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

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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.

[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

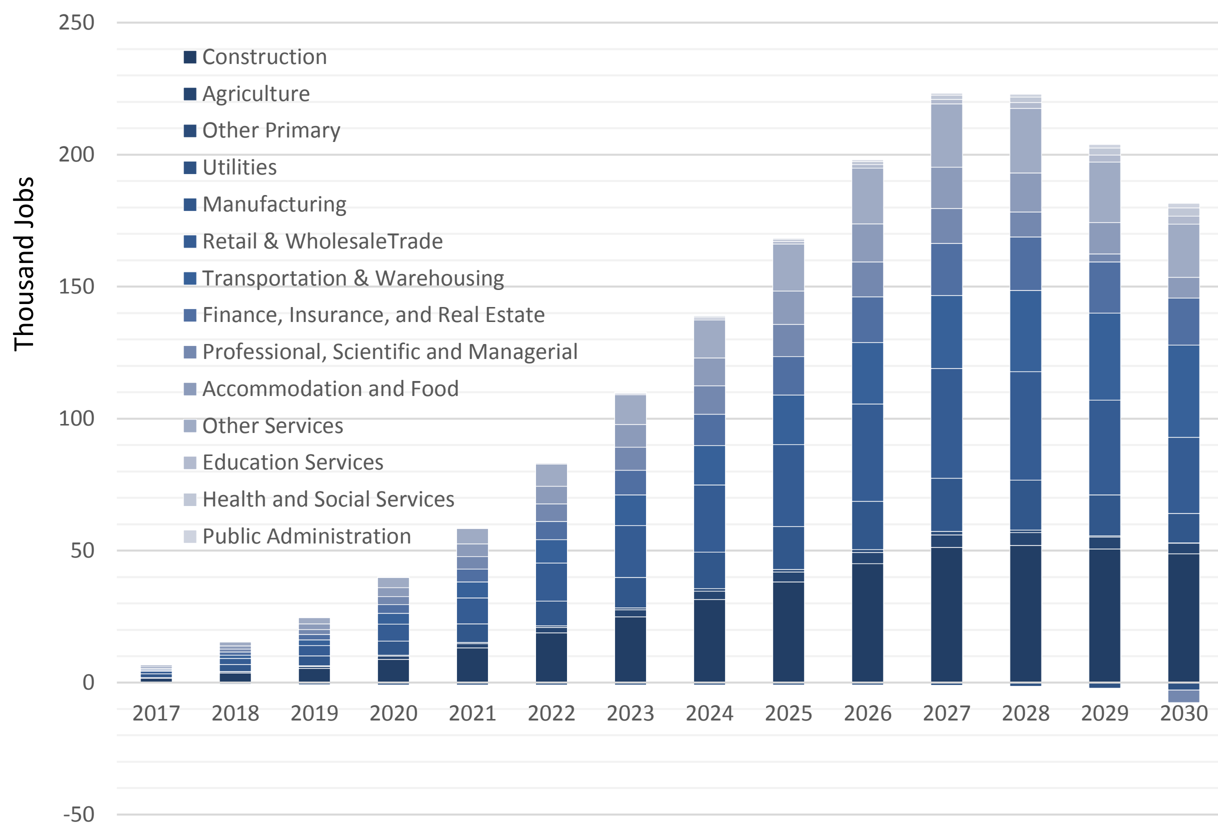
	Net Change in GDP ($2017 Billions)		Net Change in Employment (Full-time equivalent jobs)*	
	2017-2030	Average Annual	2017-2030	Average Annual
CANADA-WIDE[2]	**$355.9**	**$25.4**	**1,655,965**	**118,283**
British Columbia	$54.4	$3.8	256,420	18,316
Alberta	$32.7	$2.3	82,576	5,898
Saskatchewan	$10.7	$0.8	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.

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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.

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[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

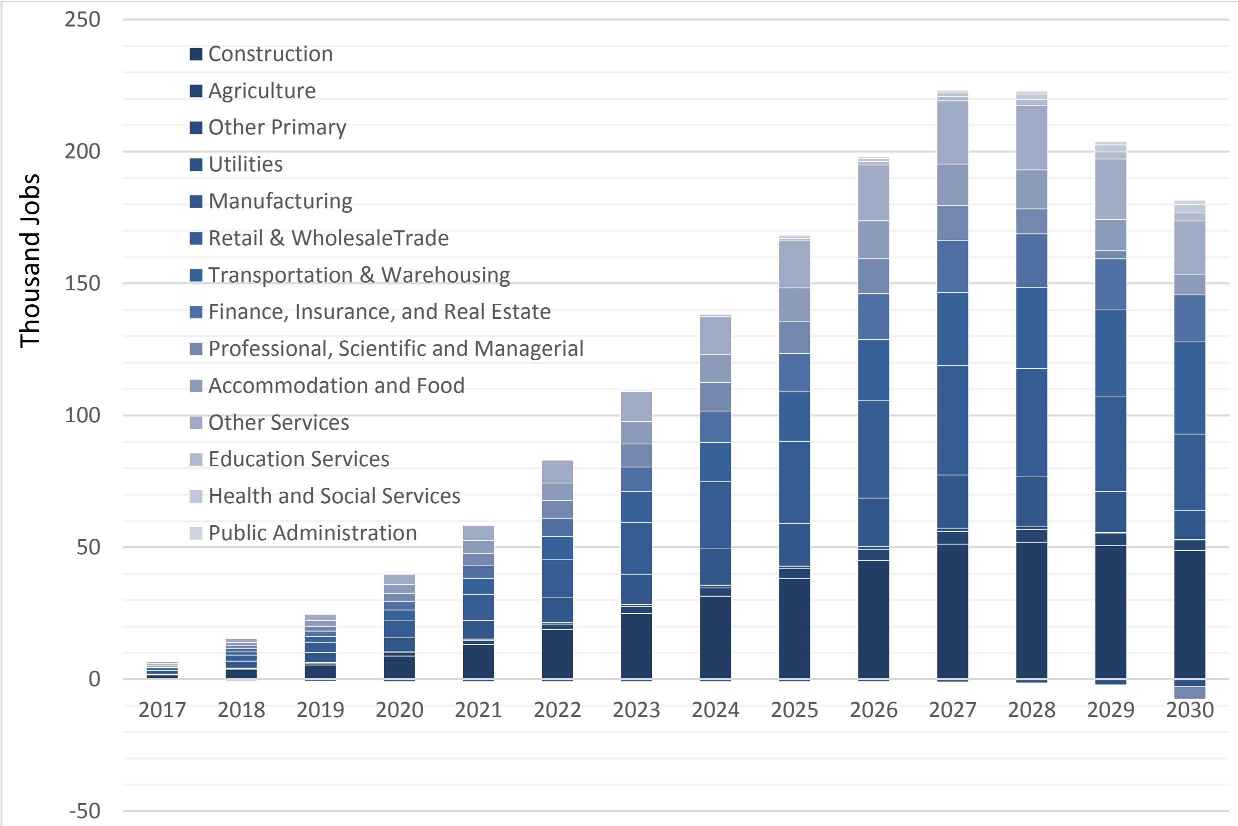
	Net Change in GDP ($2017 Billions)		Net Change in Employment (Full-time equivalent jobs)*	
	2017-2030	Average Annual	2017-2030	Average Annual
CANADA-WIDE[14]	**$355.9**	**$25.4**	**1,655,965**	**118,283**
British Columbia	$54.4	$3.8	256,420	18,316
Alberta	$32.7	$2.3	82,576	5,898
Saskatchewan	$10.7	$0.8	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



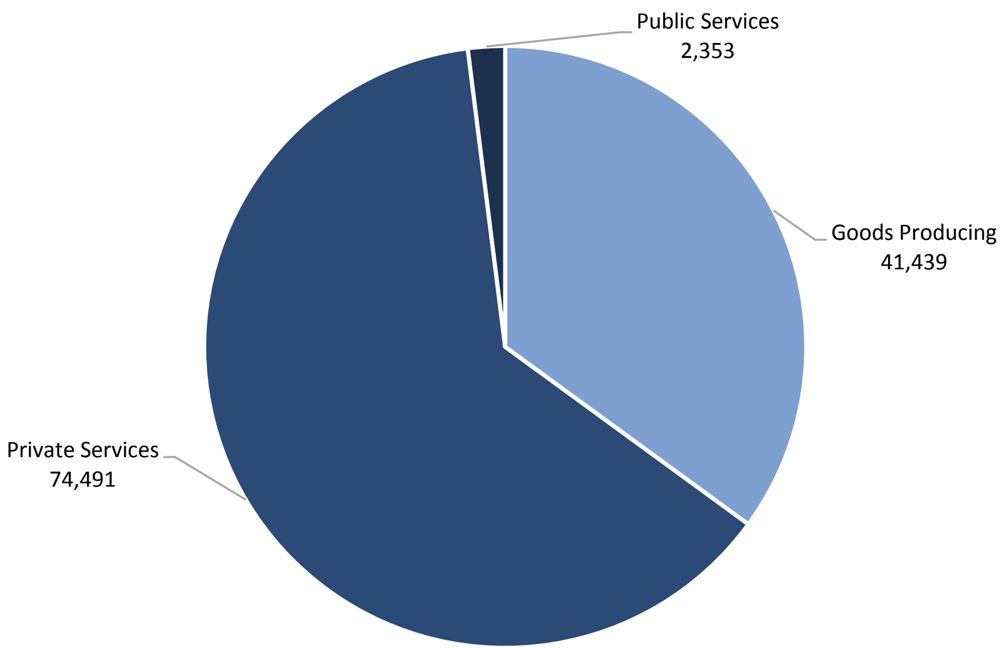
Grouping industry segments into aggregate industry sectors – Public Services, Goods Producing, and Private Services – provides additional insights into the distribution of the overall employment impact (see Figure 2 on the following page). Public Services, which includes education, health, and public 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;

[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]

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[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.

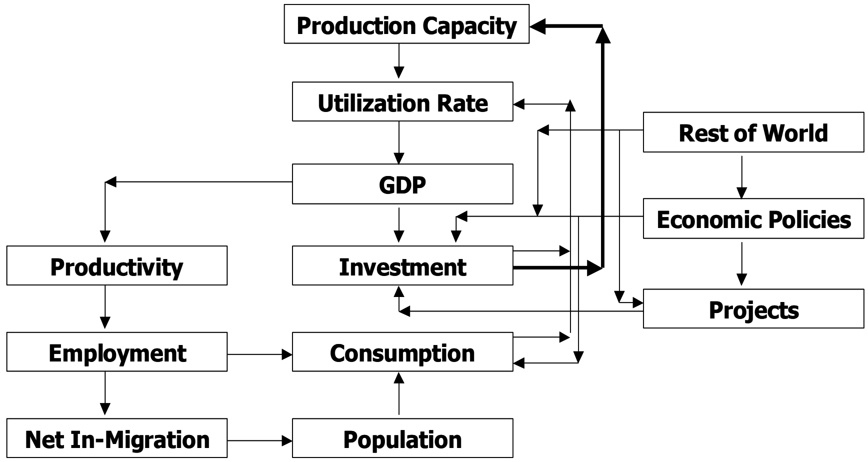
There are three main markets in the model. These markets correspond to the domestic and foreign products, the labour market, and financial markets. Each of these markets is concerned with the determination of demands, supplies, and prices.

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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