated in 2022 by Bijan Pourkarimi of Energitix and reviewed by Andrew Pape-Salmon, now a commissioner with the BC Utilities Commission. This update was made possible by funding from FortisBC.

1. Langlois, Pierre and Gauthier, Geneviève. Canadian Energy Efficiency Outlook: A national Effort for Tracking Climate Change 1. The Fairmount Press, Lilburn, GA, 2018.

CASE STUDY: BRITISH COLUMBIA

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1 Background

The three major sources of energy consumed in British Columbia (BC) are electricity (233 PJ), natural gas (271 PJ), and petroleum-based products (461 PJ)[1]. In 2019, more than 90% of the electricity generated by BC-based utilities came from hydroelectric sources; less than 5% from fossil fuels; and the remaining from other renewable sources of energy, including bioenergy[2]. BC Hydro provides electricity service to over 95% of the province's electricity customers. FortisBC Inc., hereby referred to as FortisBC (electric), services most of the remaining parts of the province in south central BC. Five municipal utilities provide distribution service, with one providing electricity generation. Several district energy utilities provide hot water and steam within communities.

Distribution of natural gas in BC is carried out by two utilities: FortisBC Energy Inc., hereby referred to as FortisBC (gas), which services over 96% of the province's natural gas customers, and Pacific Northern Gas which services parts of northern BC.

Policies and measures to encourage energy efficiency have been actively pursued in the province since the late 1980s. To date, almost all of the efforts have focused on the industrial, agricultural and building sectors. Limited efforts in the transportation sector have focused on reducing greenhouse gas (GHG) emissions.

Energy efficiency is actively pursued by major electric and natural gas utilities, the provincial government and certain local governments. Energy efficiency is an important strategy for reducing energy bills, reducing GHG emissions, expanding economic opportunities and competitiveness, creating jobs, and enhancing community resiliency.

The business drivers for Demand-Side Measures[3] (DSM) can vary between gas and electric utilities. DSM is generally aligned with being an energy "resource" for electric utilities, provided that incremental energy supply costs exceed the cost of conserved energy, and/or if capacity additions can be delayed. Gas DSM is also considered to be a resource, but gas utilities are primarily a delivery agent, and pass commodity costs on to the consumer. Other drivers for gas DSM include GHG reduction benefits. For both types of

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[1] Statistics Canada. 2019. Report on Energy and Supply Demand in Canada: 2019 Revision. https://www150.statcan.gc.ca/n1/en/pub/57-003-x/57-003-x2022001-eng.pdf?st=SFopNVHi

[2] Statistics Canada. 2019. Report on Energy and Supply Demand in Canada: 2019 Revision. https://www150.statcan.gc.ca/n1/en/pub/57-003-x/57-003-x2022001-eng.pdf?st=SFopNVHi

[3] DSM in British Columbia is pursued under the auspices of the Demand-Side Measures Regulation.

utilities, a primary driver is customer service to help manage energy bills, despite changes in rates. This is particularly pertinent in the context of decarbonization of energy supplies, spurred by the Paris Agreement and both provincial and federal climate plans for 2030. The energy transition toward decarbonization will affect the cost of energy supplies as gas and electric utilities shift to renewable and low carbon fuels, some of which have a higher cost of supply than current resources. In some cases, this will provide an upward pressure on rates although in the shorter-term it is projected to lead to downward pressure for electricity customers because of BC Hydro's current surplus, which allows BC Hydro to sell its excess power in the domestic market, thereby benefiting its existing ratepayers. In turn, DSM is a mitigation option for consumers to afford the energy transition toward decarbonization.

1.1 A Brief History

Although mention of energy efficiency and conservation can be found in provincial policy documents that date back to the early 1980s, B.C.'s pursuit of energy savings began in earnest in 1988 when BC Hydro launched its Power Smart program. Shortly thereafter, it was fully institutionalized into the fabric of the province's energy planning when BC Hydro put DSM on an equal footing with supply-side resources in the utility's first ever integrated resource plan (IRP). West Kootenay Power, now FortisBC (electric), also launched a DSM Program and the BC Energy Efficiency Act was proclaimed.

BC Hydro has maintained an integrated resource approach to determine the size of its DSM portfolio, with the exception of a period during the late 1990s and early 2000s when DSM was temporarily significantly scaled back in response to an evolving policy deregulation framework.

In the case of FortisBC (gas) the pathway to providing natural gas DSM programs was a more gradual one. The utility's DSM program started in 1997.

PNG submitted its first DSM Plan to the BCUC in 2014 and subsequently launched a number of DSM programs in 2016.

Running in parallel to these utility programs have been a number of provincially led initiatives to improve energy efficiency, most in partnership with energy utilities. The Energy Efficiency Act sets out energy performance standards of designated appliances and equipment. The provincial government is also responsible for energy policy that affects utility DSM programs, transportation emission reductions, building energy codes and local government enforcement of codes and advancement of energy efficiency. Through the Innovative Clean Energy (ICE) Fund the Province is currently involved in a number of market transformation initiatives to promote clean energy vehicles, as well as high performance buildings and improved industrial energy management practices. Under its current three-year spending plan for 2021/22 to 2023/24, ICE Fund supported initiatives include support for the development of pre-commercial clean energy projects and technologies in BC, projects that deliver significant GHG emissions reductions in BC, and Hydrogen Strategy implementation[4].

Following the Paris Agreement under the UN Framework Convention on Climate Change, all levels of government in Canada have responded with policy measures, notably the provincial CleanBC Roadmap to

[4] https://www2.gov.bc.ca/gov/content/industry/electricity-alternative-energy/innovative-clean-energy-solutions/innovative-clean-energy-ice-fund#:~:text=The%20ICE%20Fund%20is%20a,B.C.'s%20clean%20energy%20sector

2030 and the federal 2030 Emissions Reduction Plan. Released in 2021, the CleanBC Roadmap measures include a building code for alterations to existing buildings in 2024, incremental efficiency improvements to new construction in 2022 and 2027, highest efficiency standards for space and water heating equipment (i.e., coefficient of performance of at least one) and zero-carbon new construction by 2030, a zero-emission vehicle mandate for 90% of new light-duty vehicle sales in 2030 and several industrial sector measures.

1.2 A Market Transformation Approach

The above review of B.C.'s energy efficiency history shows an integrated approach including utility-led resource acquisition and government-led policy to enable market transformation. Market transformation (MT) is, "a policy objective of encouraging or inducing social, technological and economic change in the direction of greater energy efficiency"[5]. The idea is to make permanent changes to the entire marketplace by reducing market barriers to the development and diffusion of more efficient technologies, processes and practices. Furthermore, MT implies an eventual "sunset" of financial investments by governments and utilities, following the introduction of regulated codes and standards.

The methodology of MT includes an assessment of the market barriers preventing adoption of energy efficiency, along with ongoing evaluation of the success indicators (e.g., Acceptance, Awareness, Availability, Accessibility, Affordability, otherwise referred to as the "5 A's of MT"). These need to be addressed to gain long-term energy savings. In addition to engaging energy consumers, MT strategies work with key influencers in all market channels, including product manufacturers, retailers, tradespersons, professionals, investors, and others.

Early experience in BC with transforming the marketplace for discrete technologies such as high efficiency motors, furnaces and light bulbs demonstrates the value of an integrated approach with both DSM programs and eventual codes and standards. Chapter 9 in Section 1 of this textbook includes a case study on the market transformation of the residential natural gas furnace market in Canada. The long-term savings from a market transformation approach are both substantial and more cost-effective than ones with a shorter-term timeframe and narrower scope of measures. The province has committed to taking incremental steps to increase energy-efficiency requirements in the BC Building Code and to make buildings "net-zero energy ready"[6] by 2032 in line with CleanBC goals[7]. Today, the Province, utilities, communities, and a host of other actors are taking the lessons learned from earlier market transformation initiatives to support this target.

In most cases the measures needed to achieve market transformation are similar to those that pursue energy efficiency as a low-cost utility resource, such as research and development, pilot projects, training, incentives, voluntary leadership, regulation and enforcement. What is different is the intentional and ongoing coordination of the different actors and measures needed to achieve more permanent energy savings and the explicit "exit" strategy for financial subsidies common in DSM.

[5] Blumstein, C., Goldstone, S., & Luztenhiser, L. 2000. A theory-based approach to market transformation energy. Energy Policy, 28(2), 137-144.
[6] A net-zero energy ready building is one that has been designed and built to a level of performance such that it could, with the addition of solar panels or other renewable energy technologies, achieve net-zero energy performance..
[7] https://www2.gov.bc.ca/gov/content/industry/construction-industry/building-codes-standards/energy-efficiency

2 Stakeholders

The energy efficiency framework that has evolved over 30 years in British Columbia has been significantly influenced by five major types of stakeholders:

1. Electricity and natural gas utilities
2. Provincial government
3. Municipalities
4. Federal government
5. Indigenous communities

Electricity and natural gas utilities in BC include BC Hydro, FortisBC, Pacific Northern Gas, municipal and district energy utilities, the latter two not providing DSM directly. Utilities have been advancing energy efficiency initiatives to achieve four goals, namely:

- Resource acquisition – energy efficiency and load management in lieu of new energy supplies and in some cases, capacity increases
- Customer services, information, and incentives to help consumers decrease their energy bills and increase their competitive edge and,
- Market transformation to enable voluntary leadership and codes and standards.
- GHG emission reduction

Within the Provincial Government, the BC Ministry of Energy, Mines, and Low Carbon Innovation (MEMLCI) is responsible for British Columbia's electricity, alternative energy, mining, and petroleum resource sectors, and supporting work to meet BC's greenhouse gas reduction targets. It advances energy planning, coordination among multiple players, the utility regulatory framework for DSM and equipment energy efficiency standards. The Ministry of Municipal Affairs takes leadership in supporting local governments and residents to build vibrant and healthy communities that are well governed, liveable, safe, economically resilient, and socially and environmentally responsible. The Ministry Responsible for Housing (currently Attorney General) advances building energy codes in law and delegates information and capacity building measures through partners such as BC Housing and the Building Officials Association of BC. The Ministry of the Environment oversees the Province's climate goals and sets energy and carbon performance standards for BC's public sector assets, including buildings.

Municipalities in BC advance energy efficiency through enforcement of building codes and separate climate leadership initiatives for land use planning, buildings, transportation, and industry. They also promote energy efficiency in their own operations and employ community energy managers and specialists, which are co-funded by utilities.

The federal government has a direct impact on energy efficiency in BC, in particular Natural Resources Canada (NRCan) with equipment standards under the Energy Efficiency Act and labelling through EnerGuide and ENERGY STAR®. Furthermore, the National Research Council (NRC) develops the model national energy codes.

Several First Nations throughout the province will receive funding to develop alternative energy projects and advance energy efficiency in their communities through the British Columbia Indigenous Clean Energy Initiative (BCICEI), with provincial support through CleanBC. The Fraser Basin Council is working with First Nations communities and support organizations to reduce energy use, share success stories, and build local capacity and economic development through the First Nations Home EnergySave[8]. The BC Hydro & FortisBC Energy Conservation Assistance Program (ECAP), which is targeted at income-qualified households, provides an in home visit with free energy-saving product installation including energy-saving LED light bulbs, high efficiency showerheads, and weather-stripping to reduce drafts has broad coverage in First Nations communities .

Institutions in Charge of Strategy

The five major stakeholder groups and additional supporting stakeholders partner extensively with one another to promote market transformation toward optimal levels of energy efficiency in the economy. Furthermore, they collectively lead different components of energy strategy in BC, influenced by NRCan for a broad range of issues and the NRC for building codes. Furthermore, MEM reviews regulatory proceedings of other jurisdictions such as the California Energy Commission and the US Department of Energy for product standards. Together they work to implement transformative legislation and regulatory initiatives that have positioned BC as a leader in North America.

Institutions in Charge of EE Programs

Energy efficiency programs are almost exclusively delivered by the energy utilities in BC. These are all regulated by the BC Utilities Commission, although oversight of some components of BC Hydro is provided by the Provincial Government. Energy utilities are the primary organizations that deliver DSM programs and cover the full spectrum of programs and initiatives that are in place across North America. In the last few years, there has been an increased emphasis on coordinated and jointly funded programs that target the same audience for different fuels.

Between 2008 and 2013 the Provincial Government ran a major program for existing detached houses called the LiveSmart BC: Efficiency Incentive Program, in partnership with utilities, which at some points included co-funding from the federal ecoEnergy program.

The province launched CleanBC in December 2018, which was replaced by the CleanBC Roadmap to 2030 in 2021, to reduce carbon pollution and make life better for residents, communities, and businesses. The plan includes commitments to raise standards for new construction and encourage energy-saving improvements in existing homes and workplaces. The program websites provide an online hub for accessing information, incentives, and support through www.BetterHomesBC.ca for residential programs and www.BetterBuildingsBC.ca for commercial, institutional and multi-unit residential programs. CleanBC CleanBC's Better Homes and Better Buildings initiatives are funded by the Province of British Columbia and the Government of Canada under the Low Carbon Economy Leadership Fund; the rebates are administered by BC Hydro, FortisBC and BC Housing.

3 Policy Framework

Since 2007, the primary driver of B.C.'s energy efficiency policy has been the province's 2007 Energy Plan and the amendments to the Utilities Commission Act and DSM Regulation. In 2021, the province released

[8] https://www.fraserbasin.bc.ca/First_Nations_Home_EnergySave.html

The CleanBC Roadmap to 2030, which builds on the progress made by the 2018 CleanBC Plan. Although utility resource savings programs still play central roles, the context for utility resource planning is very much framed within broader climate objectives and GHG emissions reduction.

3.1 Provincial Energy and Climate Policy Framework

In 2007, the province released *The BC Energy Plan – A Vision for Clean Energy Leadership.* The Plan included a number of measures that set the stage for expanding efforts to pursue energy efficiency and conservation in BC, including the following set of commitments that impacted utility DSM, among others:

1. A target for BC Hydro to acquire 50 per cent of its incremental resources (GWh) through conservation by 2020 (this target was subsequently changed in the 2010 *Clean Energy Act* to 66 per cent of incremental load growth and has been consistently exceeded by BC Hydro. Also, FortisBC (electric) voluntarily adopted this target and has subsequently increased it to 80% of GWh growth by 2023)
2. Ensuring a coordinated approach to conservation and efficiency – for example, BC Hydro included actions of governments in their resource and DSM plans
3. Encouraging both electric and natural gas utilities to pursue cost effective DSM opportunities, supported by amendments to the Utilities Commission Act to prioritize DSM and enable cost recovery, along with the development of the DSM Regulation
4. Developing rate structures that encourage energy efficiency and conservation

The first measure further solidified the importance of DSM as a strategic energy resource for BC Hydro. The second policy objective was led by the Ministry of Energy and Mines and Low Carbon Innovation; it was embraced by the two major utilities and was endorsed by the BC Utilities Commission in their decisions, eventually leading to multi-fuel DSM programs. The third policy objective broadened the type of DSM that utilities could pursue (i.e., within the bounds of cost-effectiveness as defined in the DSM Regulation) and signalled that there was a desire to see an expansion of both gas and electric DSM programs. Finally, the fourth commitment gave utilities a new tool to use to encourage energy conservation, namely, a rate-based signal for electric utilities to encourage industrial, commercial, and residential customers to reduce their total energy consumption. However, on April 1, 2017, BC Hydro removed the conservation rate for commercial customers, but retained it for residential and industrial. The commercial conservation rate was removed in a Rate Design Application due to its poor past performance on achieving conservation, largely due to its complexity.

A second set of policy commitments made in the 2007 Energy Plan targeted energy efficiency in the built environment more specifically:

1. Implement energy efficiency standards for buildings (by 2010) by introducing regulated standards in the BC Building Code and advancing ongoing efforts to develop energy-efficient products through regulated standards
2. Pursue public sector leadership of environmental design for new buildings and
3. Encourage increased community-level energy efficiency and greenhouse gas reductions for both their own operations and private buildings

These three built environment measures were largely a progression of the market transformation efforts outlined in the province's 2005 Energy Efficient Buildings Strategy, which in the subsequent 2008 Strategy were expanded upon.

On the industrial front, the 2007 Energy Plan included a commitment to develop an industrial energy efficiency program to address specific challenges faced by BC's industrial sector. This was essentially delegated to energy utilities, including expansion of BC Hydro and FortisBC (electric) programming at all industrial scales and new FortisBC (gas) programs.

Many of the energy and climate policy directions established in 2007 and 2008 were subsequently embedded within different pieces of legislation and supported by numerous programs (more information in Section 5). In 2010, the *Clean Energy Act* added greenhouse gas emission reductions to the province's list of energy policy objectives, including a 33% reduction below 2007 levels by 2020.

In the early 2010s market and legislative changes led to a supply surplus and reduced the reliance on DSM. Furthermore, in 2011 a provincial audit: "Review of BC Hydro"[9] considered all BC Hydro expenditures and the impact on rates and other financial indicators. Despite these factors, BC Hydro's 2013 Integrated Resource Plan (IRP) recommended a moderate DSM portfolio, consistent with the 2008 Long-term Acquisition Plan, albeit expanded DSM portfolios were considered.

The next set of major policy objectives impacting energy efficiency in BC were released as part of the 2016 Climate Leadership Plan (CLP), namely:

- Encouraging the development of high-efficiency buildings by setting a target for a net-zero energy ready building standard by 2032, establishing an Energy Step Code for new buildings, and providing a design incentive for high-performance buildings
- Updating equipment standards for space and water heating equipment by 2020 and 2025, respectively
- Advancing efficient electrification
- Refreshing the Climate Action Charter for Communities; and
- Enabling FortisBC Gas to expand their DSM program incentives by at least 100%.

The next set of major policy objectives related to energy efficiency were released as part of the 2018 CleanBC Plan aimed at reducing climate pollution, while creating more jobs and economic opportunities for people, businesses and communities. The CleanBC plan was developed as a pathway to achieve the province's legislated climate targets of reducing greenhouse gas (GHG) emissions by 40% by the year 2030, based on 2007 levels. The plan describes and quantifies measures that will eliminate 18.9 megatonnes (Mt) of its 2030 target, while the remaining reduction initiatives were to be quantified over the following few years. Highlights of the CleanBC plan include[10]:

- By 2040, every new car sold in B.C. will be a zero-emission vehicle.
- The province is speeding up the switch to cleaner fuels at the gas pump – with further reductions to the carbon intensity of transportation fuels: 4.0 Mt of carbon pollution reduced by 2030

[9] https://news.gov.bc.ca/files/Newsroom/downloads/bchydroreview.pdf

[10] Highlights Report – CleanBC Plan, 2018 - https://news.gov.bc.ca/files/CleanBC_HighlightsReport_120318.pdf

- Every new building constructed in B.C. will be "net-zero energy ready" by 2032. Along the way, government is requiring new buildings to be more efficient, and ramping up funding for renovations and energy retrofits to existing homes and offices, including $400 million to support retrofits and upgrades for B.C.'s stock of publicly funded housing: 2.0 Mt of carbon pollution reduced by 2030
- Government is helping B.C. to reduce residential and industrial organic waste, turning it into a clean resource: 0.7 Mt of carbon pollution reduced by 2030
- The province is helping industry lower its emissions and reduce its pollution: 8.4 Mt of carbon pollution reduced by 2030

In 2021, the province released The CleanBC Roadmap to 2030, which builds on the progress made by the 2018 CleanBC Plan. It will help power more businesses and communities with clean, renewable hydro power. Working with large industry partners, it will ensure sector-specific plans to reduce their climate pollution. Most importantly, it will encourage innovation of clean alternatives, which will become more affordable to British Columbians. The foundational roadmap actions in the CleanBC Roadmap to 2030 include[11]:

- A stronger price on carbon pollution, aligned with or exceeding federal requirements, with built in supports for people and businesses
- Increased clean fuel requirements and doubling the target for renewable fuels produced in B.C. to 1.3 billion litres by 2030
- An accelerated zero-emission vehicle (ZEV) law (26% of new light-duty vehicles by 2026, 90% by 2030, 100% by 2035)
- New ZEV targets for medium- and heavy-duty vehicles aligned with California
- Complete B.C.'s Electric Highway by 2024 and a target of the province having 10,000 public EV charging stations by 2030
- Actions to support mode-shift towards active transportation and public transit
- Stronger methane policies that will reduce methane emissions from the oil and gas sector by 75% by 2030 and nearly eliminate all industrial methane emissions by 2035
- Requirements for new large industrial facilities to work with government to demonstrate how they align with B.C.'s legislated targets and submit plans to achieve net-zero emissions by 2050
- Enhancing the CleanBC Program for Industry to reduce emissions while supporting a strong economy
- Implement programs and policies so that oil and gas emissions are reduced in line with sectoral targets
- A cap on emissions for natural gas utilities with a variety of pathways to achieve it
- New requirements for all new buildings to be zero carbon and new space and water heating equipment to be highest efficiency by 2030
- The adoption of a coefficient of one as a minimum energy performance standard for space and water heating equipment to by 2030
- The introduction of an easy to use, web-based home energy labelling program

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[11] https://www2.gov.bc.ca/assets/gov/environment/climate-change/action/cleanbc/cleanbc_roadmap_2030.pdf

- The phasing out of utility gas equipment incentives
- Implement a 100% Clean Electricity Delivery Standard for the BC Hydro grid
- A new program to support local government climate and resiliency goals with predictable funding
- Support for innovation in areas like low carbon hydrogen, the forest-based bioeconomy and negative emissions technologies
- Household affordability will continue to be a key focus, especially for those who need it most.

3.2 Utility Resource Planning Policy Framework

Electricity and natural gas in BC have, for the most part, been regulated by the British Columbia Utilities Commission (BCUC) since 1980.

Legislation and BCUC policies require utilities to file a long-term (i.e., 20-years) resource plan (LTRP) or Integrated Resource Plan (IRP) and associated short-term (i.e., up to 5 years) DSM Plan that includes, among other things, objectives or goals for DSM investment, budgets, and energy saving targets and achievement (in GWhs or TJs), by sector and measure type.

Utility DSM expenditures require approval from the BCUC before rates can be set to recover those expenditures. The DSM Regulation sets out rules that the BCUC must follow when assessing the adequacy and cost-effectiveness of proposed DSM expenditures.

One major difference in the regulatory context between natural gas and electric utilities is the application of what is called the Modified Total Resource Cost (MTRC) test. The MTRC is based on the Total Resource Cost (TRC), which is one of the standard DSM cost-benefit calculations used across North America to determine if a measure is cost-effective (i.e., the cost associated with the DSM program are less than its benefits, such as the avoided cost of energy saved). In the case of the MTRC, up to 40% of a natural gas utility's DSM natural gas savings is valued at the avoided cost of clean electricity rather than the avoided cost of natural gas which is historically lower. The intention of the MTRC is to give explicit value to the greenhouse gas emissions reduced whenever a unit of natural gas is saved and to assist with enabling cost effective DSM in periods of low-cost natural gas. As a result, a significant portion of natural gas utility DSM portfolios in BC are justified on the grounds of GHG reductions. The MTRC also includes a 15% adder for non-energy benefits[12]. The DSM portfolios of electric utilities which are generated from nearly 100% renewable sources, are primarily justified because of their associated avoided cost of supply.

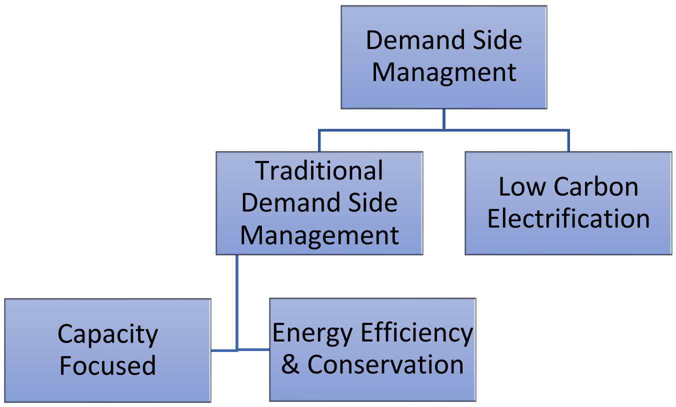
The DSM regulation requires utilities to offer energy efficiency programs targeted to low-income households as well as rental accommodations. Low-income programs include a 40% non-energy benefit adder instead of the 15% adder[13].

Once approved these long-term planning documents and their associated expenditure schedules provide considerable information about the strategic scope for each utility's DSM program. A number of different strategies are used by the utility to achieve these savings for each of its major rate classes, specifically: codes and standards support, rates, and programs. In its 2020 to 2021 Revenue Requirement Application,

[12] Guide to the Demand Side Measures Regulation – 2014, https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/energy-efficiency/guide_to_the_dsm_regulation_july_2014_c2.pdf
[13] https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/10_326_2008#section3

BC Hydro presented the different components of its Demand Side Management. These are illustrated in Figure 1 below.

Figure 1 Demand Side Management Components[14]



BC Hydro is also currently pursuing pilot studies on load curtailment and demand response and a low carbon electrification program in line with the CleanBC Energy Objectives to reduce GHG emissions and encourage the switching from one kind of energy source to another that decreases GHG emissions in BC. **Table 1** details how BC Hydro's five-year, $260 million Low Carbon Electrification Plan aligns with BC's Energy Objectives.

Table 1 – Low Carbon Electrification Plan Alignment with BC Energy Objectives[15]

Energy Objective	Low-Carbon Electrification Plan
To ensure that BC Hydro's rates remain among the most competitive	The incremental revenue from LCE undertakings reduces forecast rate increases.
To reduce B.C. GHG emissions	BC Hydro's planned low-carbon electrification undertakings up to and including fiscal 2022 are forecast to result in natural gas and other fossil fuel savings. These savings will reduce B.C. GHG emissions by approximately 330,000 tonnes of CO_2e/year.
To encourage the switching from one kind of energy source or use to another that decreases GHG emissions in B.C.	BC Hydro's planned LCE undertakings are focused on reducing GHG emissions.
To encourage economic development and the creation and retention of jobs	BC Hydro's planned LCE undertakings create economic activity and jobs within the province.

[14] BC Hydro 2020-2021 Revenue Requirement Application. Figure 10-1
[15] BC Hydro 2022 Revenue Requirement Application. Table 10-11

BC Hydro's 2020 to 2021 Revenue Requirement Application detailed its demand side measures initiatives and expenditures as well its low-carbon electrification undertakings in Appendix X and Appendix Y, respectively. **Table 2** and **Table 3** below provide the savings and electrification results and associated expenditures compared to plan values for fiscal 2017 to fiscal 2019. In **Table 2**, the Plan Values represent the planned amounts described in BC Hydro's Previous Application. Actual results represent the results that were actually achieved. Energy savings and new incremental capacity have been achieved through a combination of codes and standards, rate structures, and programs.

Table 2 – BC Hydro Traditional DSM Incremental Savings and Expenditures (F2017 to F2019)[16]

	New Incremental Energy Savings (GWh/year)		New Incremental Associated Capacity Savings (MW)		Expenditures ($ million)	
	Plan Values	**Actual**	**Plan Values**	**Actual**	**Plan Values**	**Actual**
F2017	701	772	131	132	113.7	97.4
F2018	621	719	111	127	119.5	82.3
F2019	736	TBD	123	TBD	127.9	TBD

Table 3 – BC Hydro Low Carbon Electrification Incremental Load and Expenditures (F2019)[17]

	New Incremental Energy Load (GWh/year)		New Incremental Associated Capacity Load (MW)		Expenditures ($ million)	
	Plan Values	**Actual**	**Plan Values**	**Actual**	**Plan Values**	**Actual**
F2019	110	TBD	16	TBD	9.4	TBD

Table 4 and **Table 5** below provide the actual fiscal 2020 and forecast fiscal 2021 energy impacts, capacity impacts and associated expenditures compared to plan values from BC Hydro's previous Application. The forecast amounts for fiscal 2021 represent a year-end forecast, as of August 2020.

[16] BC Hydro 2020-2021 Revenue Requirement Application. Table 10-2
[17] BC Hydro 2020-2021 Revenue Requirement Application. Table 10-3

Table 4 – BC Hydro Traditional DSM Incremental Savings and Expenditures (F2020 to F2021)[18]

	New Incremental Energy Savings (GWh/year)		New Incremental Associated Capacity Savings (MW)		Expenditures ($ million)	
	RRA	Actual/ Forecast	RRA	Actual/ Forecast	RRA	Actual/ Forecast
F2020	700	722	128	128	90.8	78.5
F2021	753	747	136	133	89.1	82.4

Table 5 – BC Hydro Low Carbon Electrification Incremental Load and Expenditures (F2020 to F2021)[19]

	New Incremental Load (GWh/year)		New Incremental Associated Capacity Load (MW)		Expenditures ($ million)	
	RRA	Actual/ Forecast	RRA	Actual/ Forecast	RRA	Actual/ Forecast
F2020	214	213	29	29	17.8	16.9
F2021	61	65	9	9	7.7	7.6

Until 2008 FortisBC (gas) operated a modest DSM program valued ~$4 million per year, focusing mainly on condensing gas furnaces. In 2008 a landmark BCUC application established a comprehensive program across all sectors that has since forecasted to grow to over $101 million per year in 2022[20]. Based on the updated forecast expenditures, FEI's updated projected savings for 2021 and 2022 are set out in **Table 6**.

Table 6 – FortisBC (gas) 2021 & 2022 Program Area Energy Savings- Plan vs. Projection[21]

	Incremental Annual Gas Savings, Net (GJ)					
	2021			2022		
	DSM Plan	Revised Forecast	Variance	DSM Plan	Revised Forecast	Variance
Residential	300,891	272,112	90%	328,860	238,323	72%
Commercial	418,482	442,553	106%	478,288	471,200	99%
Industrial	316,955	467,328	147%	316,955	543,268	169%
Low-Income	77,141	57,547	75%	77,707	64,128	83%
All Programs	1,113,469	1,239,520	111%	1,201,809	1,1307,919	109%

[18] BC Hydro 2022 Revenue Requirement Application. Table 10-2
[19] BC Hydro 2022 Revenue Requirement Application. Table 10-3
[20] FortisBC Energy Inc. 2021-2022 Updated DSM Expenditure Application. Table 4-1
[21] FortisBC Energy Inc. 2021-2022 Updated DSM Expenditure Application. Table 4-2

FortisBC (gas)'s planning scenario in its latest 2022 LTGRP is referred to as the Diversified Energy (Planning) Scenario, which is based on its Clean Growth Pathway[22]. The Clean Growth Pathway is FortisBC (gas)'s framework to transition to a low-carbon energy future and is supported by four key pillars, which figure prominently in the 2022 LTGRP[23]:

- **Pillar 1:** Transitioning to renewable and low-carbon gases to decarbonize the gas supply
- **Pillar 2:** Investing in Demand-side Management (DSM) programs in support of energy efficiency and conservation measures to reduce energy use among residential, commercial, and industrial customers
- **Pillar 3:** Investing in low- carbon transportation infrastructure to reduce emissions in this sector; and
- **Pillar 4:** Investing in liquefied natural gas (LNG) to lower GHG emissions in marine fueling and global markets**.**

British Columbia (BC) has committed to achieving net-zero greenhouse gas emissions by 2050. The province recently updated its climate targets to a 40% reduction in carbon emissions from 2007 levels by 2030, and a 60% reduction from 2007 levels by 2040. Achieving these long-term targets will require immediate and coordinated action by policy makers, regulators and industry. As indicated by these four pillars, FortisBC Energy Inc (FEI) plans to meet provincial emission reduction targets through accelerating its renewable and low-carbon gas supply, supporting the decarbonization of buildings through DSM activities, and growing customer demand in sectors that reduce GHG emissions. FortisBC (gas)'s Clean Growth Pathway to 2050 focuses on providing practical solutions than can be implemented by leveraging FortisBC (gas)'s existing infrastructure in achieving GHG reductions in alignment with the province's objectives.

The FortisBC (electric) 2019-2022 DSM Expenditure Application indicates a greater reliance on DSM, going from expected annual savings and expenditures of 32.6 GWh/year and $10.90 million in 2019 to a gradual increase to 33.1 GWh/year and $11.40 million by 2022[24]. This plan would account for 77% of projected load growth over this period – well over the 66% target that was set for BC Hydro in the *Clean Energy Act*. This plan is supported by amendments to the DSM Regulation.

The DSM plan for all three utilities includes expenditures and savings in residential, commercial, and industrial programs as well as enabling activities. BC Hydro also includes expenditures and savings in codes and standards as well as rate structure, while FortisBC (Gas) includes expenditures and savings in innovative technologies.

BC Hydro collaborates extensively with all levels of government and standards development organizations to support energy efficiency and low-carbon policies and regulations. Industrial savings, meanwhile, are largely targeted through incentive programs.

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[22] Clean Growth Pathway to 2050 (2018), (https://www.cdn.fortisbc.com/libraries/docs/default-source/about-us-documents/clean-growth-pathway-brochure.pdf)

[23] FortisBC Energy Inc. 2022 Long Term Gas Resource Plan (LTGRP) – Page 1-1

[24] FortisBC Inc. 2018. 2019 to 2022 Demand Side Management Expenditures Plan – Table 5-1.

3.3 Municipal Government Policy Framework

Municipal governments represent another group of actors in B.C. with the authority and resources to influence a broad range of energy efficiency and conservation measures in the province. The authority to do so is granted under the *Local Government Act* and specified within the *Community Charter* for all local governments except for the City of Vancouver, which has separate authority granted under the *Vancouver Charter*.

For many regional local governments in BC, the motivation to reduce energy use both within their own operations and across their communities is derived from targets included in official community policies. The Climate Action Charter (CAC) was launched at the 2007 UBCM Convention. Since then, almost every local government in B.C.—187 of 190 municipalities, regional districts and the Islands Trust—has signed the CAC[25]. Under the CAC, local governments commit to work towards carbon neutral operations, measure community-wide emissions, and create complete compact, energy-efficient communities. Furthermore, with the introduction of the BC Energy Step Code, Local governments can choose to require or incentivize a given step of the BC Energy Step Code in new construction.

In BC, the City of Vancouver has more authority than any other local government in the province to pursue energy efficiency and carbon pollution reductions, including establishing its own energy and GHG requirements for new and existing buildings. Vancouver has enacted a number of policies for reducing energy and carbon emissions and supported them with a range of measures, including stringent energy and carbon performance building code requirements. In May 2022, the City's Council passed a number of measures that will introduce mandatory building energy use and GHG emissions reporting, starting in 2024. Although Vancouver's policies are led by carbon reduction targets, energy efficiency is recognized as a foundational strategy for achieving these.

At a regional level, the Metro Vancouver Regional District (MVRD) developing an approach to significantly reduce greenhouse gas (GHG) emissions from large buildings. Large buildings are those over 25,000 ft2 (2,322 m2) and includes residential, commercial, office, and institutional buildings across the region. MVRD is responsible for managing and regulating air quality in the region under authority delegated from the provincial government in the Environmental Management Act. The proposed approach to managing GHG emissions would require building owners across the region to report the GHG emissions from their buildings on an annual basis to ensure that emissions fall below limits established by Metro Vancouver for specified building types and sizes.

[25] https://www2.gov.bc.ca/gov/content/governments/local-governments/climate-action/bc-climate-action-charter

4 Legal and Regulatory Framework

4.1 Provincial and Municipal Framework

The following acts in BC have direct stipulations for energy efficiency and conservation, some of which have relevant regulations which are noted:

- Energy Efficiency Act ([RSBC 1996] CHAPTER 114) and the Energy Efficiency Standards Regulation;
- Utilities Commission Act ([RSBC 1996] CHAPTER 473) and the DSM Regulation
- Vancouver Charter ([SBC 1953] CHAPTER 55)
- Community Charter ([SBC 2003] CHAPTER 26)
- Clean Energy Act ([SBC 2010] CHAPTER 22)
- Building Act ([SBC 2015] CHAPTER 2)

The *Energy Efficiency Act* (EEA) was enacted in 1990. It allows the province to regulate products sold, manufactured or leased in BC that control or affect the use of energy. It also provides authority for the Province to set specific testing, labeling and reporting requirements for these products. The Act compliments the federal Energy Efficiency Act (S.C. 1992, c. 36) which is restricted to regulating the efficiency of selected products that move across national or provincial borders.

The *Utilities Commission Act* (UCA) was enacted in 1980 and was most recently amended in 2015. It stipulates the administrative framework and responsibilities of the BC Utilities Commission (BCUC). Sections 44.1 (Long-term resource and conservation planning) and 44.2 (Expenditure schedule) of the UCA are the most directly relevant to energy efficiency in BC.

Section 44.1 requires utilities to submit to the BCUC a long-term resource plan (LTRP) that includes, among other things, an estimate of the demand for energy the utility expects to serve, a plan of how it intends to reduce the estimated demand, an estimate of the demand that remains and how it intends to meet this remaining demand. This ordering is important because it requires utilities to first consider and demonstrate how it plans to fulfill anticipated future demand with demand side measures. Only after this is done, are other resources considered. Once submitted to the BCUC, the LTRPs are typically subject to a public hearing. The commission then rules on the appropriateness of the LTRP, as per the UCA, taking the evidence provided by the utility and interveners at the public hearing into account. Section 2.1 of section 44.1 of the act did not require BC Hydro to file a long-term resource plan prior to February 282, 2021.

One exception to the regulatory process outlined above is that as of 2010 BC Hydro was required to submit its Integrated Resource Plan (an LTRP) to the Minister of Energy and Mines for approval instead of the BCUC until February 28, 2021. It was then the responsibility of the BCUC to rule on the appropriateness of any expenditure applications (other than any expenditures exempted from BCUC review by the province).

Section 44.2 of the UCA addresses the process for receiving the BCUC's permission to proceed with a schedule of planned utility capital expenditures, including demand-side measures, and to recover those expenditures in rates. Utility expenditure plans, which are submitted to the BCUC separately from LTRPs, provide greater levels of granularity on DSM program types and target sectors. All BCUC applications receive scrutiny by "intervener" groups and BCUC staff prior to a decision by Commissioners.

The BCUC is guided by the DSM Regulation which sets out select rules that the commission must follow when assessing the adequacy and cost-effectiveness of proposed DSM. The Regulation was enacted in the fall of 2008[26]. Since that time, it has been amended three times: December 2011, July 2014 and April 2017. Some key elements of the regulation include:

- A requirement for utilities to have programs for low-income households, rental accommodations, schools, codes and standards support, and Energy Step Code adoption by local governments.
- Portfolio-level evaluation of education programs, energy efficiency training, community engagement, technology innovation programs, and effective public awareness programs.
- The ability for utilities to attribute a portion of savings from a regulated standard to a utility program that facilitates or advances the introduction of that standard.
- At least 1% of DSM expenditures, or $2 million per year, on average must be on codes and standards support, which include the BC Energy Step Code.
- A requirement for the total resource cost test to be used to determine cost-effectiveness and a stipulation for how the avoided cost of supply is determined.
- A requirement that FortisBC (electric) use, for the avoided cost of energy, its long-run marginal cost of clean BC electricity (rather than the short-term spot market price).
- Permission for the use of a modified total resource cost (MTRC) for a portion of the portfolio. The MTRC permits the avoided cost of natural gas savings to be priced at BC Hydro's long run marginal cost of electricity generated from clean or renewable sources in BC.
- Inclusion of estimates of the non-energy benefits (NEB) associated with each planned DSM measure

Finally, the UCA requires utilities to report on the effectiveness of their DSM portfolios through their annual report to the BCUC. As such, all utilities in BC with DSM programs have evaluation, measurement and verification initiatives in place.

The Vancouver Charter and Community Charter provide powers to municipalities and regional districts to advance energy efficiency and greenhouse gas management via their community plans, regional growth strategies and building construction regulations. A legislative amendment, introduced in the spring of 2022, added authority for the Council to make bylaws requiring reports about greenhouse gas emissions or the use of energy or water.

For new construction and major retrofits, the Building Act is arguably the most important piece of legislation for advancing energy efficiency; it includes the BC Building Code and any energy efficiency requirements that fall under the Code. The Community Charter and the Vancouver Charter give local governments the ability to administer and enforce provincial building requirements. All local governments, with the exception of Vancouver, are limited to referencing the building requirements that are included in the provincial Code. Vancouver is able to set its own building requirements under the Vancouver Building Bylaw and incorporated energy efficiency into its own building bylaw before the province incorporated energy efficiency into the provincial building code.

[26] BC Ministry of Energy and Mines. 2014. Guide to the Demand-Side Measures Regulation.

4.2 Buildings and Equipment

There are at least three BC-specific regulations or bylaws that set minimum energy performance standards (MEPS) for products, equipment, and buildings in the province:

1. Energy Efficiency Standards Regulation
2. BC Building Code
3. Vancouver Building Bylaw

The Energy Efficiency Standards Regulation (EESR) lists the testing and performance standards for the more than 40 products that are regulated under the Energy Efficiency Act. Major product categories covered by the EESR are:

- Manufactured fenestration products
- Household appliances
- Heating, ventilation and air conditioning products
- Water heaters
- Lighting products
- Electric motors
- Computers and monitors
- Small battery charging systems

Since it was first adopted in 1990 there have been 7 amendments to the EESR. The seventh amendment was approved in the winter of 2021[27]. The amendment includes new and updated standards for computers and monitors, residential windows, residential gas boilers, and commercial gas boilers, as well as regulatory upkeep.

The EESR is unique in that it applies to products manufactured or sold in B.C. However, its authority does not extend to building sites, except in the case where a regulated product is assembled on site. In all other cases, the minimum energy performance of a product used in the construction of a building is regulated by the standards stipulated in either the BC Building Code or the Vancouver Building Bylaw. The scope of these building standards, though, is more limited than the EESR because they do not extend to household appliances, plug loads and other equipment installed post-construction.

As with most provinces, BC's Building Code is largely adopted from the National Building Codes that are established by the National Research Council of Canada. For energy performance, the BC Building Code currently references ASHRAE Standard 90.1 and the National Energy Code for Buildings (NECB) for large, complex buildings (Part 3 buildings). For housing and small buildings (Part 9 buildings) it references the National Building Code with some BC exceptions.

The BC Building Code was amended in April 2017 to include the BC Energy Step Code. The BC Energy Step Code is a voluntary roadmap that establishes progressive performance targets (i.e., steps) from the current energy-efficiency requirements in the BC Building Code to "net-zero energy ready" buildings, aligned with the stated goal for 2032. The step code established five steps from the current BC Building Code requirements to net-zero energy ready requirements for Part 9 residential buildings. The same

[27] https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/energy-efficiency/eesr_amendment_7_approval.pdf

progression for Part 3, wood-frame residential buildings is four steps. It is a voluntary tool local governments across B.C. can use to encourage or require the construction of more energy-efficient buildings in their communities, and do so in a consistent, predictable way. The BC Energy Step Code takes an exclusive performance-based approach with energy modelling and whole-building airtightness testing, rather than the traditional prescriptive approach. It identifies an energy-efficiency target that must be met and lets the designer/builder decide how to meet it[28].

The Vancouver Building Bylaw includes additional requirements beyond the BC Building Code for new construction and major retrofits, such as higher energy efficiency for walls, roofs, windows and skylights; energy efficient hot water tanks, boilers and furnaces; and improved airtightness in one and two family houses. More recently, the City of Vancouver announced its intention to use a phased approach that will eventually require all new buildings built in the city to be zero emissions by 2030[29]. To achieve this, buildings will need to be either built to a high-efficient, zero emission standard and/or be heated by a low carbon energy source such as clean electricity, renewable natural gas or a district energy system that is increasingly fueled by a renewable energy supply.

4.3 Greenhouse Gas (GHG) Emissions

There are several laws and regulations in BC that either put a price on greenhouse gas emissions or requires some level of public disclosure about emissions levels. Although these laws and regulations do not directly address energy efficiency, energy efficiency is often used as a cost-effective strategy to reduce exposure to carbon-related costs and risks. Likely the best-known law that falls within this category is the Carbon Tax Act ([SBC 2008] CHAPTER 40) and its accompanying Carbon Tax Regulation. The Act initially placed a price of $10 per tonne of CO2equivalent on nearly all greenhouse gas emissions in the province. On April 1, 2022, B.C.'s carbon tax rate rose from $45 to $50 per tonne of CO2equivalent.

The Greenhouse Gas Reduction Targets Act ([SBC 2007] CHAPTER 42) is for all provincial public sector operations to be carbon neutral by 2010. This Act was changed to the Climate Change Accountability Act ([SBC 2007] Chapter 42) in November 2018. BC has legislated targets for reducing greenhouse gas emissions 40% below 2007 levels by 2030, 60% by 2040, and 80% by 2050. The province also has an interim target to reduce emissions 16% by 2025. To help meet provincial targets, the province also established 2030 emission reduction targets of 27-32% for the transportation sector, 38-43% for the industrial sector, 33-38% for the oil and gas sector, and 59-64% for buildings and communities, with 2007 as the baseline[30]. To be in compliance with the Act, a public sector organization must measure its emissions; demonstrate efforts to reduce its emissions through conservation measures; purchase provincially approved offsets for any remaining emissions; and report annually on its progress. Although the Act and its accompanying Carbon Neutral Government Regulation do not stipulate a specific level of

[28] Government of British Columbia. BC Energy Step Code: http://www2.gov.bc.ca/gov/content/industry/construction-industry/building-codes-standards/energyefficiency/energy-step-code

[29] https://vancouver.ca/green-vancouver/zero-emissions-buildings.aspx

[30] https://www2.gov.bc.ca/gov/content/environment/climate-change/planning-and-action/legislation

energy performance for various public sector operations, the annual reporting does show that these requirements have successfully spurred a number of significant energy efficiency improvements.

Another important piece of climate legislation affecting energy use is The Local Government (Green Communities) Statutes Act. Enacted in 2008, it requires local governments to include greenhouse gas emission targets, policies and actions in their Official Community Plans and Regional Growth Strategies.

5 Financial Mechanisms

Many DSM programs include financial mechanisms such as incentives and rebates designed to overcome affordability barriers, along with other elements such as education and capacity building to address other barriers. As programs shift the market and enable codes and standards to come into effect, financial mechanisms can be reduced or eliminated and programs shift their focus to new opportunities to enable the next level of market transformation.

5.1 Incentive programs

Incentive programs covers a broad spectrum of the utilities' customer base. These typically include programs for residential, small, and medium general service (commercial, institutional, multi-unit residential common areas), large general service (industrial) and transmission voltage LGS (large industrial with their own substation).

5.1.1 BC Hydro Power Smart

BC Hydro has fully implemented "Power Smart" DSM program since 1989. **Table 7** and **Table 8** below summarize the savings and expenditures.

Table 7 – BC Hydro Incremental Annual Electricity Savings (GWh/yr)

Sector	2013-14[31]	2014-15[32]	2015-16[33]	2016-17[34]	2017-18[35]	2018-19[36]	2019-20[37]	2020-21[38]
Residential	49	47	43	50	38	41	44	44
Commercial	97	83	73	102	51	48	58	51
Industrial	122	181	214	166	81	227	129	160
Rates (includes transmission service rate)	272	(11)	(15)	(25)	20	117	117	119
Codes & Standards	145	144	557	309	352	403	373	405
TOTAL Energy	**686**	**444**	**872**	**602**	**543**	**836**	**722**	**780**

Table 8 – BC Hydro Expenditures (million dollars)

Sector	2013-14[39]	2014-15[40]	2015-16[41]	2016-17[42]	2017-18[43]	2018-19[44]	2019-20[45]	2020-21[46]
Residential	$17.6	$14.2	$16.0	$12.5	$11.8	$12.1	$17.9	$18.3
Commercial	$42.6	$36.7	$33.6	$34.5	$24.7	$19.0	$18.5	$16.2
Industrial	$36.1	$45.7	$64.8	$23.2	$20.5	$49.2	$18.0	$19.1
Rates	$1.0	$1.2	$1.3	$0.8	$0.6	$0.6	$0.3	$0.4
Codes and Standards	$1.6	$3.1	$3.1	$5.1	$4.8	$4.9	$5.2	$5.2
Capacity		$4.7	$8.6	$8.4	$6.9	$3.3	$4.4	$3.7
Supporting Initiatives	$21.3	$19.1	$17.7	$13.0	$13.1	$15.0	$14.2	$14.1
TOTAL	**$120.3**	**$124.8**	**$145.2**	**$97.4**	**$82.3**	**$104.2**	**$78.5**	**$77.0**

[31] BC Hydro. 2014. "Table 1 Expenditures and Incremental Electricity Savings for F2014". Report on Demand-Side Management Activities for F2014. In Appendix Y (Attachment 1)
[32] BC Hydro. 2015 –BC Hydro Report on Demand Side Management Activities for F2015 – Table 1
[33] For 2015-2016 to 2018-2019: BC Hydro. 2016. Table 1 "Cumulative Energy Savings at Customer Meter (GWh/yr) in Appendix W – DSM Data Tables of the Fiscal 2017 to Fiscal 2019 Revenue Requirements Application.
[34] BC Hydro. 2017 –BC Hydro Report on Demand Side Management Activities for F2017 – Table 1
[35] BC Hydro. 2018 –BC Hydro Report on Demand Side Management Activities for F2018 – Table 1
[36] BC Hydro. 2019 –BC Hydro Report on Demand Side Management Activities for F2019 – Table 1
[37] BC Hydro. 2020 –BC Hydro Report on Demand Side Management Activities for F2020 – Table 1
[38] BC Hydro. 2021 –BC Hydro Report on Demand Side Management Activities for F2021 – Table 1
[39] BC Hydro. 2014. "Table 1 Expenditures and Incremental Electricity Savings for F2014". Report on Demand-Side Management Activities for F2014. In Appendix Y (Attachment 1)
[40] BC Hydro. 2015 –BC Hydro Report on Demand Side Management Activities for F2015 – Table 1
[41] BC Hydro. 2016 –BC Hydro Report on Demand Side Management Activities for F2016 – Table 1
[42] BC Hydro. 2017 –BC Hydro Report on Demand Side Management Activities for F2017 – Table 1
[43] BC Hydro. 2018 –BC Hydro Report on Demand Side Management Activities for F2018 – Table 1
[44] BC Hydro. 2019 –BC Hydro Report on Demand Side Management Activities for F2019 – Table 1
[45] BC Hydro. 2020 –BC Hydro Report on Demand Side Management Activities for F2020 – Table 1
[46] BC Hydro. 2021 –BC Hydro Report on Demand Side Management Activities for F2021 – Table 1

In accordance with Directive 49 of the F20-F21 RRA Decision, BC Hydro reports on the Low Carbon Electrification expenditures within the DSM Regulatory Account. **Table 9** summarizes BC Hydro's Low Carbon Electrification expenditures.

Table 9 – Low Carbon Electrification – BC Hydro Expenditures (million dollars)

Sector	2019-20[47]	2020-21[48]
Initial Projects	$13.1	$0.1
BC Hydro Projects	$3.8	$4.0
TOTAL	**$16.9**	**$4.1**

5.1.2 FortisBC EEC

FortisBC's gas and electric utilities merged their DSM programs under one banner – FortisBC Conservation and Energy Management **Table 10** and **Table 11** summarize the annual savings and expenditures for FortisBC gas.

Table 10 – FortisBC Natural Gas DSM Savings (Annual TJ/yr)

Sector	2014[49]	2015[50]	2016[51]	2017[52]	2018[53]	2019[54]	2020[55]	2021[56]
Residential	94.1	121.4	121.9	137.2	223.5	192.5	336.5	299.7
Commercial	254.9	270.9	255.4	238.7	234.2	281.2	334.5	413.6
Industrial	19.7	16.6	18.3	105.5	123.4	301.7	269.4	297.8
Low Income	24.9	24.1	36.9	47.3	45.1	53.2	76.4	50.7
Conservation Education & Outreach	No direct savings					1.2	0	58.2
Innovative Technologies	No direct savings	1.6	6.3	4.9	No Savings Estimated			
Enabling Activities	No direct savings					2.1	16.0	22.6
TOTAL	**393.6**	**434.6**	**438.8**	**533.5**	**626.2**	**832.0**	**1,032.7**	**1,142.5**

[47] BC Hydro. 2021 –BC Hydro Report on Demand Side Management Activities for F2021 – Table 9
[48] BC Hydro. 2021 –BC Hydro Report on Demand Side Management Activities for F2021 – Table 9
[49] The FortisBC Energy Utilities. 2015. Energy Efficiency and Conservation Program. 2014 Annual Report. Table 2-2
[50] FortisBC Energy Inc. 2016. Natural Gas Demand-Side Management Programs. 2015 Annual Report. Table 2-2
[51] FortisBC Energy Inc. 2017. Natural Gas Demand-Side Management Programs. 2016 Annual Report. Table 2-2
[52] FortisBC Energy Inc. 2018. Natural Gas Demand-Side Management Programs. 2017 Annual Report. Table 2-2
[53] FortisBC Energy Inc. 2019. Natural Gas Demand-Side Management Programs. 2018 Annual Report. Table 2-2
[54] FortisBC Energy Inc. 2020. Natural Gas Demand-Side Management Programs. 2019 Annual Report. Table 2-3
[55] FortisBC Energy Inc. 2021. Natural Gas Demand-Side Management Programs. 2020 Annual Report. Table 2-3
[56] FortisBC Energy Inc. 2022. Natural Gas Demand-Side Management Programs. 2021 Annual Report. Table 2-3

Table 11 – FortisBC Gas DSM Expenditures ($millions)

Sector	2014[57]	2015[58]	2016[59]	2017[60]	2018[61]	2019[62]	2020[63]	2021[64]
Residential	$10.9	$12.7	$12.5	$12.2	$12.6	$22.1	$32.9	$51.5
Commercial	$9.4	$10.7	$10.6	$10.8	$10.1	$11.7	$13.6	$21.3
Industrial	$0.7	$1.0	$1.0	$2.1	$3.2	$6.5	$6.1	$6.1
Low Income	$0.9	$1.6	$2.3	$2.6	$2.7	$6.7	$7.2	$9.0
Conservation Education & Outreach	$2.7	$2.8	$2.4	$2.6	$3.1	$6.1	$5.2	$4.5
Innovative Technologies	$0.5	$0.6	$0.8	$0.9	$1.0	$2.0	$2.1	$3.7
Enabling Activities	$2.4	$2.4	$2.5	$2.7	$2.7	$9.4	$8.8	$10.7
TOTAL	**$27.6**	**$31.9**	**$32.2**	**$34.0**	**$35.5**	**$64.5**	**$75.8**	**$106.8**

Table 12 and **Table 13** summarize the annual savings and expenditures for FortisBC electric.

[57] The FortisBC Energy Utilities. 2015. Energy Efficiency and Conservation Program. 2014 Annual Report. Table 2-2
[58] FortisBC Energy Inc. 2016. Natural Gas Demand-Side Management Programs. 2015 Annual Report. Table 2-2
[59] FortisBC Energy Inc. 2017. Natural Gas Demand-Side Management Programs. 2016 Annual Report. Table 2-2
[60] FortisBC Energy Inc. 2018. Natural Gas Demand-Side Management Programs. 2017 Annual Report. Table 2-2
[61] FortisBC Energy Inc. 2019. Natural Gas Demand-Side Management Programs. 2018 Annual Report. Table 2-2
[62] FortisBC Energy Inc. 2020. Natural Gas Demand-Side Management Programs. 2019 Annual Report. Table 2-2
[63] FortisBC Energy Inc. 2021. Natural Gas Demand-Side Management Programs. 2020 Annual Report. Table 2-2
[64] FortisBC Energy Inc. 2022. Natural Gas Demand-Side Management Programs. 2021 Annual Report. Table 2-2

Table 12 – FortisBC Electricity DSM Savings (Annual GWh/yr)

Sector	2014[65]	2015[66]	2016[67]	2017[68]	2018[69]	2019[70]	2020[71]	2021[72]
Residential	8.7	5.3	11.3	10.1	5.2	6.5	7.2	7.9
Commercial	5.3	5.9	8.1	16.1	23.9	15.0	11.1	12.3
Industrial	0.6	1.1	2.1	0.9	1.6	3.0	6.8	8.7
Low Income	-	0.3	1.2	0.7	0.7	1.3	0.8	0.7
Conservation Education & Outreach	-	-	-	-	-	-	-	-
Supporting Initiatives	-	-	-	-	-	-	0.2	-
Portfolio	-	-	-	-	-	-	-	-
Demand Response	-	-	-	-	-	-	-	-
TOTAL	**14.6**	**12.6**	**22.7**	**27.8**	**31.4**	**25.8**	**26.1**	**29.6**

Table 13 – FortisBC Electricity DSM Expenditures ($millions)

Sector	2014[73]	2015[74]	2016[75]	2017[76]	2018[77]	2019[78]	2020[79]	2021[80]
Residential	$1.7	$0.8	$1.4	$1.4	$1.7	$2.2	$2.3	$2.9
Commercial	$0.9	$1.3	$2.3	$4.0	$3.5	$3.4	$2.8	$3.5
Industrial	$0.2	$0.2	$0.3	$0.2	$0.4	$1.1	$1.8	$2.7
Low Income	-	$0.3	$1.1	$0.5	$0.4	$0.9	$0.8	$0.8
Conservation Education & Outreach	-	-	-	-	-	$0.6	$0.6	$0.6
Supporting Initiatives	$0.2	$0.3	$0.7	$0.6	$0.5	$0.9	$0.8	$1.1
Portfolio	$0.5	$0.6	$0.7	$1.0	$0.7	$0.8	$0.9	$0.8
Demand Response						$0.2	$0.1	$0.3
TOTAL	**$3.5**	**$3.5**	**$6.5**	**$7.7**	**$7.2**	**$10.1**	**$10.2**	**$12.7**

[65] FortisBC Inc. 2015. Demand-Side Management. 2014 Annual Report. Table 5-1
[66] FortisBC Inc. 2016. Electricity Demand-Side Management Programs. 2015 Annual Report. Table 1-1
[67] FortisBC Inc. 2017. Electricity Demand-Side Management Programs. 2016 Annual Report. Table 1-1
[68] FortisBC Inc. 2018. Electricity Demand-Side Management Programs. 2017 Annual Report. Table 1-1
[69] FortisBC Inc. 2019. Electricity Demand-Side Management Programs. 2018 Annual Report. Table 1-1
[70] FortisBC Inc. 2020. Electricity Demand-Side Management Programs. 2019 Annual Report. Table 1-1
[71] FortisBC Inc. 2021. Electricity Demand-Side Management Programs. 2020 Annual Report. Tables 4-2, 4-3, 4-4, 4-5
[72] FortisBC Inc. 2022. Electricity Demand-Side Management Programs. 2021 Annual Report. Table 1-1
[73] FortisBC Inc. 2015. Demand Side Management. 2014 Annual Report. Table 4-1
[74] FortisBC Inc. 2016. Electricity Demand-Side Management Programs. 2015 Annual Report. Table 1-1
[75] FortisBC Inc. 2017. Electricity Demand-Side Management Programs. 2016 Annual Report. Table 1-1
[76] FortisBC Inc. 2018. Electricity Demand-Side Management Programs. 2017 Annual Report. Table 1-1
[77] FortisBC Inc. 2019. Electricity Demand-Side Management Programs. 2018 Annual Report. Table 1-1
[78] FortisBC Inc. 2020. Electricity Demand-Side Management Programs. 2019 Annual Report. Table 1-1
[79] FortisBC Inc. 2021. Electricity Demand-Side Management Programs. 2020 Annual Report. Table 1-1
[80] FortisBC Inc. 2022. Electricity Demand-Side Management Programs. 2021 Annual Report. Table 1-1

5.1.3 Local Government Development Incentives and the Energy Step Code

Provincial legislation established requirements for greenhouse gas reduction targets, including energy efficiency. These are frequently achieved through building development approvals. Developments that are within the current zoning bylaw for a city or neighbourhood are required to meet the BC Building Code energy efficiency standards. For local governments interested in incenting or requiring new building projects to exceed the energy efficiency standards of the base building code, the Province introduced the BC Energy Step Code in 2017. The BC Energy Step Code is an optional, performance-based compliance path in the BC Building Code that local governments may use, if they wish, to incentivize or require a level of energy efficiency in new construction that goes above and beyond the requirements of the BC Building Code. A number of additional municipal planning incentives are also readily available to developers such as density bonuses, building height relaxation, building permit rebates, and rebates for blower door testing and Step Code plan review.

5.2 Public vs. private EE investment and leveraging from incentive programs

Under the BCUC cost-effectiveness evaluation framework, utilities have estimated the extent of private investment leveraged by incentive programs. For example, FortisBC's Efficient Boiler Program or the Condensing Make-up Air Unit Program have a utility incentive that covers up to 75% of the product purchase price or where qualifying criteria includes installation, up to 75% of the combined product purchase price and installation costs, leveraging an investment by the owner. BC Hydro's Continuous Optimization Program leveraged $2.80 of private funds for every $1 of utility investment in 2016.

CASE STUDY 3: NOVA SCOTIA

As noted in Chapter 10 of Section 1 of this textbook, Nova Scotia scored the third highest in Canada in Efficiency Canada's 2021 Report Card. Rather than updating the previous case study published in 2018, the best summary of the progress that has been made in Nova Scotia since then is contained in Efficiency One's 2021 annual report "Good Energy for All: Leading the Way, for all Nova Scotians"[1]. The full report includes their audited financial statements but these have not been included in this case study. As background the earlier case study is also included at the end of the report.

1. Efficiency One. "Good Energy for All: Leading the Way, for all Nova Scotians". Efficiency One, Halifax, NS, 2022.

Good Energy For All

Leading the way,
for all Nova Scotians.

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Darrell Boutilier, Dept. of Facilities Management, Dalhousie University
& Kyle MacKenzie, Senior Service Technician, Johnson Controls

About us

EfficiencyOne is a leading efficiency enterprise. We believe in the good things efficiency brings to our lives, and we work with a number of outstanding partners to transform how our customers use energy and other resources. We welcome you to take a closer look.

Letter from our Board Chair

Over two years have passed since the beginning of the pandemic, and in that time, we have seen the best of Nova Scotians. Whether it was communities embracing rapid testing, supporting small businesses, or getting vaccinated, this province led by example in responding to a global crisis. I am proud of EfficiencyOne's commitment to working with Nova Scotians safely and flexibly during these uncertain times.

As our collective attention focused on the pandemic, another global crisis continued to grow at an extraordinary rate: climate change. The number of extreme weather events is increasing, and Nova Scotia is experiencing more frequent and intense storms, coastal erosion, and flooding. These events will have a significant impact on every aspect of our lives, economy, health and natural resources, ecosystems, and biodiversity. Like the pandemic, urgent action is needed, and Nova Scotia can again lead by example in reducing harmful greenhouse gas emissions.

While Nova Scotia has made progress in reducing emissions—down 30% since 2005—a challenging path lies ahead to achieve a net-zero future. That is why our Board of Directors formed a special committee in 2021 to guide the development of a White Paper, *2050: Net-Zero Carbon Nova Scotia.* The White Paper examines the strategies, technologies, and solutions available to the province to address these challenges and identifies strategic actions that must be taken. Its primary conclusion is that there is no single action that will get us to net-zero. Instead, we need a comprehensive strategy that combines a fundamental shift to renewable electricity, wide-spread electrification of energy systems, and increased energy efficiency. It is encouraging to see that many of the actions identified in the White Paper are represented in the goals of *Nova Scotia's Environmental Goals and Climate Change Reduction Act.*

To ensure we continue to "walk the talk", our Board also approved an Environmental, Social and Governance (ESG) framework to better communicate our ESG contributions and to push and inspire us to higher goals and targets for future ESG work. We start reporting on our ESG contributions in this Annual Report.

The Halifax Climate Investment, Innovation and Impact (HCi3) Fund, a new subsidiary of EfficiencyOne, launched in 2021. HCi3 uses ESG principles to guide investments and grants to advance climate change initiatives in the Halifax region. This work allows us to continue to support businesses and organizations to reduce carbon emissions, improve public health and the local economy, and will enable the scaling of local solutions through the sharing of experience and expertise.

> "We need a comprehensive strategy that combines a fundamental shift to renewable electricity, wide-spread electrification of energy systems, and increased energy efficiency."

Karen Miner, Managing Director of the International Centre for Co-operative Management (Saint Mary's University), became our newest Director in 2021. Her expertise and experience in values and community-based business models and her deep understanding of governance that advances environmental, social, and economic goals have strengthened our Board. In 2022, we will welcome Cathie O'Toole, General Manager/CEO of Halifax Water, to our Board. Cathie brings 20 years of experience in public sector finance and administration, and a profound knowledge of meeting environmental and regulatory requirements and customer needs. At the same time, we say goodbye to Michele Wood-Tweel who is a founding member of our Board of Directors. Michele's vast experience in the accounting profession and public sector board experience was instrumental in establishing an organization with the highest commitment to stewardship of public resources. With all my colleagues, I want to thank Michele for her outstanding contributions to our customers, partners, employees, and the mission of EfficiencyOne.

On behalf of the Board of Directors, I want to thank our customers, employees, partners, and the more than 2,600 Nova Scotians working in the energy efficiency industry. Together, we continued to reduce energy use, save money, improve quality of life, and enhance competitiveness by reducing emissions and contributing significantly to Nova Scotia's climate change reduction goals. We look forward to escalating our collective success in 2022 and beyond.

William (Bill) Lahey,
Chair of the Board, EfficiencyOne
President and Vice Chancellor, University of King's College

Letter from our President and Chief Executive Officer

2021 was another challenging year as Nova Scotians continued to face the impacts of COVID-19. At EfficiencyOne, we had to pivot the way we work to keep customers safe, ensure Nova Scotians had access to efficiency services, and modify our approach to address interruptions to our programs and services. As we learn how to live with COVID-19, EfficiencyOne remains resilient and committed to helping ensure everyone can access and benefit from energy efficiency.

We continue to see strong partnerships develop with Mi'kmaw communities across the province through the Mi'kmaw Home Energy Efficiency Project. Since the launch of the program in 2018, 80% of upgrades have been completed by community-preferred contractors, who have worked within—or are from—the community.

In the spring of 2021, EfficiencyOne partnered with Natural Resources Canada to deliver the Canada Greener Homes Grant—one of only two provinces in Canada that will co-deliver the program with the federal government. To date, more than 10,000 Nova Scotians have registered for our Home Energy Assessment service, which qualifies them to participate in Greener Homes. Greener Homes is administered through Efficiency Nova Scotia and offers grants up to $5,000. It's a one-stop solution to financial support and expertise to make homes more energy efficient, with additional rebate support to make these investments even more affordable, to even more Nova Scotians.

"EfficiencyOne remains resilient and committed to helping ensure everyone can access and benefit from energy efficiency."

Across Nova Scotia, we are seeing increasing home prices and a lack of affordable rentals. Our Affordable Multifamily Housing service offers benefits for property owners and their tenants. Property owners benefit from rebates on upgrades to their property, including space and water heating, window and door replacements, as well as attic, wall and basement insulation. In return, they sign an agreement to rent units for below market value. This in turn provides tenants affordable rents and lower bills.

We welcomed two new members to the EfficiencyOne leadership team in 2021. Sarah MacDonald joined us as Chief Operating Officer, and Sarah Buckle joined our subsidiary, Halifax Climate Investment, Innovation and Impact Fund as its first Executive Director and Chief Climate Investment Officer.

I want to thank our staff, delivery agents, and partners for their dedicated investments in advancing the energy efficiency industry and helping Nova Scotia achieve its climate action goals. I invite you to read the stories and results in our Annual Report and to celebrate the success of our entire industry.

Steve MacDonald

Stephen MacDonald,
President and Chief Executive Officer, EfficiencyOne

Our Board of Directors

We are led by an independent Board of Directors with extensive professional experience serving private, public and non-profit organizations. Effective and efficient governance is an essential foundation for our success.

William (Bill) Lahey, B.A., B.A. (Juris), LL.M
Chair of the Board of Directors and Founding Chair

Faten Alshazly, B.Sc., M.F.A.

Corinne Boone, B.A., MES, CDI.D

Raymond Côté, B.Sc., M.Sc.

Jack Kyte, B.Sc., DIJ

Carol MacCulloch, B.Comm., M.A.

Joan McArthur-Blair, B.A., M.Ed., Ed.D.

Karen Miner, BBA, MA Planning, ICD.D

Sean O'Connor, B.Comm., C.P.A., C.A

Dan O'Halloran, M.Sc., P.Eng.

Vicky Sharpe, B.Sc, Ph.D, ICD.D

Michele Wood-Tweel, FCPA, FCA

Learn more about our Board of Directors

2021 Performance

Electrical energy saving targets are regulated by the Nova Scotia Utility and Review Board and funded by electricity ratepayers in accordance with the Public Utilities Act.

Residential	Electrical Savings (GWh)	GHG Savings (tonnes)
Appliance Retirement	2	2,619
Instant Savings	14	9,270
Home Energy Assessment	3	2,124
Green Heat	7	6,585
Efficient Product Installation	8	4,798
New Home Construction	6	3,666
Affordable Multifamily Housing and Non-Profits	0.4	236
Mi'kmaw Home Energy Efficiency Project	0.3	185
Residential Subtotal	**41**	**29,483**

Business, Non-Profit & Institutional	Electrical Savings (GWh)	GHG Savings (tonnes)
Business Energy Rebates	33	28,741
Custom	23	15,690
Energy Management Information Systems	.02	16
Small Business Energy Solutions	9	6,519
Strategic Energy Management	2	1,083
Business, Non-Profit & Institutional Subtotal	**68**	**52,048**

TOTAL SAVINGS:	**109**	**81,531**
TOTAL DEMAND SAVINGS:	**28 MW**	

**Numbers have been rounded*

2021 Performance

The Province of Nova Scotia and the Government of Canada provide funding for energy efficiency programs for mainly non-electrically heated homes and the installation of solar photovoltaic (PV) systems.

Savings from Other Programs	Energy Savings (GJ)	GHG Savings (Tonnes)
HomeWarming	34,078	2,113
Mi'kmaw Home Energy Efficiency Project	5,114	364
Affordable Multifamily Housing and Non-Profits	5,967	327
Green Heat	61,095	1,656
Home Energy Assessment	45,348	1,938
Instant Savings	17,259	1,184
Efficient Product Installation	28,976	2,008
SolarHomes	70,570	11,506
Small Business Energy Solutions (non-electric)	4,093	105
Total Savings from Other Programs	**272,501**	**21,200**

24% contribution to Nova Scotia's overall GHG emission reductions since 2011, avoiding over 1MT of CO_2e annually. That's equivalent to removing over 195,000 gasoline powered vehicles driven for 1 year.

Energy savings from all fuel sources achieved in 2021 are equivalent to the annual energy use of over **7,500** average Nova Scotian households.

Environmental, Social, and Governance

Environmental

1,638
total number of solar installations

102,732
GHG emission reductions achieved from programs and services (tonnes)

24%
contribution to Nova Scotia's overall GHG emission reductions

Governance

37
employees completed mental health awareness training

58%
of Board Members self-identify as women

100%
of our program delivery partners are WCB Safety Certified

99%
safety audit score

47
employees completed WHMIS training

Environmental, Social, and Governance

Social

Over
21,000
students were engaged through Green Schools

Over $1B
in customer bill savings

84% of public schools are now participating in Green Schools

$208M
total bill savings for low-income homeowners and tenants

over **230**
homes in all 13 Mi'kmaw communities received energy efficient upgrades

2,600
jobs supported in Nova Scotia's energy efficiency sector

16%
of employees self-identify as a visible minority

56%
of employees self-identify as women

255
total number of Preferred Partner Network members

84%
employee engagement

89%
average overall customer satisfaction score out of 100

Al Gould, Community-Preferred Contractor,
Mi'kmaw Home Energy Efficiency Project

Work in Our Community

A Vision for a Net-Zero Future

Across the province, Nova Scotians should be proud of the significant actions we have taken to reduce our greenhouse gas (GHG) emissions. Emissions are down 30% since 2005, demonstrating our ability to plan and put those plans into action when needed. But a challenging path lies ahead. Nova Scotia needs to further invest in energy efficiency, electrification, and decarbonization if we are to achieve our goal of a net-zero future. However, along with those challenges come opportunities–to do things better and smarter. We have already begun.

In 2021, EfficiencyOne outlined the challenges and opportunities facing our province as we continue to focus on emissions reductions, in the White Paper *2050: Net-Zero Carbon Nova Scotia.*

> "Urgent action is needed to mitigate the effects of climate change. There is no single action that can get us to net-zero as a province, but our choices today determine our GHG emissions in 10-20 years."
>
> Stephen MacDonald, *President and Chief Executive Officer, EfficiencyOne*

Click here to play the video

The White Paper outlines five strategic pathways that will empower us to not just address our climate challenges but to seize the opportunity to create a better future for all Nova Scotians. Those five strategic ways forward are: energy efficiency and decarbonization; partnerships, collaboration, and training; innovative financing and private investment; equity; and regional capacity building.

According to the White Paper, the three highest sources of emissions generated in Nova Scotia are electricity, transportation, and buildings. These three areas also represent our greatest opportunity for incorporating solutions towards reaching net-zero and include: further enhancing energy efficiency; a plan for net-zero emission buildings, both new and existing; expanding the use of electric vehicles and their infrastructure; facilitating growth in distributed renewable energy installations such as solar and battery storage for this energy.

Achieving Net-Zero Together

In order for our path towards net-zero to work—and benefit—all Nova Scotians, we must include everyone living in this province.

We are committed to continuously investing in, and expanding, our services that create opportunities for more Nova Scotians to actively participate and make a change, including Mi'kmaw communities, low-income homeowners and renters.

2021 Highlights:

- Completed energy efficient upgrades to over 230 homes in all 13 Mi'kmaw communities.
- Held two Appliance Retirement events in Whitney Pier and North Preston. Community members could retire eligible appliances and receive cash back.
- Completed projects in 41 multi-unit residential buildings, 6 shelters, and 3 non-profit community centers, through our Affordable Housing program.

2021

also saw the creation of the province's new climate change legislation, the **Environmental Goals and Climate Change Reduction Act**. This Act focuses on key areas that will help move our province towards net-zero, including many of the areas outlined in the White Paper.

Engaging Youth to be Future Climate Leaders

Click here to play the video

Since 2015, our Green Schools initiative has been inspiring and empowering schools across Nova Scotia to adopt smarter, more sustainable energy habits. Through this free program, our engagement officers support students, teachers, and the larger school community as they learn to waste less and become more energy efficient.

Of course, 2021 was a challenging year for all, including the public school system. Our commitment to continuing our partnership and participation with schools required creative solutions, while following health regulations. We shifted our Green Schools initiative to virtual engagements throughout Nova Scotia, completing over 1,600 engagements and reaching 22,000 students through the school year. We are proud to report that approximately 84% of Nova Scotia's public schools are now participating each year in Green Schools.

Check out

FUTURES: A Green Schools NS Podcast

The FUTURES podcast is part of our Green Schools Nova Scotia initiative and celebrates the inspiring journeys and important work of Green Heroes and those working in green careers.

Shelby MacDonald, Operations Assistant at Trinity Energy Group - Taking an Unexpected Route to a Career in Energy Efficiency

LISTEN HERE

CBRM Mayor Amanda McDougall Talks Life After High School and Sustainability in Municipal Politics

LISTEN HERE

Green Hero Kaden Myles on Saving Energy and Upcycling Old Jeans

LISTEN HERE

Virtual Field Trips

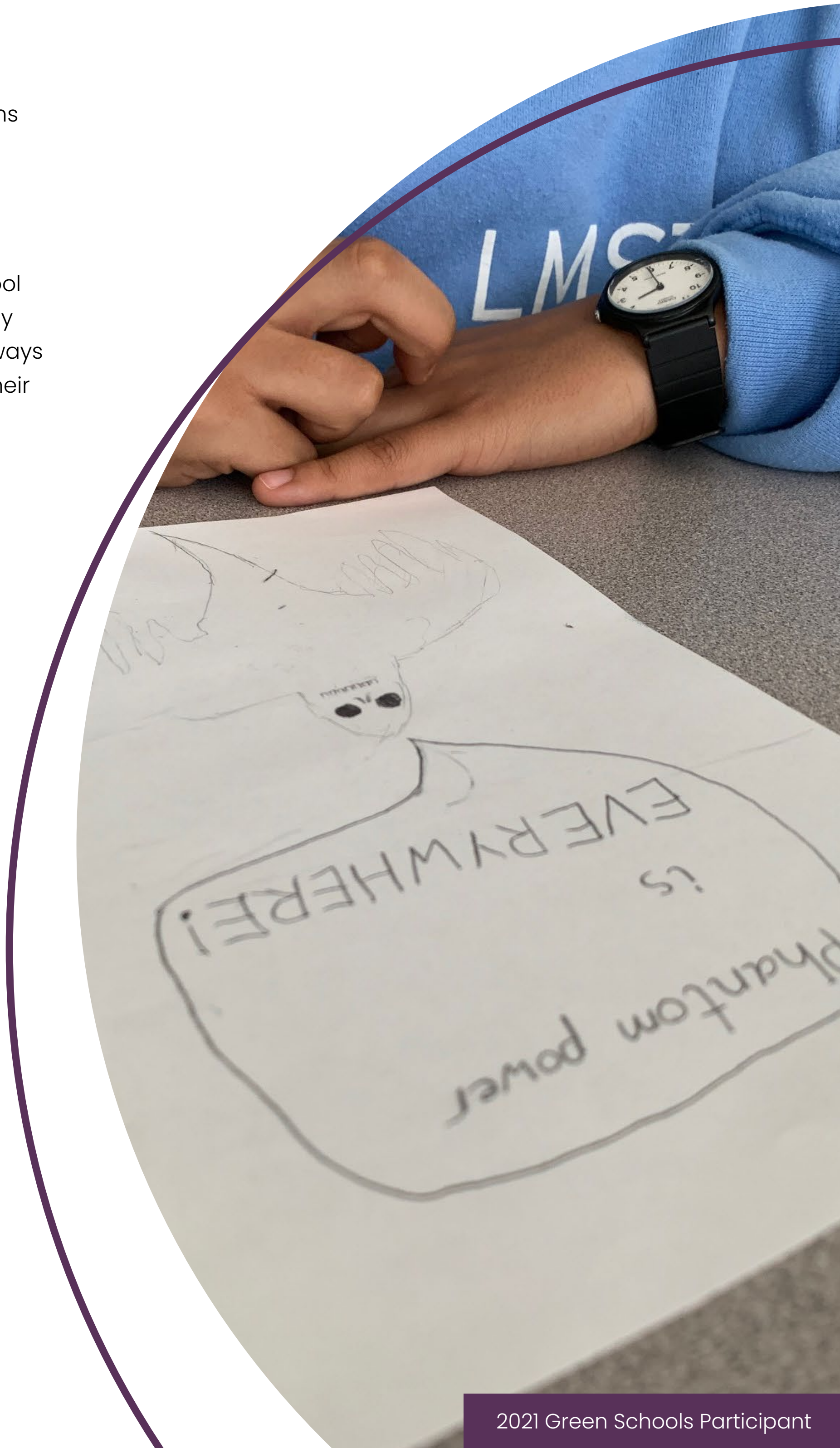
In 2021, Virtual Field Trips were introduced. They enabled students to experience a green career in Nova Scotia. During these Virtual Field Trips, students go on a pre-recorded video tour and participate in a live Q&A with a local professional working in the energy efficiency sector.

2021 Virtual Field Trip Highlights:

- Over 45 classrooms participated
- Engaged with over 950 students in classrooms from schools across the entire province
- Partnered with the Business is Jammin' (BIJ) program of the Black Business Initiative

The video field trips are proving to be a great tool for students to learn about careers in the energy efficiency sector, as well as for learning about ways to introduce or encourage green practices in their own lives, at home and school.

Watch video field trips ❯



2021 Green Schools Participant

Supporting Climate Action Across Nova Scotia

We are proud to be one of only two provinces to have partnered with Natural Resources Canada to deliver the Canada Greener Homes Grant on the federal government's behalf. In Nova Scotia, the Canada Greener Homes Grant will be co-delivered with Efficiency Nova Scotia's Home Energy Assessment service, meaning anyone who enrolls in the service will automatically be registered for the federal grant.

Administering the Canada Greener Homes Grant through Efficiency Nova Scotia makes it easy for Nova Scotians to take advantage of up to $5,000 in grants offered through the program. In addition to providing this one-stop point of access for financial support, Nova Scotians also benefit from having access to Efficiency Nova Scotia's expertise and additional rebate support. We are excited to be able to help make investing in energy efficiency even more affordable, to even more Nova Scotians.

SolarHomes

Nova Scotians have embraced solar as part of the immediate action required to address the climate crisis. The SolarHomes service helps Nova Scotians harness the sun's energy by offering rebates on approved solar solar photovoltaic (PV) systems.

2021 Highlights:

- Over 1,600 rebates were provided on installed solar PV systems totalling 16.8 MW of new solar generation capacity.
- These systems reduced approximately 20 GWh of energy usage, saving Nova Scotians around $3 million in energy costs.
- Approved Solar Installer List has nearly 70 companies across the province.

From the numbers, Nova Scotians appear equally excited to participate in a program that enables them to lower their energy costs and do their part to fight climate change. In just 10 months, over 10,000 Nova Scotians have registered for the Greener Homes Grant Program.

Accepting the Challenge, Building the Capacity

This increase in interest in Home Energy Assessments, as a result of the Canada Greener Homes Grant, could have presented capacity challenges, but our partner companies rose to the challenge and quickly began to hire and train to meet the incredible demand from Nova Scotians.

Click here to play the video

Municipalities taking climate action

Our On-site Energy Managers (OEMs) are trained energy efficiency professionals who work with large energy users, including Municipalities, to identify and lead viable energy efficiency projects.

Cape Breton Regional Municipality (CBRM)

- Developed an energy policy and management plan, which includes a $4 million investment, between 2022 and 2026, on structural, mechanical, and electrical energy efficiency projects over 15 facilities.

Halifax – In partnership with HalifACT

- Completed the retrofit of Woodside Ferry Terminal, transitioning the building from oil to an advanced heating and cooling system, LED Lighting and other energy efficient features.
- These projects, and many others, will help remove 1,150 tonnes of GHG emissions

Strait Regional Area

- Employed a roving OEM which resulted in four Municipalities establishing corporate environmental targets as well as developing detailed Energy Management plans.
- Identified opportunities for annual savings of 821,000 kWh, equivalent to $116,500 in utility costs.

Bridgewater

- The Energize Bridgewater program, which aims to reduce energy costs for low-income homeowners by at least 51%, entered its next phase of identifying potential partnerships in order to accomplish the programs' ambitious goals.
- $1.4 million was committed for upgrades to the Lunenburg County Lifestyle Centre which includes an innovative use of thermal storage tanks to improve heat transfer.

2021: A Foundational Year for HCi3

The Halifax Climate Investment, Innovation and Impact (HCi3) Fund is a non-profit subsidiary of EfficiencyOne and a member of Low Carbon Cities Canada (LC3)—a collaboration among seven local LC3 centres and the Federation of Canadian Municipalities' Green Municipal Fund to reduce greenhouse gas (GHG) emissions from cities. 2021 was an important year for HCi3 and its first year of operations.

2021 Highlights:

- Received $17.7M from the Federation of Canadian Municipalities' Green Municipal Fund, funded by the Government of Canada. The funding included a $15M endowment that provides a long-term, independent and sustainable financing model for HCi3's work.

- Signed a memorandum of understanding with the city of Halifax, with a commitment to work together to meet the goals of HalifACT: Acting on Climate Together.

- Hired HCi3's Executive Director and Chief Climate Investment Officer and HCi3's Program Manager.

- Formed an Advisory Group with local climate leaders with the mandate to provide strategic input and advice on HCi3's programming, and act as advocates for HCi3.

- Built relationships with key partners and stakeholders to build awareness around shared goals and equitable climate solutions.

- Developed the HCi3 Grant Program, which launched in early 2022 and will support a broad range of innovative projects that provide climate solutions in the Halifax region.

- Successfully invested the endowment in multiple asset-classes with a strong focus on ESG. The investment returns will contribute to stable funding and allow us to create greater impact through equitable climate solutions.

To learn more about HCi3, read the organization's 2021 Annual Report at hci3.ca

NOVA SCOTIA

Brendan Haley, PhD

Banting Post-Doctoral Fellow, School for Resource and Environmental Studies, Faculty of Management, Dalhousie University, Halifax, Nova Scotia

Nova Scotia is home to a public purpose organization dedicated to promoting energy efficiency that acts as an "energy efficiency utility" for the electricity system and efficiency service provider for consumers who use other fuel sources. This organization was first created as the Efficiency Nova Scotia Corporation (ENSC) and later restructured to make "Efficiency Nova Scotia" a franchise operated by a non-profit corporation called EfficiencyOne (E1). Nova Scotia has nationally leading energy savings in a short period of time under its unique organizational model.

This article explains why and how these organizations were created and subsequently reformed, Nova Scotia's energy efficiency performance, and future opportunities and challenges. The Nova Scotia case presents a number of examples and lessons for energy efficiency students and practitioners on topics such as stakeholder engagement, energy politics, public utility regulation and planning, organizational management and leadership, program design, and the use of new energy efficiency technologies and practices.

This case study is informed by documentary analysis, interviews, and quantitative indicators. It is also significantly informed by the author's experience with energy efficiency in Nova Scotia as an environmental stakeholder and a member of the Board of Directors of EfficiencyOne and Efficiency Nova Scotia Corporation.[81]

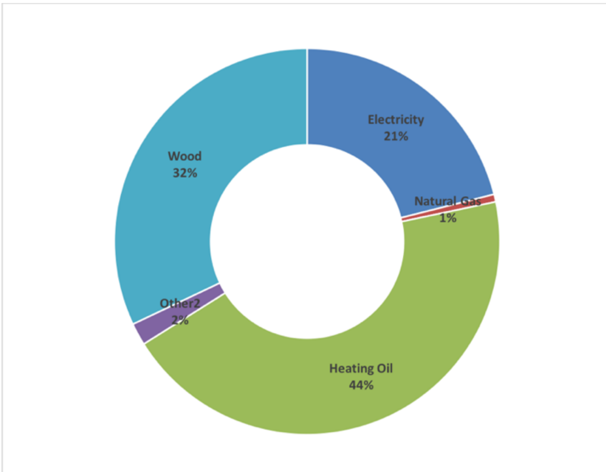
1. Nova Scotia's Energy Context

Nova Scotia's electricity system principally relies on coal fired generation, and oil and wood are prominent home heating fuels (Figure 1). A small natural gas distribution network principally serves large commercial and institutional buildings. The province's energy system is depicted in Figure 2, where the thickness of lines represents the magnitude of energy used (in petajoules) from primary energy sources to end-use. This Figure also illustrates the amount of energy that actually provides useful services, and the amount that is lost in conversion or wasted. In 2013 only 32% of the energy produced for domestic use in Nova Scotia provided useful services. As in most energy systems, the level of energy waste is substantial.

Nova Scotia has significantly reduced electricity sector greenhouse gas (GHG) since 2005 because of declining energy demand, as well as the use of renewable energy and lower carbon fuels to lower the GHG intensity of electricity production (Figure 3). Demand reductions were driven by the efficiency strategies discussed in this chapter, and the exit of large industrial electricity users in industries such as pulp and paper. If the savings attributable to electricity demand side management (DSM) started in late 2008 are counted as part of the fuel mix, Nova Scotia received 9% of its electrical energy services from energy efficiency in 2016 (Figure 4). This means energy efficiency acts as a resource that is equivalent to one of the largest generation units in the Nova Scotia electrical system.

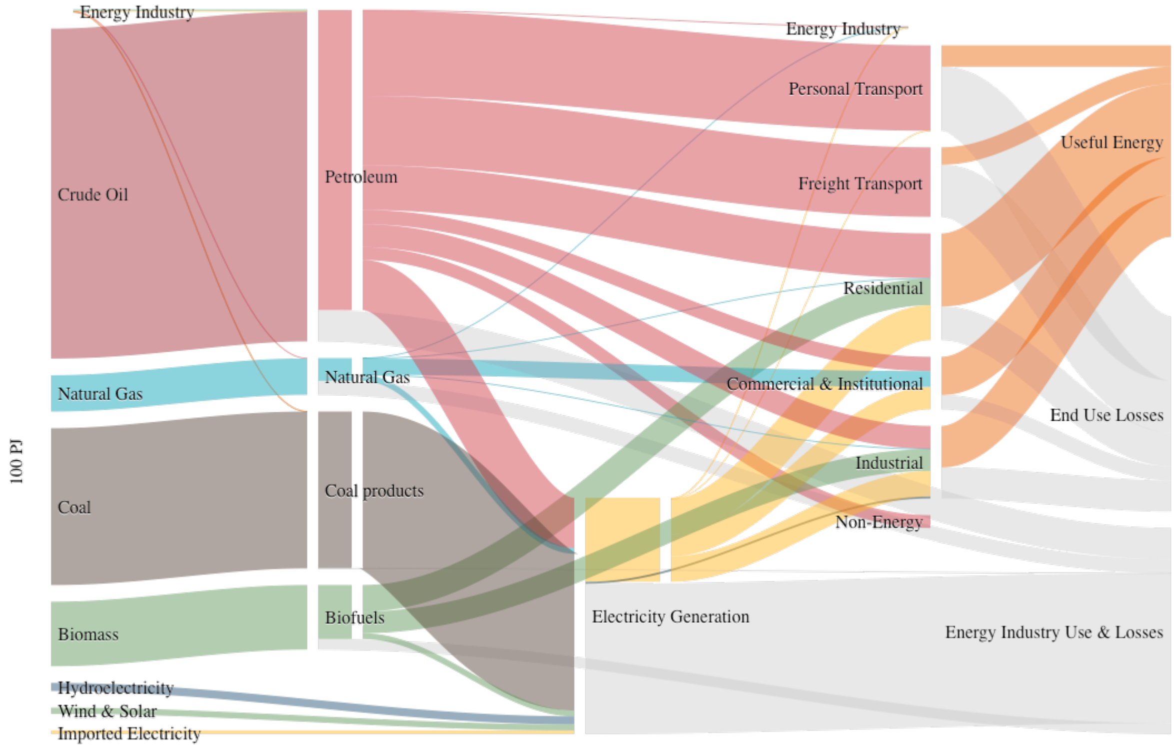
[81] The author was energy coordinator for the Ecology Action Centre from 2005 to 2008 and a member of the ENSC, and then E1 Board of Director since 2012.

Figure 1: Residential Heating in Nova Scotia (2014) (Petajoules)[82]



[82] Natural Resources Canada, National Energy Use Database, http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/showTable.cfm?type=CP&sector=res&juris=ns&rn=5&page=0

Figure 2: Nova Scotia Domestic Energy System (2013)[83]



[83] Canadian Energy Systems Analysis Research (CESAR). http://www.cesarnet.ca/. This Figure represents domestic energy flow, and thus excludes energy production for export and includes any imports required to meet final demand.

Figure 3: Nova Scotia Electricity Demand, GHG Emissions and GHG Intensity[84]

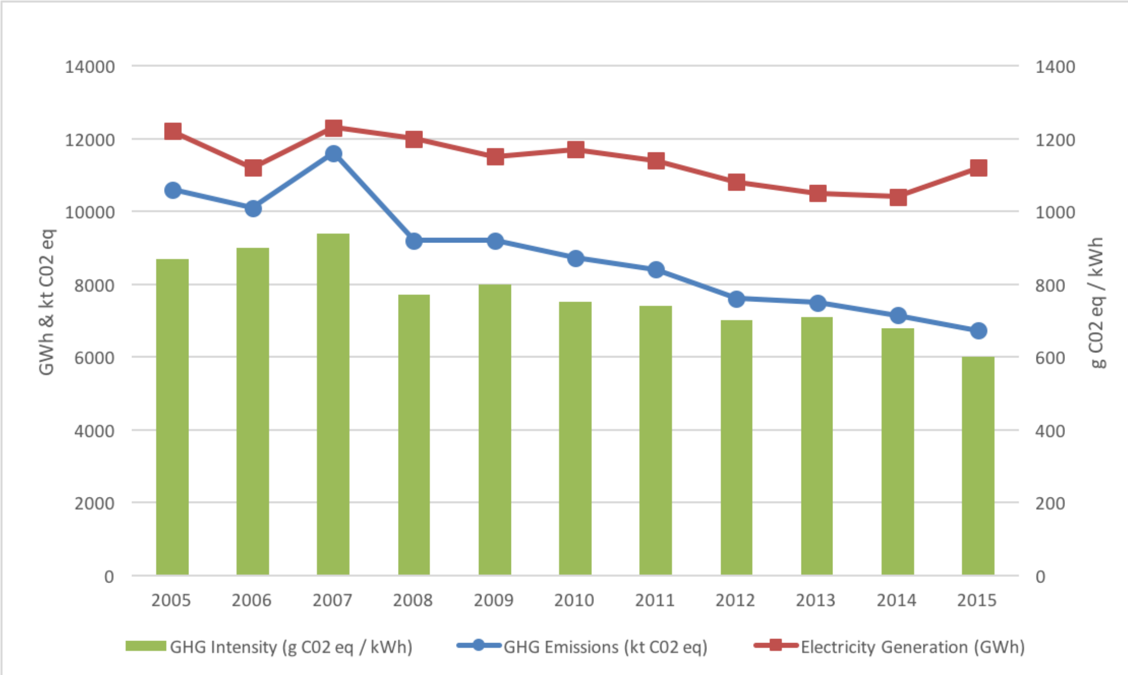
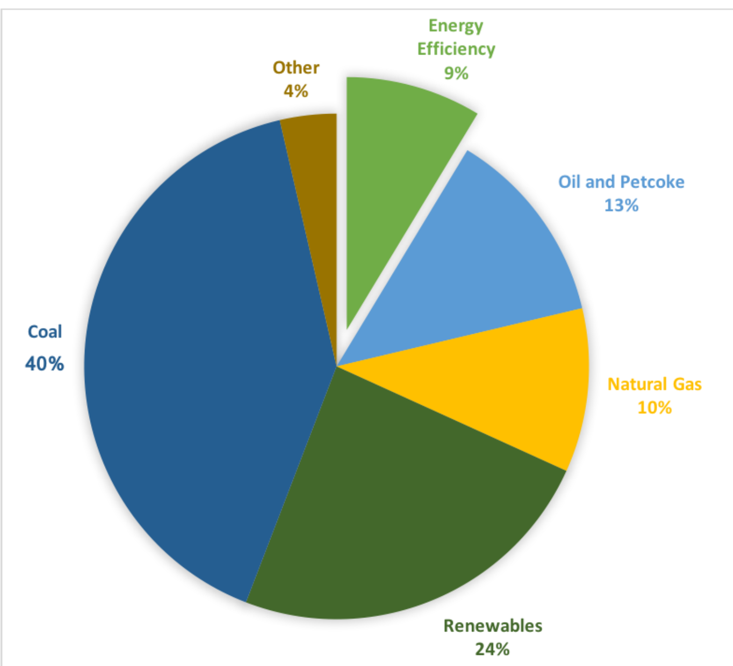


Figure 4: Nova Scotia's Electricity Fuel Mix with Energy Efficiency (2016) (GWh)[85]



[84] Environment Canada, "National Inventory Report: 1990-2015: Greenhouse Gas Sources and Sinks in Canada," 2017 Table A13-4. 2015 data is preliminary.
[85] Efficiency One, June 2017.

1.1 Regulatory Context

The Nova Scotia Utility and Review Board (UARB) is a regulatory body that oversees electricity and natural gas utilities. Nova Scotia Power is the vertically integrated electricity utility[86] that serves the province. The utility was privatized in 1992, and is owned by its parent company, Emera. There are also six independent municipal distribution utilities in the province. The UARB grants a franchise for natural gas distribution (approved by Cabinet), which is currently held by Heritage Gas, which is a subsidiary of AltaGas Utility Group. Natural gas is a relatively new energy source in Nova Scotia. Heritage Gas made its first sale in 2003.[87] Heating oil, propane, and wood are sold to consumers through independent retailers. These fuel sources are not regulated under the UARB, and the prices of these fuels are based on market dynamics. Given the limited use of natural gas and the unregulated nature of wood, propane and heating oil, electricity is the primary type of energy regulated by the UARB.

The creation of a separate energy efficiency organization within the electricity sector was a major institutional innovation. Under this model Nova Scotia Power remains the utility responsible for the generation, transmission, and distribution of electricity (i.e. energy supply), while the UARB oversees a separate entity to deliver electrical energy savings. The original governance and service model is outlined in Figure 5, demonstrating the different roles energy delivery and savings play at governmental, regulatory, electricity system, and electricity end use levels. The UARB is an independent, quasi-judicial body that receives its powers from the provincial government under the Public Utilities Act. Government Ministries relevant to utility governance include Finance, through which the UARB reports to the legislature, and the Ministries of Energy and Environment, which create policies and regulations that influence the electricity system.

The UARB oversees Nova Scotia Power's electricity system plans, and it approves the electricity rates charged to electricity customers.[88] Nova Scotia has a "cost of service" regulatory system, where the rates approved by the regulator ensure the utility is able to recover the total costs required to provide electricity service while earning a reasonable rate of return.[89] Regulatory oversight is meant to ensure that the electricity system costs are minimized, while meeting standards for reliability and environment stewardship. Electricity customers are charged the UARB approved rates based on their demand and energy usage. As shown in Figure 5, customers receive electricity in return for bill payments.

Other jurisdictions have included demand side management (DSM) activities as part of the utility's mandate to provide electricity service. Nova Scotia created a separate organization, called the Efficiency Nova Scotia Corporation (ENSC), to conduct DSM activities. Under this model, the UARB approves DSM plans and budgets. Nova Scotia Power collects revenues consistent with the cost of providing electricity service, which includes energy efficiency. Nova Scotia Power then pays ENSC to undertake UARB approved DSM activities. As shown by the green lines in Figure 5, these funds are used to offer energy efficiency services to electricity consumers that can help them reduce their energy usage and

[86] Vertically integrated means that the utility controls generation, transmission, and distribution divisions within one company. In other jurisdictions, these service areas can be provided by different organizations

[87] Heritage Gas Ltd., Re, 2004 NSUARB 72 (CanLII), <http://canlii.ca/t/1hkr9>, retrieved on 2017-05-08

[88] See James Bonbright, *Principles of Public Utility Rates* (New York: Columbia University Press, 1961). For review of principles used in establishing electricity rates.

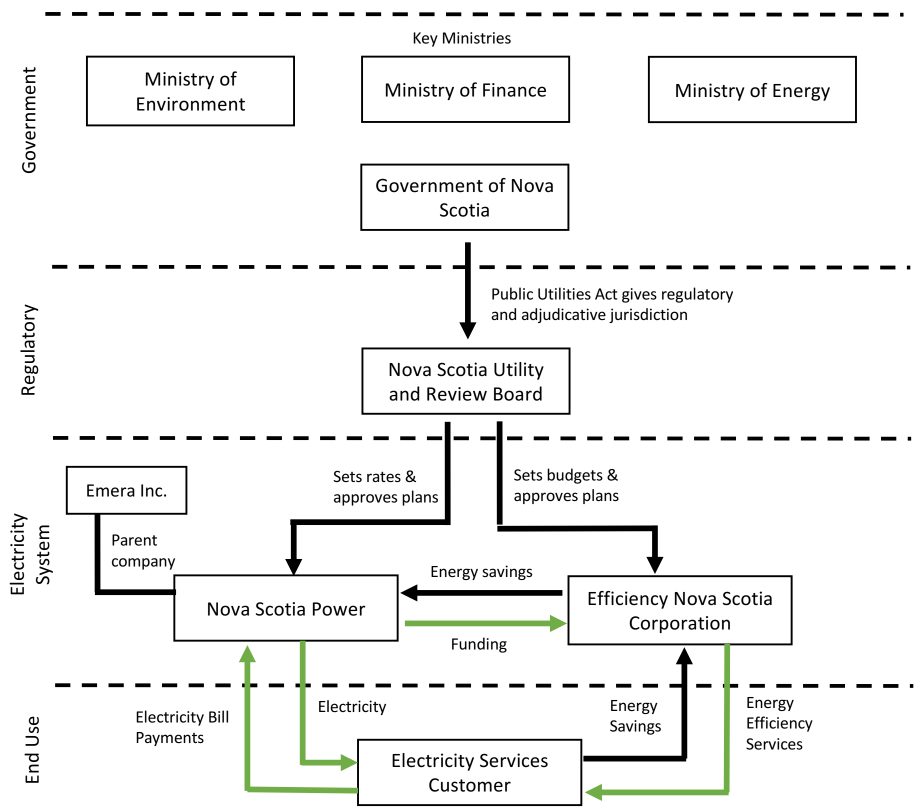
[89] Nova Scotia Power's approved rate of return on equity is set in the range of 8.75% to 9.25%, as of 2013.

subsequent energy bills. A key principle of the model is that energy savings also provide a valuable resource to the electricity system. End use energy savings are tracked by ENSC (and later independently evaluated and verified), reflected by the black energy savings arrow in Figure 5. If the costs of producing these savings are lower than the costs of supplying electricity, the energy savings help minimize the overall costs that Nova Scotia Power must incur to provide electricity service. As noted above, the minimization of electricity system costs is a key regulatory objective of the UARB.

This model makes Efficiency Nova Scotia Corporation operationally independent from both the government and the supply utility. As will be discussed below, ENSC was created by the government but it is not under Ministerial direction. The organization was established to provide saved energy to Nova Scotia Power consistent with public utility regulation objectives. ENSC is responsible for developing the energy savings plans and strategies and achieving UARB-approved energy savings. It is not controlled by Nova Scotia Power or its parent company.

The next section will provide a history of how and why Nova Scotia developed a separate organization to provide energy efficiency services, and the way the governance model was subsequently reformed in 2015.

Figure 5: Governance and Service Model (2011-2014)



1.2 2. Energy Efficiency History

1.3 2.1 Early Energy Efficiency and Utility Board Process

The Nova Scotia government offered energy efficiency programs since the late 1970s in the wake of the energy crisis and the movement to build a "conserver society".[90] Funding was high in the early 1980s, but decreased significantly in the 1990s and early 2000s when energy became less of a political priority. Information campaigns and audit programs were primarily targeted towards the residential sector.[91]

Nova Scotia Power also offered limited programming, primarily restricted to information campaigns and demonstrations of technologies such as heat pumps.[92] The UARB held a demand side management (DSM) hearing in 1992. The review of Nova Scotia Power's plan noted that the utility had a "hesitancy to adopt DSM options". The hearing resulted in a postponement of DSM activities after Nova Scotia Power submitted a significantly reduced load forecast in the middle of the hearing, taking into account the early 1990s recession.[93] Neither the UARB nor government seriously discussed DSM until a series of rate

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[90] See Henry Trim, "Planning the Future: The Conserver Society and Canadian Sustainability," *The Canadian Historical Review* 96, no. 3 (2015): 375–404.
[91] Government of Nova Scotia, "Seizing the Opportunity: Volume 2, Part VII Energy Efficiency," 2001.
[92] Ibid.
[93] This revised load forecast was also submitted within a month of the government passing legislation to privatize the utility.

hearings in the mid 2000s. In 2004 interveners[94] (including the Province of Nova Scotia) noted that Nova Scotia Power had undertaken limited DSM efforts. Nova Scotia Power proposed holding a technical conference on the subject, which was approved by the UARB.[95]

Nova Scotia Power conducted deliberative polling exercises with customers, informed by experts and stakeholders. Participants in these processes supported improved environmental performance, even if it meant higher electricity bills, after receiving information on electricity systems.[96] Nova Scotia Power used the results of these "Customer Energy Forums" to justify a 2006 Conservation and Energy Efficiency Plan proposal to spend $5 M in that year to save an estimated 72 GWh. However, experts and stakeholders before the UARB roundly criticized the plan. The plan itself was presented late in the regulatory proceedings. There was no justification for the budget amount, and reviewers found the plan to be inconsistent with best practices in program design and cost-effectiveness. The UARB ordered that the small amount that Nova Scotia Power had already directed towards demand side management ($550,000) be used to hire expert consultants to develop a more robust plan and that a hearing would be held on DSM in 2006. Some stakeholders expressed concern that Nova Scotia Power faced a conflict of interest as DSM administrator, because energy savings would reduce utility energy sales revenue. The UARB asked that the expert consultant consider this issue.

As the new DSM plan was being developed energy efficiency became a stronger political priority. In response to oil price increases, the province announced $10 M in funding for energy efficiency in the fall of 2005, alongside rebates for low-income families.[97] During the 2006 election, the incumbent Progressive Conservative Premier promised to create an energy efficiency agency. In October 2006, the government created an agency called *Conserve Nova Scotia* which received $10.2 million in funding in the 2007 provincial government budget. The new agency faced immediate political controversy. The Premier appointed his former chief of staff to the role of CEO, despite having no previous expertise in energy conservation.[98] Conserve Nova Scotia was created as a Special Operating Agency. This administrative structure could provide more operational flexibility than programs operated by government Ministries, yet is less arm's length than a crown corporation. The government offered few policy signals of how Conserve Nova Scotia and electricity DSM planning would be integrated.

In September 2006, Nova Scotia Power tabled its updated DSM plan. The plan provided more thorough information on program design and conducted an efficiency potential study.[99] The potential for energy savings is usually divided into technical, economic, and achievable potential. Technical potential estimates the amount of energy savings that are possible by implementing all efficiency measures. Economic potential estimates how many energy savings are cost-effective by comparing the cost of efficiency programs with the savings created in areas such as fuel costs and power plant construction. Finally, achievable potential considers how many of these savings can be realistically achieved given barriers that prevent customer adoption and transformation of markets. The consultants used a "benchmarking" approach to develop achievable potential, which involved surveying DSM funding levels in other jurisdictions. This led to a recommendation to spend $6.6 M in the first year of the program and

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[94] Are interveners and their role in regulatory processes explained elsewhere in the book?
[95] Should I provide an explanation of what a technical conference is? Explained elsewhere in the book?
[96] Genevieve Fuji Johnson, "Deliberative Democratic Practices in Canada: An Analysis of Institutional Empowerment in Three Cases," *Canadian Journal of Political Science* 42, no. 3 (2009): 679–703.
[97] See Nova Scotia Department of Energy 2005. "Smart Choices for Cleaner Energy: A Green Energy Framework".
[98] The Chronicle-Herald, "Premier Defends Appointment of Foley Melvin to New Post," July 15, 2006.
[99] Reference to text book chapter and shorten explanation?

ramp up to a level consistent with 2% of utility revenues by 2010 (about $20 M) because this was consistent with the average of other jurisdictions. The consultant's report also recommended that Nova Scotia Power administer DSM programs, arguing that the utility should use it to promote customer service and branding. It also recommended a mechanism for the utility to recover lost revenues from lower sales that result because of DSM (see chapter 6.4).

The DSM plan did not receive significant stakeholder support. Environmental organizations argued that the budget and savings levels had been artificially capped. The average savings level was a result of political decisions made in other jurisdictions rather than actual achievable potential. Leading jurisdictions were spending 3% of utility revenues on DSM and were planning to quickly ramp up to higher savings levels. Major opposition to the plan came from large volume industrial electricity users who were concerned that they would pay significant costs to fund DSM, yet receive few direct benefits from program participation. Two large pulp and paper plants that accounted for 20% of total electricity sales suggested they should be exempted from paying the costs of DSM in their rates.

This DSM plan was never considered in a hearing. A separate process to consider Nova Scotia Power's strategy to meet air emission regulations resulted in the UARB ordering Nova Scotia Power to conduct an Integrated Resource Plan (IRP). The UARB postponed the DSM hearing to receive more information from the IRP. An IRP is a technical and economic modelling exercise that considers how to minimize electricity system costs over the long term. It typically considers both energy demand and supply options, and thus treats energy efficiency as a "resource" to help minimize the utility's revenue requirements. This process presented an opportunity to revisit the efficiency potential estimates and to demonstrate the role energy efficiency could play as a cost-effective resource. An aggressive scenario, equivalent to spending 5% of utility revenues on DSM, was considered as a modelling input. When the results of the IRP were announced in May 2007, they found that this aggressive level of DSM spending and savings was robustly cost-effective. The plan with this level of DSM spending, as well as a significant increase in renewable energy, had a net present value savings of $1 billion in comparison with the next best scenario which would require building a new coal plant in 2016.

The IRP results did not persuade key stakeholders on the effectiveness of DSM. The higher level of spending only increased stakeholder concerns over issues such as the potential ineffectiveness of energy savings programs and unequal costs across different rate classes. Despite some differences of opinion on issues such as the appropriate level of investment, environmental, large industrial, municipal, consumer and low-income stakeholders developed a coalition to call for "accountability". In a letter dated September 7th, 2007 this group of stakeholders outlined key principles for energy efficiency administration and planning. This included creating clear performance indicators for energy savings and equitable service provision, that the administrator be free from conflicts of interest or competing priorities, development of a clear performance contract, the exploration of incentives and disincentives for performance, a high degree of public oversight, and the protection of DSM funds for their intended purpose.[100]

The legal counsel to the UARB responded to this letter by stating that the regulatory process could consider all of these issues, except for the question of non-utility administration. They clarified that

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[100] Letter from stakeholders to NSUARB re: Electric Energy Efficiency Administration and Planning, September 7th, 2007 found in Final Collaboration report by NSPI, UARB Staff and Consultants – Documentation Related to the DSM Collaborative Process Volume II of III, dated January 31, 2008.

having an entity other than Nova Scotia Power administer would require legislative changes to the Public Utilities Act. The government did not indicate a willingness to consider alternative administrative models. On October 31st 2007, the Ecology Action Centre (EAC) coordinated a stakeholder meeting to discuss alternative accountability and administrative frameworks. The group invited the Vermont Energy Investment Corporation (who were the EAC's consultants before the UARB process), as well as a New England environmental organization called Environment Northeast (now Acadia Centre) to provide information on utility and non-utility administrative models. Stakeholder's insistence that the administrator issue be examined spurred the province to announce (two days before the EAC sponsored meeting) that stakeholder consultations on the administration of DSM would commence after the utility board DSM hearings.[101]

Nova Scotia Power presented a revised DSM plan that included the more aggressive level of investment, yet did not satisfy stakeholders concerned about accountability. The new plan allowed Nova Scotia Power to recover lost revenue, but did not provide incentives or penalties for non-performance. Stakeholders also highlighted the lack of meaningful participation through the proposed advisory council. A meeting was held in January 2008 where a large group of stakeholders walked out in protest. The third page headline in the newspaper the next day read, "Don't let NSP control program: opponents".[102] Shortly after this event, Nova Scotia Power communicated to stakeholders that they would not support utility administration in the upcoming government process. This paved the way for stakeholders to reach a settlement agreement before the UARB, signed on February 29th, 2008. Stakeholders worked with the utility to develop an initial set of efficiency programs administered by Nova Scotia Power that would launch in the fall of 2008. The programs were designed to be easily transferable to a new administrator, mostly by contracting out delivery to third parties. A program development working group was created for stakeholders, Conserve Nova Scotia, and UARB staff to assist with program design and implementation.

1.4 2.2 Government Consultation on DSM Administration

The government process to consider administrative models commenced in late February, 2008. The process was led by Dr. David Wheeler, who was the Dean of Management at Dalhousie University. Dr. Wheeler had a background in sustainable business, which made him uniquely positioned to garner trust amongst both environmental and business stakeholders. The consultation process was designed to include multiple stakeholders, to start with general agreements on principles, to solicit expert evidence, and to enable iterative discussion and solicitation of stakeholder views.[103] The process considered the advantages and disadvantages of utility administration models in areas such as New York and Massachusetts, the Vermont and Oregon models of third-party administration, and government administration as practiced by Efficiency New Brunswick. During the consultation process, representatives of industrial consumers made a concerted push for a taxpayer funded government administered model. They fell back on the argument that they would pay the majority of the costs and receive little benefit if funding was through electricity rates.[104] Yet, the vast majority of other

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[101] Energy/Conserve Nova Scotia, "Province To Seek Input on Administration of Electricity Demand Management Program," October 29, 2007, https://novascotia.ca/news/release/?id=20071029010.

[102] Brian Flinn, "Don't Let NSP Control Program: Opponents," *The Daily News*, January 12, 2008.

[103] Michelle Adams, David Wheeler, and Genna Woolston, "A Participatory Approach to Sustainable Energy Strategy Development in a Carbon-Intensive Jurisdiction: The Case of Nova Scotia," *Energy Policy* 39, no. 5 (2011): 2550–59.

[104] Judy Myrden, "Paper Mills Don't Want to Pay; NSP's Biggest Customers Balk at Their Share of Funding for Proposed Energy-Efficiency Agency," *The Chronicle-Herald*, April 5, 2008, http://nouveau.eureka.cc/Link/dal01A2T_1/news·20080405·HH·0apr5new_txt0180.

stakeholders highlighted the benefits of a form of administration that was ratepayer funded, but independent of both the government and the utility. The primary concern with government administration was that it would lead to unstable budgets because of competing political priorities and be open to political interference and patronage (as was already a concern with the Premier's Conserve Nova Scotia CEO appointment). The provincial government was also unlikely to fund the aggressive levels of DSM called for in the IRP. On April 20th, 2008, Dr. Wheeler submitted his report, which recommended the creation of a "Performance Based Independent Efficiency Agency". The model would be a non-profit entity governed by a Board of Directors that would be funded by ratepayers, and regulated by the UARB to meet clear performance targets.

The UARB approved the settlement agreement and the launch of an initial set of programs days after Dr. Wheeler provided a verbal report of his recommendation. Despite the inability to reach an absolute consensus on the final administrative model, most stakeholders were proud of what they accomplished. The Canadian Manufacturers and Exporters Final submission to the hearing stated that the DSM plan "represents a consensus the likes of which has not been seen much, if ever before".

1.5 2.3 Efficiency Nova Scotia Corporation Act

While the Wheeler report, and the settlement agreement, called for a new entity to be up and running by June 2009, government legislation to implement Wheeler's recommendation was not presented until October 2009 (there was a provincial election and a change in government in June 2009). The Efficiency Nova Scotia Corporation Act received royal assent on November 5, 2009. The Act created ENSC as a non-profit corporation (and explicitly stated that it is not a crown corporation). Management and control of the corporation was vested in a Board of Directors, with initial Board members chosen by Cabinet and subsequent appointment made by the Board itself. The Board of Directors would appoint a Chief Executive Officer. The UARB was given supervision of ENSC's electricity DSM programs under the Public Utilities Act. The Act also enabled ENSC to engage in efficiency and conservation activities other than electricity demand side management and said ENSC could enter into agreements with the government. This permitted ENSC to also deliver energy efficiency services to the majority of households that do not heat with electricity, dependent on government funding. The Act also created a separate electricity DSM fund, with explicit language that prevented government from accessing these funds or treating them as public monies. This prevented "budget raids", where governments could revert funds from energy efficiency to other political priorities. The legislation also included a clause that requires Nova Scotia Power to provide ENSC with adequate information upon request (e.g. records, customer electricity usage and load), to ensure the efficiency organization is not hindered by information that would be readily available under utility administration. Upon release of the Act, the government announced that it would close Conserve Nova Scotia. The legislation created an entity with strong amount of independence from both government and the generation utility, while enabling the potential to create an organization that could provide efficiency services to Nova Scotians regardless of the type of fuel they used.

1.6 2.4 Start-up and Ramp-up

On January 26, 2010, the government appointed the four initial members of the Board of Directors. These appointments were widely considered to be non-partisan. The Board members were prominent Nova Scotians with backgrounds in government administration, business, non-profits, and accounting. The initial Board had to work diligently to establish an entirely new organization. The Board met 37 times in 2010 and worked without any staff until May 2010.[105] Without any pre-existing organizational infrastructure the board needed to establish by-laws and corporate governance policies, and work with the CEO to secure legal support, office space, insurance, website, IT services etc. The initial Board conducted an abbreviated competitive process to select an interim CEO, which awarded the job to Allan Crandlemire – an experienced civil servant in the Department of Energy who served as Executive Director of Conserve Nova Scotia.[106] ENSC received funding for start-up costs. The provincial government provided a $175,000 grant in May 2010, and provided $216,000 of in-kind assistance. The UARB approved under $1 M in start-up funding, as well as $450,000 to help transition existing programs from Nova Scotia Power from the DSM budget.[107]

The initial Board also consulted with other efficiency organizations, in particular the Energy Trust of Oregon and Efficiency Vermont. They developed an initial vision and mission and emphasized the intention to create a performance-driven organization, with a "private sector head and a non-profit heart".[108] Electricity DSM activities were transferred to ENSC in December 2010. In 2011, ENSC administered a DSM plan that was developed by Nova Scotia Power. The 2012 DSM Plan would be developed by the organization itself. The UARB approved a budget of $600,000 to develop the plan, and a first stakeholder consultation took place in November 2010.[109] On March 31, 2011 Conserve Nova Scotia ceased operations and the Province signed a 3-year service agreement with ENSC with funding to design, develop and administer non-electrical efficiency programs.

Allan Crandlemire, the first CEO, describes the start-up period as "intensity in the extreme".[110] The logistics of acquiring and equipping office space and creating back office support were substantial. ENSC needed to hire staff and develop the 2012 DSM plan quickly. Nova Scotia Power's method of staffing and administration facilitated transfer by sub-contracting program delivery and restricting NSP staff to recent graduates and co-op students. Many of the recent graduates were interviewed and hired through an open competition and the senior managers worked under secondment to eventually become full hires of ENSC. The Nova Scotia Power operations were physically transitioned over to ENSC over a long weekend. Employees from Conserve Nova Scotia also joined ENSC.

The transfer of staff from Nova Scotia Power and Conserve Nova Scotia provided some efficiency know-how. Yet, the vast majority of staff came from elsewhere. Few potential hires had efficiency related experience. New graduates were hired because they demonstrated an environmental orientation and

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[105] Efficiency Nova Scotia Corporation, 2010 Annual Report, p. 3.

[106] An open competition for the ENSC CEO position was held in 2011

[107] NSUARB, letter from Peter W. Gurnham to William Lahey regarding Efficiency Nova Scotia Corporation Funding – P-199, June 1, 2010

[108] Allan Crandlemire, Report from Interim CEO in Efficiency Nova Scotia Corporation, 2010 Annual Report, p. 6.

[109] 2010 Annual Report, p. 27 & NSUARB, letter from Peter W. Gurnham to William Lahey regarding Efficiency Nova Scotia Corporation Funding – P-199, June 1, 2010

[110] Personal Communication with Allan Crandlemire, May 19, 2017

strong motivation.[111] These employees were quick learners and soon made substantial contributions to management operations and program design.

The efficiency effort in Nova Scotia experienced a dramatic ramp-up in both electricity and non-electrical efficiency efforts. The organization had annual savings targets from the UARB, and made an absolute commitment to meet or exceed the targets to build confidence in DSM. Within 5 years, Nova Scotia had achieved electricity savings and budget levels well ahead of other Canadian jurisdictions and consistent with leading American states.[112] The efficiency program had exceeded its targets every year, except the first year of ENSC administration in 2011, when the savings target had doubled from the previous year. Government funding had also increased from a $10.2 M annual budget for all fuels when Conserve Nova Scotia was created to a 2013/14 expenditure of $21 M, dedicated to non-electrical efficiency programming (Table 2).[113]

Switching to a new administrative model in the middle of a dramatic ramp up of effort was not easy, but it was achieved with few problems - demonstrating that starting up a new organization with aggressive efficiency targets is possible with the right leadership, diligence, and mission orientation.

Table 1: Electricity DSM Annual Budgets and Savings[114]

	Approved UARB Targets			Actual			Spending as % of utility revenue	Annual incremental savings as % of generation
	$ (M)	GWh (target)	MW (target)	$ (M)	GWh	MW		
2008/2009	12.9	66	9	11.9	86	15	0.8%	0.6%
2010	22.6	81	17	24.0	82	16	2.1%	0.7%
2011	41.9	159	31	40.7	142	29	3.4%	1.2%
2012	43.7	124	23	48.0	158	34	4.0%	1.5%
2013	46.2	135	26	43.4	163	34	3.3%	1.4%
2014	48.7	138	27	38.7	152	27	2.9%	1.4%
2015	39.0	121	21	31.9	138	23	2.3%	1.2%
2016	33.2	133	20	30.7	137	26	2.3%	1.2%

[111] Personal Communication with Allan Crandlemire, May 19, 2017

[112] See Leslie Malone and Tim Weis, "N.S. Now National Leader in Cutting Energy Waste," *The Chronicle Herald*, August 6, 2013, http://thechronicleherald.ca/opinion/1146251-ns-now-national-leader-in-cutting-energy-waste. In the American Council for an Energy Efficient Economy 2013 scorecard, top marks were given to states with savings as a percentage of electricity sales 1.5% or greater and budgets as a percentage of utilities revenues 4% or greater. Table 1 shows Nova Scotia reaching these levels in 2012. Annie Downs et al., "The 2013 State Energy Efficiency Scorecard" (Washington, DC: American Council for an Energy-Efficient Economy. http://aceee. org/research-report/e13k, 2013), 31, http://www.truevaluemetrics.org/DBpdfs/Metrics/ACEEE/ACEEE-2013-State-Energy-Efficiency-Scorecard.pdf.

[113] This includes three year service agreements as well as a variety of other efficiency programs, such as supporting energy efficiency in ice rinks and promoting solar thermal technologies.

[114] Savings and budgets from EfficiencyOne and DSM filings before UARB. Electricity utility revenue and generation for calculations in last two columns from Nova Scotia Power Annual Reports. 2008/2009 Figures based on Q4 results in 2008 and full year in 2009 because the efficiency programs started in the fall of 2008. The 2010 spending over approved budget is due to additional start-up funds.

Table 2: Non-Electrical Energy Efficiency Annual Budgets and Savings[115]

	Spending $ (M)	Gigajoules (evaluated)	Annual incremental GJ savings as % of residential non-electrical demand[116]
2011/12	8.1	108,186	0.3%
2012/13	19.1	239,363	0.7%
2013/14	21.1	180,828	0.6%
2014/15	19.0	186,472	0.7%
2015/16	14.4	129,531	
2016/17	12.7	69,015[117]	

1.7 2.5 Managing Legal Challenges, Economic and Political Change

ENSC successfully started up the organization and quickly ramped up its levels of energy savings. The primary challenges it faced in the ensuing years related to managing the organization in the midst of macroeconomic events, legal complications, and political change.

The pulp and paper industry faced declining export sales, which significantly decreased electricity demand in the province. In September 2011, a Port Hawkesbury paper plant was shut down with the owners seeking to sell the mill, and the Bowater paper mill in Liverpool was closed in June 2012. Nova Scotia Power projected a major decrease in electricity use and rate increases for existing customers to cover the electricity system's fixed costs.[118] Given the decrease in electricity demand, the editorial board of a major provincial newspaper called for a pause on energy efficiency programs and the resulting ratepayer charge.[119] It looked as if DSM could be shelved again, as it was in the 1990s after a recession decreased load projections.

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[115] From EfficiencyOne. Results are for the Provincial fiscal year which spans April 1st to March 31st. Annual targets are not presented for Provincial programs (non-electrical programs) because targets and budgets are multi-year in nature, and not all initiatives have targets (e.g., pilot programs).

[116] This indicator compares the evaluated GJ annual savings in the fiscal year (e.g. 2011/12) with annual non-electrical demand for the calendar year (e.g. 2011) by combining the GJ demand from all non-electrical secondary energy use for the residential sector in Nova Scotia (this includes natural gas, heating oil, wood, propane, and coal). Data on residential demand is from Natural Resources Canada's National Energy Use Database, and energy savings figure are from EfficiencyOne.

This indicator provides a rough approximation of savings relative to demand. First because this is a comparison of fiscal years and calendar years, creating a lag in comparing energy savings to annual energy demand. Note as well that the energy savings are counted after upgrade work has actually been completed which might be because of program activities (e.g. audits) that occurred months earlier. In addition, a small amount of savings occurred in outside of the residential sector. For example, there was an ice rink energy efficiency program.

[117] 2016/2017 savings results are saving tracked by EfficiencyOne. Evaluated savings were not available at the time of publication.

[118] John Demont, "Power Demand Tied to NewPage Fate; NSP Foresees Drop in Electricity Use If There's No Deal to Reopen Paper Mill," *The Chronicle-Herald*, May 4, 2012.

[119] Editorial, "Conservation Charges: Power Policy Muddle?," *The Chronicle Herald*, July 31, 2012, http://thechronicleherald.ca/editorials/122460-conservation-charges-power-policy-muddle.

ENSC also faced challenges related to how its novel institutional model was treated for taxation purposes. In April 2012, a ruling from the Canada Revenue Agency stated that ENSC could not claim Harmonized Sales Tax Input Tax Credits (ITC) for the delivery of energy efficiency services. Under Canadian tax rules a company providing a good or service can receive a refund on sales taxes paid that relate to conducting business. For ENSC, the inability to claim these tax credits would unexpectedly increase its expenses by about 10% ($4-$5 million dollars per year). This tax ruling presented a challenge to both the concept of energy efficiency as a resource and Nova Scotia's organizational model. The Canada Revenue Agency did not view ENSC's provision of energy efficiency services to Nova Scotia Power in exchange for ratepayer funds as a commercial arrangement. Yet agreements to provide other forms of energy (e.g. wind energy) to Nova Scotia Power are understood to be commercial in nature. ENSC argued that the denial of ITC's results in "double-taxation" as HST is charged both when funds are collected from ratepayers by Nova Scotia Power and after those funds are paid to ENSC to provide efficiency services.[120] ENSC contested the ruling in 2012, and a resolution is still outstanding. The organization covered the extra taxation costs through a loan from the provincial fund and by creating a reserve of DSM funds that could have otherwise gone to providing efficiency services.[121] This "HST issue" is a unique problem related to forging a new organizational model. If efficiency services were delivered by the utility or a government agency, energy efficiency would not face this extra tax liability.[122]

Significant changes to the existing regulatory and organizational model were introduced after an October 2013 change in government. In 2012, the provincial Liberal Party introduced an election platform that took aim at rising electricity rates and Nova Scotia Power. Their platform promised to "break Nova Scotia Power's monopoly" and reduce the utility's profits. The platform also promised to "Make Nova Scotia Power pay for the Efficiency Tax". Nova Scotia Power bills were labelled with an efficiency charge, which the political platform labelled a tax. The Liberal Party won a majority government and introduced a revised energy efficiency model in the province.

1.8 2.6 A New Demand Side Management Model

In April 2014, the government introduced an *Electricity Efficiency and Conservation Plan*, and introduced the *Electricity Efficiency and Conservation Restructuring Act.* The new efficiency policy framed energy efficiency as a way to introduce competition in the electricity sector, stating that "if it costs less to save energy than it costs to produce energy, saving energy wins".[123] The restructuring also more fully clarified that the separate efficiency organization acts as an "energy efficiency utility". The relevant changes are visualized in Figure 6 (red markings).

Under the Act, "Efficiency Nova Scotia" was converted into a franchise awarded by the Minister of Energy. What was Efficiency Nova Scotia Corporation reconstituted itself into a non-profit corporation called EfficiencyOne (E1), and was awarded the franchise for 10-years (2016 to December 2024, with 2015 as transition year). Efficiency Nova Scotia (ENS, because the word Corporation is dropped from franchise brand) would operate under a supply agreement between E1 and Nova Scotia Power, supervised and approved by the UARB. This change made it clearer that the payment of funds for energy efficiency services was a commercial agreement, and thus enables HST tax credits to be claimed for

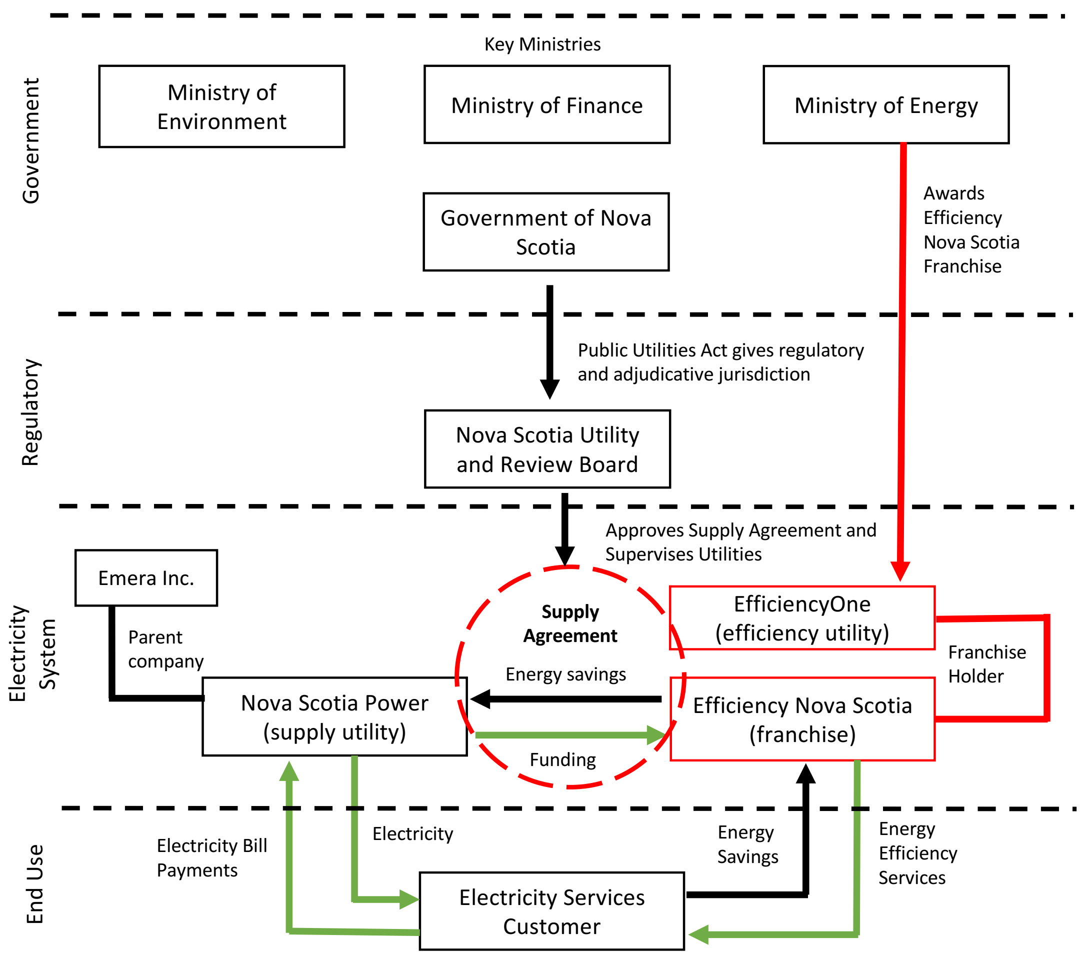
[120] Efficiency Nova Scotia Corporation 2014 Annual Report
[121] Efficiency Nova Scotia Corporation 2012 and 2013 Annual Reports
[122] The CRA allowed claim of HST ICT's under the agreements with the Province of Nova Scotia for non-electrical efficiency services.
[123] Government of Nova Scotia, Electricity Efficiency and Conservation Plan, page 3.

efficiency services. The Act, clearly states that the franchise holder is deemed to be a public utility (i.e. an efficiency utility). The rate rider was removed for consumer electricity bills, with costs for energy efficiency services now being embedded within the general rates collected for all revenue requirements to manage and operate the electricity system.

2015 was treated as a transition year. The government implemented a legislated budget cap of $35 million, plus any over-recovery of funds from 2013.[124] For future budgets, the Act stipulated that Nova Scotia Power would undertake "cost-effective" and "reasonably available" electricity efficiency and conservation activities. It also stated that the UARB must take into account the "affordability" to Nova Scotia Power's customers. The new regulatory model also anticipated that Nova Scotia Power and EfficiencyOne would enter into an agreement and provide a joint application to the UARB; however, in the event that an agreement could not be finalized the UARB would establish a final agreement. How things would operate under the new regulatory and economic context would be tested in a 2014 IRP process and the development of a 2016-2018 DSM Plan.

[124] This over-recovery of funds in 2013 led to an approved budget of $39 M

Figure 6: New Governance and Service Model (post 2014)



1.9 2.7 Energy Efficiency Under the New Model

The concern that lower load growth due to the loss of major industrial users (mostly pulp and paper) would justify a significant decrease in DSM activity was not supported by the results of a 2014 Integrated Resource Plan. The long-term, least-cost resource plan was consistent with a level of DSM funding of $56 million in 2015, ramping up to $87 million by 2020. This was higher than previous budgets and much higher than the $35 million budget cap in 2015.[125] However, Nova Scotia Power's final report did not present this level of DSM savings as part of its preferred long-term plan.[126] The generation utility instead presented scenarios with significantly lower levels of DSM, justified by restricting the minimization of revenue requirements to short term periods. NSP argued that focusing on the short-term revenue requirements met the "affordability" criterion in the new Act governing energy efficiency. The UARB criticized NSP for adopting "a course of action which could be significantly more

[125] See Fagan, Bob, Rachel Wilson, David White and Tim Woolf "Filing to the Nova Scotia Utility and Review Board on Nova Scotia Power's October 15, 2014 Integrated Resource Plan" Synapse Energy Economics, October 20, 2014.
[126] 2014 Integrated Resource Plan

expensive for ratepayers in the long term" and required the generation utility to revise the IRP under the guidance of the UARB's expert consultants.[127] This decision prompted the Minister of Energy to write to the UARB to state that the government intended "affordability" to consider costs during the three-year supply agreement, which might not correspond with "benefits over a longer period of time".[128]

EfficiencyOne and Nova Scotia Power were unable to come to an agreement for the 2016-2018 DSM plan. E1 proposed a plan with an average annual budget of $40.5 M, while Nova Scotia Power suggested a $22 M annual budget. E1 argued that "affordability" should consider both short and long-term costs to electricity users, and the influence of DSM on reducing electricity bills for program participants as well as electricity rates. The application also argued for a shift from the Total Resource Cost Test (TRC) towards the Program Administrator Cost Test (PAC). E1 argued that that the TRC included customer costs without considering other resource and customer benefits, and that the PAC test was more consistent with Integrated Resource Planning and the UARB's mandate to consider the minimization of costs to the utility system. The UARB ordered an average annual budget of $34 M per year and similar energy savings targets to those proposed under a $40.5 M budget. Stakeholders agreed to continue discussion on cost-effectiveness testing changes, including the possible inclusion of non-energy benefits within the TRC test. The UARB found that the government's legislation places greater emphasis on short-term rate impacts, but that "a focus exclusively on short-term affordability would be detrimental to ratepayers since long-term costs would never be considered".[129]

1.9.1 2.7.1 New Efficiency Activities

One consequence of the new franchise, is that EfficiencyOne can engage in a variety of activities outside of electricity DSM and non-electrical efficiency services provided to the province, as a private non-profit corporation. E1 created a subsidiary called *EfficiencyOne Services* to undertake activities outside of the Efficiency Nova Scotia franchise, within Nova Scotia and in other jurisdictions. To ensure proper segregation between Efficiency Nova Scotia and EfficiencyOne Services' non-regulated activities, E1 has developed an Affiliate Code of Conduct. These other activities of E1 are guided by the organization's Strategic Plan's purpose, which is to change "lives by unleashing the power of efficiency". The activities of EfficiencyOne Services are especially related to the strategic priority to "unleash the global potential of efficiency by growing and sharing Nova Scotia's expertise and experience". Thus far EfficiencyOne Services has managed a mercury diversion program[130], and provided consulting services to other provincial organizations and federal government departments.

1.10 2.8 Relevance of the Nova Scotia Experience

This review of the development and reform of energy efficiency in Nova Scotia demonstrates the context specific factors that determine the choice of an administrative model and the ultimate success

[127] UARB letter to Mr. Landrigan re: M05522 – Nova Scotia Power Inc. – Integrated Resource Plan 2014 / P-884.14, November 5, 2014.
[128] Letter to UARB from Minister Andrew Younger re: Clarification of Government's position with regards of the Electricity Efficiency and Conservation Restructuring (2014) Act with respect to deferrals and "affordability", December 1, 2014.
[129] UARB Decision In the Matter of an Application for Approval of a Supply Agreement for electricity energy efficiency and conservation activities between EfficiencyOne and Nova Scotia Power Incorporated, the establishment of a final agreement between the parties and approval of a 2016-2018 Demand Side Management Resource Plan, August 12, 2015, Pg. 45.
[130] However, the Department of Energy granted an exception to run the mercury diversion program under the Efficiency Nova Scotia brand.

of an energy efficiency policy framework. A variety of lessons can be drawn from the Nova Scotia experience the far.

The first concerns the potential for stakeholders to influence policy change. The consideration of non-utility administrative models was pushed by a stakeholder coalition, despite resistance from existing policy institutions. The Nova Scotia experience also demonstrates that it is possible to start-up an entirely new organization and to ramp up energy savings quite aggressively with the right mix of cooperation, leadership and motivation. A third lesson is that pioneering a new organizational model can come with unexpected costs and complications, as exemplified by the issue with claiming HST Input Tax Credits.

The early history in Nova Scotia also shows that an energy efficiency administrator must navigate macroeconomic and political changes. While Nova Scotia is not fully exploiting the province's energy efficiency potential, the administrative model has been extraordinarily resilient to changes that might have significantly decreased energy efficiency progress. The use of an evidence based Integrated Resource Planning process that compares the costs of energy efficiency programs to supply side options demonstrated the continued benefits of energy efficiency despite significant decreases in electrical load. All three political parties in the province have helped shape the current administrative model. While one political party campaigned against the "efficiency tax", they ultimately produced a policy based on the concept of energy efficiency as a cost-effective energy resource. E1 as an independent efficiency utility was also able to present its own proposal and counter-evidence before a transparent public utility regulatory hearing in response to Nova Scotia Power's arguments for significant reductions in energy efficiency effort. And the UARB ruling acknowledged the importance of DSM to the electricity system in the short and the long term. The resilience of energy efficiency efforts under the efficiency utility model contrasts with the reduction and postponements of efficiency initiatives under both utility and government administration in the face of macroeconomic changes and shifting political priorities.

2 3. How Efficiency Nova Scotia Operates

The previous section provided information on aggregate budgets and energy savings and how they were negotiated within regulatory processes. This section will take a closer look at efficiency programs, strategies, and policies developed in Nova Scotia.[131]

2.1 3.1 Trade Allies and Efficiency Sector

Most Efficiency Nova Scotia efficiency programs are delivered by independent contractors and awarded on a competitive basis. This allows the DSM program administrator to capture the benefits of competition on factors such as price, quality and innovative program implementation ideas. It also contributes to the development of a provincial energy efficiency industry. An assessment estimated that 1200 people are directly employed on a full-time basis in energy efficiency within the province.[132] Companies that have been attracted to and grown within Nova Scotia include, Summerhill, an efficiency

[131] The rest of this article will refer to EfficiencyOne (E1) and Efficiency Nova Scotia (ENS) synonymously with respect to electric DSM activities and non-electrical activities under the ENS brand. Reference to E1 can also refer to activities outside of electric DSM and government funded programs as explained in section 2.7.1.

[132] Canmac Economics Limited (2013). The Nova Scotia Energy Efficiency Sector Economic Impact Study.

services company that located in Nova Scotia after the launch of the DSM programs; Equilibrium Engineering, a rural firm that sold 50% of their business to Québec based Econoler in a partnership that enables the firm to remain in its rural Nova Scotia location while accessing Econoler's international clients[133]; and Trinity Maintenance Solutions, a company founded in 2006 that has grown to 80 employees with three branches in Nova Scotia and New Brunswick.[134]

Efficiency Nova Scotia continues to develop its Trade Network of energy efficiency providers (e.g. insulation and heating system installers, electricians). Network partners must complete program and customer service training, adhere to standards for safety and insurance, customer relations, and environmental responsibility. Efficiency Nova Scotia provides network partners with marketing support, leads and referrals, and discounted rates for training and workshops.[135]

2.2 3.2 Efficiency Services and Strategies

Efficiency Nova Scotia's DSM programs cover residential as well as business, non-profit and institutional participants. Programs can be tailored to specific energy efficiency barriers and customer needs, and are constantly monitored to make mid-course adjustments to improve programs and meet energy savings goals. The organization has been able to consistently achieve a high level of customer satisfaction (89-91% since 2011). Tables 3 and 4 provide a breakdown of DSM electricity savings by program in 2015 and non-electrical savings in the 2015/2016 fiscal year.

Table 3: Electricity Demand Side Management 2015 Annual Savings

	GWh (Evaluated)	% of 2015 GWh Savings
Residential		
Appliance Retirement	3.0	2%
Instant Savings	10.1	7%
LED Holiday Light Exchange	0.1	0%
Home Energy Assessment	4.7	3%
Green Heat	1.9	1%
Residential Direct Install	15.7	11%
Rental Properties and Condos Service	3.3	2%

133 The Chronicle Herald, "NowNS: Energy-Saving Expertise Makes Equilibrium Export Winner," March 15, 2016, http://thechronicleherald.ca/business/1349242-nowns-energy-saving-expertise-makes-equilibrium-export-winner.
134 http://trinitymaintenance.com/about/
135 Efficiency Nova Scotia. Efficiency Trade Network: General Participation Agreement, available at https://www.efficiencyns.ca/wp-content/plugins/effone-etn/etn-app/dist/assets/general-participation-agreement.pdf

New Home Construction	4.0	3%
Home Energy Report (Pilot)	27.2	20%
Total Residential	70.0	51%
Business, Non-Profit and Institutional		
Business Energy Rebates	36.4	26%
Custom[136]	20.7	15%
Energy Management Information Systems (Pilot)	3.8	3%
Strategic Energy Management (Pilot)	3.9	3%
Business Energy Solutions	7.0	5%
Total Business, Non-Profit and Institutional	68.0	49%

Table 4: Non-Electrical 2015/16 Energy Savings

	Gigajoules (evaluated)	% of 2015/2016 GJ Savings
HomeWarming (Low Income Homeowner Service)	49,253	38%
Home Energy Assessment	59,188	46%
New Home Construction *	3,705	3%
Residential Direct Install	252	0%
Multi-Unit Residential Direct Install	10,031	8%
Multi-Unit Residential Common Areas *	5,896	5%
Solar (includes rebates for HRM Solar City participants) *	1,206	1%
Total	129,531	

* Programs also include electricity savings claimed under demand side management

[136] Custom includes Custom Retrofit, Custom New Construction and Existing Building Commissioning

Energy savings strategies include assessments of energy efficiency in existing businesses and houses, and building plan assessments (e.g. Home Energy Assessment, New Home Construction, Business Energy Solutions and Custom programs). Financial incentives are provided for energy assessments, after upgrades, and at the point of sale or as mail-in rebates for measures such as lighting and equipment (e.g. Instant Savings, Business Energy Rebates). Efficiency Nova Scotia has also implemented "direct install" programs for both businesses and residents – directly upgrading lighting, hot water system components and installing smart thermostats for free. This direct connection with customers creates an opportunity to promote other energy savings opportunities. One direct install program was coordinated across the 13 First Nations bands in Nova Scotia, and involved training and employment of local First Nations. Appliance Retirement is a program where Efficiency Nova Scotia representatives pick up old operating fridges, freezers, and air conditioners and ensure they are recycled and that CFCs are removed. Green Heat offers rebates and financing to install wood or pellet heating equipment, heat pumps, as well as solar air and solar domestic water heating for electrically heated homes.

Efficiency Nova Scotia operated a successful low-income program, providing significant building envelope retrofits to 8,079 low income homes between 2011 and 2016. The policy changes implemented in 2014 saw the electricity portion of this program funded via a contribution by Nova Scotia Power to Clean Nova Scotia (a charitable non-profit organization). This takes the program out of the UARB's supervision and oversight. ENS has also worked to increase efficiency services for low-income tenants by running a pilot project that provides extensive building upgrades to affordable multi-unit housing. The consent agreement signed by landlords stipulates that energy savings will help offset tenant rental rate increases. In a case of unaffordable rental increases, ENS can recover the cost of the audits and rebate incentives from landlords.[137]

A large segment of achieved energy savings have come from Custom retrofits in the business, non-profit, and institutional sector. This program offsets the costs of engineering studies and provides incentives and interest-free financing for upgrades in equipment or processes (e.g. compressed air, motors, refrigeration, cogeneration). The On-Site Energy Manager program embeds an efficiency specialist in the operations of large energy users like municipalities, hospitals, and large industries. The costs of these services are deducted from incentives and cost shared with participants. This strategy enables customized solutions and directs these energy users to relevant programs.

Efficiency Nova Scotia has also worked to integrate behaviour change or "people-centered"[138] efficiency initiatives alongside technology upgrades. For instance, a Strategic Energy Management Pilot creates plans for industrial and institutional (e.g. school board) operations to make energy efficiency part of daily activities rather than a one-time project. A strategic energy plan is developed with a commitment from senior management. The program facilitates activities such as energy mapping and monitoring, targeting and reporting, employee engagement, and training and workshops. It targets 15% or greater reduction in energy usage per organization. The Energy Management Information System program

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[137] https://www.efficiencyns.ca/affordable-housing-consent/

[138] Karen Ehrhardt-Martinez and John A. Laitner, "Rebound, Technology and People: Mitigating the Rebound Effect with Energy-Resource Management and People-Centered Initiatives," in *ACEEE Summer Study on Energy Efficiency in Buildings*, 2010, 7–76, http://library.cee1.org/sites/default/files/library/8566/CEE_Eval_ReboundTechnologyPeople_1Jan2010.pdf.

provides detailed energy monitoring of business and industrial plant operations, enabling operators to understand and act on energy use information. Efficiency Nova Scotia was also the first jurisdiction in Canada to work with Opower to provide residential customers with information on their energy consumption in comparison to similar energy users through the Home Energy Report. This program was used to help drive participation in other programs, and contributed to significant first year energy savings. The launch of the program spurred some media reports citing concerns about the confidentiality of consumer data and sharing of data between Nova Scotia Power and Efficiency Nova Scotia.[139]

The non-electrical efficiency programs are primarily focused on the residential sector. Provincial funding has supported a robust low-income program, and programs for new homes, existing homes, multi-unit residential buildings, solar technologies, and a program to improve efficiency in ice rinks. In 2015/16 the Province shifted its funding to focus on the low-income sector. The energy savings for 2015/16 are shown in Table 4.[140]

2.2.1 3.2.1 Codes and Standards, Market Transformation, and Enabling Strategies

In addition to promoting energy savings through programs, E1/ENS promotes energy savings by reforming Codes and Standards, transforming markets, and through a series of other "enabling strategies".

E1 can provide relevant information on markets and technologies to improve energy efficiency standards. The organization is involved in the Canadian Advisory Council on Energy Efficiency, and is a member of the Canadian Standards Association's Steering Committee on Performance Efficiency and Renewables.

Nova Scotia was one of the first provinces to change legislation to enable Property Assessed Clean Energy (PACE) under municipal government legislation. The PACE program allows residents to pay the initial costs of energy upgrades through the regular payments tied to a municipal local improvement charge. The Halifax municipality's Solar City program first used this financing arrangement to promote solar thermal installations, installing about 400 systems in two years.[141] Efficiency Nova Scotia offers a full design, implementation, and administration of PACE for municipalities on a not-for-profit basis.

E1/ENS has also actively promoted the Passive House standard. This ultra-efficient standard meets certain standards for heating/cooling and primary energy demand, airtightness, and thermal comfort. Efficiency Nova Scotia seeks to develop capacity to meet the standard throughout the housing supply chain, amongst designers, architects, engineers, builders, manufacturers, and training institutions.

EfficiencyOne is developing more sophisticated data analytics capabilities to understand customer experiences and the motivations that drive participation in energy efficiency programs. These insights guide program design and marketing strategies. The latest marketing focuses on "the good things

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[139] Chris Lambie, "Some Users Say Privacy at Risk in Power Project; NSP, Efficiency N.S. Comparisons of Energy Consumption Involve Personal Data," *The Chronicle-Herald*, May 31, 2013.

[140] Some non-electrical savings in programs such as New Home Construction and Home Energy Assessment occurred in the 2015/2016 fiscal year result from programs budgets expended in previous years.

[141] Solar City Pilot Program Summary, January 14, 2015. Halifax Regional Council Item No. 11.1.7. http://www.halifax.ca/council/agendasc/documents/150331ca1117.pdf

efficiency brings", emphasizing the multiple reasons to improve energy usage, including improved comfort, economic security, aesthetics, and business productivity.[142]

2.2.2 3.2.2 Evaluation, Measurement and Verification (EM&V)

The stakeholders that played an important role in calling for an independent model, also emphasized the importance of a robust evaluation, measurement and verification process. All electricity DSM savings are evaluated through a three-stage process. First, EfficiencyOne staff track and calculate energy and demand savings for each program. Second, an independent evaluator, retained by EfficiencyOne, evaluates savings claims. Evaluation and savings verification can include customer site visits, surveys of program participants, and independent savings estimates. Finally, a consultant is retained by the UARB to conduct a final evaluation of program performance and verification of evaluated savings. For non-electrical savings, EfficiencyOne retains an independent evaluator, which prepares a final report submitted to the Province. Program strategies can change based on estimates of program free ridership and spillover, and program evaluation reports (see Chapter 10). The EM&V process can both contribute to continual program improvement and ensure public confidence that savings claims "are real". About 3% of the total electricity DSM budget is typically spent on the independent evaluation of Efficiency Nova Scotia's tracked savings.

2.3 3.3 Organizational Culture

E1 has a mission oriented and innovative culture. Staff frequently point to this culture as a fundamental reason for the organization's success. "Mission alignment" was one of the early rationales for choosing an independent administrative model. Stakeholders wanted an administrator that was free from conflicts of interest and focused on the goal of saving energy. However, starting up a new organization in a province launching an aggressive energy efficiency program was risky. The organization needed to find and attract staff with the right competencies and motivations. As noted above, the initial team consisted of a few energy veterans and a cadre of motivated young graduates. The employee demographics are still reflective of this mix. In 2016, the average age of the employees was 37 and 31% of employees were under 30. The participation of women at E1 is also significantly higher in comparison to the energy sector, including the renewable energy sector. Female participation in the energy sector is about 20-25%.[143] In 2016, 60% of E1 employees were female, 46% of leadership roles were filled by females, and 29% of the executive leadership team was female.

E1 has a fun, engaging, and mission oriented culture. The annual energy savings targets as well as an internal "balanced scorecard" provide clear, measurable goals. Yet, the organization has also internalized the higher level social, environmental, and economic rationales that justify its sustainability transition oriented mission. A 2013 survey of employees found a very high degree of "affective commitment", meaning that employees were "emotionally attached to and involved in the organization and its mission".[144] Annual scores on Corporate Research Associate's employee engagement index have been between 86% and 95%.

[142] See EfficiencyOne Annual Report 2016
[143] See Rabia Ferroukhi et al., "Renewable Energy and Jobs" (International Renewable Energy Agency, 2013), http://www.irena.org/rejobs.pdf chapter 6.
[144] Presentation by Dr. Catherine Loughlin to Efficiency Nova Scotia Corporation, June 13, 2013.

Employees note that the organization practices what it preaches with respect to social and environmental commitment (e.g. extensive recycling, cycling and carpooling, LEED platinum office space, staff vegetable garden with donations to food bank). The relatively quick early growth of the organization meant young employees could quickly rise to leadership positions.[145] The organization has also been able to attract senior management talent from elsewhere in the province (e.g. Irving Shipbuilding, Canadian Federation of Independent Business, BellAliant, Art Gallery of Nova Scotia, Nova Scotia Gaming Corporation). EfficiencyOne has been recognized as an Employee Recommended Workplace (2017),[146] one of Canada's Greenest Employers (2013 to 2017),[147] one of Nova Scotia's Top Employers (2013) and one of Atlantic Canada's Top Employers (2013).[148]

"There is definitely no shortage of motivated people, coming up with bright ideas who really collaborate to accomplish the goals of EfficiencyOne with the support of management and their peers"

2.4 3.4 Operating a High-Performance Organization

Now that Efficiency Nova Scotia/E1 is beyond the start-up phase it strives to maintain its level of performance and the key ingredients that have led to success. These ingredients include

1) Independence from the supply side utility and government
2) A transparent, accountable, and performance based regulatory model providing clear energy savings targets coupled with rigorous and independent evaluation, measurement and verification of energy savings
3) An engaging and cooperative organizational culture dedicated to a sustainability mission
4) A dynamic approach to program development, capable of making mid-course corrections and exploring new energy savings opportunities
5) Sophisticated customer analytics, marketing, and "enabling strategies" that promote market transformation
6) Forging alliances and enabling the wider energy efficiency sector

Yet, the organization cannot stand still. The next section will consider what the future might hold for energy efficiency in Nova Scotia.

[145] Personal Communication with Allan Crandlemire, May 19, 2017
[146] https://www.employeerecommended.com/2017-finalists
[147] http://content.eluta.ca/top-employer-efficiencyone
[148] http://www.atlanticbusinessmagazine.net/article/atlantic-canadas-25-top-employers/

3 4. The Future of Energy Efficiency in Nova Scotia

The Nova Scotia case demonstrates that the political, economic, and legal foundations that enable a given energy efficiency approach frequently shift, and that an efficiency organization needs to shift with them. It is not entirely certain what the future holds. There are three future themes that appear relevant to the organization at this time: first, achieving deeper energy savings; second, more fully integrating climate mitigation objectives into energy efficiency approaches; third, considering the influence of new technologies on the social and organizational aspects of energy efficiency strategies.

3.1 4.1 Deeper Energy Savings

E1 has initiated a strategic shift in its energy efficiency programs to achieve deeper energy savings, in a manner that simplifies and improves customer participation. Internally this process is known as "Programs 2.0". E1 recognizes the need to decrease focus on measures such as lighting, which could reach market saturation and/or be evaluated to have high rates of free ridership. The desire is to increase the bundling of measures such as lighting with upgrades to space heating and cooling, appliances, more extensive building envelope improvements, better control and measurement of industrial operations etc. These other measures will improve customer experience because they can produce substantial energy savings and they will deliver longer term energy savings. The focus will therefore be on maximizing the cost-effective savings available in each building or for each customer. This will likely require increased customer support for longer, more complex, and more expensive projects. An even more customer-centric approach could be required because achieving deep savings will require one building premises to participate in multiple programs that are now considered administratively distinct.

Figures 7 and 8 show the electrical energy savings per premises in the business, non-profit, and institutional (BNI) and residential sectors. Efficiency Nova Scotia has recently achieved deeper savings for each premise in the BNI sector as programs such as Strategic Energy Management and Energy Management Information Systems promote more comprehensive audits and upgrades. The residential sector has remained relatively steady, yet seen a decrease in savings per premises in recent years, which might principally be explained by the Home Energy Report program which achieved impressive savings by multiplying relatively small savings from behavioural change across a large number of households, thus leading to lower savings per premise.

Achieving deeper energy savings and providing more comprehensive energy efficiency services to customers will require shifts in regulatory rules and norms. Achieving deeper savings could involve higher first year costs to save energy, but lower long run costs as savings measures endure and accumulate over time. Yet, in recent years the UARB has reduced the DSM budget while requiring aggressive annual energy saving targets, which could potentially cause E1 as the efficiency utility to prioritize short term savings. Prioritizing longer term savings could require a shift in regulatory oversight towards monitoring lifetime energy savings and savings per premises or savings per customer. Moving towards deeper energy savings could also require changes in cost-effectiveness testing. Deeper energy savings measures might require a full account of non-energy benefits and/or shift to a program administrator or societal cost test (see chapter 6.3).

Figure 7: Electricity DSM Savings Per Premise – Business, Non-Profit, Institutional Sector

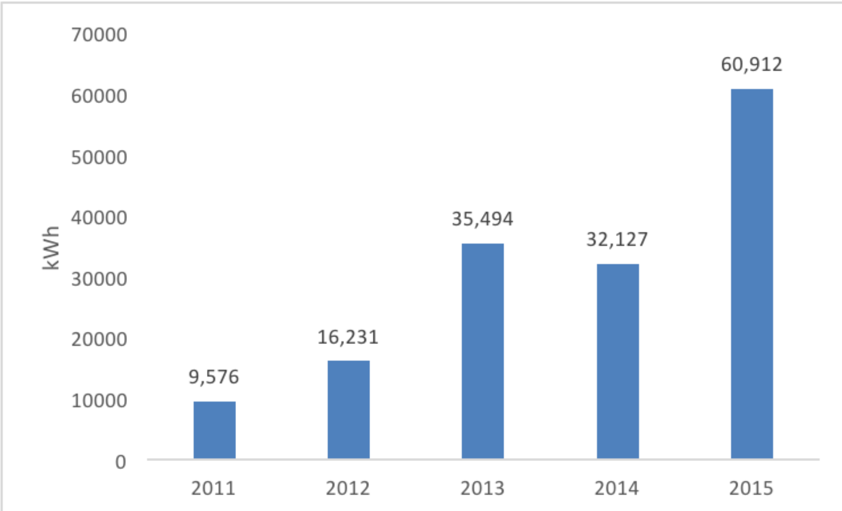
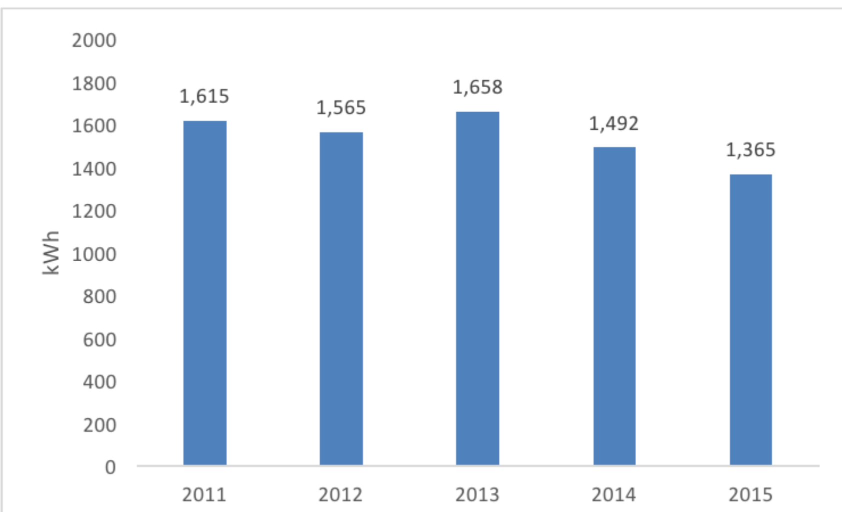


Figure 8: Electricity DSM Savings Per Premise – Residential Sector



3.2 4.2 Climate Mitigation

A future where energy efficiency is relied upon to help reduce GHG emissions could also create changes in program strategies and policy frameworks. Other jurisdictions are using carbon pricing revenue to fund energy efficiency and creating energy transition organizations involved in DSM as well as other climate related initiatives such as electrification and climate finance.[149] Efficiency policies focused on climate change, might take a multi-fuel approach that includes converting some energy end uses to

[149] See Alberta Energy Efficiency Advisory Panel, "Getting It Right: A More Energy Efficient Alberta," 2016; Gouvernement du Québec, "The 2030 Energy Policy: Energy in Québec, A Source of Growth," 2016; Government of Ontario, "Ontario's Five Year Climate Change Action Plan 2016-2020," 2016.

electricity (e.g. transportation and heating). The current administrative structure in Nova Scotia was chosen in part because of the ability to provide multi-fuel services to customers, while receiving funding from multiple sources based on different regulatory structures and policy priorities. The future could include an expansion of non-electrical efficiency services from the current focus on residential low-income populations, funded via government budgets, carbon pricing revenues, natural gas utilities, or a charge on non-regulated fuels such as oil and wood. A new policy framework might need to be created to promote climate-friendly electrification, because DSM often focuses on reducing rather than building electrical load. A stronger multi-fuel approach, including electrification, could require system planning that considers optimizing across all fuels (not only electricity).[150]

Nova Scotia is witnessing an increase in heat pump installations. The moderate climate and limited natural gas make this an attractive technology to replace oil furnace heat. However, many installations are occurring without first upgrading the building envelope and therefore right-sizing the unit to optimal heat and cooling demands. Increased electric heating could lead to a higher winter peak, which requires the utility to consider how to meet seasonal and short-term power demands. Thus far efficiency strategies have focused on savings to reduce energy related costs throughout the year, while the future might involve greater focus on reducing peak demand and creating flexible demand side resources to integrate variable renewable sources such as wind and solar.

Climate change might also call for a stronger emphasis on market transformation approaches in sectors such as housing through programs that build capacity and expertise in supply chains to adopt efficient technologies and building practices. These initiatives could deliver long term energy savings and help meet climate goals, yet can be more difficult to measure. Nova Scotia will have to consider how to enable these activities, while continuing to demonstrate accountability for performance.

3.3 4.3 New Technologies and Shifting Efficiency Frameworks

E1 continuously monitors new efficient technologies, such as smart thermostats, heat pump clothes dryers and water heaters. Indeed, efficiency strategies play a key role in promoting the adoption of new technologies. There are also technological changes that could change the nature of existing regulatory frameworks. In particular, increased computing power and advanced metering could provide real-time data. This could change the nature of evaluation, monitoring and verification protocols by tracking energy savings using real-time data rather than deemed energy savings calculated from formulas, simulations, and sample sizes. Some see the potential for real-time data and standardization to attract private capital investments in energy efficiency.[151] Nova Scotia's new model, where E1 exists as an independent non-profit, could potentially take advantage of these market and organizational changes. For instance, E1 is exploring the development of a public-purpose energy services company that would leverage social enterprise capital to finance energy improvements in community based building such as affordable housing and educational institutions.[152]

[150] For an example, se Rhode Island State Energy Plan, Energy 2035 at http://www.energy.ri.gov/energyplan/
[151] See Investor Confidence Project at http://www.eeperformance.org/
[152] See http://www.ppescohowto.org/Media/Default/resources/PPESCO_CAR_FINAL.pdf

4 5. Summary Lessons from the Nova Scotia Model

This case study of Nova Scotia examined the history that created the province's unique institutional model, the present operation of efficiency initiatives in the province, and potential future developments. Since Nova Scotia embarked on creating Canada's first energy efficiency utility, other jurisdictions have taken interest. Independent efficiency models are being considered and/or implemented in Alberta, Manitoba, and Ontario.

The history demonstrates that the choice of an independent energy efficiency model was chosen through a process of stakeholder deliberation. Transfer to a new entity was enabled by Nova Scotia's limited prior history of electricity DSM, but the existence of some energy efficiency capabilities in the province through government efficiency programs. Nova Scotia's policy deliberations led to the creation of an organization with a significant degree of independence, yet strong oversight and accountability for performance. Other jurisdictions might choose different organizational models because of their unique contexts. One thing the Nova Scotia case demonstrates is that it is possible to start up and aggressively ramp up energy savings if the organization is given the leeway to do it, its leaders work hard, and the people within the organization are driven by a mission. Since its creation, Efficiency Nova Scotia, and now EfficiencyOne, have maintained a mission-driven organizational culture and continued to create and adopt new energy saving strategies.

The Nova Scotia model could play a valuable role in energy futures that place a stronger emphasis on deep energy savings, climate change mitigation, and the use of new technological platforms. The organization's independence creates flexibility to achieve energy savings in multiple sectors, across fuels, using numerous strategies, and leveraging multiple funding sources. Realizing the potential of the administrative and organizational model might depend on if Nova Scotia can adapt its regulatory and policy frameworks to promote the next generation of energy transition opportunities.

CASE STUDY 4: ONTARIO

The original Case Study in the first edition of this textbook was reproduced with permission of Pierre Langlois of Econoler who published it in Canadian Energy Efficiency Outlook: A national Effort for Tracking Climate Change [1]. It is still available in this publication. A great deal has changed in Ontario since then. The following s a brief summary of the highlights as they had an impact on energy efficiency in the province. It supplements the article written by Peter Love in 2015 "Past, Present and Future of Energy Conservation in Ontario". This article is reproduced with permission of Energy Regulation Quarterly where this article was first published.

2015 marked the start of the 2015-2020 Conservation First Framework (CFF) 1. The CFF emphasized the importance of a coordinated effort between the 60+ Local Distribution Utilities (LDCs) between the gas and electricity sectors. Its target was 7 TWh delivered by LDC's to residential and business customers and 1.7 TWh from large transmission-connected customers through the Industrial Accelerator Program (IAP) with a total combined budget of $2.2 billion.

In the middle of the CFF, a new government was elected. Their initial focus within the electricity sector was to follow upon election promises to cancel renewable energy projects and making a commitment to reduce electricity bills. Within a year of election, they cancelled the CFF and IAP and greatly reduced the role of the LDCs [2]. In its place, IESO was directed to offer programs to the commercial/institutional/industrial customers, low-income residential consumers and on-reserve First nation communities. The total budget was $353 million with the program to end in 2020. The IESO was also directed to conduct a conservation potential study within six months. In their 2021 annual report [3], IESO noted that over the 10-year life of the Save on Energy Program, a total of 16 TWh of electricity had been saved and that demand response programs from 2008-2021 had contributed an estimated 2,057 MW of persisting demand savings by the final year.

In October 2022, the government announced an increase of $342 million over the duration of the four-year 2021-2024 Conservation Demand Management (CDM), bring total funding to more than $1 billion . New programs are to include a residential Demand response Program, targeted outreach to greenhouses, additional projects for commercial/municipal/institutional/industrial customers and improvements to the local Initiatives programs. IESO estimates that the new programs will annual savings of 1.1 TWh and 285 MW of peak demand savings by 2025.

Another important change that received much less notices was policy changes to energy policy that impacted conservation was initiated by the previous government concerns distribution rates [5]. Whereas they had been largely variable in the past, the OEB approved the move to fixed rates over the next 4 years in 2016. This will mean that conservation programs will have a reduced cost benefit as the energy saved will have no impact on the distribution portion of their final bills. This is an example of how energy pricing policy can impact the cost effectiveness of conservation programs.

The DSM picture for natural gas was relatively unaffected. While to new government's 2018 "Made in Ontario Environment Plan" referred to 2.3 MT of emission reductions coming from natural gas conservation programs [6], this was later inexplicably reduced to 0.03 MT in 2022 [7].   In 2021, Enbridge filed their 2022-2027 5-year DSM plan which approved a budget of $132 million in 2022 for DSM, similar to the funds invested in these programs in 2021[8]. It also proposed future investments of $142 increasing by 2% a year to $170 million by 2027. This plan has not yet been approved.

The only other additional comment on this paper is that since its publication in 2015, the importance of achieving net zero carbon emissions as soon as possible has become paramount. Based on this, there is a tenth development and that is that energy efficiency must be part of an overall net zero plan. One of the best examples of such an approach was the work recently completed by Toronto 2030 District which concluded that conversion of the buildings in downtown Toronto to heat pumps was the most cost effective way of achieving the net zero target [9].

1. Langlois, Pierre and Gauthier, Genevieve. Canadian Energy Efficiency Outlook: A National Effort for Tracking Climate Change. The Fairmount Press, Lilburn, Ga. 2018.
2. Minister of Energy, Northern Development and Mines. "Discontinuation of the Conservation First Framework". IESO, Toronto March 21, 2019.
3. IESO. "2021 Annual Report". IESO, Toronto, 2022.
4. Minister of Energy. "Ontario to Provide New and Expanded Energy-Efficiency Programs". Ontario Ministry of Energy, Toronto, October 4, 2022.
5. Ontario Energy Board. "Chapter 3: Incentive Rate-Setting Application". OEB, Toronto, July 20, 2017.
6. Minister of Environment, Conservation and Parks. "Preserving and Protecting our Environment for Future Generations: a Made-in-Ontario Environment Plan". Ontario Ministry of Environment, Conservation and Parks, Toronto, 2018.
7. Ministry of Environment, Conservation and Parks. Ontario Emissions Scenario as of March 25, 2022. Ontario Ministry of Environment, Conservation and Parks, Toronto, 2022.
8. Enbridge Gas Inc. "Multi-Year Demand Side Management Plan (2022-2027). OEB, Toronto, September 29, 2021.
9. Toronto 2030 District. "Integrated Pathways to Decarbonization". Toronto 2030 District, Toronto, 2022.

THE PAST, PRESENT AND FUTURE OF ENERGY CONSERVATION IN ONTARIO

*Peter Love**

This article summarizes the key components of Ontario's past and present activities in energy conservation. It then uses this background to identify some of the likely key elements and drivers of future activities. Before going further, it is useful to first define energy conservation and identify some of its distinctive challenges as well as its major benefits.

Different jurisdictions use various terms such as energy efficiency, energy conservation, demand response, demand side measurement (DSM), conservation and demand management (CDM). For the purposes of this article, energy conservation is the all-encompassing term that includes the following three main elements:

- **conservation behaviour** – using existing technology more efficiently (eg a light switch and programmable thermostat)
- **energy efficiency** – using more energy efficient technology (eg LED light bulbs and LEED buildings)
- **demand response** – using less energy at peak periods (eg using electrical appliances at off-peak periods or shedding industrial load at on-peak periods)

In comparison to the much higher profile associated with energy supply, conservation suffers from a few challenges. Most importantly, it is hard to see: it is in the walls and inside appliances. It is also harder to measure than energy supply, but can be done using widely accepted protocols. And it requires all sectors to participate. But the benefits to society are too important to ignore. As we currently waste approximately 68 per cent of the primary energy consumed,[1] the potential is huge. The environmental benefits of not using energy in the first place are obvious. Not so obvious are the economic and employment benefits. A recent study conducted for NRCan found that the most aggressive conservation scenario would result in an increase in GDP of $582 billion, add up to 350,000 people to the workforce, grow provincial tax revenues by $2.7 billion and cut CO_2 emissions by 92 MT/year over the next 15 years.[2]

Those who have tried to follow the evolution of electricity conservation in Ontario over the last ten years can be excused for being confused, as there have been four distinct initiatives:

- Ontario Energy Board (OEB) Third Tranche funding for Local Distribution Companies (LDCs)
- Ontario Power Authority (OPA) programs that were delivered by LDCs

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1 Sankey Diagram of Canada's Energy Systems, *Canada's Energy Systems in 2010,* online: Canadian Energy Systems Analysis Research (CESAR) < http://www.cesarnet.ca/visualization/sankey-diagrams-canadas-energy-systems?scope=Canada&year=2010&modifier=none&display=value&hide=all&scalevalue=0.0146510307286385 01>.

2 Leslie Malone et al, "Energy Efficiency: Engine of Economic Growth in Canada – A Microeconomic Modeling & Tax Revenue Impact Assessment" (March 2014), online: Acadia Center/ENE <http://acadiacenter.org/wp-content/uploads/2014/10/ENE_ExecSummary_EnergyEfficiencyEngineofEconomicGrowth_EasternCanada_EN_2012_0611_FINAL2.pdf>.

as well as other channel partners

- Ontario Ministry of Energy which drove the province-wide roll out of smart meters
- LDCs whose programs will be approved by the Independent Electricity System Operator (IESO who were merged with OPA) and whose targets will be monitored by the OEB

This article will put these and other initiatives into a historical context and will use the experience gained from them to identify key elements of future initiatives.

THE PAST

Although not documented, it would be safe to assume that before the use of fossil fuels, First Nations and early settlers did their best to conserve energy as they had to cut firewood, walk/paddle or feed animals to keep warm and move about. The adoption of s. 92A (1) of the *Constitution Act, 1867*, by way of the 1982 amendments specifically assigned the provinces with the jurisdiction to legislate on matters relating to non-renewable and forestry resources which includes conservation.[3] This is part of the reason why this article is focussed on Ontario. The World Wars brought increased attention to the need to conserve food, resources and energy with gasoline rationing introduced in April 1942; some Canadians decided to put their cars in storage for the duration of the war.[4]

In 1973, the federal Department of Energy, Mines and Resources (now Natural Resources Canada) created the Canadian Office of Energy Conservation that has offered various information and incentive programs since then, operating more recently as the Office of Energy Efficiency. Also that year [1973], the Science Council of Canada called on all Canadians to begin the transition to a "conserver society".[5] In Ontario, the Ministry of Energy began developing policies and programs in 1975.

In 1980, the Royal Commission on Electric Power Planning (known as the Porter Commission) recommended that future planning should be reoriented to emphasize demand management.

Ontario Hydro set a target of 1000 MW of load shifting and 1000 MW of conservation in 1982. In 1989 it included a budget of $3 billion in conservation programs as part of its Demand/Supply Plan that was subsequently withdrawn. During this process, it began offering demand-side management programs that were able to reduce electricity consumption by 1,200 MW before it was discontinued in 1993;[6] this was also the time when the new Darlington nuclear plant began operating at a time when there was a surplus of capacity.

In 1990, the *Ontario Energy Efficiency Act* provided the province the ability to require minimum energy performance standards (MEPS) on the sale of specified energy consuming products. In 1992, the federal *Energy Efficiency Act* provided the federal government the ability to require MEPS on products traded across provincial or international boundaries. To date, about 80 products in Ontario have MEPS; updated requirements introduced in 2013 were estimated to result in savings of about 2 TWh by 2030.[7]

Ontario's first Building Code was introduced in 1975 and, like the *Energy Efficiency Act,* required new buildings (both low rise and high rise) and major renovations to meet minimum energy performance standards. Despite attempts to remove these provisions in the late 90s, they remained and are now among the highest in North America[8] and were estimated to save 550 MW when fully implemented.[9]

The Ontario Energy Board established the original regulatory framework that governed demand-side management programs by the two natural gas utilities in Ontario in 1993. Using California's example, the conservation programs

3 *Constitution Act, 1867* (UK), 30 &31 Vict, c 3, s 92A.
4 *WW2,* online: The Canadian Military Heritage Project <http://www.rootsweb.ancestry.com/~canmil/ww2/home/ration.htm>.
5 Science Council of Canada, "Natural Resource Policy Issues in Canada", (Ottawa: Science Council of Canada, 1973) at 39.
6 Rebecca Mallinson, "Electricity Conservation Policy in Ontario: Assessing a System in Progress", York university Faculty of Environmental Studies (Toronto: March 2013) at 148 [*Mallinson*].
7 Ontario, Office of the Premier, News Release, "Ontario Regulations Coming into Force on January 1 2013" (Toronto: 31 December 2012) at 8.
8 Canadian Energy Efficiency Alliance, Press Release, "New Energy Efficiency Code in Ontario– Best in North America!" online: CEEA <http://energyefficiency.org/new-energy-efficient-building-code-in-ontario-best-in-north-america/>.
9 Chief Energy Conservation Officer, *2006 Ontario Power Authority Annual Report,* "Ontario – a new era in electricity conservation" (Toronto: OPA, 2006) at 65.

were required to meet a cost effectiveness test called the Total Resource Cost Test. This test has been criticized for a number of reasons, foremost being that it does not include environmental or social externalities.[10] To date, savings from these programs are estimated to be more than 1,000 million m^3 from 2007 to 2012.[11]

In 2004, the Ontario government granted electricity distributors an increase in their rates by $163 million by way of the third installment of their incremental market adjusted revenue requirement (MARR) provided they invested an equivalent amount in CDM funding. Most Local Distribution Company's (LDCs) in Ontario then launched a range of conservation programs which were estimated to have reduced peak demand by 357 MW.[12]

Also in 2004, the Electricity Conservation & Supply Task Force issued its report which called for the creation of a "conservation culture", the creation of a conservation champion and, like the Porter Commission, recommended that demand reduction be evaluated on a level basis with supply alternatives.[13]

The Conservation Bureau was established within the Ontario Power Authority in 2005; over the next 10 years, it launched a broad range of conservation programs delivered by LDCs as well as various associations and private companies. These programs were funded by all electricity ratepayers with approval provided by ministerial directives. Its initial target of 1350 MW by 2007[14] was achieved and total savings to 2013 are estimated to be 1900 MW and 8.6 TWh.[15] In recognition of the challenges associated with conservation mentioned earlier (hard to see and measure), over 150 conservation events were celebrated each year and a detailed Evaluation, Measurement & Verification protocol was developed.

One final noteworthy initiative was the installation, completed in 2013, of smart "time-of-use" meters and time-of-use rates for all 4.3 million residential customers, the first jurisdiction in North America to make this important investment. Although an independent study concluded that Ontario's roll-out aligned with best practices in four out of six characteristics, it found the 1.9:1 ratio of peak to off-peak prices to be far below the optimal ratio of 4.9:1.[16]

THE PRESENT

Following consultations, the Ontario government released it Long-Term Energy Plan, "Achieving Balance" in 2013.[17] Although called an energy plan, it is almost entirely an electricity plan, with no mention of conservation of natural gas or oil. It noted that conservation will be the first resource to be considered for electricity planning and set a target of 30 TWh by 2032 (16 per cent reduction in forecast gross demand) with 7 TWh by 2020 and 2500 MW of demand response. It also released "Conservation first: A Renewed Vision for Energy Conservation in Ontario"[18] which, like the Long-Term Energy Plan made no mention of natural gas or oil conservation. It did however make clear the government's' commitment to conservation first and that the Local Distribution Companies (LDCs) would have an expanded role with more autonomy and programming choice. In 2015, LDCs will be submitting their conservation programs individually or in groups to the Independent Electricity System Operator, which now includes OPA, for approval.

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10 Mark Winfield, "An Efficient Balance? Applying the Total Resource Cost Test to CDM Initiatives of local Electricity Distribution Companies in Ontario: Assessment and Recommendations for Reform", York University Faculty of Environmental Studies (Toronto: June 2009) at 35.

11 Ontario Energy Board, *Demand Side Management Framework for Natural Gas Distributors (2015 – 2020)* (Toronto: OEB, December 2014) at 10 [*OEB Guidelines*].

12 Chief Energy Conservation Officer, "Taking Action – Supplement: Conservation Results 2005-2007", (OPA: Toronto, 2008).

13 Pratt, Courtney & Electricity Conservation and Supply Task Force, *Tough Choices: Addressing Ontario's Power Needs-Final Report to the Minister (2004);* See also *Mallinson, supra* note 7 at 161.

14 Chief Energy Conservation Officer, Annual Report 2008: *Be the Change to a Culture of Conservation*, (Toronto: OPA, November 2008) at 1, 17.

15 Ontario Ministry of Energy, *Conservation First: A Renewed Vision for Energy Conservation in Ontario* (Toronto: Ministry of Energy, December 2013) at 17 [*Conservation First*].

16 The Brattle Group, *Assessing Ontario's Regulated Price plan: A White Paper,* Toronto: OEB, 2011.

17 Ontario, Ministry of Energy, *Achieving Balance: Ontario's Long Term Energy Plan*, (Toronto: Ontario Ministry of Energy, December 2013) [*Achieving Balance*].

18 *Conservation First*, *supra* note *15.*

In recognition of some of the limitations of the TRC test, the government now allows a 15 per cent adder to be added onto the benefits of a conservation program. This was an attempt to account for at least some of the externalities that are not included in current program evaluations.

An analysis of Ontario's electricity conservation targets found that, while its past targets were more aggressive, its 2030 target would rank 17th compared to targets set by US states.[19]

Although most well known for promoting the use of renewable energy, the *Green Energy Act* of 2009 also included a few important conservation initiatives. It required the Environmental Commissioner of Ontario to report on Ontario's progress on conservation and to make recommendations on what further action is required. Recent annual reports have noted that further investments should be made in natural gas conservation programs, that there is a total lack of conservation programs for oil and oil products such as transportation fuel and that there should be a greater price differential between off peak and on peak electricity rates.[20]

Another important initiative of the *Green Energy Act* required all public agencies (municipalities, universities, schools and health care (MUSH)) to submit energy consumption/green house gas emissions by 2013 and a plan to reduce energy/GHG by 2014. Despite there being no penalty for non-compliance, over 90 per cent of all such organizations have submitted their data and more than 80 per cent have submitted their plans. This is expected to result in major investments and savings in these sectors in the future.

In late 2014, the Ontario Energy Board issued CDM Guidelines for electricity distributors and DSM Guidelines for natural gas distributors.[21] While the electricity guidelines focused on achieving the government's target of 7 TWh by 2020, the natural gas guidelines had no such target. One of the most important features of the natural gas guideline is that it recommended DSM budgets increase from $65 million to $155 million/year.[22]

Unlike the electricity and natural gas conservation programs that are funded by their respective ratepayers in Ontario, at the federal level all energy conservation activities are funded out of general revenue. This has resulted in the cancellation of federal incentive programs (such as EcoEnergy for home energy retrofits) with a focus on providing product information/labelling, support for various tools (such as EnerGuide rating for homes), Minimum Energy Performance standards (MEPS), etc.

THE FUTURE

Although as is clear from the previous two sections that much has been achieved, much more remains to be done. Here are some of the most important developments needed for the full potential for conservation to be realized in Ontario.

- **Culture of Conservation** – As noted earlier, the need for a move to a conserver society was first identified in 1973 and a culture of conservation was first promoted in 2004. In 2011, the Canadian Council of Chief Executives (composed of 150 CEOs of largest enterprises in Canada) called for the building of a culture of energy conservation in Canada.[23] While limited progress has been made, much remains to be done before saving energy comes as natural to Canadians as dressing warmly in the winter. All mandatory as well as voluntary programs should all be framed in such a way that they are seen as being part of a move to this new culture.
- **Customer/Tennant Engagement** – One of the principal vehicles for bringing about a new culture of conservation is the direct engagement of energy customers and tenants in voluntary energy conservation programs.

19 *Mallinson, supra* note 7 at 32.
20 Environmental Commissioner of Ontario, "Looking for Leadership: Annual Greenhouse Gas Progress Report – 2014", (Toronto: Environmental Commissioner of Ontario, 2014) at 33.
21 *OEB Guidelines, supra* note 11.
22 *Ibid* at 17-18.
23 Canadian Council of Chief Executives, "Energy-Wise Canada: Building a Culture of Energy Conservation", (December 2011) online: Canadian Council of Chief Executives, < http://www.ceocouncil.ca/wp-content/uploads/2011/12/Energy-Conservation-Paper-FINAL-December-20111.pdf>.

Important progress has been made here by a number of leaders but there is vast scope for progressive programs.

- **Supply Subsidies** – While conservation is already cost effective (in Ontario, every $1 invested in energy efficiency avoided $2 in costs to the electricity system),[24] it would be an even more valuable if traditional energy supplies were not subsidized. A recent study by the International Monetary Fund estimated the direct support to energy producers to be over $1.5 billion and over $30 billion in uncollected tax on externalized costs such as carbon emissions.[25] And as more provinces join BC, Quebec, Alberta (to a more limited extent) and soon Ontario in having a price on carbon, the advantage of carbon free conservation will be even larger. The federal government may be forced, politically, to establish a national carbon pricing program, as recommended by the Canadian Council of Chief Executives.[26]
- **Smart Energy Network** – As the electricity grid and other energy networks get smarter, conservation should play a larger role and take advantage of new smart technologies. Future smart appliances will know when energy prices are lower and shift demand automatically. The waste heat energy from some appliances (refrigerators, dishwashers, etc) will be used to preheat water for others. These new technologies will automate behaviour change. And the ratio between on peak and off peak electricity rates should be increased to closer to the optimal level of 4.9:1.
- **Integration of Electricity/Natural Gas Conservation Programs** – Energy consumers do not want to hear about one type of program offered by electricity users and a different one offered by gas utilities.
- **Existing Buildings** – While great progress has been made in encouraging builders of both new homes and commercial buildings to voluntarily certify their buildings to higher standards (e.g. EnergyStar and LEED, respectively), much less progress has been made on existing buildings. With 1-1.5 per cent of new stock being added each year, existing buildings will continue to make up the majority of our building stock. Initiatives are underway at both the local and provincial level to require reporting on building performance which will drive energy efficiency retrofits.
- **Evaluation, Measurement & Verification** – Ontario has become a leader in the development and implementation of independent program evaluations and has allocated up to 5 per cent of program budgets. This is particularly important as measuring energy efficiency requires the use of comprehensive protocols.
- **Codes & Standards** – Easily forgotten, mandatory minimum energy efficiency codes and standards continue to play a critical role in reducing energy demand. Energy planners love this approach as they are reliable.
- **Transportation** – And finally, it is critical that major initiatives be undertaken in transportation which is responsible for 34 per cent of energy consumption In Ontario.[27]

While it is clear that a good start has been made in conserving energy in Ontario, it is equally clear that there remains a great deal more to do. Creating a true "Culture of Conservation" will take leadership and engagement by all sectors of society. ■

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24 *Conservation First*, *supra* note 15 at 1.
25 Mitchell Anderson, "IMF Pegs Canada's Fossil Fuel Subsidies at $34 Billion", *The Tyee* (15 May 2015), online: The Tyee <http://thetyee.ca/Opinion/2014/05/15/Canadas-34-Billion-Fossil-Fuel-Subsidies/>.
26 Canadian Council of Chief Executives, "Framing an Energy Strategy for Canada: Submission to the Council of the Federation", (July 2012) at 10, online: Canadian Council of Chief Executives <http://caid.ca/FraEneStrCanSub2012.pdf>.
27 Ontario, Ministry of the Environment and Climate Change, *Ontario's Climate Change Discussion Paper 2015* (Toronto: Ministry of Environment and Climate Change, 2015) at 30.

CASE STUDY 5: ENERGY EFFICIENCY IN ALBERTA

By Jesse Row, Executive Director, Alberta Energy Efficiency Alliance

Energy efficiency initiatives in Alberta have had a long and varied history. As in many jurisdictions, these efforts began decades ago and resulted in both new energy codes for buildings (1981) and the creation of energy efficiency programs in the provincial government and utility companies. An assessment of energy efficiency activities in Alberta compiled by the Energy Efficiency Branch of Alberta Energy demonstrated that approximately $8.3 million and 102 person years of resources were dedicated to energy management programs in the province in 1992.[153] Examples of these programs include:

- Old Fridge Roundup by TransAlta Utilities ($1.1 million budget)
- District Conservation Project by Edmonton Public Schools ($900,000 budget)
- High Efficiency Motors Rebate Program by Alberta Power ($500,000 budget)
- Industrial and Commercial Energy Audit Program by the Government of Alberta ($276,000 budget)
- A variety of research, development, and demonstration programs

Unfortunately, this was the last assessment of its kind since the provincial government was undertaking major budget cuts while also restructuring the utility sector in the mid-1990s. As a result, most substantial energy efficiency programs in the province were gradually discontinued.

This trend changed in 2000, with the Government of Alberta establishing Climate Change Central (C3) – an organization that, among other initiatives, was responsible for administering government funded energy efficiency programs. Over the years, funding for energy efficiency programs varied as provincial budgets cycled between surpluses and cutbacks, and political attention to climate change rose and fell (Alberta released climate change strategies in 2002 and 2008). Over its 14-year history, C3 delivered 23 programs that reduced emissions by 4.5 MT,[154] including:

- Residential retrofits (with estimated energy savings of $320 million)
- An interest-free loan program for municipalities (loaned a total of $37 million)
- Promoting the use of hybrid vehicles in the taxi industry
- Supporting fuel efficiency and alternative fuel efforts in the trucking industry
- Supporting the early adoption of solar energy on municipal buildings

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[153] Energy Efficiency Branch of Alberta Energy, An Assessment of Energy Efficiency in Alberta (1993): 61-65.
[154] Climate Change Central, "Alberta's Climate Change Central to Close," http://www.marketwired.com, (June 2, 2014).

As part of its 2008 climate strategy, the Government of Alberta also established an emissions offset system, and the Climate Change and Emissions Management Fund (CCEMF). Both these mechanisms were sources of funding for a handful of energy efficiency initiatives in the private sector over the years (E.g., energy efficiency projects accounted for approximately 5% of all emission offsets generated between 2007 and 2020[155]).

Prior to 2011, ATCO Gas (a natural gas distribution company in the province) delivered modest demand side management programs including education and outreach activities. In 2010, it was proposed that this $1.6 million effort be increased to close to $4 million through the ATCO Gas 2010-2012 General Rate Application. However, in 2011 the Alberta Utilities Commission (AUC) denied cost recovery for the total ATCO Gas DSM budget. The stated reasoning, at the time, was due to the fact that DSM activities were not explicitly listed in the legislation governing Alberta's utility system.

In 2014, C3 ceased delivering programs and was shut down due to lack of government funding. Since then, a handful of specialty programs have been offered for the municipal and agriculture sectors, indigenous communities, as well as a loan program for seniors, but no large-scale programming was offered in the province until a change in government occurred and a new provincial agency, Energy Efficiency Alberta (EEA) was established in 2016.

EEA was a provincial agency funded through a portion of revenues from the newly created carbon levy. In its first three years of program delivery, EEA invested $229 million into programs for the industrial, commercial, non-profit/institutional and residential sectors. The programs were estimated to deliver over $800 million of energy savings and 6.8 Mt CO_2e in GHG emission reductions through the upgrades and actions it supported.[156]

Following another change in government, the provincial agency was subsequently closed in September 2020, and its existing programs and programs under development were transferred to other organizations.

By October 2022, the active energy efficiency programs in Alberta consisted of:

- Emissions Reduction Alberta: Energy Savings for Business program; periodic calls for proposals with a focus, at times, on energy efficiency
- Alberta Municipalities: Clean Energy Improvement Program (PACE financing currently available in 6 municipalities with another 10 in development)
- Municipal Climate Change Action Centre: various programs with a focus on supporting municipal facilities
- Municipal programs in Edmonton, Calgary, Medicine Hat, Canmore, Banff and Red Deer.

Future Opportunities

Despite historically lower levels of energy efficiency initiatives than other provinces, there remain significant opportunities to increase the uptake of energy efficiency in Alberta.

One of the largest opportunities is to approach energy efficiency through the utility system, similar to how every other province in Canada approaches it, by investing into energy efficiency and even broader

[155] Alberta Environment and Parks, 2019 Compliance Workshop Emission Offset presentation (2020): 26-27.
[156] Energy Efficiency Alberta, 2019-2020 Annual Report (2020): 9.

demand side management (DSM) initiatives. The primary purpose of incorporating DSM into utility systems across the country, and internationally, is to reduce system-wide costs and overall utility bills for customers.

The scope of DSM in other jurisdictions is normally focused on traditional energy efficiency programs, but it can also include demand response programs as well. As the variety of consumer-based, behind-the-meter technologies increases, such as distributed generation and battery storage, opportunities related to DSM may increase even further into distributed energy resource management systems (DERMS) and other smart grid technologies given they all involve engaging consumers in energy related decisions and behaviours.

In Alberta, there are multiple reasons why DSM should be further considered as a utility cost management tool. Those providing utility oversight and operations (i.e., the Government of Alberta, the Alberta Utilities Commission, the Alberta Electric System Operator, distribution utilities, rural electrification associations, natural gas co-ops, and utility consumer advocates) are increasingly wrestling with multiple competing demands on the system. These range from cost management to emission reduction to the adoption of new technologies both on the consumer and upstream sides of the meter. DSM increases the ease of dealing with all of these demands. DSM works with consumers to reduce total and peak demand at a lower cost than other measures such as increasing supply and delivery systems. DSM can also increase the flexibility of demand, which will be increasingly important as both electricity supply and demand become more dynamic. While DSM isn't able to meet all future needs by itself, it is a tool that should be available to help manage costs into the future in combination with other tools currently available.

DSM in utility systems has also been used as a foundational component of broader energy efficiency improvements whether it is capacity building prior to adoption of new codes and standards, or as a long-standing set of programs that maintain market capacity even during times when government funding for energy efficiency declines, a cycle often seen in Alberta's past experience. When government funding is available either provincially or federally, utility DSM programs can then be designed to be complimentary to government initiatives – achieving greater results through a combination of approaches.

While DSM is a critical missing piece in Alberta currently, increases in codes and standards are also needed to 'lock-in' efficiency advancements to ensure they're universally available to all consumers. These include continued advancements within the building code and product standards, introduction of an alternations code for buildings, and ultimately the establishment of building performance standards to support the continuous advancement of building efficiency levels. When paired with necessary capacity building and upgrade support programs, these regulations can help ensure all consumers are supported to lower their energy bills while reducing emissions at the same time.

CASE STUDY 6: KEYS TO DEVELOPMENT OF SUCCESSFUL PACE FINANCING PROGRAMS

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Keys to Developing a Successful PACE Financing Program

As CHBA's Net Zero Home Energy Labelling Program continues to gain momentum, with it now adding renovation and multi-unit dwelling to the program (in pilot stages) as well, it is clear that successful innovative financing programs could dramatically increase affordability and access for more Canadians to attain Net Zero levels of performance in their new or existing home. **PACE programming offers just such a solution.**

PACE (Property Assessed Clean Energy) is an innovative financing tool that is transforming the economics of sustainability, making it both more profitable and more affordable than ever before. Since 2008 when first introduced in Berkeley California, across the United States PACE has financed over 8 billion dollars in energy efficiency and renewable energy measures and has grown exponentially despite significant financial constraints and without any need for tax dollar support.

This document was developed by the Canadian Home Builders' Association (CHBA) in collaboration with:

1. PACE Canada
2. Canadian Association of Consulting Energy Advisors
3. Clean Air Partnership
4. Efficiency Canada
5. Morley Mountain Homes
6. North Ridge Developments Corporation
7. s2e Technologies
8. Vancity Community Investment Bank

Simply put, PACE allows property owners to borrow money to finance measures which serve to advance a "public good" agenda (typically energy efficiency and renewable energy measures) and repay the loan through a surcharge via their property tax bills. Thus, allowing longer term paybacks and addressing upfront capital barriers that often undermine measure implementation. The PACE financing (loan) is secured via a tax lien and is attached to the property itself rather than the property owner. It therefore in no way affects the credit of the property owner—another benefit.

The simplicity of the concept belies its power. PACE makes previously unaffordable or financially unattractive energy efficiency and renewable energy measures both affordable and desirable.

PACE loans have the following characteristics:

- the loan covers 100% of all costs (soft, hard and associated),
- the term and interest rate are set for the life of the loan,
- the loan is secured by a tax lien and can transfer to the new owner on resale,
- repayment terms can extend up to 30 years, and
- finally, the loan does not accelerate in the event of a tax payment default or foreclosure, only the outstanding annual tax assessments become due and payable.

Taken together, these features set PACE apart from other forms of financing and make it uniquely attractive to both homeowners and businesses.

PACE financing is applicable to both retrofit existing buildings and upgrade new construction projects, and to building owners to refinance existing PACE qualifying measures.

With over 10 years of experience in the field to look back at, it is clear that PACE's success is predicated not only on its financial characteristics but just as significant, on the ecosystem that has evolved to service and support it. The ecosystem consists of the enabling legislative framework and the stakeholders:

- borrowers,
- municipalities,
- lenders (PACE Originators),
- consultants,
- subcontractors, and
- administrators.

Each stakeholder has a key role to play and the ecosystem must be structured to ensure that stakeholders' needs and wants are met. Understanding the role of the ecosystem is essential; jurisdictions that have failed to support the ecosystem's stakeholders have seen PACE programs underperform, or worse yet, completely fail.

Keys to Success for PACE Program Development

PACE's success and the key role it will play in economic stimulus, job creation and climate change is predicated on creating a market for the private sector to "pull" the world towards a sustainable future by harnessing the sustainability sector to the profit motive.

Cisco Devries, considered to be the "founder" of PACE, said the following at a PACE conference in 2018. "There are only a handful of ways to structure a PACE program successfully and a multitude of ways to encumber it to the point of failure". Given his background and history as a founder of Renew Financial, one of the largest PACE Originators in the USA, any jurisdiction considering setting up a PACE program will do well to heed his words and structure the ecosystem accordingly.

With that in mind, the following are key elements that create a successful PACE program.

Unlimited Capital

Key PACE stakeholders (consultants, sub-contractors, and originators) will only fully support and promote PACE if they are confident that there is no limit on the availability of capital to service the demand they support and create. While private capital comes with what appears to be a higher interest rate than public funds, public funds are inherently limited, and private capital by contrast includes numerous administrative and other costs that are often externalized from public capital. Most compellingly, private capital is functionally unlimited in nature, and building PACE programs upon private capital is critical to the success of these programs. The uncertainty associated with public funds arising from the limits on capital availability and the risk of political manipulation has resulted in significant underperformance in publicly funded PACE programs. Businesses who would actively promote and service the PACE ecosystem will limit their engagement if they cannot be certain that their investment (time, HR, capital, marketing) will not be undermined by a lack of available funds. On the other hand, when specialized PACE lenders are involved, they use their ability to bundle and securitize their loans to ensure that PACE capital is always available to service the demand.

R-PACE & C-PACE

Residential PACE (R-PACE) and Commercial PACE (C-PACE) programs serve two completely distinct markets and must be structured accordingly.

R-PACE is targeted to the homeowner. R-PACE's success relies heavily on contractors' engagement and proactive participation. Most homeowners who used PACE to finance a retrofit did not know about or consider PACE until the contractor brought it to their attention. For this reason, contractors' needs must be prioritized in any R-PACE program. Furthermore, consumer protection measures must be incorporated. Striking a balance between protection measures, simplicity, approval process and timing, and ease of use by contractors is key to the success of any R-PACE program. For example, using RenoMarkTM members as a qualified list of contractors is a great and simple way to support consumer protection.

C-PACE is targeted to all other non-R-PACE property owners: commercial, hospitality, institutional, industrial, etc. The approval process is lengthy and significantly more involved than R-PACE and requires front end cost commitments to cover items such as costing, energy modelling, business case analysis, and mortgage lender approval, none of which are required in the R-PACE approval process. So while R-PACE approvals need to be free and quick (minutes to just a few days to confirm ownership, tax history and sufficient equity) to ensure contractors' engagement, C-PACE approvals typically require front end capital investment and two to six months to prepare.

Originators

These are the PACE lenders and fall into two categories: R-PACE and C-PACE. In both cases however, the lenders play a key role in seeking out and creating interested borrowers who become clients. This active engagement by the Originators plays a key role in PACE's growth and development. The higher interest charged by Originators reflects in part the role they play in marketing and creating PACE projects.

Role of Government

For government, the value of PACE is that it enables property owners to make investments that are in the public interest (energy efficiency, water efficiency, GHG emissions reduction, extreme weather resilience, etc.). To realize this value, the most important PACE success factor is confidence in the eyes of all other stakeholders (including property owners, investors, contractors, suppliers, and mortgage lenders): confidence that the program will remain a going concern, that the only changes will be to improve and streamline, that the program will be resilient to changes in political direction, and that risk is minimized (and, more specifically, that consumers are protected). This is best accomplished if the role of government is solely to set rules, and to ensure that those rules focus on ends rather than means.

Where PACE legislation is too specific on means and methods, the resulting complexity will discourage communities from launching in the first place; what programs do launch will struggle to contain overhead costs. Where government serves as funder, the program is subject to budget scrutiny with each election cycle, and is at risk of cancellation or disruption in ways that erode the confidence that is so critical for program success; there is also the risk that the program will grind to a halt once the allocated funds are fully invested.

By contrast, PACE legislation that is focused on outcomes will encourage local programs that have minimal complexity and overhead costs, where the municipality can play as small a role as its elected representatives prefer. It will also open the door to private sector investment that effectively has no upper limit, especially if the legislation allows PACE loans to be securitized (bundled together and sold off) and the proceeds used to recapitalize the program.

Connecting Capital to Public Good Measures

At its core, PACE programs are most successful when they respect that the most cost-effective performance measures are implemented when the ecosystem is designed to attract unlimited capital and deliver that capital at the lowest cost possible to the borrowers with the least amount of administrative cost in the transaction. Eliminating any measure which interferes with this equation yields successful PACE programs. Washington state's recent C-PACE legislation serves as an excellent example; the approval process has been simplified to such an extent that the role of the 3rd party C-PACE program administrator has been entirely eliminated and replaced with a simple registration process that is handled by the existing municipal government infrastructure.

Conclusion

PACE can play a significant role in the meeting Canada's climate objectives, and support homeowners in their goals to reduce the GHG impact of their homes. Further, PACE programs can support the development of a robust industry supporting energy efficiency in every local community. This program also has the potential to develop a pool of patient capital toward energy efficiency and climate change mitigation. As the PACE model becomes more entrenched, there may be opportunities to expand the financing model beyond clean energy objectives, and support other public interest goals, such as creating more multi-generational homes, and supporting more seniors as they age in place.

CASE STUDY 7: PRODUCTIVITY IMPROVEMENTS THOUGH ENERGY AUDIT – A CASE STUDY FOR A FORGING UNIT IN NORTHER INDIAN STATE OF PUNJAB

This article is reprinted with the permission of Professor Amit Kohli of Yorkville University.

Productivity Improvement through Energy Audit- A Case Study for a Forging Unit in Northern Indian state of Punjab

AMIT KOHLI

4.1 ABSTRACT

Since last two- or three-decades energy sector is witnessing a substantial strain due to sharp growth in industrial sector. More than 40 % of generated electricity is utilized in industrial sector. As this consumption is high, the percentage losses are too competitive due to lack of energy saving concept among the consumers. After reviewing the papers, it has been found that the total requirement is more than the availability of electricity. The percentage deficit is nearly 26 % during the year 2006-2007, which is further expected to increase. This has resulted in the need of demand side management to cope up with the difference in generation and supply to maintain reliable supply services. To improve upon the situation and to bridge the gap, Energy Audit is useful and effective in overcoming the demand side management. Further such programs can help to find new horizon for improving the existing energy scenario in India. In this dissertation an effort is made to show the effectiveness of energy audit through a typical case study conducted at a forging unit located in Northern Indian state of Punjab. The existing energy scenario in case organization has been evaluated through energy audit. The key areas of major losses in oil fired boiler and furnace have been monitored using equipment like infrared thermometer and flue gas analyzer. The solutions have been recommended and implemented to achieve the desired goal. After the implementation various energy losses were remonitored. The difference in energy losses before and after implementation shows the saving and hence increases in productivity. The losses in boilers found are loss of heat due to radiation through pipelines, loss of heat due to flue gas temperature, loss of heat due to excess in steam pressure and loss due to unused condensate. The action taken to avoid losses shows 10 %, 5.2 %, 98.7% and 39.5 % saving of furnace oil respectively. Similarly, the losses in furnaces are heat loss due to radiation, heat loss due to openings through the furnaces and loss due to flue gas exit temperature. The action taken to avoid losses shows 9.3 %, 0.311 % and 90 % saving of furnace oil respectively, which is the outcome of the study.

4.1.1 INTRODUCTION

These days' energy cost has become a key factor in deciding the product cost. Energy cost is a significant factor in industrial economics as compared to Factor of production like capital, land, and labour. The imperatives of energy shortage have called for energy conservation measures, which essentially mean reduction of energy requirements for an activity. Energy Audit helps in energy cost optimization, pollution control, and safety aspects and suggests the methods to improve the operating and maintenance practices of the system. It is instrumental in coping with the situation of scarcity of energy availability, reliability of energy supply, decision on appropriate energy mix and decision on using improved energy conservation technology.

The Energy Audit provides the vital information base for overall energy conservation program covering essentially energy utilization analysis and evaluation of energy conservation measures. It aims at:

- Identifying the cost of various energy inputs.
- Assessing cost of current level of energy consumption in various operations in a company.
- Relating energy inputs and production output.
- Identifying potential areas of energy economy.
- Highlighting wastages in major areas.
- Fixing of energy saving potential targets for individual organization.
- Implementation measures for energy conservation and realization of savings.

LITERATURE REVIEW

5 The present state of art in the field of energy audit is to utilize the energy at its optimum level. The demand of electrical energy has been increasing rapidly in the developing countries.

Hughes (1976) studied the effect of excess air on combustion of coal-fired boiler. He has stated that the excess air varies with the type of fuel and moisture content of fuel. He has reported that 72 % of the heat value of the carbon is lost if carbon is not oxidized completely. He has also found that excess air above 300 per cent reduced the boiler efficiency to less than 35 per cent.

Bosnjakovic (1979) made an important contribution to the formulation of new criteria of performance and techniques of the assessment of thermodynamic perfection of the processes.

Rao et.al. (1980) stated that in oil fired boiler combustion at proper air supply can be obtained by maintaining O_2 and CO concentration of flue at minimum. He also stated that as percentage of excess air decreased, O_2 decreased to zero and CO_2 increased to maximum. By adjusting percentage of excess air when CO_2 concentration was raised from 4 to 14 per cent, the combustion efficiency increased from 30 to 70 per cent.

Francis et. al. (1981) studied the effect of air supply rate on oil fired industrial boiler. He stated that O_2 and CO in flue gas could co- exist in measurable quantities when the boiler was operated at deficient air supply rates. He has also stated that maximum combustion efficiency could be obtained when boiler was operated slightly on the excess airside.

Walsh (1981) has stated that for complete combustion of fuel in boilers, the chemical reaction between combustibles of the fuel and oxygen of the air requires certain time, temperature, and turbulence. These three factors depend upon moisture content of the fuel and air – fuel ratio.

Clear (1981) stated the disadvantages of supplying excess air to the furnace. The excess air tends to cool and slow the combustion reaction. It increases flue gas velocities resulting in carrying over of unburnt particles. In addition, excess air accelerates the corrosion in the system due to reactive oxygen in the hot air.

Neuberger (1982) stated that it is important to control air fuel ratio in furnaces, as too much wastes fuel needlessly heating excess air, while too little air causes unburnt fuel and smoke.

METHODOLOGY

A forging unit involved in making hand tools: -

- PHASE I: - Literature Review and Visit to Various Companies.
- PHASE II: Case Study (Analyzing Present Status)
- PHASE III: Case Study (Developing Alternatives to Reduce Cost)
- PHASE IV: Implementing the Solution.

By visiting various companies, interaction with executives and literature review, the information on energy audit in engineering industry was gathered in the first phase. This phase is followed by a case study conducted in an engineering organization. From the information gathered and data collected for various energy operated units in case organization, the present on-going expenditure has been calculated. In third phase referring to the standards by PCRA (2002) and B.E.E (2003), solutions have been obtained for various units under study with an objective to reduce operating cost. The solutions have been recommended / implemented to achieve the desired goal in the last phase.

PRESENT WORK

The study describes the current estimation of operational costs of various energy-operated units in the case-company. The energy audit of boiler and furnaces has been performed. For observations, various equipments have been used. The important of them are infrared thermometer, clamp meter and flue gas analyzer. After calculating the status of losses, alternatives to reduce the losses have been developed. After implementation of alternatives, energy losses have been calculated once again to find the savings because of reduction of losses. The expenditure involved on the alternatives and pay back period has also been taken into consideration.

The heat losses considered in water tube boiler in forging industry are as follows: -

- Loss of heat due to radiation through pipelines
- Loss of heat due to flue gas temperature
- Loss due to excess in steam pressure
- Loss of heat due to unused condensate

1) Loss of heat due to radiation through pipelines

Average temperature of water pipe from boiler to various electroplating tanks is noted down with the help of infrared thermometer. It comes out to be 150^0C i.e 558^0 F.

Heat losses = 500 BTU/hr/ft = (500*0.25*10) = 1250 k cal. / hr

5.1.1.1 Saving

Heat losses due to radiation have been reduced through insulating the pipe using fibre glass wool (insulation thickness 65mm). After providing insulations, losses have been calculated again as

Average temperature = 40^0C = $104\ ^0$ F

Heat losses = 50 BTU/hr/ft = (50*0.25 *10) kcal. /hr/ft =125 kcal. /hr

Energy Savings = (1250-125) = 1125 k cal. /hr
Fuel savable = (Total heat loss)/ (G.C.V) = (1125 kcal. /hr) / 8670 kcal. /litre = 0.129 litre/ hr

Fuel saving per annum (assuming 306 working days with 7 hours/ day)

= (0.129 * 7 * 306 * 25) (@ INR. 25 / litre)

= INR. 6948.5 per year

Expenditure for applying of new insulation = INR.5000

Thus, Pay back period = (Expenditure*12 / Saving) = (5000*12 / 6948.5) = 9 months.

2) Loss of heat due to flue gas temperature

Substantial amount of heat is lost in high temperature flue gases leaving chimney. Efforts are needed to utilize this escaped heat. Flue gases have been using for preheating input air at the forging industry.

Fuel oil consumption = 28 kg/hr (Measured with Dip Stick)

Mass of flue gases (m) = 775 kg/hr (using flue gas analyzer)

T_f = flue gas temperature = 350 ^{0} C (Measured with flue gas analyzer)

Ta = Ambient temperature = 30^0 C

Specific heat of flue gas Cp = 0.23 kcal. /kg (BEE, 2003)

Heat Loss in Flue Gas = (m*Cp*(T_f-Ta)) **(**BEE, 2003)

= (775*0.23*[350-30])

= 62744 kcal. /hr.

Saving

To reduce excess air, butterfly valve was adjusted. then the heat loss was again calculated.

Mass of flue gases (m) =448 kg/hr

Heat Loss in Flue Gas **=** (448*0.23*[350-30])

= 3297.28 kcal. /hr

Heat Loss In Flue Gas (without modification) **=** 62744 kcal. /hr

Energy Savings = (62744- 3297.28) = 29771.2 kcal. /hr.

Fuel savable = (Total heat loss) / (G.C.V) = (29771.2 kcal. /hr)/(8670 kcal. /litre)

= 3 .4 litre/ hr

Fuel saving per annum (assuming 306 working days with 7 hours/day)

= (3.4 * 7 * 306 *25) (@ INR. 25 / litre)

= INR.183880 per year

Expenditure = Nil.

3) Loss due to excess in steam pressure

In the boiler under study, the steam is generated at pressure of 12 kg. / cm^2. The temperature of saturated steam at this pressure is 188^0C.

Enthalpy at 12 kg/cm^2 = 665 kcal. /kg (steam tables)

Rated Capacity of boiler = 400 kg/hr.

Energy required to produce a pressure of 12 kg/cm^2 = (665*400) = 266000 kcal. /hr.

Saving

To reduce the energy required in the boiler (under study), the pressure has been reduced from 12 kg / cm^2 to 5 kg/ cm^2 without affecting the performance of plant. The pressure

of steam has been adjusted by the installing industrial pressure switch (IPS).

Enthalpy at 5 kg/cm^2 = 657 kcal. /kg (From Steam Tables)

Energy required to produce a pressure of 12 kg/cm^2 = (657*400) = 262800 kcal. /hr.

Energy Savings = (266000-262800) = 3200 kcal. /hr.

Fuel savable= (Total heat loss)/ (G.C.V) = (3200 kcal. /hr)/ (8670 kcal. /litre) = 0.37 litre/ hr

Fuel saving per annum (assuming 306 working days with 7 hours/day)

= (0.37 * 7 * 306 * 25) (@ INR. 25 / litre)

= INR.19764.7 per year

Expenditure for applying pressure regulator = INR.2000

Pay back period (in months) = (Expenditure*12 / Saving) = (2000*12 / 19764.7)

= 1.2 months.

4) Loss of heat due to unused condensate

After giving off its latent heat to the heating coil of the process equipment, the steam condenses. If this condensate is fed to the boiler, it can reduce the fuel requirement.

The loss of heat energy by not using the condensate is calculated below: -

Capacity of boiler, m = 400 kg/hr

Specific heat of water, Cp = 0.98 kcal. /kg

Temperature of condensate, T_C = 100^{0}C(Measured with infrared thermometer)

Temperature of water, T_W = 20^{0}C.

Heat loss = (m*Cp*(T_C -T_W))

= (400* 0.98 *(100-20)) =31360 kcal. /hr.

Saving

Bimetallic steam trap has been used at the boiler under study to recover the heat of unused condensate.

Temperature of condensate during transmission = 90^{0}C (after a loss of 10 ^{0}C in the pipes)

Hence, energy required achieving the temperature of 100 ^{0}C

= {m*70%*Cp*(100-90)} + {m*30% *Cp *(100-20)}

= {400*70%*1*(100-90)} + {400*30%*1*(100-20)}

= {400 * 0.7 *1* 10} + {400 * 0.3 * 1* 80}

= (2800 + 9600) = 12400 kcal. / hr

Heat loss by not using condensate = 31360 kcal. /hr

Energy Savings = (31360- 12400) = 18960 kcal. /hr.

Fuel savable= (Total heat loss)/ (G.C.V) = (18960 kcal. /hr) / (8670 kcal. /litre)

= 2.2 litre/ hr

Fuel saving per annum (assuming 306 working days with 7 hours/day)

= (2.2 * 7 * 306 * 25) (@ INR. 25 / litre)

= INR.117105.88 per year

Approximate Expenditure for applying pressure regulator = INR.55000

Pay back period (in months) = (Expenditure*12 / Saving) = (55000*12 / 117105.88)

= 6 months.

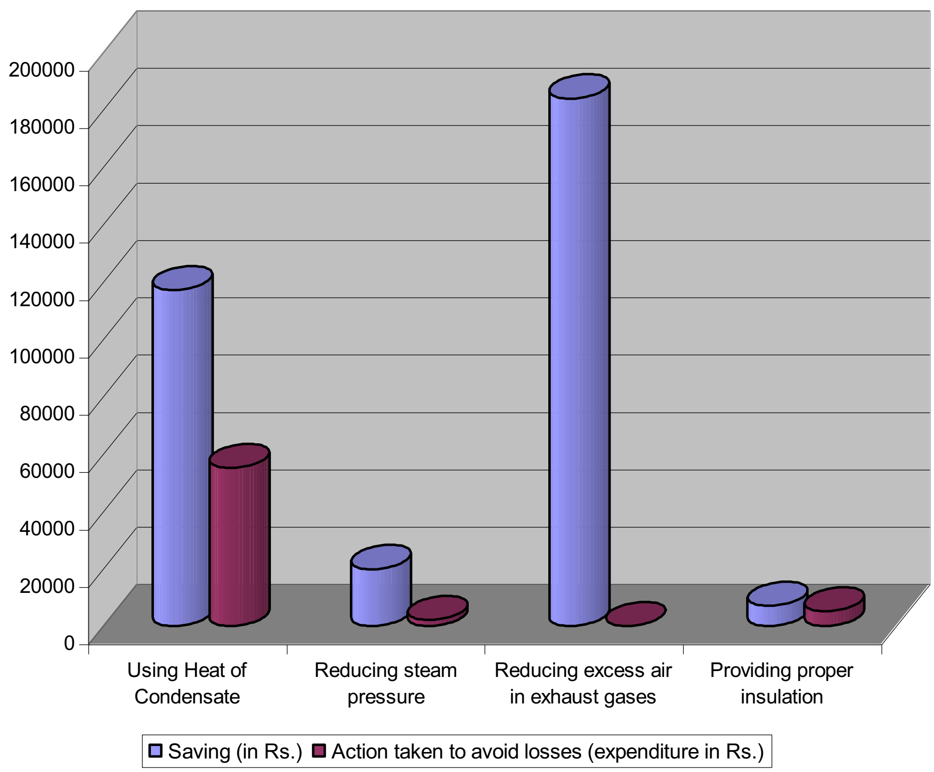

Figure 1: SAVING (IN INR.) Vs. ACTION TAKEN TO AVOID LOSSES (EXPENDITURE IN INR.)

LOSSES IN FURNACES

. The heat losses considered are as follows: -

- Heat loss due to radiation
- Heat loss due to openings through the furnaces
- Loss due to flue gas exist temperature

1) Heat loss due to radiation

There are 5 furnaces in case organization. The average temperature is noted down at outer shell and the heat loss is calculated as:

Total surface area = (2.347+1.594 + 1.509 + 1.464 +1.66) = 8.574 m^2

Heat losses = (4237.9 + 3086.28 + 2727.65 + 2630.4 + 2630.2) = 15312.43 kcal. /hr

Calorific value of Light Diesel Oil = 8670 k cal. / litre

Equivalent loss of fuel oil = (Heat loss/Calorific value of oil) = 1.766 litre/hr

(BEE, 2003)

Total % loss of fuel oil = (Equivalent loss of fuel oil/average fuel oil consumption)*100

=((1.766/12) *100) =14.7%.

Saving

Ceramic coating at the inner surface of the walls was implemented to reduce the heat losses. Calculation of heat losses after providing insulation: -

Total surface area = (2.347+1.594 + 1.509 + 1.464 +1.66) = 8.574 m^2

Heat losses = (1806.35+548.48+1206.33+1019.55+1058.7) = 5639.41 kcal. /hr

Equivalent loss of fuel oil = (Heat Loss/Calorific Value of oil) = (5639.41)/(8670)

= 0.65 litre/hr

Total % loss of fuel oil = (Equivalent loss of fuel oil/average fuel oil consumption)*100

= (0.65/12) *100=5.4%. (After providing ceramic coating)

Fuel savable corresponding to above losses preventable by improving insulation

(BEE, 2003)

= (Total %age loss without insulation) – (Total %age loss with insulation)

= (14.7-5.4) = 9.3%

Fuel Oil consumption = 80 to 100 litre per 8 hours

Average fuel oil consumption = 12 litre/hr for one furnace

Fuel savable =(9.3 * 7 * 306 * 12 / 100) (assuming 306 working days with 7 hours/ day)
= 2390.47 litre per year

Net saving (In INR)=(INR. (25*2390.47))(@ INR. 25 / litre)

= INR.59761.7 per year

Approximate expenditure for applying of new insulation = INR.20000

Pay back period (in months) = (Expenditure*12 / Saving) = (20,000*12 /59761.7)

= 4 months

2) Heat loss due to openings through the furnaces

A lot of heat from the furnace escapes to the outside environment as unused heat. Heat losses due to openings can be calculated considering black body radiations at furnace temperature, emissivity and factor of radiation.

Surface area of opened portion and average temperature inside furnace was noted down. The gates provided at the opening (ordinary steel gates) are the resource of maximum heat losses when opened. The study reveals that the time taken for placing / pushing in material is 20–30 second after every 3 minutes. The existing losses are as below: –

Average Temperature of furnace = 1155^{0}C

Total heat loss = (Black body radiation * Emissivity factor* Radiation factor* Area of the opening) = (20*0.6*0.61*50.4) = 368.93 kcal. /hr

Fuel loss per hour= (Total heat loss)/ (calorific value of fuel)= 368.93/ 8670= 0.04 litre/ hr

Total % loss of fuel oil through charging side= ((Equivalent loss of fuel oil/average fuel oil consumption) *100) =((0.04 /12) *100) = 0.33%

Similarly Total % loss of fuel oil through discharging side = 0.25%

Saving

In order to reduce fatigue as well as to ensure ease in closing the gates, vertical lifting doors balanced by counterweights were installed at Forging industry, India at charging side. After providing furnace door lifting mechanism with counterweights, the losses are calculated as follows: -

Temperature of furnace = 1185^{0}C

Total heat loss = (Black body radiation * Emissivity factor* Radiation factor* Area of the opening) = (24*0.4*0.61*3.53)= 20.67 kcal. /hr

Fuel loss per hour = (Total heat loss)/(calorific value of fuel) = (20.67/ 8670)

= 0.0024litre/ hr

Total % loss of fuel oil = ((Equivalent loss of fuel oil/average fuel oil consumption)*100)

= ((0.0024 /12) *100) = 0.019%.

As no gates have been installed on discharge side, the radiation losses from the discharge side remains as such.

Total loss from charging and discharging side = (0.019+0.25)% = 0.269 %

Savings after providing doors = (Net % loss without mechanism)- (Net % loss with mechanism) = ((0.58) -(0.269)) = 0.311 %

Fuel savable = ((0.311* 7 *306* 12)/100) (assuming 306 working days with 7 hours/ day) = 79.93 litre per year

Amount savable = INR. (25* 79.93)(@ INR. 25 / litre) = INR.1998.5 per year

Approximate expenditure of applying new gates = INR.2000/-

Pay back period (in months) = Expenditure*12 / Saving = (2,000*12 /1998.5)

= 12 months

3) Loss due to flue gas exist temperature

Optimum quantity of air (oxygen) is required for burning of fuel oil. An excess content of air than required leads to loss of heat through flue gases. Further less air than required leads to the incomplete combustion and results in smoke. It has been observed practically that too low air results in black fumes, and too many results in white fumes, and optimum air results in brown fumes.

Using Siegert Formula (PCRA, 2002)

Heat loss in flue gas= {K* (Tg-Ta)/1.8}/ (% CO_2 In Flue Gas)

Where

Tg= Flue gas outlet temperature (calculated, using flue gas analyzer)

Ta = Ambient temperature

K= Constant factor specific for a given fuel oil = 0.32 for fuel oil.

Thus, Heat loss in furnace 1= ((0.32(430-37)/1.8)/ (7.8)) = 8.9%

Heat loss in furnace 2= (0.32(400-36.9)/1.8)/ 2.1=30.7%

Heat loss in furnace 3= (0.32(425-37)/1.8)/ 2.2 = 31.3%

Heat loss in furnace 4=(0.32(410-37)/1.8)/ 2.2 = 30.14%

Heat loss in furnace 5=(0.32(425-36.9)/1.8)/ 2.2 = 31.36%

Saving

Controlling the excess air content, we can control losses due to flue gases. In this regard, the metallic radiation recuperators were installed.

Total energy saving = 90 %

Equivalent Fuel Oil consumption = 80 to 100 litre per 8 hours

Average = 12 lts/hr for one furnace

Fuel saving per annum (assuming 306 working days with 7 hourstable/ day)

= ((90 * 7 * 306 * 12)/100)

= 23136.6 litre

Amount savable = (23136.6 * 25) (@ INR. 25 / litre)

= INR. 578340 per year

Expenditure for applying of new insulation   = INR. 20,000

Thus, Pay back period = (Expenditure*12 / Saving) = (100000*12 / 578340) = 2 months.

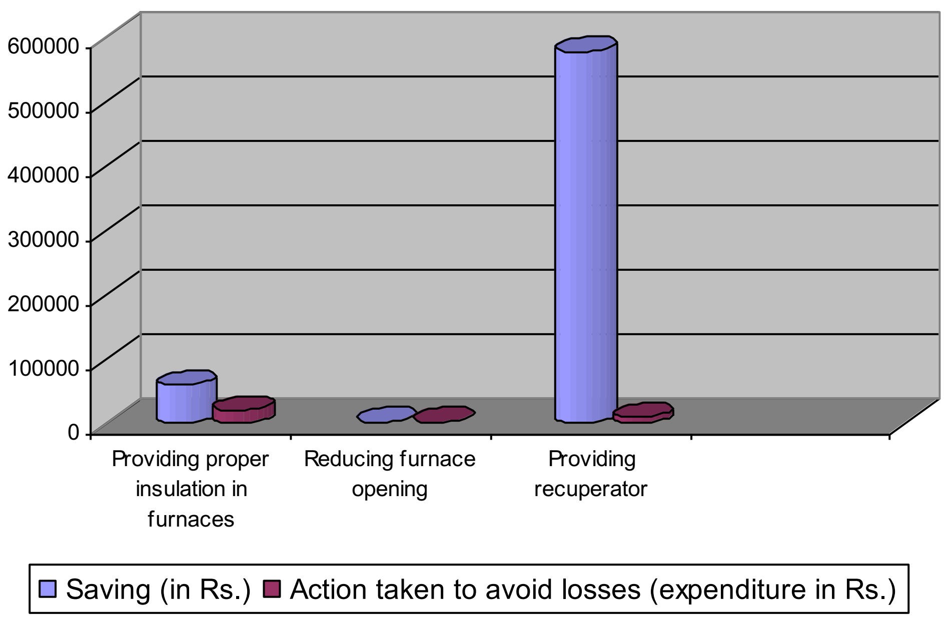

Figure 2: SAVING (IN INR.) Vs. ACTION TAKEN TO AVOID LOSSES (EXPENDITURE IN INR.)

RESULTS AND CONCLUSION

For reduction of losses in boiler, various actions like insulating the pipe using fibre glass wool, adjustment of butterfly valve, installing industrial pressure switch and providing bimetallic steam trap to recover the heat of unused condensate were performed. Various actions to reduce heat losses in furnaces like providing ceramic fibre coating at the inner surface of the walls, providing gates at charging and discharging doors, providing recuperator to control excess air contents help in reduction of losses has resulted in enormous energy savings. In furnaces, various actions like providing ceramic fibre coating at the inner surface of the walls, providing gates at charging and discharging doors, providing recuperator to control excess air contents help in reduction of losses has resulted in enormous energy savings at case organization A periodic inspection of such elements can help in determining their current status and corrective actions can be taken well in time to reduce losses.

6 Table 1: MECHANICAL SYSTEM (BOILER AND FURNACES)

6.1.1.1.1.1 *6.1.1.1.1.2 ENERGY LOSSES IN BOILER*					
Energy Losses	**Action Taken To Avoid Losses**	**Anticipated Light Diesel Oil Saving Per Annum**		**Expenditure (INR.)**	**Pay back period in months**
		6.1.1.1.1.3	**Cost (INR.)**		
Loss of heat due to radiation through pipelines	Providing Proper Insulation.	277.9	6948.5	5,000	9
Loss of heat due to flue gas temperature	Adjustment of butterfly valve	7355.24	183880	NIL	NIL

Loss due to excess in steam pressure	Reducing steam pressure	790.58	19764.7	2,000	1
Loss of heat due to unused condensate	Using heat of condensate	4684.23	117105.88	55,000	6
6.1.1.1.1.4 *6.1.1.1.1.5* *6.1.1.1.1.6* *6.1.1.1.1.7* *6.1.1.1.1.8 ENERGY LOSSES IN FURNACES*					
Heat loss due to radiation	Providing proper insulation in furnaces	2390.47	59761.7	20,000	4
Heat loss due to openings through the furnaces	Reducing furnace opening	79.93	1998.5	2,000	12
Loss due to flue gas exist temperature	Providing recuperator	23136.6	578340	100000	2

6.1.1.1.2 References

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CASE STUDY 8: ENERGY SERVICE PERFORMANCE CONTRACTS

This is a chapter from Canadian Energy Efficiency Outlook: a National Effort for Tackling Climate Change [1] and is reproduced with the permission of Pierre Langlois of Econoler.

1. Langlois, Pierre and Gauthier, Geneviève. Canadian Energy Efficiency Outlook: a National Effort for Tackling Climate. The Fairmont Press, Lilburn, GA, 2018.

CASE STUDY: ENERGY SERVICE PERFORMANCE CONTRACTS *

Author: Peter Love, President, Energy Services Association of Canada

Description and Benefits

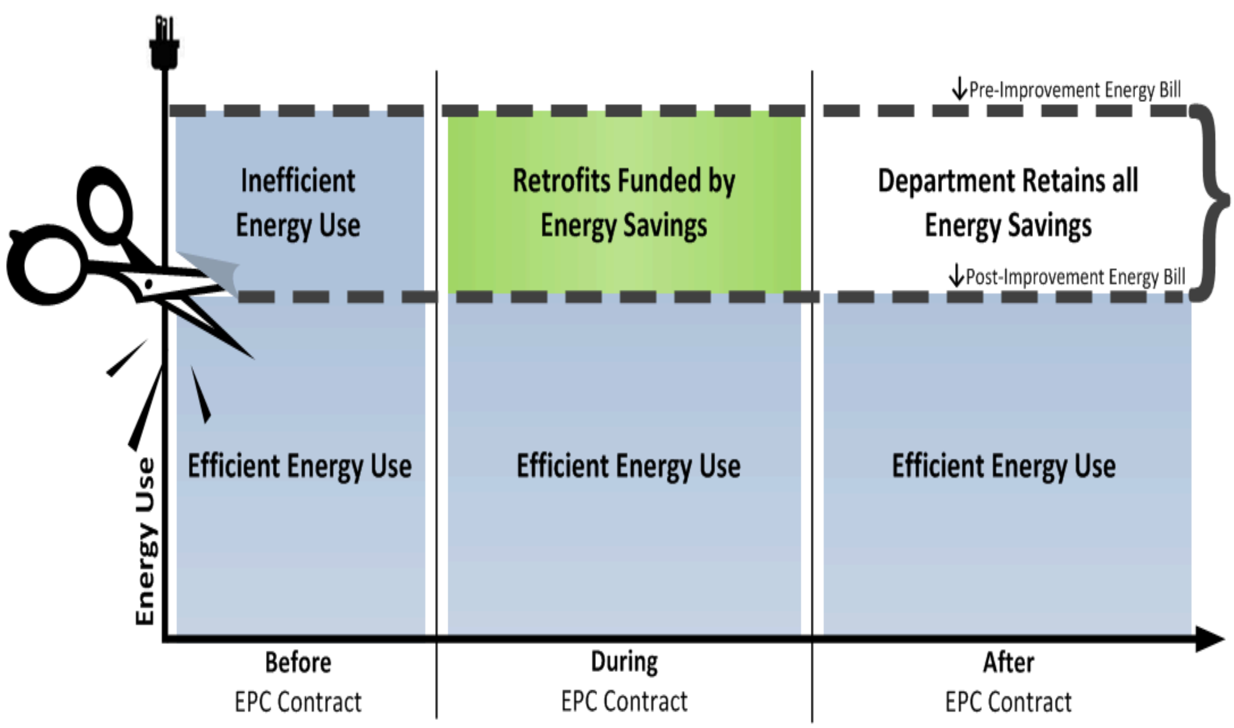
Guaranteed Energy Service Performance Contracts (ESPCs) have been successfully used in Canada for over 35 years to upgrade the energy efficiency of existing buildings, particularly publicly owned buildings such as municipal and other government buildings, universities/colleges, schools and hospitals (MUSH).

An ESPC is an agreement between an end user and an Energy Service Company (ESCO) that guarantees that the energy savings from the energy efficiency upgrade will finance the initial capital cost of the project over the course of the project. It thus captures future energy savings from a retrofit project in order to finance the initial capital cost. Most importantly, it transfers the financial and technical risks associated with a major energy efficiency upgrade to third parties.

Figure 1 illustrates how an ESPC works. Before the contract, some of the energy is used in the building is wasted on inefficient uses. During the contract, the reduced energy costs are used to finance the up front capital costs. At the end of the contract, the end user pays a lower energy bill for as long as the new equipment lasts.

FIGURE 1

ILLUSTRATION OF HOW AN ESPC WORKS



Source: NRCan [1]

Specific benefits of using ESPCs include the following:

- ***Turnkey*** – One contract covers a wide range of products and services
- ***Comprehensive*** –Achieve much deeper energy savings than traditional approac
- ***No Up Front Capital* Required**
- ***35 Years Experience***
- ***Immediate Recognition and Resolution of Problems***
- ***Financed by Energy Waste so Taxpayers Never Make up any Loses***
- ***Cost Effective*** – Based on 25 years of experience with these contracts, NRCan has concluded that they are NOT more expensive than traditional processes.
- ***Includes Monitoring & Verification***

Further information on the ESPCs and their uses around the world can be found in World ESCO Outlook [2]

History

The first ESCO in Canada and one of the first in the world, Econoler, was created by Quebec Hydro and a local engineering firm in 1981 and developed a new concept for that time based on a shared savings approach where the contract under an open book approach terminated upon complete payment of all project costs (fast out approach) even if this is reached before the term of the contract.

Over a period of 10 years, the market developed under the concept developed by Econoler and expended throughout the country under the leadership of Econoler who entered into a partnership with Petro Canada to do so.

The market slowed down in the early 1990s where Utility based DSM programs got introduced massively in many of the different provinces in Canada. ESCOs remained active nevertheless mainly driven through the leadership of the Federal government under the Federal Building Initiative, addressing the potential in federal facilities.

In the 2000s, Guaranteed Energy Service Performance Contracts (ESPCs) started to be the typical way to use EPC to upgrade the energy efficiency potential of existing buildings, particularly publicly owned buildings such as municipal and other government buildings, universities/colleges, schools and hospitals (MUSH) at the provincial level.

Market and Activities

As most of the companies that provide ESPCs in Canada also provide other services, it is difficult to estimate the current size of the Canadian ESPC industry. The most recent compilation done by the Energy Services Association of Canada identified 280 projects that had been completed over the last 10 years[4.] These projects range in size from $1 – 50 million and it is estimated that annual revenues for for projects that had a performance guarantee is about $300 million.

The map on Figure 2 illustrates the distribution by province of these 280 projects completed in the last 10 years, broken down into the following sectors:

Federal government	28
Provincial/territorial government	1
Municipal government	25

Universities/Colleges	8
School Boards	35 (most multiple locations)
Healthcare	55
Industrial	6
Commercial	16
Apartments/condos	98
Other	9
Total	280

FIGURE 2

ESPC PROJECTS IN CANADA BY PROVINCE AND SECTOR: 2006-2016

Source: Energy Services Association of Canada "Guaranteed Energy Savings"[4]

As all of the projects in the apartment/condo sector were for public housing agencies, more than 90% of the projects undertaken in the last 10 years have been for public institutions. Virtually all of these public sector projects involved ESCOs submitting competitive tenders in response to Request for Proposals (RFPs).

NRCan's Federal Building Initiative (FBI) program was established in 1992 to promote the use of ESPCs in federal departments; they have developed model RFPs as well as contracts for federal departments [5]. Examples of RFPs and contracts used by other public bodies are also available. Another good source for model RFPs and contracts were developed by the independent, membership based Energy Services coalition in the US www.energyservicescoalition.org

While the Canadian market has been relatively stable for the last few years, when ESPCs first began to be used in the 80s and 90s, the Canadian market was about 15% of the US market, far higher than the 10% that would be expected based on the size of the population and economy. As the US market was recently estimated to be $5 bil US 5, the Canadian market is now less than 4.5% of the US market. Here is thus a great opportunity to expand this market in Canada just to be the same size as the US market.

The Energy Services Association of Canada was created in 2010 to advocate greater use of EPSCs across Canada, particularly within governments. Further information on this association and the Canadian markets for ESPCs can be found in their recent annual magazine [4] and on their web site www.energyefficiency.org

There are three other important features of ESPCs. The first is that since the ESCOs are guaranteeing the energy performance, they ensure that the building is properly commissioned, the building operators are trained on how to operate the building to ensure optimal performance and building occupants are made aware of the improvements and their role. The second is that these contracts can also be used to at least partially fund non-energy deferred maintenance priorities. This is typically achieved by extending the term of the contract. And third, smaller projects or different facilities under the same owner can be bundled together to increase the scope and energy savings.

Federal Policies, Programs and Frameworks

The federal government established the Federal Building Initiative (FBI) in 1991 to improve energy performance in federal facilities using an ESPC. To date, 87 projects have been completed with many involving as many as 17 different buildings. Since its inception, it is estimated to have attracted over $350 million in private sector funding through use of ESPCs and generated over $45 million in annual savings. While the program has been in continuous operation since inception, the level of activity has been unstable. Eleven new projects were initiated in 1995 but none in 2011 and 2004, only one in 2006 and 2010 and two in 2008, 2009, 2011 and 2012. In the most recent fiscal year, competitions were held for six military bases with an understanding that all the remaining 25 bases will have energy efficiency retrofits undertaken using ESPCs over the next five years.

The federal government has been a leader in promoting the use of ESPCs since shortly after they began to be used. It is also noteworthy that as only about one third of federal buildings have undertaken major energy efficiency retrofits using ESPCs, a great deal remains to be done.

The FBI have a small dedicated staff that support other departments, particularly those where the individuals responsible have not undertaken an ESPC ever or for many years. They offer energy management training, assistance with raising employee awareness, model RFP and contract documents, step-by-step guides [7], maintain a list of qualified bidders, offer seminars and networking events, design/analysis tools and publish best practices case studies. Most importantly, they will assign a dedicated FBI Program Officer to support each project.

There are 8 FBI case studies on the FBI web http://www.nrcan.gc.ca/commercial/cbr/pubs/4201 and 7 on the Energy Services Association of Canada site http://energyservicesassociation.ca/case-studies/index.html. One of these case studies are for the Place du Portage complex in Gatineau; the highlights of this project are summarized in Figure 3 (or in sidebar?)

FIGURE 3

CASE STUDY: PLACE DU PORTAGE PHASE IV

ENERGY SERVICES ASSOCIATION OF CANADA
PROMOTING PERFORMANCE BASED SOLUTIONS

case study

Place du Portage Phase IV

Place du Portage Phase IV achieves major energy savings with Ameresco.

*Performance-based solutions become **the premier choice** for energy and infrastructure renewal initiatives, resulting in fiscally and environmentally responsible outcomes.*

Project Description

Ameresco was selected by Public Works and Government Services Canada (PWGSC) to implement a comprehensive energy program and facility renewal at Place du Portage Phase IV, an 895,762 ft^2 facility occupied predominantly by Human Resources and Skills Development Canada (HRSDC). This project is part of the Federal Building Initiative (FBI) designed by Natural Resources Canada to promote the reduction of energy and greenhouse gas emissions, and to improve facility performance.

Opportunity

Ameresco performed an in-depth review of the facility's systems to identify measures that could reduce energy and operating costs. Improvements included two chiller replacements, building automation system (BAS) replacement and upgrade, lighting retrofit and lighting control systems, cooling tower renewal, complete variable air volume (VAC) conversion, sub-metering and HVAC re-commissioning.

Results

The annual environmental benefit from this program sees a reduction of 9,491,400 kWh per year in electricity, 589,300 m^3 per year of equivalent natural gas, and 1,200 tonnes per year of greenhouse gas emissions. The $8.6 million project had a simple payback of 7.3 years, and took advantage of $1.48 million in incentives from Hydro Quebec.

A more detailed analysis of this project is available at:

http://www.ameresco.com/page/case-studies-library

AMERESCO
Green • Clean • Sustainable

Source: Energy Service Association of Canada [8]

One of the most useful publications that FBI offers, particularly useful for those who are not familiar with using ESPCs, is Energy Performance Contracting: Guide for Federal Buildings7.

As noted earlier, the FBI program also encourages federal departments to consider using experienced, unbiased advisors who act as facilitators who assist in the planning, implementation and management of energy efficiency projects. The role of facilitators is described further later in this chapter.

The FBI office also organizes 6-7 Community of Practice meetings to share experiences and ideas. The FBI web site notes that "this is an innovative networking group that uses the shared experiences of seasoned real property and environmental managers to help federal energy managers develop the best possible energy efficiency tactics and strategies" [8].

One of the main drivers behind the use of ESPCs to improve the energy efficiency of existing federal buildings is the Federal Sustainable Development Strategy (FSDS). In 2008, the Federal Sustainable Development Act was passed; it provides the legal framework for developing and implementing the FSDS. The Act requires the development and publication of a strategy every three years. It also identifies 26 departments and agencies that are responsible for preparing their own sustainable development strategies. Fifteen other federal organizations also contribute to the FSDS on a voluntary basis.

The 2016-19 TSDS centres on 13 aspirational, long term goals, one of which is "Low Carbon Government". The target is to reduce GHG emissions from federal government buildings and fleets by 40% below 2005 levels by 2030, with an aspiration to achieve it by 2025. A recent estimate of the efforts to date indicate that the federal government is falling far short of it 2020 target with a 4.6% reduction [10]. It is thus widely accepted that more aggressive action is required.

Although meeting the FSDS target will be a large challenge, one very positive recent development is that the federal government's Office of Greening Government Operations (OGGO) was recently moved from the Department of Public Services and Procurement Canada (PSPC) to the Treasury Board. OGGO works with federal government departments to reduce the footprint of government operations. They do this by providing advice and guidance as well as compiling and reporting results. They have specifically identified FBI as a "key mechanism to help departments achieve their emission reduction targets" as established by the FSDS. The move for the OGGO from PSPC to Treasury Board sends a very clear signal to all departments that the federal government is determined to meet its ambitious targets.

Another recent federal development of interest is the announcement of an additional $120 billion to be spent on infrastructure over the next 10 years with $40 billion specifically for green infrastructure. While much of this will likely be used to fund construction of new buildings, it can also be used to fund upgrades to existing buildings.

Provincial Policies and Legal Frameworks

Atlantic Canada

Like all other regions of Canada, there have been a wide range of successful ESPCs projects across the Atlantic provinces. Examples where case studies have been published are Canadian Forces Bases at Gander, Halifax and Gagetown as well as Memorial University.

None of the four provincial governments in this region have an active program to promote the expanded use of ESPCs at this time. There was an initiative in Nova Scotia in the past to select ESCOs to undertake

ESPCs for public buildings in four regions; although the ESCOs were selected, no projects were authorized. One recent development of interest relates to work that has been undertaken by Efficiency One, at the request of the Nova Scotia government, to investigate the potential use of Public Purpose Energy Service Companies (PPESCO). These are similar to traditional ESPCs with the same delivery process (audit, proposal, contract, financing, installation, commissioning and training) with savings guarantees and ongoing M&V and reporting. The differences are that they target only public buildings, are smaller than traditional EPSCs (eg less than $ 1 million projects), operate as non-profits, uses capital from third party sources (eg Social Impact Bonds or Community Economic Development Investment Funds) and seeks lower rates of return. The Nova Scotia government has expressed interest in working with existing ESCOs to implement one project using this model as a pilot Efficiency Nova Scotia program. If successful, it may then become one of the programs that Efficiency Nova Scotia offers.

Quebec

As noted earlier, Quebec has seen the birth of the development of the use of ESPCs 35 years ago through Econoler. The Quebec government is recognized as having been the most active and successful at promoting the use of ESPCs for the past 20 years. This has been largely accomplished through direct discussions between provincial ministries responsible for K-12, colleges/universities and hospitals and their related agencies, with those with the highest energy bills being explicitly told to use ESPCs to reduce their energy costs. It is interesting to note that the by-law entitled *Règlement sur les contrats de travaux de construction des organismes publics, chapitre C-65.1, r.5* specifically permits the use of ESPCs in Québec.

One of the more specific features of the process for selecting successful ESCOs in Quebec is the use of Net Present Value (NPV). This approach is a total of the discounted annual revenues from a project plus the residual value at the end of the project minus the initial project cost. This has been used as it has a number of interesting features; it can be considered an indication of the net value of different concepts for a project and is very simple to compare one proponents NPV with that of others. The weakness of the measure is that typically the contracts that are signed do not have provisions that relate to the failure to achieve these proposed savings and the residual value. Also, the residual value is a very imprecise number and one that is not known until the project is completed; proponents can thus include inflated residual values to make their NPVs appear very high.

Ontario

As noted in Figure 3, fully two thirds of all ESPC projects completed over the last 10 years in Canada have been completed in Ontario. Even excluding the 94 projects undertaken by one organization (Toronto Community Housing Corporation - TCHC), almost 50% of all the remaining projects were in Ontario. And this level of activity has been achieved by the most part without any clear leadership or advocacy for the use of ESPCs by the provincial government or any of their ministries or agencies.

Aside from the FBI program, the two programs undertaken by TCHC resulted in the largest investment by any other organization in Canada. The Building Renewal Program, which ran from 2005-2009, resulted in upgrades to 28 apartment buildings and 33 townhouse blocks. 6,926 suites in total. A total of $112 million was invested in building upgrades through the use of ESPCs. The subsequent Building Energy Retrofit Program, which ran from 2009-2012, resulted in upgrades to a further 26 apartment buildings and 5 townhouse blocks, 6,144 suites in total. A total of $57 million was invested in building upgrades through ESPCs. Under both programs, important improvements to the buildings were made that included both energy and non-energy related upgrades.

One interesting development that could lead to increased interest in using ESPCs was the introduction of Regulation 397/11 under the Green Energy Act that require all municipalities, universities/colleges, school boards, and public hospitals to begin submitting annual reports on their energy usage and resulting GHG emissions, starting in 2013. The same regulation also required these organizations to submit plans that include proposed measures to reduce energy and GHG emissions, starting in 2014. Ontario is the only state or province in North America that requires such reports. It has followed this initiative with a requirement that all commercial buildings disclose their energy consumption, starting with buildings over 250,000 sq. ft. in 2018 and then including all buildings over 50,000 sq. ft. by 2020. It is expected that both initiatives will increase the interest in seeking opportunities to reduce energy and GHG emissions, some of which could include using an ESPC. Figure 4 summarizes the estimated GHG emission reductions that could be made by each type of public sector building, using the GHG emission data that is required to be provided. The 1.6 MT GHG reduction potentially available represents over 10% of the gap currently faced by Ontario in meeting its 2020 emission reduction target.

FIGURE 4

ESTIMATED GHG EMISSIONS REDUCTION POTENTIAL BY PUBLIC SECTOR

	Emissions ($Mt\ CO_2$)	**40% Savings ($Mt\ CO_2$)**
Municipalities	**0.988**	**0.395**
Ontario Gov't	**0.123**	**0.049**
Federal Gov't	**0.232**	**0.093**
Post Secondary	**0.654**	**0.262**
Schools	**1.488**	**0.595**
Hospitals	**0.703**	**0.281**
Total	**4.188**	**1.675**

1.7 Mt is 27% of 6.4 Mt needed to reach 150 Mt target

Source: Energy Services Association of Canada [11]

Another development of note in Ontario is the Tower Wise program developed by the Toronto Atmospheric Fund (TAF), now known as The Toronto Atmosphere Fund, an organization created by the city with a $23 million endowment in 1991 to help it achieve its energy/GHG reduction targets. Tower Wise focusses on encouraging owners of rental apartments, condos or social housing to upgrade their buildings energy efficiency by using an ESPC. These are typically smaller projects which were often too small for traditional ESCOs to provide performance guarantees. Instead, TAF links owners with Energi, a private company that offers an insurance product that provides an energy performance guarantees for a fee, typically 2-4% of the project value. There are 7 case studies on TAF's web site http://towerwise.ca/ consisting of 3 condos, 2 social housing units and 2 rental apartments.

The most recent development in Ontario is the Climate Change Action Plan. Released in 2016, it summarizes how the province intends to use the $8 billion of revenue that is expected to be generated under its new cap-and-trade program for pricing carbon emissions. This plan includes $380-500 million to retrofit social housing, $400-800 million to retrofit schools, hospitals and universities/colleges and $90-100 million for energy efficiency retrofits of its own buildings [12]. One of the recommendations in this Plan is that the government "will enable the use of energy performance contracts across the OPS" (Ontario Public Service which consists of all government ministries).

Manitoba

Manitoba, mainly through programs managed by Manitoba Hydro, have been active in promoting energy efficiency for many years. Although there have been a few successful ESPC projects in the past, they have not been actively promoted by either the government or Manitoba Hydro.

This could change as the government is in the process of creating Efficiency Manitoba, a new crown corporation that will be mandated to achieve electricity savings of 1.5% and natural gas savings of 0.75% per year for the next 15 years. Using ESPC to achieve these objectives could be among the opportunities that this new agency may consider.

Saskatchewan

As noted in Figure 3, there were 13 ESPC projects in Saskatchewan over the last 10 years, almost as many as there were in the other four western provinces. The main reason for this was that SaskPower, the provincially owned integrated electricity utility, actively promoted the use of ESPCs by its institutional customers. They also sought an ESCO partner to undertake this work and after a competitive bid, formed a joint venture with Honeywell. Their five year agreement was renewed for a further 5 year term. Like Alberta, Saskatchewan also offers long term capital to public enterprises through a debenture program.

A recent development of interest is the RFP that was issued by Saskatoon for an ESPC.

Alberta

Alberta Infrastructure managed the most active and successful program to promote the use of ESPCs in provincial buildings of any government to date in Canada. Initiated in 1995, retrofits were completed in over 150 facilities with various vendors for projects totally $28 million. It was estimated that these projects contributed to a 10% reduction in energy use over the decade that the program ran [13].

Another leading innovation in Alberta was the Capital Borrowing Regulation under the School Act. Initially passed in 1988 and later amended, it requires that if school boards borrow funds to retrofit a school to reduce energy consumption, the provider of the services must offer a performance guarantee. Recently, the Presidents of the Alberta School Boards Association (ASBA), College Of Alberta School Superintendents (CASS) and the Association of School Business Officials of Alberta (ASBOA) issued a joint letter to all School Board Chairs, Superintendents and Secretary-Treasurers encouraging them to investigate the potential of using ESPCs for schools in their boards. One of the leading boards using ESPCs is the Edmonton School Board.

The recent final report from the Alberta Energy Efficiency Advisory Panel "Getting it Right: A More Energy Efficient Alberta" included among its recommendations that the Alberta government consider expanding this mechanism to other institutions. It also added that a complementary action would be for the government to formally authorize the use of ESPCs for public sector buildings [14].

Alberta Health Services recently entered into ESPC contracts for the Alberta Hospital and the Royal Alexandra Hospitals in Edmonton with potential plans to use these contracts at other hospitals throughout Alberta.

British Columbia

The Green Buildings BC Retrofit Program was launched in 1996 and was designed to promote energy reduction in B.C.'s provincial building stock. The program was successful in assisting school districts, universities and colleges in undertaking energy reduction programs.

The second largest ESPC initiative in Canada was undertaken by BC Housing. From 2009-2012, energy and infrastructure improvements were made in 5,000 social housing residences in over 300 buildings; total project cost was $120 million. In addition to saving $3.3 million/year, GHG emissions were reduced by 5,000 tonnes with significant reduction in deferred maintenance backlog.

B.C.'s carbon neutral government program is legislated under the ***Greenhouse Gas Reduction Targets Act*** (GGRTA) and the Carbon Neutral Government Regulation. It requires all public sector organizations (PSOs) to follow a five-step process to achieve carbon neutrality. In their initial Energy Plan, it was estimated that that there is a requirement for about $1.5 billion in energy efficiency upgrades.

Facilitators

As noted in the sections above, the federal FBI program as well as the Quebec government encourage public entities to employ independent facilitators to assist them with their projects. This has been a particularly important success factor when the project managers were unfamiliar with ESPCs.

Some ESCO clients have found this service to be critical. On the FBI web site, the following quote is made by Karen Dupuis of the RCMP Northwest Region "If the (FBI) facilitation services were not available, I don't think we could have moved forward with this project. It just wouldn't have gotten off the ground". A recent article by provided some examples of the important roles that facilitators can play [15].

Conclusions and Way Forward

At the federal level, it is encouraging that the recent federal budget allocated an additional $13.5 million, that the Department of National Defense have signed that they intend to use ESPCs to undertake major energy efficiency retrofits at every military base in Canada and that Treasury Board is now responsible for the Office of Greening Government operations and the achievement of the FSDS targets.

At the provincial level, the Energy Services Association of Canada has identified the following five policy recommendations, based on a review of best practices in other jurisdictions [16] :

1. ***Authorization that ESPCs can be used by public sector buildings*** – Although ESPCs have been successfully used in every province, no provincial government has publicly acknowledged that government departments and the public sectors they control (Broader Public Sector or BPS) can use these contracts. The US based National Association of State Energy Officials (NASEO) recently noted in a report that every state in the US has provided such authorization [17]. Such authorization is also clear at the federal level in Canada and is promoted by NRCan's Federal Building Initiative (FBI) program.

2. ***Encourage governments/BPS to use ESPCs*** – This is not only common at the federal and in every state in the US [17] but also at the federal level in Canada through the Federal Building Initiative.

3. ***Identify lead management agency to promote use of ESPCs*** – Provincial governments should follow the lead of federal government in this regard as well. In the US, the NASEO report also notes that every state in the US has identified a lead agency to promote broader use of ESPCs [17]. NRCan's FBI program has this responsibility for all government federal departments.

4. ***Empower lead agency with staff to promote ESPCs*** – As noted in Section 4, the US based Energy Services Coalition has identified six leading states where lead agencies assist with the financing as well as general support for ESPCs.

5. ***Use ESPCs to provide funding to match federal programs –*** As noted earlier, there is currently a particular opportunity to use ESPCs to provide the provincial portion of the matching grants for energy efficiency retrofits to green infrastructure and social

CASE STUDY 9: PSYCHOLOGICAL SUPPORT FOR FIVE STRATEGIES TO ENCOURAGE PERSONAL ACTION TO REDUCE GREENHOUSE GAS EMISSIONS

This is an article that was based on a paper prepared by Peter Love as part of the course Environmental Psychology at University of Toronto.

PSYCHOLOGICAL SUPPORT FOR FIVE STRATEGIES TO ENCOURAGE PERSONAL ACTION TO REDUCE GREENHOUSE GAS EMISSIONS

Peter Love

April 2022

1. INTRODUCTION

This paper will assess the social psychological basis for five strategies to encourage Canadians to take personal action to reduce Greenhouse Gas (GHG) emissions using peer reviewed psychological research papers where possible. While the focus is on individual action, it is important to note that people who do take such action may then encourage their employers to also take action as well as buy products/services from companies that show leadership and vote for politicians who identify climate change as a top priority.

Organizations such as the Intergovernmental Panel on Climate Change (IPCC) and much of the literature on climate change provide extensive research on the science of climate change and the role of adaptation and mitigation policies/strategies. The many books, articles, blogs and websites that focus on specific actions individuals can take rarely base these findings on the lessons from environmental psychology. Shafir (2012) noted "it is remarkable how small a role the attempt to understand human behaviour has played in policy circles". Two of the readings for this course did recommend specific strategies. The first article identified four key components of strategies for successful resource management: information, identity, institutions and incentives (Van Vugt). As noted in my "Reflections" on this paper, the only strategy strongly supported by environmental psychology was the second, identity. For the other three strategies, even the author recognized their weaknesses. The second article identified five "best practices" to improve public engagement on climate change:1 emphasize climate change as a present/local/personal risk; 2 facilitate affective/experiential engagement; 3 leverage relevant social group norms; 4 frame solutions in terms of what can be gained; and 5 appeal to intrinsically valued long-term environmental goals (van der Linden). These are more strongly supported by environmental psychology and components of them are included in the five strategies discussed in this paper.

The five strategies assessed in this paper are:1 positive messaging; 2 customized messaging; 3 waging war; 4 making it easier; and 5 engaging in dialogue. The selection of these five are based on a wide range of books, articles, websites and blogs, most of which are based on strategies that seemed to have worked in the real world. As few of these readings make any reference to environmental psychology, this paper will review peer reviewed environmental psychology literature that supports these five strategies, where such research is available. Interestingly, the American Psychological Association concluded one of the three main ways that psychologists can play a large role in helping to address the climate change problem is though better understanding of individuals and households (APA 2016).

2. POSITIVE MESSAGING

Well-meaning and concerned organizations and scientists, from the IPCC to Al Gore and David Suzuki, have tended to focus their messaging on the dangers associated with climate change. Roszak (1995) noted that psychology suggests that it is important not to be just a "grieving greenie" who is out to scare and shame the public into taking action. In their study, Kok et. al. (2017) documented the case against the false belief in fear appeals. Stoknes (2014) noted that climate communication using puritan framing and sacrifice were not effective as humans are loss-adverse. The alternative to this focus on the negative impacts of climate change is to focus instead on the many effective positive actions that people can take in their everyday lives that address this problem. This can range from using existing technology more efficiently (turning off lights/devices when not in use, using programable thermostats, eating less meat, walking/biking/taking public transit instead of car, etc.) to replacing older energy inefficient technologies with newer more energy efficient ones (LED lights, EnergyStar appliances, LEED certified buildings, electric vehicles, etc.). As noted earlier in this paper, Van Der Linden et. al (2015) identifies "affective and experiential engagement" as the second of their five recommended best practices and taking positive personal action to reduce energy consumption would fall into this category. One of the psychological challenges to any strategy to encourage people to take action of any type is the aversion people have to being told what to do which has been documented by various researchers including Russell (2021). One way of at least reducing this aversion would be to focus on what to do, not what not to do. Part of the basis for this is associated with the theory of psychological reactance. This theory, as first developed by Brehm (1966), states that individuals will react negatively if they feel that their freedoms are being affected by what they are being asked to do. Being asked to do something instead of being asked to not do something tends to result in less reactance.

3. CUSTOMIZED MESSAGING

One of the first lessons any successful writer learns is that it is essential to know who your audience is so you can be successful in attracting their attention. Product marketers have known that for years. Yet many agencies trying to promote pro-environment behaviour act as if one message can suit everyone. Research in Australia of 1,031 participants sought to identify the best way to encourage different groups to adapt to climate change (Hine, et al). One of their main conclusions was that "our findings support the view of many social marketers that messaging should be tailored and targeted to specific audience segments for optimal impact". Roser-Renouf (2015) noted that "messages are unlikely to be effective if a diverse population is treated as a homogeneous mass". Moser (2009) also noted that "best practice in communication begins with consciously and strategically selecting an audience and understanding that audience's mental modes and level of understanding of climate change as well as interests, values and concerns". Hassol and Somerville (2011) identified the six America attitudes in terms of their belief and concern about global warming: alarmed (12%), concerned (27%), cautious (25%), disengaged (10%), doubtful (15%) and dismissive (10%). While the numbers may have changed since she wrote this ten years ago, the categories are still very useful. The main message to take from this is that it makes no sense to think that one message will be able to convince all six categories to take action. Although the most difficult group will be the doubtful and dismissive, Hine et. al. (2015) found effective strategies to have even these groups adapt to climate change. It is also important to note that there is a large portion (about 35%) of people who are in the middle, commonly referred to as the “movable middle” that could be influenced by effective, focused communications. Various studies in other areas have highlighted the importance of this group, including those dealing with anti migration (Quinn and Young) and, more recently, anti vaccine (Behavioral Science Task Force). A similar approach was taken by the Ontario Power Authority when they retained Environics Research to identify and describe electricity consumers in terms of their interest in conservation (OPA). The four categories they identified were: Green Champions (23%, with 70% of those being women), Pragmatic Conservers (31%), Budget-Driven (34%) and Live for Today (12%). Their recommendation was that OPA focus its marketing initiatives on the middle two groups, the “movable middle”, while not antagonizing the green champions but not trying to change the attitude of the last category. Another example of how customized messaging in Community Based Social Marketing (CBSM) as developed by Doug McKenzie-Mohr (2011) with its focus on different geographical audiences and how communication tools developed for a particular community can be very effective. A final example of customized messaging is the development of specific messages for groups within society that have common interests. This approach builds on the Social Identity Theory of social psychology that explains why and when individuals categorize themselves as group members and identify with that group. Examples of such groups could be based on features such as age, gender, family status (parent/grandparent), careers (professional, union), activities (hobbies, recreation) or others. This approach was discussed in my term paper submitted as part of PSY 220 Social Psychology and subsequently published by Pivot Green (Love). It is also the basis for the one strategy identified by Van Vugt (2009), identity, that seems to have the most support based on environmental psychology. And as noted earlier in this paper, Van der Linden et. al. (2015) included “leverage relevant social group norms” as one of their five best practices.

4. WAGING WAR

There appears to be is less justification for this this concept in research published by social psychologists but is included in this paper due to the recent outstanding success of “Sickkids VS: All In” campaign. Feygina et al (2010) found that messaging that suggest pro-environmentalism is “patriotic” can eliminate the negative effect of system justification, which he found was one of the key barriers to overcoming the denial of global warming. System justification theory is the tendency for people to defend, bolster and justify prevailing social, economic and political status quo. Although being patriotic is not the same as waging war, the Oxford Languages (2021) defines patriotic as including “vigorous support” for one’s country which is certainly similar. Psychologist Kristen Neff (2021) has done extensive research on self compassion for women and concluded that what was needed was fierce self compassion, which is the name of her most recent book. The Sick Kids campaign was launched in 2016 with a fundraising goal of $1.3 billion. The huge challenge that they faced was that the hospital was seen as both government funded and a successful fundraiser. They decided that the only way to succeed was to appeal to people who had never donated to them (70% past donors were female!) or to any charity in a significant way. After a four day brainstorming session with their creative agency, Cossette, they agreed on an entire new approach that called on the people of Toronto to “fight against the greatest challenges in child health” (Strategy Awards). “At SickKids we're fighting for every kid” (Sickkids). The campaign positioned kids as ready for a fight, wearing war paint and boxing gloves and being similar to knights. They literally took the fight to the streets and neighborhoods of Toronto with friendly competitions. The campaign was a huge success and the hugely ambitious goal was surpassed. In recognition of the success and novelty of the approach, the campaign was awarded the prestigious Strategy Award in 2018 which recognized the best marketing and advertising strategies in Canada.

5. MAKING IT EASIER

In their pioneering research, Kaheman and Tversky (1992) concluded that humans and even very sophisticated organizations do not act as “econs”, applying perfect information using the perfect analytic tool to arrive at the perfectly economically rational conclusion. Instead they are influenced by a range of heuristics or mental short cuts that people use to make decisions in the real world. One of the three major heuristics they identified was the Availability Heuristic, which means that people use the most easily accessible information to make their decisions. In their widely read book Nudge, Thaler and Sunstein (2021) suggest that the best way to overcome this challenge is to make the “right” decision easier; they refer to this as “libertarian paternalism”. They explored three examples: automatic enrollment in pension plans (instead of requiring voluntary enrollment to join), automatic organ donation (instead of being required to fill out a form) and health foods at the front of the line of foods at a cafeteria (instead of less healthy foods). They also noted that “it helps to think of climate change as a global choice architecture problem”. Commercial product marketers have known about the importance of this for years and fight to try to ensure their band has the most prominent and easy to access positioning on store shelves. Applied to promoting energy conservation practices, this can include optimal product placement of energy conserving products on store shelves, clear labelling indicating the energy performance of competing products and promoting of the energy conserving alternatives through social media/advertising.

6. ENGAGING IN DIALOGUE

Katherine Hayhoe is one of the most vocal climate change scientists in the world. A strongly religious Canadian, she now teaches at Texas Tech University, in the heart of climate denying southern United States where she is Director of the Climate Science Centre. In her most recent book, she highlights the extent of the climate change problem and then goes on to lay out a wide range of personal as well government policy solutions. She concludes that, in her opinion, the most important one thing that anyone can do it to talk about the problem. She emphasizes the importance of listening carefully to try to pick up on what concerns the other person has and then talking to them about how climate change will influence the things they love. This could be children/grandchildren, the land, nature, wildlife, recreation, etc. This is particularly important in the case of energy conservation as most of what is done to reduce energy consumption is invisible. For instance, in buildings, most energy conservating products are in the walls (insulation/caulking) or in the mechanical/electrical room (heating/cooling system) and are thus not easily seen. The only way family, friends and neighbours will ever know that the house or building is energy efficient is by telling them. Fortunately, this is less of a problem for vehicles as it is easier to identify an all electric or hybrid electric vehicle by their branding. This is further enhanced in Ontario by the use of green vehicle license plates. It is also interesting to note that the importance of talking about energy/climate change is included in the list of top things individuals can do by both the United Nations Environment program (UNEP) and the David Suzuki Foundation.

7. CONCLUSION

This paper has summarized the support found in peer reviewed literature for five strategies to encourage Canadians to take personal action to reduce GHG emissions. The next step would be to confirm the effectiveness of these strategies by conducting tests on the effectiveness of each message as well as all of them together. As it would not be cost effective to try to evaluate each one separately, it might be better to test a few together using “between-subject” designs that compared two or more strategies with their opposite. An example would be positive and customized messages vs negative and generic ones. A final test would be between messages that contain all five suggested strategies compared to ones that featured their opposite (negative, generic, non-aggressive, difficult, discourage discussion). Evidence found in such test results could provide a clear path to provide Canadians with the motivation to change their behaviour and reduce Green House Gas emissions.

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CASE STUDY 10:
THE ECONOMIC IMPACTS OF IMPROVED ENERGY EFFICIENCY IN CANADA

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THE ECONOMIC IMPACT OF IMPROVED ENERGY EFFICIENCY IN CANADA

EMPLOYMENT AND OTHER ECONOMIC OUTCOMES FROM THE PAN-CANADIAN FRAMEWORK'S ENERGY EFFICIENCY MEASURES

Prepared for:
CLEAN ENERGY CANADA

dunsky ENERGY CONSULTING

APRIL 3, 2018

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APRIL 3, 2018

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ABOUT **DUNSKY**

A leading North American clean energy advisory, DUNSKY provides strategic analysis and counsel in the areas of energy efficiency, distributed renewable energy and clean mobility.

DUNSKY supports clients across North America – primarily governments and utilities – through three key services: assessing opportunities (technical, economic and achievable), designing strategies (programs, plans and policies) and evaluating performance (impact and process).

EXECUTIVE SUMMARY

> **The Pan-Canadian Framework (PCF)**
> Released in 2016, the PCF identifies a suite of policies to reduce carbon emissions and achieve Canada's Paris commitments. In addition to carbon pricing and other initiatives, it commits federal and provincial governments to a set of measures to improve energy efficiency in Canadian homes, buildings and industry.

Improvements to energy efficiency are often touted for their economic and environmental benefits. For that reason, measures to improve energy efficiency across Canada factor prominently in the federal government's **Pan-Canadian Framework on Clean Growth and Climate Change ("PCF")**, developed in partnership with provinces and territories.

Improvements to energy efficiency can lead to significant cost savings, but often also require significant up-front investment. Dunsky Energy Consulting was commissioned to assess the net macroeconomic impacts associated with the energy efficiency improvements provided for in the PCF (as well as of a second, more ambitious scenario, named "PCF+"). For purposes of this study, our macroeconomic modelling focused on actions in the built environment and industry, and did not consider additional transportation efficiency options.[1]

In modelling the combined *net* macroeconomic effects of efficiency, this study assessed the three ways in which efficiency generates employment and economic impacts, both positive and negative:

- *Increased demand for efficiency-related goods and services:* Funding energy efficiency programs is a cost to the economy; however, it also stimulates new demand – for example, hiring renovation contractors to weatherize homes generates economic activity and supports employment;
- *Redistribution of savings:* As a result of the energy efficiency improvements, households and businesses save on energy bills. This in turn increases household disposable income, lowers the cost of doing business and/or frees up capital for more productive use in industry, all of which stimulate the Canadian economy; and
- *Reduced energy sales:* Reduced energy sales limit utility revenue, at least domestically. This can negatively impact employment, for example by reducing the need to build new power plants.

All told, we find that investing in energy efficiency is a significant net benefit to the Canadian economy. **Specifically, implementing the energy efficiency actions in the PCF will add 118,000 jobs (average annual full-time equivalent) to the Canadian economy, and increase GDP by 1% over the baseline forecast, over the study period (2017-2030).**

The overall economic impact is largely driven by the money households and businesses save on their energy bills. **Under the PCF, Canadian consumers would save $1.4 billion on energy bills per year** (net of program costs), on average. For the average household, this translates into bill savings of $114 per year, or $3,300 over the lifetime of the energy efficiency measures. **Meanwhile, Canadian business, industry and institutions would save, on average, $3.2 billion each year**, savings that can improve competitiveness and/or be reinvested in more productivity-enhancing ways.

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[1] The net change in Gross Domestic Product (GDP) and employment from 2017 to 2030 was assessed using the Center for Spatial Economic's (C_4SE's) macroeconomic model. Modeling inputs – energy savings and costs for the residential, commercial, and industrial sectors – were developed by Dunsky. A description of the scenarios and detailed results are provided in the report.

Key Results: Canada-wide impacts of the Pan-Canadian Framework's energy efficiency initiatives

+1% boost in GDP
over 14 years

$7 GDP boost / $1 of spending

+118,000 Jobs
full-time equivalent

30 person-years / $1M of spending

+$1.4B Savings
for Canadian households

average $114/year per household

-52M tonnes
emissions of CO_2e by 2030

25% of Canada's Paris commitment

The net impact is distributed across the country and throughout the economy, as shown in Tables ES-1 and Figure ES-1. Table ES-1 represents the **cumulative total net increase** in GDP and job-years (*one job year = one Full Time Equivalent position for a period of one year*) over the 2017-2030 period. The net impact is relative to a reference case economic forecast without such energy efficiency improvements.

Table ES-1: Net change in GDP and employment by province in 2030 and cumulative from 2017 to 2030 - PCF

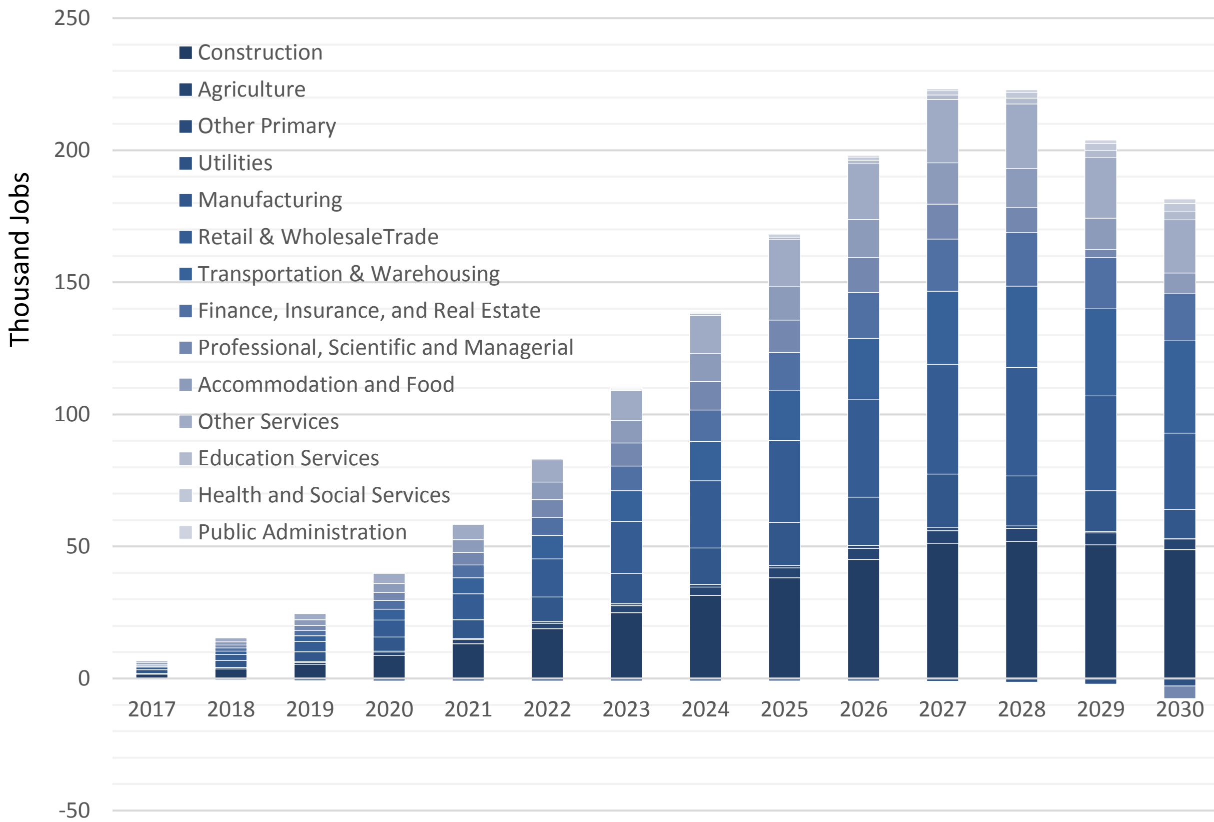
	Net Change in GDP ($2017 Billions)		Net Change in Employment (Full-time equivalent jobs)*	
	2017-2030	Average Annual	2017-2030	Average Annual
CANADA-WIDE[2]	**$355.9**	**$25.4**	**1,655,965**	**118,283**
British Columbia	$54.4	$3.8	256,420	18,316
Alberta	$32.7	$2.3	82,576	5,898
Saskatchewan	$10.7	$0.8	47,777	3,413
Manitoba	$12.6	$0.9	58,612	4,187
Ontario	$174.5	$12.5	740,695	52,907
Quebec	$55.1	$3.9	353,230	25,231
New Brunswick	$4.9	$0.3	25,879	1,849
Nova Scotia	$7.7	$0.5	58,367	4,169
Prince Edward Island	$2.4	$0.2	21,056	1,504
Newfoundland & Labrador	$2.3	$0.2	11,353	811

* "2017-2030" values reflect cumulative *job-years* (one job-year = one FTE position for a period of one year) over the policy period. "Average Annual" values reflect the total number of additional, full-time equivalent jobs in an average year.

TAKE-AWAY: Despite different energy contexts, the economies and workforces of every province benefit from the PCF's energy efficiency measures.

[2] Yukon, the Northwest Territories, and Nunavut were not modeled separately due to data constraints

Figure ES-1: Total annual net employment in Canada by industry segment (2017-2030) – PCF Scenario



TAKE-AWAY: Employment gains from the PCF's energy efficiency measures are spread across the economy; about half of new jobs would fall to the construction, trade and manufacturing sectors.

The assessment also **considered a second policy scenario that increases energy savings beyond the activities laid out in the Pan-Canadian Framework**. Under this scenario, named "PCF+", all provinces achieve the PCF commitments as well as more ambitious savings targets tied to "best in class" efficiency efforts for each fuel type (electricity, natural gas, and refined petroleum products). Best in class refers to jurisdictions across North America that have the highest levels of energy savings as a result of their energy efficiency policies and programs. Under the more aggressive savings scenario, the net increase in **GDP grows to $595 billion ($2017) and employment jumps to over 2,443,500 job-years** in total from 2017 to 2030.

Finally, we note that energy savings included in the PCF and PCF+ scenarios would reduce greenhouse gas (GHG) emissions by approximately 52 Mt and 79 Mt, respectively. Based on December 2017 GHG projections by the Government of Canada, these energy efficiency improvements to buildings and industry would meet, under the PCF scenario, 25% of Canada's Paris commitments for reducing greenhouse gas emissions by 2030. Under the PCF+ scenario, energy savings in buildings and industry would meet 39% of the nation's commitment.

Notes re. study scope

Sectors: This study's scope is limited to energy efficiency in homes, buildings and industry; it does not account for electrification and fuel switching within the building sector, nor for transportation-related energy efficiency.

Costs: This study presents a *net* impact assessment. As such, in addition to the benefits of energy savings, the study fully accounts for the costs to governments, households, and businesses to implement energy efficiency actions, as well as for the impacts of reduced energy sales on utilities.

TABLE OF CONTENTS

INTRODUCTION

CONTEXT

Canada has committed to reducing its greenhouse gas (GHG) emissions to 30 percent below 2005 levels by 2030. The **Pan-Canadian Framework on Clean Growth and Climate Change** – developed in consultation with the provinces, territories, and Indigenous peoples – is the government's plan to meet this 2030 commitment.

The Pan-Canadian Framework (PCF) opens by stating that the framework is:

> *…our collective plan to **grow our economy while reducing emissions** and building resilience to adapt to a changing climate. It will help us transition to a strong, diverse and competitive economy; foster job creation, with new technologies and exports; and provide a healthy environment for our children and grandchildren.*

The Dunsky team was retained to assess the macroeconomic impacts – with a focus on employment and GDP impacts – associated with the energy efficiency actions in the PCF.

STRUCTURE OF REPORT

This report is structured as follows:

PART A: PAN-CANADIAN FRAMEWORK

This section provides an overview of the Pan-Canadian Framework with a focus on the energy efficiency actions within the built environment and industrial sectors. National emission reduction estimates for each action are also presented.

PART B: STUDY FRAMEWORK

This section describes the study methodology, including the policy scenarios considered, the modeling assumptions and inputs, and the macroeconomic model used.

PART C: ECONOMIC IMPACTS

This section summarizes the net employment and Gross Domestic Product results at the national level and by industry sector (e.g. construction, manufacturing, etc.) along with net consumer cost savings and a discussion of what drives the overall economic impacts.

PART D: GHG REDUCTIONS

This section summarizes the GHG reductions associated with the two policy scenarios.

Provincial economic impact results and additional information related to modeling assumptions and inputs are provided in Appendices.

PART A

PAN-CANADIAN FRAMEWORK

ENERGY EFFICIENCY & THE PAN-CANADIAN FRAMEWORK

The Pan-Canadian Framework on Clean Growth and Climate Change (PCF) is available here. The following summarizes the plan with a focus on the energy efficiency actions for the built environment and large industry. These actions formed the basis of the policy scenarios modeled in this study and ultimately the resulting economic impact.

OVERVIEW

In December 2016, the federal government released the PCF, developed in partnership with the provinces and territories and in consultation with Indigenous peoples. The PCF – as well as measures outlined in Budget 2017 – sets forth a carbon pricing framework, identifies a suite of critical policies, and identifies the roles of various jurisdictions in unlocking the low-carbon economy and achieving Canada's GHG emissions reduction targets.

Pillars of the Pan-Canadian Framework:[1]

1. Pricing carbon pollution;
2. Complementary measures to further reduce emissions across the economy;
3. Measures to adapt to the impacts of climate change and build resilience; and,
4. Actions to accelerate innovation, support clean technology, and create jobs.

With respect to the 'complementary measures to further reduce emissions' PCF pillar, the plan includes actions in seven key areas: Electricity; Built Environment; Transportation; Industry; Forestry, Agriculture, and Waste; Government Leadership; and, International Leadership.

The PCF's "Built Environment" and "Industry" areas are the focus of this study, and more specifically its actions related to energy efficiency, which are summarized in the following sub-section. Together, the estimated GHG reduction associated with these actions ranges from approximately 37 Mt CO_2e to 78 Mt CO_2e. In December 2017, the estimated difference between Canada's projected emissions in 2030 (722 Mt) and its 2030 target (517 Mt) was 205 Mt.[3] The federal government estimates that the announced PCF measures will reduce Canada's emissions by 139 Mt to 583 Mt by 2030. **Energy efficiency actions could play a key role in the plan and achieving Canada's 2030 target.**

ENERGY EFFICIENCY ACTIONS

The tables on the following page summarize the new energy efficiency actions – for the built environment and large industry – in the PCF that are included in this study. The PCF Working Group on Specific Mitigation Opportunities also released a public report with estimated GHG emissions reductions in 2030 associated with each of the actions.[4] These estimates are included below.

[3] Government of Canada's 7th National Communication and 3rd Biennial Report (2017). Available on-line: http://unfccc.int/files/national_reports/national_communications_and_biennial_reports/application/pdf/82051493_canada-nc7-br3-1-5108_eccc_can7thncomm3rdbi-report_en_04_web.pdf

[4] Specific Mitigation Opportunities Working Group – Final Report (2016). Available on-line: http://www.climatechange.gc.ca/Content/6/4/7/64778DD5-E2D9-4930-BE59-D6DB7DB5CBC0/WG_Report_SPECIFIC_MITIGATION_OPPORTUNITIES_EN_V04.pdf

BUILT ENVIRONMENT

Table 1: Energy efficiency actions in the Pan-Canadian Framework for the built environment

NEW ACTION	ESTIMATED GHG REDUCTION IN 2030
Making new buildings more energy efficient – Governments will work to adopt increasingly stringent model building codes starting in 2020. The goal is to have the provinces and territories adopt a net-zero energy ready model building code by 2030.	The Working Group on Specific Mitigation Opportunities estimates that this will lead to a 4 Mt reduction in GHG emissions from the residential sector and a 5 Mt reduction from the commercial-institutional sector by 2030. **Estimated Reduction in 2030 = 9 Mt CO_2e**
Retrofitting existing buildings – Governments will work to develop a model code for existing buildings by 2022, with a goal of the provinces and territories adopting the code. Governments will also work together with the aim of requiring building energy use labeling in 2019. Governments will also work to sustain and, where possible, expand their building retrofit efforts.	The Working Group on Specific Mitigation Opportunities estimates that this will lead to a 1Mt to 6 Mt reduction in GHG emission from the residential sector in 2030, depending on the level of effort (1.5% to 10% energy savings by 2030). It also estimates a less than 1 Mt to 6 Mt reduction from the commercial-institutional sector in 2030, again depending on the level of effort (2% to 17% energy savings by 2030). **Estimated Reduction in 2030 = ~1 Mt to 12 Mt CO_2e**
Improving energy efficiency for appliances and equipment – The federal government will set new standards for heating equipment and other key technologies.	The Working Group on Specific Mitigation Opportunities estimates that this will lead to a 6 Mt reduction in GHG emissions from more efficient space and water heating equipment, a 1 Mt reduction from more efficient products, and less than 1 Mt from regulations to phase out residential space and water heating equipment that is less efficient than heat pumps (assumes implementation begins in 2028). **Estimated Reduction in 2030 = ~7 Mt CO_2e**
Supporting building codes and energy efficient housing in Indigenous communities – Governments will collaborate with Indigenous Peoples to work toward improved building efficiency standards and incorporate energy efficiency in their building renovation programs.	This a commitment to strategic implementation and support. The Working Group on Specific Mitigation Opportunities did not estimate GHG emissions reductions for these actions. It is assumed the above reductions incorporate savings from Indigenous communities.

LARGE INDUSTRY

Table 2: Energy efficiency actions in the Pan-Canadian Framework for large industry

NEW ACTION	ESTIMATED GHG REDUCTION IN 2030
Improving industrial energy efficiency – Federal, provincial, and territorial governments will work together to help industries save energy and money, including by supporting them in adopting energy management systems.	The Working Group on Specific Mitigation Opportunities estimates that this will lead to a 6-9 Mt reduction in GHG emissions based on the accelerated use of energy management systems, and a 14-41 Mt reduction in GHG emissions from regulations to set emissions standards for new and/or existing facilities (5-15% improvement). **Estimated Reduction in 2030 = ~ 20 Mt to 50 Mt CO_2e**

PART B

METHODOLOGY

METHODOLOGY

The economic impacts of investing in energy efficiency have been highlighted in other reports.[5] The purpose of this study is to produce an up-to-date and policy-relevant assessment of the economic impact of investing in energy efficiency in Canada.[6] The following outlines the study framework, including the policy scenarios considered, development of the modeling inputs, and the macroeconomic model and process.

The study focuses on energy efficiency improvements in the residential, commercial, and industrial sectors. Specifically, efficiency improvements that reduce demand for electricity, natural gas, and refined petroleum products (excluding transportation fuels).

The analysis captures the impact of investing in energy efficiency from 2017 to the end of the Pan-Canadian Framework in 2030. Energy efficiency measures implemented in 2030, for example, will continue to deliver energy savings post-2030; however, for the purposes of this study we present a snapshot of the result within the plan period – i.e. out to 2030.

OVERVIEW

Research, analysis, and modeling was conducted to identify the economic and fiscal impacts associated with the energy efficiency actions in the Pan-Canadian Framework as well as a more ambitious case.

To complete this work, a three-pronged approach was taken:

1. **Define the policy scenarios:** Dunsky established parameters for the scenarios using publicly-available resources. This included establishing the actions to be included as well as the level of ambition.
2. **Develop the modeling inputs:** Dunsky conducted research and analysis to derive residential, commercial, and industrial energy savings and spending levels used in the model. The inputs were developed using a top-down approach, and are based on publicly-available information and assumptions developed by Dunsky and others.
3. **Conduct the macroeconomic modeling and analysis:** Using the inputs developed by Dunsky, the Center for Spatial Economics (C_4SE) used its macroeconomic model to generate economic and fiscal impacts for each policy scenario and sub-case (see next sub-section).

Using this methodology, net changes in employment, GDP, and tax revenue at the national level and for each province and industrial segment were established. A discussion of how energy efficiency investment and savings impact jobs, GDP and GHG emissions accompanies the results in Parts C and D.

[5] See, for example, Acadia Center's 2014 report – *Energy Efficiency: Engine of Economic Growth in Canada*. Available at: http://acadiacenter.org/document/energy-efficiency-engine-of-economic-growth-in-canada/

[6] Yukon, the Northwest Territories, and Nunavut were not modeled separately due to data constraints that would have been cost prohibitive to address within the scope of this study. For example, establishing efficiency program unit program and participant costs or emissions intensities for space and water heating in the commercial and industrial sectors. Since the economic impacts are based on high-level, national emission reductions estimates, the national and provincial results do include a small amount of savings in the Territories. In 2016, approximately 0.3% of Canada's overall energy consumption in the residential, commercial and industrial sectors is attributed to the Yukon, the Northwest Territories, and Nunavut.

POLICY SCENARIOS

Two policy scenarios are being assessed in this macroeconomic modeling study. In addition to the actions in the Pan-Canadian Framework, we included a "stretch" scenario to assess the impact of even greater investment in energy efficiency. This is in part because Environment and Climate Change Canada projects a gap of 66 Mt between announced actions, including the PCF, and the 2030 emissions reduction target. The second scenario addresses how leading levels of investment in energy efficiency across Canada might impact the economy and help close the emissions gap. Additional detail on the policy scenarios is provided in Appendix A.

PAN-CANADIAN FRAMEWORK ("PCF")

The first policy scenario – the Pan-Canadian Framework or PCF – includes all relevant commitments governments adopted under the December 2016 PCF with respect to actions in the built environment and industrial sector.

Actions include:

- **Existing Housing:** 10% reduction in energy use through energy efficiency retrofits
- **New Housing:** 40% improvement from 2012 model code as new codes evolve toward "net-zero ready" by 2030
- **Existing Buildings:** 17% reduction in energy use through energy management and energy efficiency retrofits
- **New Buildings:** 65% improvement from 2015 model code as new codes evolve toward "net-zero ready" by 2030
- **Appliances and equipment:** More stringent energy efficiency standards
- **Large Industry:** Energy management and emissions standards

PAN-CANADIAN *PLUS* (*"PCF+"*)

The "stretch" scenario – the Pan-Canadian Plus or PCF+ – would see all provinces achieving the PCF commitments plus more ambitions savings targets tied to "best in class" efficiency efforts for each fuel type (electricity, natural gas, and refined petroleum products).

Best-in-class savings levels include:

- **Electricity** – Ramp up to 2.5% annual savings in five years (avg. 2.0% during initial 5 yrs)*

  In Massachusetts, utility incentive programs alone are currently expected to achieve average incremental annual electricity savings above 2.9%.
- **Natural Gas** – Ramp up to 1.75% annual savings in five years (avg. 1.3% in initial 5 yrs)*

  In Illinois and Minnesota, legislation requires incremental annual savings of 1.5% for natural gas. While slightly below the level modeled here, these exclude most savings from codes and standards.
- **Refined Petroleum Products (RPPs)** – Ramp to 2.5% savings⁑ in five years (avg. 1.9% in initial 5 years)*

  Québec's recent energy policy seeks an average of nearly 3%/yr absolute reduction in RPP consumption (40% absolute reduction by 2030).

* Savings are incremental annual savings as a % of annual consumption. For example, "2% annual savings" implies that after five years, demand is (2%x5yrs=) 10% lower than it would otherwise have been, due to improvements in energy efficiency. If demand would have grown at 2%/year without such improvements, the assumed savings would effectively result in flat demand over the period. ⁑ RPP savings percent is applied to RPP *consumption* only.

For each of the above policy scenarios, economic and fiscal impacts were assessed at the national and provincial levels and for each fuel type (electricity, natural gas, or refined petroleum products). In total, 88 individual modeling runs were considered.

MODELING INPUTS

The key inputs for the macroeconomic model include: 1) forecasted end-use demand for each province, sector, and fuel type; 2) annual increment and cumulative energy savings at the province and sector level for each fuel type; 3) annual program and participant spending at the province and sector level for each fuel type; and, 4) efficiency program and participant spending allocation by industry segment for each fuel type. The assumptions and process used to derive each of the inputs are provided below.

END-USE DEMAND

Purpose: Establishes the baseline energy demand in the model. Also used in the PCF+ policy scenario to establish energy savings levels based on an average annual percent reduction in demand.

Approach: End-use demand for the PCF and PCF+ scenarios is based on the National Energy Board's 2016 Energy Future Update (reference case); however, adjustments were made to account for demand that is not amenable to energy efficiency programs. The commercial and industrial forecast for Refined Petroleum Products (RPPs) were adjusted to remove "non-energy products" in the end-use forecast. The adjustments are based on historical data in the National Energy Use Database (NEUD). In addition, natural gas associated with oil sands production (current and future) in Alberta and LNG production (current and future) in British Columbia was removed.

ENERGY SAVINGS

Purpose: Establishes the reduction in energy use in a given sector and industry, and thus the change in energy input shares in the model (i.e. the amount of energy relative to other inputs), which in turn impacts capital and labour as well as the mix of household capital expenditures and ultimately overall economic output.

Approach: Only national-level emission reductions associated with the PCF was publicly available at the time the inputs were developed. The PCF Mitigations Working Group estimates that the built environment, energy efficiency actions will generate 16 to 30 Mt of GHG emission reductions by 2030. For this study we assume 28 Mt by 2030 (based on an incremental ramp-up starting in 2018). The Mitigations Working Group also estimates that the large industrial emitters actions will generate 20 to 50 Mt of GHG emissions reductions by 2030. For this study we assume 30 Mt by 2030; starting in 2018 and ramping up over time.

For the PCF and PCF+ scenarios, the national emissions estimates were converted to energy savings based on the steps and assumptions outlined in Appendix A. The resulting annual incremental and cumulative energy savings were broken down by province, fuel type, and sector. Province-specific emissions shares and factors were used in the process.

The PCF scenario also includes current and approved utility or third-party energy efficiency programs. Dunsky established the annual incremental and cumulative savings associated with these programs. If utility/third-party efficiency savings were higher than the PCF in a given year (e.g. 2017 to 2018+ before the PCF actions begin or are still ramping up), then the utility savings were included over those of the PCF.[7]

For the PCF+ scenario, instead of including current and approved utility energy efficiency programs, "best-in-class" annual savings targets (as a % of annual consumption) were considered. The targets are based on leading North American jurisdiction and the high scenario in the Acadia Center study, and are 2.5% for electricity, 1.75% for natural gas, and 2.5% for refined petroleum products (all ramped up over five years).[8] The annual savings targets were applied to the demand forecast (2017-2030).[9] If these best-in-class targets produced savings in excess of the PCF savings levels in a given year, then the best-in-class savings were included over those of the PCF.

Table 3: Total energy savings (PJ) in 2030 for each fuel type at the national level.

	Electricity	Natural Gas	RPP	Total
Pan-Canadian Framework	246	626	92	965
Pan-Canadian Framework +	695	810	144	1,650

PROGRAM & PARTICIPANT SPENDING

Purpose: In order to capture both benefits and costs, the macroeconomic model captures spending required to achieve anticipated energy savings (e.g. spending on home energy retrofits or higher first-cost for efficient appliances). The spending stimulates economic output, but is also captured as a cost (i.e. negative impact) to consumers, business and industry.

Approach: Total energy efficiency investment levels in the model are based on annual program and participant spending levels in 2016 through 2030 for each province and fuel type. Unit program and participant costs were established for each provinces and fuel type. The unit costs are based on the unit costs in the Acadia Center study, which were developed by Dunsky using a combination of publicly available information and assumptions based on our experience and expertise.[10]

To note, the Acadia center study has three sets of unit costs based on three scenarios that represent increasing "levels of ambition." For the PCF scenario, the unit cost from Acadia Center's Mid Scenario were used as the level of ambition in the Mid Scenario is considered roughly equivalent to the PCF actions. For existing and approved utility programs, the unit costs from BAU+ Scenario were used for each of the provinces. For the "best-in-class" utility programs, the unit costs from the High scenario were used.

[7] Current and approved utility energy efficiency program savings levels were established through a review of utility energy efficiency plans, reports, and dockets for each province and fuel type, where applicable. The most recent data and information was used.
[8] Acadia Center (2014). *Energy Efficiency: Engine of Economic Impact in Canada*.
[9] Existing and approved energy efficiency savings were added back into the demand forecast to avoid double counting (i.e. electricity savings are equal to 2.5% of annual consumption as opposed to 2.5% + existing efforts).
[10] See Appendix A6 in the Acadia Center study (pg. 38).

Total unit program and participant costs were applied to the incremental annual energy savings for each province and fuel type to generate total annual program and participant spending from 2016 through 2030.

Table 4: First-year program spending (nominal $M) for each fuel type at the national level.

	Electricity	Natural Gas	RPP	Total
Pan-Canadian Framework	1,151	169	39	1,359
Pan-Canadian Framework +	2,209	640	195	2,267

Table 5: Average annual program spending (nominal $M) from 2017-2030 for each fuel type at the national level.

	Electricity	Natural Gas	RPP	Total
Pan-Canadian Framework	2,130	1,544	295	3,969
Pan-Canadian Framework +	8,090	3,098	707	11,894

EFFICIENCY SPENDING ALLOCATIONS

Purpose: Directs how the energy efficiency program and participant spending is allocated in the model to each industry sector (e.g. to sectors such as machinery manufacturing, construction, retail trade, etc.).

Approach: For each fuel type and sector, program and participant spending percentages were developed for a group of industry sectors. The breakdown by industry sector is based on the Acadia Center study, which is representative of comprehensive yet generic energy efficiency programs.[11] Tables outlining the breakdown are available in Appendix A.

MACROECONOMIC MODEL

C_4SE maintains a set of macroeconomic models that are used to produce base case projections for each provincial economy. The projections contain assumptions about the key drivers for the economy such as economic growth and inflation in the US and other trading partner economies, oil and natural gas prices, federal and provincial government fiscal policies, monetary policy and so on. These projections are updated semi-annually and published in the C_4SE Provincial Economic Forecast.

The published forecast represents the base case, a second projection is built from the base case and will incorporate the reduced input shares for natural gas, refined petroleum products and electricity for the various industries along with the consumer expenditure share of natural gas, refined petroleum products and electricity for households.

The C_4SE modelling approach is to incorporate the amount and types of investment on the part of business, government, and households that is required to achieve the reduction in energy use.

[11] See Appendix A3 in the Acadia Center study (pg. 35).

Government transfers to industries and households and the use of retained earnings or borrowing by participants in the energy reduction programs will be used to fund the investment.

The C_4SE modelling system focuses on gross output for each industry rather than GDP. The models are structured so that a reduction in the use of electricity, natural gas and RPP by firms will result in an increase in the share of capital and labour in gross output in a given industry. This will happen as firms purchase new energy efficient technologies and hire associated workers. Importantly there will be an increase in the share of value-added (net output or GDP) in gross output in each industry. In the case of households, the reduction in the share of electricity, natural gas, and RPP in consumer expenditures is replaced by an increase in the share of the other household expenditure categories.

There are a few key assumptions in C_4SE's analysis related to the financing of government energy reduction programs and about how households and business finance purchases of capital, as well as how energy efficient capital is introduced into the economy. In the case of government programs, it is assumed that any additional expenses made through energy reduction programs are offset by reductions in other expenditures.

It is assumed that both households and firms substitute more energy efficient capital for both the new and replacement demand expenditures found in the base case projection. In addition, capital expenditures will increase somewhat as the energy efficient capital will represent a more valuable type of capital. The decision to purchase more energy efficient capital will take place as households and firms assume that the expenditures for the higher valued capital will be offset by future reduced expenditures on electricity, natural gas and refined petroleum.

The impact of the reductions in natural gas, refined petroleum products and electricity usage will be determined by comparing GDP, employment and other important economic concepts for the efficiency scenario against the base case projection for each province.

The C4SE models are unlike traditional econometric models because they are calibrated. The calibration is chosen by the model builder and the objective is to produce good simulation properties. The primary limitation of our approach is that some coefficients may be too large/small and this may have the effect of increasing or decreasing the estimated economic impacts of the efficiency measures.

Additional information regarding the C_4SE macroeconomic model and limitations with respect to the modeling approach is provided in Appendix B.

PART C

NATIONAL ECONOMIC IMPACTS

ECONOMIC IMPACTS: GDP, EMPLOYMENT & SAVINGS

This section summarizes the results of the macroeconomic modeling. National and provincial results reflect scenarios where energy efficiency programs for all three fuel types – electricity, natural gas, and refined petroleum products – are implemented concurrently. Results for each individual fuel type are summarized in Appendix C.

OVERVIEW

The economic impact associated with investing in the energy efficiency actions in the Pan-Canadian Framework, and beyond, were modeled using the C4SE macroeconomic model. Results indicate a **significant increase in Gross Domestic Product (GDP) and employment associated with implementing the energy efficiency actions in the Pan-Canadian Framework (PCF)**, and an even greater impact if provinces were to go beyond the PCF and achieve energy savings levels that are roughly in-line with leading jurisdictions in North America ("PCF+").

How do the actions generate increased economic output and jobs?

Implementing the energy efficiency programs requires spending on efficient goods and services. People working in the construction sector will be deployed to install new insulation, professional services will be engaged to design net zero buildings and energy management programs, and individual and businesses will purchase new, more efficient equipment. We know from previous studies that implementing the energy efficiency programs generates approximately 15-25 percent of the overall economic impact.[12]

The bulk of the economic impact – approximately 75-85 percent – arises from an increase in household disposable income and improved competitiveness from a lower cost of doing business. When energy bills go down, individuals have more disposable income that can be re-invested in the local economy – restaurants, the arts, home renovations, etc. When business use less energy their input costs go down, making them more competitive in the global economy, which is also positive for their suppliers. Saving on fuel costs also allows for new investments (e.g. plant upgrades) that they would not have otherwise been able to justify.

Are the costs, or negative impacts, considered?

This is a net impact assessment – the costs to government, households, and businesses to implement the energy efficiency actions are accounted for as are the negative impacts associated with reduced energy sales (e.g. negative impact on utilities) and substitution effects (e.g. more capital and less labour) are captured. To note, it is assumed that natural gas and refined petroleum products that are no longer needed in Canada find buyers in the global market out to 2030. For electricity, all of the savings in the hydro provinces, which are in surplus, are assumed to be exported for the first five years of the study, but not subsequently. In reality, this is a conservative assumption as other provinces may export surplus electricity, and the hydro provinces will likely be able to continue to export beyond the initial period.

It is also important to note that fuel switching is not included in this assessment. A move toward electrification of buildings and transportation can offset some, if not all, of the reduced demand in the electricity sector, thereby mitigating any negative impact on utilities from energy efficiency savings.

[12] Acadia Center (2014). *Energy Efficiency: Engine of Economic Impact in Canada*. Page 20.

GROSS DOMESTIC PRODUCT RESULTS

At the national level, the Pan-Canadian Framework scenario results in **a net increase in GDP of $356 billion** in total from 2017-2030 from investing in energy efficiency improvements and the savings realized by households and businesses. This translates into **$7 of GDP for every $1 spent on efficiency programs**. The GDP impact changes over time as spending increases and more savings are realized. At its high point, the annual increase in GDP is $50 billion; on average, GDP increases by $25 billion over the baseline forecast. In total, the energy efficiency actions in the PCF will **increase GDP by 1% over the period.**

Under the Pan-Canadian Framework+ scenario, the higher level of ambition results **in a net increase in GDP of $595 billion** in total from 2017-2030, or **$4 of GDP for every $1 spent**. The reason the GDP per program dollar metric is lower in the more ambitious case is because going after deeper savings is more expensive. In the PCF+ scenario, the maximum annual increase in GDP is $65 billion.

Table 6: Net GDP Impacts for Canada (all fuels) from energy efficiency investments in 2017-2030 (in $2017 Billions)

	Pan-Canadian Framework (PCF)	Pan-Canadian *Plus* (PCF+)
GDP per $1 of Program Spending	$7	$4
Cumulative Net Increase in GDP	$355.9	$595.0
Maximum Annual Increase in GDP	$50.0	$65.0
Average Annual Increase in GDP	$25.4	$42.5
Total Program Costs	$48.4	$148.6

Results for each province are provided in Table 7 on the following page. Not surprisingly, impacts vary by province. This is due to a number of factors, including the size and structure of the provincial economy, the magnitude of the investment as a percent of its GDP, energy prices, export markets and others.

Similarly, differences in GDP impact between the PCF and PCF+ scenarios also vary by province. There are a number of reasons for this, including the fact that some provinces are currently investing more in energy efficiency and thus a larger portion of the "best-in-class" savings level will already be captured in the PCF results, making the jump from the PCF to the PCF+ less significant (and economically impactful) compared to provinces who are currently doing less. Others include the relative shares of energy sources in each province, as well the same factors described in the previous paragraph.

Finally, it is worth noting that the PCF is focused on GHG emissions savings. As a result, efficiency improvements in the electricity sector in provinces where hydroelectricity and other renewable power sources are considered the marginal resource going forward (e.g. British Columbia, Manitoba, Quebec, and Newfoundland and Labrador) do not contribute to the emissions reduction target. As discussed in the methodology section, for these provinces, we applied half of electricity savings to other fuels within the province with the other half being distributed to other provinces. However, in the PCF+ scenario, emissions reductions were not a constraint and all provinces ramp up to 2.5 percent annual electricity savings.

Table 7: Average Annual & Cumulative Net Change in GDP (all fuels) from energy efficiency investments

	Net Change in GDP ($2017 Billions)			
	Pan-Canadian Framework		Pan-Canadian *Plus*	
	Average Annual	2017-2030	Average Annual	2017-2030
Canada[13]	**$25.4**	**$355.9**	**$42.5**	**$595.0**
British Columbia	$3.8	$54.4	$7.0	$97.8
Alberta	$2.3	$32.7	$5.1	$71.5
Saskatchewan	$0.8	$10.7	$1.5	$20.9
Manitoba	$0.9	$12.6	$1.9	$26.0
Ontario	$12.5	$174.5	$15.2	$212.6
Quebec	$3.9	$55.1	$9.7	$135.5
New Brunswick	$0.3	$4.9	$0.7	$10.2
Nova Scotia	$0.5	$7.7	$0.9	$12.8
Prince Edward Island	$0.2	$2.4	$0.3	$3.8
Newfoundland & Labrador	$0.2	$2.3	$0.3	$3.9

EMPLOYMENT RESULTS

At the national level, the Pan-Canadian Framework is expected to lead to a net increase of 118,000 full-time equivalent jobs across the Canadian economy, on average, throughout the period (total increase of 1,655,965 "person-years" of employment spread evenly across 14 years). In practice, jobs are distributed unevenly across time, as illustrated in figure ES-1. In total, 34 job-years are created, *net of any losses,* for every million dollars spent on efficiency programs.

Under the Pan-Canadian Framework+ scenario, the higher level of ambition results in a net increase in employment, on average, of 175,000 full-time equivalent jobs, or 16 job-years for every million in program spending.

WHAT DOES A "JOB-YEAR" REPRESENT?

In this study, a job-year represents the equivalent of one full-time position for a period of one year. In other words, one Full-Time Equivalent (FTE) for one year.

The C4SE model uses labour force survey employment data that counts both full-time and part-time employment. Resulting net employment impacts – a combination of full and part time jobs – were converted to FTEs outside the model using the assumption that 1 FTE = 40 hrs/week for one year over the study period.

[13] Results for the three territories were not modeled separately due to data constraints that would have been cost prohibitive to address within the scope of this study. See report for additional details.

Table 8: Net Employment Impacts for Canada (all fuels) from energy efficiency investments in 2017-2030

	Pan-Canadian Framework (PCF)	Pan-Canadian *Plus* (PCF+)
Average Annual Increase in Employment (FTE-eq.)	**118,283**	**174,541**
Maximum Annual Increase in Employment (FTE-eq.)	223,780	280,650
Cumulative Net Increase in Employment (FTE-eq.)	1,655,965	2,443,572
Job-years per $Million of Program Spending (FTE-eq.)	30	16
Total Program Costs ($2017 billion)	$48.4	$148.6

All provinces – whether energy producing or not – see net gains in both GDP and employment due to Pan-Canadian Framework initiatives, as can be seen below.

Table 9: Average Annual & Cumulative Net Change in Employment (all fuels) from energy efficiency investments

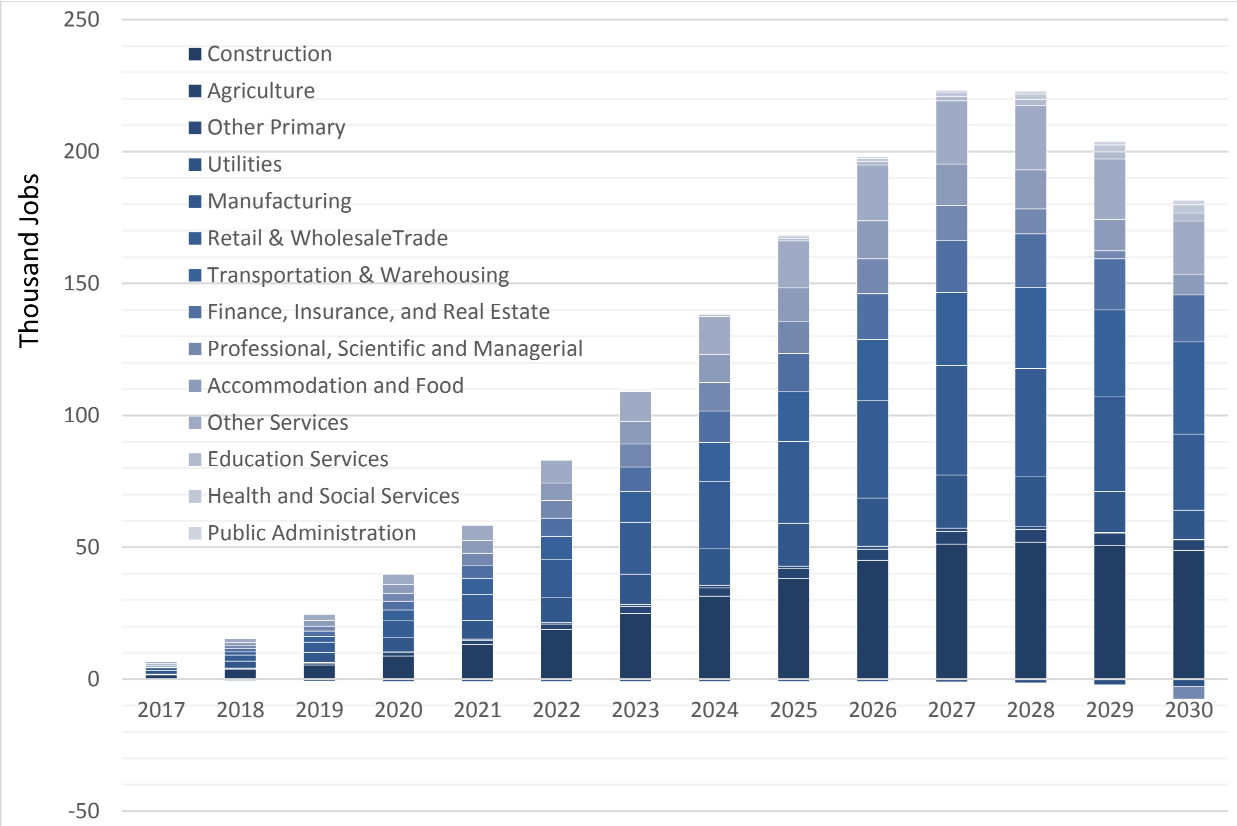
	Net Change in GDP ($2017 Billions)		Net Change in Employment (Full-time equivalent jobs)*	
	2017-2030	Average Annual	2017-2030	Average Annual
CANADA-WIDE[14]	**$355.9**	**$25.4**	**1,655,965**	**118,283**
British Columbia	$54.4	$3.8	256,420	18,316
Alberta	$32.7	$2.3	82,576	5,898
Saskatchewan	$10.7	$0.8	47,777	3,413
Manitoba	$12.6	$0.9	58,612	4,187
Ontario	$174.5	$12.5	740,695	52,907
Quebec	$55.1	$3.9	353,230	25,231
New Brunswick	$4.9	$0.3	25,879	1,849
Nova Scotia	$7.7	$0.5	58,367	4,169
Prince Edward Island	$2.4	$0.2	21,056	1,504
Newfoundland & Labrador	$2.3	$0.2	11,353	811

* "2017-2030" values reflect cumulative *job-years* (one job-year = one FTE position for a period of one year) over the policy period. "Average Annual" values reflect the total number of additional, full-time equivalent jobs in an average year.

In addition, the employment benefits are distributed across segments of the Canadian economy. As shown in Figure 1, at the beginning of the energy efficiency investment period, sectors that are associated with implementing the energy efficiency programs – e.g. construction, manufacturing, and retail/wholesale trade – make up the majority of the employment impact. As more energy savings accumulate, consumers and business shift energy dollars into other aspects of the economy and increased demand for local goods and services increases economic output and jobs.

[14] Yukon, the Northwest Territories, and Nunavut were not modeled separately due to data constraints that would have been cost prohibitive to address within the scope of this study.

Figure 1: Total annual net employment in Canada by sector (2017-2030) – PCF Scenario



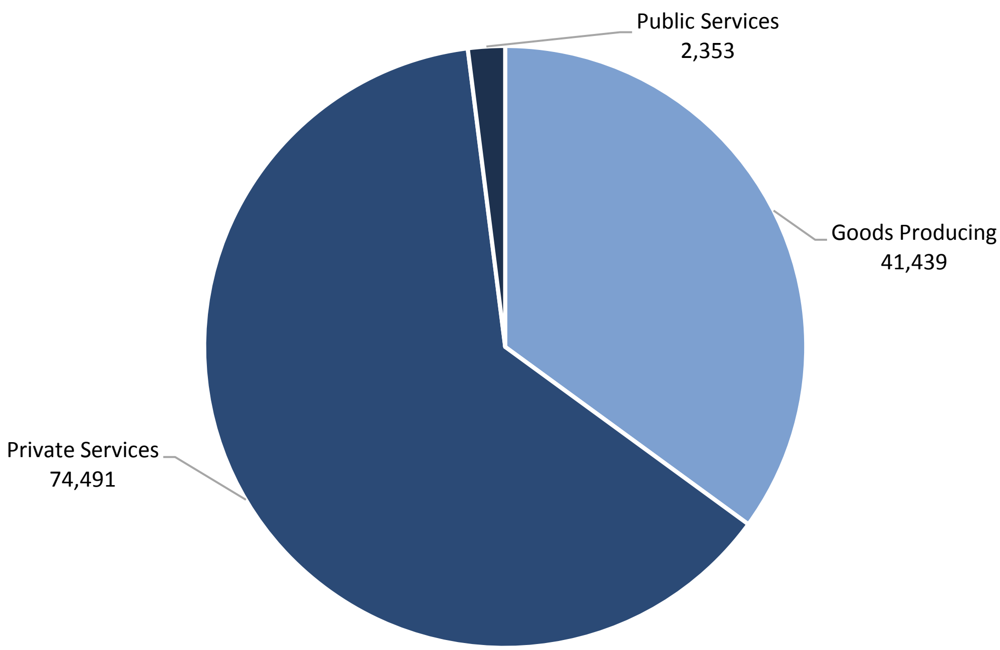
Grouping industry segments into aggregate industry sectors – Public Services, Goods Producing, and Private Services – provides additional insights into the distribution of the overall employment impact (see Figure 2 on the following page). Public Services, which includes education, health, and public administration, sees an average annual increase of approximately 2,350 FTEs during the study period. This is approximately two percent of the net employment impact. Increased economic activity and GDP increases demand for government services and expenditures, driving employment in this area.

The Goods Producing sector includes construction, manufacturing, utilities, agriculture, and other primary. The increase in employment in this aggregate sector – on average 41,400 FTEs per year or 35 percent of the overall impact – is primarily driven by the construction sector. Construction receives a majority of the new spending on energy efficiency measures and services, and also benefits from more investment as consumers and businesses substitute energy dollars for renovation-related purchases, new housing starts, and other related goods and services. Manufacturing jobs make up approximately one quarter of the Goods Producing jobs, driven largely by lower energy costs, increased demand for goods manufactured in Canada, and increased demand more generally from improved competitiveness, requiring additional labour in large manufacturers and their partners.

The Goods Producing sector captures the net negative impact on the utilities sector. The reduction in employment is tied to reduced energy sales and a reduction in the need for new capacity. As mentioned above, the clean energy economy will require a move to electrification of buildings and transportation. This new demand is not accounted for in this modeling assessment. In addition, we have taken a conservative approach with electricity exports and assumed that 100 percent of the electricity saved in the hydro provinces would find an export market in the first five years only. In reality, utilities in these jurisdictions will most likely be able to export electricity beyond the five-year period, and utilities in other provinces may also be able to export a portion of their electricity savings – which would reduce the negative impact.

The remaining industry segments are included under Private Services, which is responsible for 63 percent of the net increase in employment – on average 74,490 FTEs per year. Approximately half of the net increase in employment in this aggregate sector comes from 'retail and wholesale trade' and 'transportation and warehousing'. As bill savings accumulate, households have more disposable income that is invested in retail and related purchases; business experience improved competitiveness and demand for their goods and services, which also has an impact on their supply chain. Other segments, such as 'accommodations and food' and 'finance, insurance, and real estate' also see employment gains as a result of the reinvestment of energy dollars.

Figure 2: Average annual net jobs in Canada by aggregated industry sector – PCF Scenario



Private Services captures the net negative impact on the Professional, Scientific, and Managerial (PSM) segment. The net negative impact on the PSM sector is small as a percentage of this relatively large sector – it represents a -0.2% reduction from the base of 2.407 million PSM workers. The reduction in workforce is attributed to reduced activity or investment in the construction sector. PSM employs administrators, planners, designers, engineers, etc., and has a relatively strong linkage with the construction sector. Under the energy efficiency scenarios, future investments are brought forward, resulting in inflationary and crowding out effects and thus a slowing down of the economy relative to the reference case. As construction experiences a downward cycle closer to 2030, PSM sector employment declines as well.

BILL SAVINGS

As mentioned, a significant portion of the economic impact is driven not by the initial investment in energy efficiency measures and services but by the savings that either increase household disposable income or improve business productivity, in turn leading to larger returns and/or improved competitiveness.

The tables below summarize consumer and business savings over the lifetime of the energy efficiency measures under the PCF and PCF+ scenarios. To note, the macroeconomic impacts present a snapshot of the economic impact within the policy framework timeframe; however, bill savings in this section reflect average and cumulative savings from 2017 to 2045 – thus capturing consumer savings over the lifetime of the energy efficiency measures implemented in 2017 to 2030.[15]

The bill savings are **net savings** – they account for both positive impacts (lower energy inputs) and negative impacts (cost to implement the programs).

Table 10: Residential and Commercial, Institutional and Industrial (C&I) bill savings from reduced energy costs – PCF scenario ($2017)

PCF Scenario	Residential	C&I
Average Annual Household Savings	$114 / year	*
Average Cumulative Household Savings	$3,306	*
Cumulative Savings (Billions)	$40.0	$92.6
Average Annual Savings (Billions)	$1.4	$3.2

Table 11: Residential and Commercial, Institutional and Industrial (C&I) bill savings from reduced energy costs – PCF+ scenario ($2017)

PCF+ Scenario	Residential	C&I
Average Annual Household Savings	$151 / year	*
Average Cumulative Household Savings	$4,380	*
Cumulative Savings (Billions)	$53.0	$140.7
Average Annual Savings (Billions)	$1.8	$4.9

*Average annual and average cumulative savings by business/industrial facility were not calculated because of the large variance in size and energy profile between businesses/facilities in these sectors.

[15] See Appendix A, in particular footnote 28, for addition information on the assumed average Effective Useful Life (EUL) for each scenario and fuel type.

PART D

GHG EMISSIONS REDUCTIONS

GHG EMISSIONS REDUCTIONS

This section summarizes the GHG emissions savings associated with the PCF and PCF+ policy scenarios. These emissions savings were estimated outside of the macroeconomic model.

OVERVIEW

As part of international efforts to combat climate change, the Canadian government made commitments to reduce its greenhouse gas emissions (GHG) by 30% relative to 2005 levels by 2030. These are commonly referred to as the “Paris commitments”, or commitments made under the “Paris accord”. As of December 2017, Environment and Climate Change Canada (ECCC) has determined that respecting that commitment would require reducing current emissions by 205 megatonnes (Mt).[16]

The Pan-Canadian Framework is a broad plan that outlines a variety of actions – including but not limited to energy efficiency – that Canada intends to take as part of its efforts to meet or exceed that commitment. According to ECCC’s modelling, the full array of actions contained in the PCF are expected to reduce GHG emissions by 139 Mt.[17]

EMISSIONS REDUCTIONS FROM THE PCF ENERGY EFFICIENCY SCENARIO

According to ECCC’s modelling, measures accounted for under the PCF scenario in this study, i.e. the energy efficiency measures to apply in homes, buildings and industry, are expected to contribute more than a third of the total PCF impact, reducing GHG emissions by an estimated 52 Mt in 2030. These emissions savings are a result of reduced end-use consumption of electricity, natural gas, and refined petroleum products (e.g. heating oil) in the residential, commercial, and industrial sector.[18]

When additional efforts are undertaken to further reduce the amount of energy consumed in homes, buildings, and industrial processes, as assessed under the PCF+ scenario, an estimated 79 Mt of GHG could be saved by 2030. The energy efficiency improvements in the built environment and industry could represent a significant portion of the GHG savings needed to achieve the 2030 target – approximately 25% of the requirement under the PCF scenario, and 39% under PCF+.

Table 12: Estimated GHG emissions reductions from the PCF and PCF+ energy efficiency scenarios

	2020	2025	2030
PCF – Cumulative Emissions Savings (Mt CO2e)	5	21	**52**
PCF+ – Cumulative Emissions Savings (Mt CO2e)	18	45	**79**

[16] Environment and Climate Change Canada’s Modelling of greenhouse gas projections. Accessed on February 6, 2018: https://www.canada.ca/en/services/environment/weather/climatechange/climate-action/modelling-ghg-projections.html?wbdisable=true

[17] Government of Canada’s 7th National Communication and 3rd Biennial Report. Accessed on March 5, 2018: http://unfccc.int/files/national_reports/national_communications_and_biennial_reports/application/pdf/82051493_canada-nc7-br3-1-5108_eccc_can7thncomm3rdbi-report_en_04_web.pdf

APPENDICES

APPENDIX A – ASSUMPTIONS & INPUTS

Additional detail related to the key assumptions and the process used to develop the modeling inputs is provided in this appendix.

BASIS FOR THE SCENARIOS

The PCF and PCF+ scenarios target end-use consumption for three fuel types: electricity, natural gas, and refined petroleum products. They reflect energy efficiency policies and programs that reduce demand for energy in the residential, commercial, and industrial sectors. This is a top-down assessment; specific programs and measures are not modeled. Instead, a level of ambition – in terms of GHG emissions or energy savings – forms the basis of the scenarios. Actions that might be undertaken and examples from jurisdictions that are coming close to or achieving a similar level of energy savings are provided below.

The **PCF scenario** is based on the energy efficiency actions for the build environment and industrial sector in the framework. The *Working Group on Special Mitigation Opportunities Final Report* outlines the policy goal, tools, details, and other consideration, for each of the actions. The report also includes the estimated reduction in energy use (percent) and GHG savings referenced in this report. For example, one of the action areas is to increase the energy efficiency of the existing housing stock. This would be done through a combination of financial incentives (e.g. grants and financing), regulations, and enabling measures, and the focus would be on building envelop retrofits. The Working Group estimates that actions would lead to a 1.5% to 10% reduction in energy use and 1 Mt to 6 Mt in energy savings.[19]

Another example action – Net-Zero Ready Codes for New Housing - would require all homes to be net-zero ready by 2030, so that homes built as of 2030 would use approximately 40% less energy relative to the 2012 model national code. It is assumed that jurisdictions will increase the stringency of their building codes in the lead up to 2030, and establish building labelling programs and workforce training to fully support net-zero ready codes in 2030. Ontario has announced it will make changes to its building codes in-line with the PCF, and introduce a mandatory Home Energy Rating and Disclosure (HER&D) labelling program in 2019. The Build Smart: Canada's Building Strategy outlines a roadmap and timeline to implement the PCF initiatives, including the net-zero ready action.[20]

In the industrial sector, the policy goal is to enhance energy efficiency beyond a business-as-usual 1% per year improvement. This could be done by accelerating the use of energy management systems using financial incentives and/or mandating emissions and energy standards. Recognized energy management systems are estimated to generate annual savings of: ISO 50001 = 1%-2%; Superior Energy Performance = 2%-4%; and, ENERGY STAR for Industry = 4%-8 per year.

The **PCF+ scenario** considers higher levels of ambition based on targets and energy savings achieved in leading jurisdictions across North America. As described in the following sub-section, annual percent savings targets were used to establish energy savings for this scenario. These targets are the same as those used in the Acadia Center macroeconomic modeling study conducted for Natural Resources Canada

[19] See *Annex 1: Summary Table of Policy Options* and *Annex 2: Policy Option Profiles* for additional details. Available at: http://www.climatechange.gc.ca/Content/6/4/7/64778DD5-E2D9-4930-BE59-D6DB7DB5CBC0/WG_Report_SPECIFIC_MITIGATION_OPPORTUNITIES_EN_V04.pdf
[20] See https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/emmc/pdf/Building_Smart_en.pdf.

and are summarized below. To note, PCF actions will contribute to the PCF+ targets; broadening the scope of coverage and additional incentives to achieve deeper savings will be needed to achieve PCF+.

- **Electricity – ramp up to 2.5%** savings in five years. A number of U.S. states are achieving a comparable level of electricity savings from incentive programs alone (PCF+ assumes a combination of incentives and regulatory requirements). For example, in 2015, Rhode Island achieved 2.9% electric savings, and Massachusetts' current three-year plan has annual targets above 2.9%. These states are meeting their mandated targets through a comprehensive and integrated portfolio of programs that target lighting, consumer products, heating and cooling equipment, retrofits and new building programs, and behavioral programs, among others. See, for example, Massachusetts' 2015 Annual report for an overview of its programs and sample projects.[21]
- **Natural Gas – ramp up to 1.75%** savings in five years. Jurisdictions with leading natural gas energy efficiency savings targets include Illinois and Minnesota, which have legislated targets of 1.5%, primarily associated with incentive programs. In Illinois, government approved new energy saving targets and minimum spending levels for utilities. The state also has relatively stringent commercial building energy codes, is rolling out smart meter infrastructure, among other initiatives.[22]
- **Refined Petroleum Products – ramp up to 2.5%** savings in five years. Historically, energy efficiency efforts have focused largely on regulated fuels, namely electricity and natural gas, and few regions have adopted clear targets for RPPs. Among the first, Quebec's recent target to reduce consumption of petroleum products by 40% by 2030 translates into greater than 2.5% savings per year across all fuels and all sectors (including transportation). Efficiency Maine Trust, Efficiency Vermont, and EfficiencyOne in Nova Scotia are jurisdictions with programs that target heating oil. For example, Efficiency Maine Trust provides audits, rebates, and financing to homeowners for air sealing, insulation, and heating systems upgrades.[23]

ESTABLISHING ENERGY SAVINGS LEVELS

For the PCF and PCF+ scenarios, the national emissions estimates (residential and commercial sector = 28 Mt by 2030; industrial sector = 30 Mt by 2030) were converted to energy savings using the following:

PCF Scenario

1. For each of the actions, the national GHG emissions reduction estimates were broken down by province. For the built environment, the breakdown is based on the provinces' share of emissions related to space and water heating (residential share if a residential action;

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[21] Massachusetts' 2015 Annual Plan available at: http://ma-eeac.org/wordpress/wp-content/uploads/EEAC-Year-2015-Annual-Report-the-the-Legislature.pdf

[22] See ACEEE's *2017 State Energy Efficiency Scorecard* for additional details. Available at: http://aceee.org/sites/default/files/publications/researchreports/u1710.pdf

[23] More detail on Efficiency Maine's Home Energy Savings Program is available here: https://www.efficiencymaine.com/at-home/home-energy-savings-program/

commercial share if a commercial action).[24] For the industrial sector, the breakdown is based on the provinces' share of emissions in the industrial sector as a whole.[25]

2. Provincial-level emissions were converted to energy savings (PJ) using province-specific emissions intensity factors for the residential, commercial, and industrial sectors. For the built environment actions, the emissions factors are based on the space and water heating fuel mix in each province.[26] For the industrial actions, the emissions factors are based on the industrial sector fuel mix in a given province.[27] In British Columbia and Quebec – where the marginal electricity resource is hydropower – electricity savings will not contribute to emissions reductions under the PCF. We therefore assumed that those provinces would direct a larger share of their energy efficiency efforts to non-electric fuels (natural gas and heating oil).. A portion of the savings that would have otherwise come from electricity (50 percent of their allocated electricity savings) were also distributed to other provinces in proportion to those provinces' share of space and water heating emissions.
3. Energy savings were then broken down by fuel type based on the percent share of electricity, natural gas, or refined petroleum product consumption in a given province and sector. To note, savings associated with other fuels (e.g. wood) were not included in the modeling assessment.
4. Annual incremental savings were converted to annual cumulative savings using assumed average efficiency measure lifespans for each fuel type and sector.[28]
5. Finally, because the PCF framework includes existing commitments at the provincial level as well, current and approved utility (or another program administrator) energy efficiency program annual savings from 2016 to 2030 were established (annual incremental and cumulative). Exceptionally, when utility efficiency savings were higher than the PCF in a given year (e.g. 2017 to 2018+ before the PCF actions begin or are still ramping up), then the utility savings were included over those of the PCF.[29]

[24] Built environment emissions shares were determined using NRCan Office of Energy Efficiency's Comprehensive Energy Use Database (accessed August-October 2017). Each province's share is based on its average total emissions from space and water heating from 2010 to 2014. Actions B1 and B2 use residential space and water heating shares while actions B3 and B4 use commercial space and water heating shares. We assume the bulk of the savings from action B5 comes from heating and cooling equipment and use a combination of residential and commercial shares.

[25] Industrial emissions shares were determined using NRCan Office of Energy Efficiency's Comprehensive Energy Use Database (accessed September/October 2017). Each province's share is based on its average total emissions from 2010 to 2014. For the Atlantic provinces, aggregated OEE data was broken down based on the breakdown of provincial total for Manufacturing Industries, Construction, Petroleum Refining and Agriculture and Forestry in the latest National Inventory Report. Emission from mining are excluded for the Atlantic provinces and Alberta. For the other provinces, it is assumed that mining does not include upstream oil and gas and is included in the total shares.

[26] Province-specific built environment emissions factors are based on data from the NRCan Office of Energy Efficiency's Comprehensive Energy Use Database (accessed August-October 2017). They are a weighted average based on energy use and emissions in 2014. To note, the OEE's data does not include emissions from electricity. Marginal electricity emissions factors were developed based on Dunsky's knowledge of provincial electricity resource mix (current and future).

[27] As with the built environment, province-specific industrial emissions factors are based on data from the NRCan Office of Energy Efficiency's Comprehensive Energy Use Database (accessed September/October 2017). They are a weighted average based on energy use and emissions in 2014. Electricity emission are also included based on marginal electricity emissions factors.

[28] For electricity, the Effective Useful Life (EUL) for existing/approved programs = 10 yrs (residential) and 14 yrs (C&I); for the PCF actions = 20 yrs (residential and C&I); and, best-in-class = 14 yrs (residential) and 18 yrs (C&I). For natural gas and RPP, the EUL for existing/approved programs = 21 yrs (residential) and 15 years (C&I); for the PCF actions = 26 yrs (residential) and 17 yrs (C&I); and, best-in-class = 26 (residential and 20 (C&I).

[29] Current and approved utility energy efficiency program savings levels were established through a review of utility energy efficiency plans, reports, and dockets for each province and fuel type, where applicable. The most recent data and information was used.

PCF+ Scenario

For the PCF+ policy scenario, the same steps were followed; however, instead of including current and approved utility energy efficiency programs, "best-in-class" annual savings targets (as a % of annual consumption) were considered. The targets are based on leading North American jurisdiction and the high scenario in the Acadia Center study, and are 2.5% for electricity, 1.75% for natural gas, and 2.5% for refined petroleum products (all ramped up over five years).[30]

The additional steps include:

6. The annual savings targets were applied to the demand forecast (2017-2030).[31]
7. Incremental savings were converted to annual cumulative savings using assumed average efficiency measure lifespans for each fuel type and sector (see footnote 5).
8. If these best-in-class targets produced savings in excess of the PCF savings levels in a given year, then the best-in-class savings were included over those of the PCF.

Table 13: Total energy savings (PJ) in 2030 for each fuel type at the national level.

	Electricity	Natural Gas	RPP	Total
Pan-Canadian Framework	246	626	92	965
Pan-Canadian Framework +	695	810	144	1,650

PROGRAM AND PARTICIPANT SPENDING LEVELS

Total energy efficiency investment levels in the model are based on annual program and participant spending levels in 2016 through 2030 for each province and fuel type. Unit program and participant costs were established for each provinces and fuel type. The unit costs are based on the unit costs in the Acadia Center study, which were developed by Dunsky using a combination of publicly available information and assumptions based on our experience and expertise.[32]

Table 14: Total levelized unit program costs for all sectors (nominal dollars)

	Electricity (cents/kWh)		Natural Gas (cents/m3)		RPP ($/GJ)	
	PCF	PCF+	PCF	PCF+	PCF	PCF+
British Columbia	3.3	3.8	14.5	20.0	2.7	3.7
Alberta	3.3	4.0	13.5	18.7	3.6	4.8
Saskatchewan	3.4	4.0	11.5	15.7	2.3	3.1
Manitoba	3.5	4.1	15.1	20.7	2.2	3.0
Ontario	5.7	6.7	9.8	13.6	3.6	4.8
Quebec	4.4	5.6	9.1	12.2	2.4	3.2

[30] See Acadia Center study at: http://acadiacenter.org/document/energy-efficiency-engine-of-economic-growth-in-canada/
[31] Existing and approved energy efficiency savings were added back into the demand forecast to avoid double counting (i.e. electricity savings are equal to 2.5% of annual consumption as opposed to 2.5% + existing efforts).
[32] See Appendix A6 in the Acadia Center study for additional detail regarding how the unit costs were developed.

New Brunswick	4.4	5.6	9.1	12.2	2.4	3.2
Nova Scotia	4.9	5.9	8.9	11.8	2.3	3.1
Prince Edward Island	5.0	5.9	8.9	11.8	2.3	3.1
Newfoundland & Labrador	3.4	3.9	8.9	11.8	4.7	6.4

Total unit program and participant costs were applied to the incremental annual energy savings for each province and fuel type to generate total annual program and participant spending from 2016 through 2030.

Table 15: First-year program spending (nominal $M) for each fuel type at the national level.

	Electricity	Natural Gas	RPP	Total
Pan-Canadian Framework	1,151	169	39	1,359
Pan-Canadian Framework +	2,209	640	195	2,267

Table 16: Average annual program spending (nominal $M) from 2017-2030 for each fuel type at the national level.

	Electricity	Natural Gas	RPP	Total
Pan-Canadian Framework	2,130	1,544	295	3,969
Pan-Canadian Framework +	8,090	3,098	707	11,894

EFFICIENCY SPENDING ALLOCATIONS

For each fuel type and sector, program and participant spending percentages were developed for a group of industry sectors. The breakdown by industry sector is based on the Acadia Center study, which is representative of comprehensive yet generic energy efficiency programs.[33] The allocations (by percent of total spending) are presented in the tables below.

Table 17: Industry allocation for program and participate spending by sector for electricity.

	Electricity						
	Program Spending				Participant Spending		
	Residential	*Commercial*	*Industrial*		*Residential*	*Commercial*	*Industrial*
Wood product manufacturing	1%	0%	0%		1%	0%	0%
Non-metallic mineral production 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%

[33] See Appendix A3 in the Acadia Center study (pg. 35).

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	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%

Table 18: Industry allocation for program and participate spending by sector for natural gas and RPP.

	Natural Gas & Refined Petroleum Products						
	Program Spending				**Participant Spending**		
	Residential	*Commercial*	*Industrial*		*Residential*	*Commercial*	*Industrial*
Wood product manufacturing	1%	0%	0%		1%	0%	0%
Non-metallic mineral production 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%

APPENDIX B – C_4SE ECONOMIC MODEL

Stokes Economic Consulting maintains the C_4SE multi-sector provincial economic models. The purpose of these models is to produce medium to long-term economic projections and conduct economic impact studies. The modelling system is maintained by their Staff Economists under the supervision of Aaron Stokes. The forecasts are updated semi annually and the forecast horizon is 20 years.

The provincial models have a number of distinguishing features. They are KLEM models – capital (K), labour (L), energy (E), and materials (M) are combined to produce gross output in each industry sector. Materials are used in fixed proportion to output while capital, labour, and energy are variable inputs to production. Refined petroleum products, natural gas and electricity are included as energy inputs. In addition, the provincial models incorporate information on major capital projects. The inventory of major projects for each province is a key driver for the economy over the short to medium term.

The model's economy is organized into four broad sectors. Firms employ intermediate materials, capital, and labour to produce a profit maximizing output and supply financial instruments. Households consume the domestic and foreign products, supply labour and demand financial assets under the assumption of utility maximization. Governments collect taxes, purchase the domestic and foreign products, produce output and supply financial instruments. Foreigners – agents outside the province – purchase the domestic product, supply the foreign product, and demand and supply financial instruments.

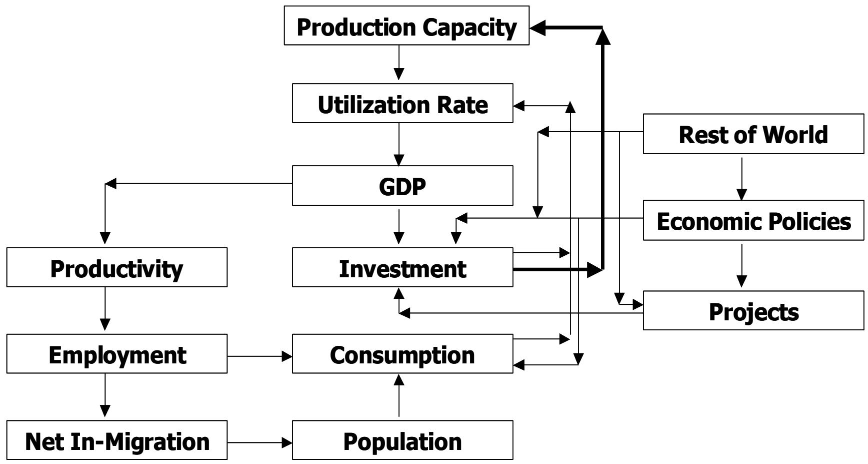
There are three main markets in the model. These markets correspond to the domestic and foreign products, the labour market, and financial markets. Each of these markets is concerned with the determination of demands, supplies, and prices.

The main outside forces driving the economy are the influences of the rest of the world and economic policies. These two sets of influences shape the views of local decision makers including the decision to undertake major projects. Real GDP growth, inflation, and interest rates in the rest of the world drive local economic growth through their influence on exports, local inflation, and the cost of credit. Policy variables such as tax rates and government expenditures on programs also impact local economic growth.

The models employ Statistics Canada's latest economic and demographic data. The economic data are based on a reference year of 2012. The input-output coefficients in the models are based on the 2013 input-output tables. The industry classification system used for the models is the NAICS – North American Industry Classification System.

The calibration of the model involves statistical estimation of parameters, extraneous parameter estimates and economic theory that implies specific values for key parameters in the model such as those for the input-output coefficients.

The basic workings can be seen from figure shown below.



Given the external forces and the production capacity of the various sectors in the economy, firms set capacity utilization rates based on expected sales thereby determining real output.

Once real output for each industry is determined, employment for all industries is set through the productivity of labour. Employment combined with wages, other income, and consumer prices then determines private consumption. Employment when compared with labour force then drives net in-migration, which in turn sets population growth.

Population growth combined with personal income then determines private consumption. Population also impacts government consumption, as a change in population leads to a change in the demand for government services. Both government consumption and investment are affected.

The increase in real output combined with changes in consumption then changes private investment decisions. The changes in consumption and investment decisions, in turn, lead to changes in capacity utilization rates and output. This type of cycle continues until the one-year solution of the model is obtained.

In the long term, the key determinants of changes in overall economic activity in the model are growth in fixed investment expenditures and productivity growth. The rate of productivity growth is determined by changes in technology and modifications to the way in which business is conducted. Productivity is an exogenous variable – is set outside of the model.

LIMITATIONS

The C_4SE modelling system can accommodate assumptions about reduced energy usage on an individual industry by industry basis. Energy input savings to the production process and energy efficiency capital investment assumptions were, however, provided by Dunsky Energy Consulting on a sector basis for the residential, commercial, and industrial sectors. The modelling work was therefore performed at the industry level where the sector inputs were allocated across the C_4SE model industries; however, it is important to recognize that industries have differing capacities to reduce energy usage. Labour productivity also differs by industry in the C_4SE economic models which would lead to different employment impacts under alternate industry capital investment allocations.

The economic modelling approach makes the conventional assumption that capital, labour, and energy are substitutes in the production of gross output. As energy efficiency capital investments reduce energy inputs in the production process, the share of capital and labour rises over time. The impact on labour from the usage of less energy and more capital in the production process starts small, and the full effect is only felt after three years. There is also a distinction between short and long-term impacts in the household sector expenditure categories.

It is important to note that there are positive effects on aggregate output as well as upward pressure on prices generated as the energy efficiency investments are undertaken. The effect of higher prices and additional output set the economy onto a new path and generate a new economic cycle as these higher prices ‘crowd out’ or reduce future investment. The economy then faces a negative multiplier as these investments are completed after 2030 and crowding out effects continue to occur. This new cycle causes the level of aggregate output and employment to eventually fall below the base case scenario. Economic growth will then cycle back above and below the base case scenario into the future until prices and output stabilize. Nonetheless, the net result on GDP and employment is positive as energy inputs become a smaller share of the production process while capital and labour’s share become larger. We note that the purpose of this study was to assess a specific policy framework and provide a “snapshot” of the economic impact during that timeframe. A longer time horizon would change the average annual and cumulative net impacts; however, at least out to 2045 the net impacts are positive over the base economic scenario.

The C4SE model was used to estimate macroeconomic impacts, while GHG emission reductions resulting from energy efficiency were calculated outside of the model based on energy savings and the emission intensities of different fuel sources. We note that the increased economic activities projected in this report could increase demand for energy and GHG emissions, a phenomenon often called “the rebound effect”; however, the magnitude of this effect resulting from energy efficiency programs is uncertain. In reality, rebounds from re-spending of energy bill savings are relatively small because energy spending is a small portion of GDP – approximately 2% in Canada based on the most recent input-output tables from Statistics Canada. However, a broader study considering how technological and structural changes, as well as changes in prices and incomes, would be needed to understand the potential GHG implications. This is a larger question regarding the carbon intensity of economic growth that is outside the scope of this study.

APPENDIX C – ECONOMIC IMPACT RESULTS

Appendix C summarizes GDP and employment impacts for the PCF and PCF+ scenarios by province and fuel type as well as bill savings. The results reflect the total net change over the period of 2017 to 2030.

PAN-CANADIAN FRAMEWORK SCENARIO

Table 19: PCF Scenario – Net change in GDP ($2017 Billions) by province and fuel type (2017-2030)

	All Fuels	Electricity	Natural Gas	Refined Petroleum Products
Canada	**$355.9**	**$54.1**	**$140.8**	**$156.7**
British Columbia	$54.4	$5.0	$20.1	$27.4
Alberta	$32.7	$4.2	$22.5	$5.3
Saskatchewan	$10.7	$1.1	$5.8	$3.5
Manitoba	$12.6	$4.0	$5.2	$4.9
Ontario	$174.5	$25.2	$70.5	$76.2
Quebec	$55.1	$11.1	$15.5	$28.2
New Brunswick	$4.9	$1.1	$0.6	$3.1
Nova Scotia	$7.7	$1.8	$0.6	$5.2
Prince Edward Island	$2.4	$0.8	$0.2	$1.4
Newfoundland & Labrador	$2.3	$0.1	-$0.4	$2.6

Table 20: PCF Scenario – Net change in employment (job-years) by province and fuel type (2017-2030)

	All Fuels	Electricity	Natural Gas	Refined Petroleum Products
Canada	**1,655,965**	**236,136**	**602,017**	**799,487**
British Columbia	256,420	13,161	100,750	138,435
Alberta	82,576	5,749	78,237	-3,403
Saskatchewan	47,777	5,805	27,197	13,708
Manitoba	58,612	18,315	19,759	23,898
Ontario	740,695	105,801	272,132	353,048
Quebec	353,230	59,975	97,572	191,920
New Brunswick	25,879	6,696	3,365	15,715
Nova Scotia	58,367	14,966	4,702	38,266
Prince Edward Island	21,056	5,450	1,551	13,450
Newfoundland & Labrador	11,353	218	-3,248	14,450

PAN-CANADIAN FRAMEWORK+ SCENARIO

Table 21: PCF+ Scenario – Net change in GDP ($2017 Billions) by province and fuel type (2017-2030)

	All Fuels	Electricity	Natural Gas	Refined Petroleum Products
Canada	**$595.0**	**$174.4**	**$184.0**	**$218.6**
British Columbia	$97.8	$23.1	$26.0	$43.0
Alberta	$71.5	$8.2	$40.6	$20.8
Saskatchewan	$20.9	$2.6	$10.8	$7.0
Manitoba	$26.0	$11.0	$8.2	$7.8
Ontario	$212.6	$44.7	$77.0	$86.6
Quebec	$135.5	$77.0	$18.0	$38.8
New Brunswick	$10.2	$3.6	$1.7	$4.1
Nova Scotia	$12.8	$2.4	$1.5	$5.2
Prince Edward Island	$3.8	$1.7	$0.2	$1.6
Newfoundland & Labrador	$3.9	$0.7	-$0.5	$3.8

Table 22: PCF+ Scenario – Net change in employment (job-years) by province and fuel type (2017-2030)

	All Fuels	Electricity	Natural Gas	Refined Petroleum Products
Canada	**2,443,572**	**837,626**	**660,535**	**865,286**
British Columbia	370,814	90,341	102,699	161,939
Alberta	120,994	-19,894	111,862	25,825
Saskatchewan	70,327	7,846	39,462	21,132
Manitoba	112,706	53,021	25,284	36,023
Ontario	782,762	200,930	259,801	310,256
Quebec	799,764	449,345	106,913	229,463
New Brunswick	48,453	20,030	7,507	16,778
Nova Scotia	92,888	21,746	9,522	32,011
Prince Edward Island	30,524	12,000	2,326	14,485
Newfoundland & Labrador	14,340	2,261	-4,841	17,374

BILL SAVINGS – PCF AND PCF+ SCENARIOS

Table 23: PCF Scenario – Total residential and C&I bill savings ($2017 Billions) and total and average annual household savings ($2017) by province.

	Residential			Commercial & Industrial
	Total Savings ($2017 Billions)	Savings per household (lifetime)	Savings per household (avg. annual)	Total Savings ($2017 Billions)
British Columbia	**$2.5**	$1,042	$36	**$16.0**
Alberta	**$2.5**	$1,138	$39	**$7.1**
Saskatchewan	**$0.9**	$1,583	$55	**$2.4**
Manitoba	**$1.0**	$1,633	$56	**$2.8**
Ontario	**$18.0**	$2,728	$94	**$39.5**
Quebec	**$9.5**	$2,289	$79	**$14.7**
New Brunswick	**$1.5**	$4,270	$147	**$4.8**
Nova Scotia	**$2.6**	$5,980	$206	**$2.1**
Prince Edward Island	**$0.6**	$8,486	$293	**$0.5**
Newfoundland & Labrador	**$0.9**	$3,915	$135	**$2.8**

Table 24: PCF+ Scenario – Total residential and C&I bill savings ($2017 Billions) and total and average annual household savings ($2017) by province.

	Residential			Commercial & Industrial
	Total Savings ($2017 Billions)	Total savings per household (lifetime)	Annual savings per household (avg/year)	Total Savings ($2017 Billions)
British Columbia	**$5.3**	$2,300	$79	**$18.9**
Alberta	**$2.9**	$1,333	$46	**$27.5**
Saskatchewan	**$1.0**	$1,828	$63	**$4.7**
Manitoba	**$1.4**	$2,361	$81	**$4.5**
Ontario	**$21.0**	$3,211	$111	**$46.7**
Quebec	**$13.8**	$3,370	$116	**$28.8**
New Brunswick	**$2.7**	$7,900	$272	**$4.1**
Nova Scotia	**$2.9**	$6,623	$228	**$2.5**
Prince Edward Island	**$0.7**	$8,955	$309	**$0.5**
Newfoundland & Labrador	**$1.3**	$5,922	$204	**$2.4**

APPENDIX D – FISCAL IMPACT RESULTS

Appendix D summarizes federal and provincial fiscal impacts for the PCF and PCF+ scenarios by province across all fuel types. The results reflect the total net change over the period of 2017 to 2030.

PAN-CANADIAN FRAMEWORK SCENARIO

Table 25: PCF Scenario – Net change in federal tax collections ($2017 Billions) by province – all fuel types (2017-2030)

	Personal Income Tax	Corporate Income Tax	Sales Tax	Total
Canada	**$54.2**	**$5.6**	**$23.1**	**$82.8**
British Columbia	$9.5	$0.1	$4.3	$13.8
Alberta	$4.2	-$2.9	$3.6	$4.9
Saskatchewan	$1.4	-$0.1	$0.8	$2.1
Manitoba	$2.0	$0.4	$1.0	$3.4
Ontario	$28.0	$4.9	$9.3	$42.2
Quebec	$6.7	$2.0	$3.1	$11.8
New Brunswick	$0.6	$0.5	$0.3	$1.4
Nova Scotia	$1.0	$0.6	$0.4	$2.0
Prince Edward Island	$0.3	$0.0	$0.2	$0.4
Newfoundland & Labrador	$0.4	$0.2	$0.1	$0.7

Table 26: PCF Scenario – Net change in provincial tax collections ($2017 Billions) by province – all fuel types (2017-2030)

	Personal Income Tax	Corporate Income Tax	Sales Tax	Total
Canada	$37.8	$3.5	$47.1	$88.5
British Columbia	$5.4	$0.2	$7.2	**$12.8**
Alberta	$4.2	-$1.8	$1.6	**$3.9**
Saskatchewan	$0.8	-$0.1	$1.9	**$2.6**
Manitoba	$1.4	$0.2	$2.4	**$4.0**
Ontario	$17.2	$3.3	$19.7	**$40.2**
Quebec	$7.1	$0.9	$11.0	**$19.0**
New Brunswick	$0.5	$0.4	$1.0	**$1.9**
Nova Scotia	$0.8	$0.5	$1.4	**$2.7**
Prince Edward Island	$0.2	$0.0	$0.6	**$0.8**
Newfoundland & Labrador	$0.3	$0.1	$0.5	**$0.8**

PAN-CANADIAN FRAMEWORK+ SCENARIO

Table 27: PCF+ Scenario – Net change in federal tax collections ($2017 Billions) by province – all fuel types (2017-2030)

	Personal Income Tax	Corporate Income Tax	Sales Tax	Total
Canada	**$107.1**	**$12.6**	**$46.4**	**$166.1**
British Columbia	$21.2	$0.1	$8.8	$30.1
Alberta	$9.8	-$4.9	$7.8	$12.7
Saskatchewan	$3.3	-$0.2	$1.7	$4.7
Manitoba	$4.9	$0.7	$2.5	$8.1
Ontario	$45.5	$9.9	$14.8	$70.2
Quebec	$17.3	$4.3	$8.7	$30.3
New Brunswick	$1.6	$1.2	$0.7	$3.6
Nova Scotia	$2.1	$1.2	$0.8	$4.1
Prince Edward Island	$0.5	$0.0	$0.3	$0.8
Newfoundland & Labrador	$1.0	$0.2	$0.3	$1.5

Table 28: PCF+ Scenario – Net change in provincial tax collections ($2017 Billions) by province – all fuel types (2017-2030)

	Personal Income Tax	Corporate Income Tax	Sales Tax	Total
Canada	$75.5	$8.0	$99.1	$182.6
British Columbia	$11.1	$0.2	$17.1	**$28.4**
Alberta	$9.0	-$3.1	$2.5	**$8.5**
Saskatchewan	$1.8	-$0.1	$4.0	**$5.7**
Manitoba	$3.3	$0.3	$5.9	**$9.6**
Ontario	$27.9	$6.6	$31.5	**$65.9**
Quebec	$18.6	$1.9	$30.7	**$51.2**
New Brunswick	$1.1	$1.0	$2.6	**$4.8**
Nova Scotia	$1.7	$1.0	$2.7	**$5.4**
Prince Edward Island	$0.4	$0.0	$1.0	**$1.4**
Newfoundland & Labrador	$0.6	$0.1	$1.1	**$1.9**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