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June 22, 2018

British Columbia Utilities Commission
Suite 410, 900 Howe Street
Vancouver, BC
V6Z 2N3

Attention: Mr. Patrick Wruck, Commission Secretary and Manager, Regulatory Support

Dear Mr. Wruck:

Re: FortisBC Energy Inc. (FEI)

Application for Acceptance of Demand Side Management (DSM) Expenditures Plan for the period covering from 2019 to 2022

Pursuant to section 44.2 of the *Utilities Commission Act*, FEI hereby applies to the British Columbia Utilities Commission for acceptance of the attached DSM Expenditures Plan covering the period from 2019 to 2022.

If further information is required, please contact the undersigned.

Sincerely,

FORTISBC ENERGY INC.

Original signed:

Diane Roy

Attachments

cc (email only): Energy Efficiency and Conservation Advisory Group
Registered Interveners to the FEI Annual Review for 2018 Rates
Registered Interveners to the 2008 Gas EEC/DSM Application

FORTISBC ENERGY INC.

2019-2022 Demand Side Management Expenditures Plan

June 22, 2018

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1. INTRODUCTION

In this application (the Application) FortisBC Energy Inc. (FEI or the Company) requests acceptance pursuant to section 44.2 of the *Utilities Commission Act* (UCA) of the Demand Side Management (DSM) expenditure schedule in Table 6-1 covering the period from 2019 to 2022. FEI is also seeking approvals related to the amortization and accounting treatment of its DSM expenditures as discussed in Section 9 below.

FEI's proposed DSM expenditure schedule reflects FEI's 2019-2022 DSM Plan (DSM Plan), included as Appendix A. The DSM Plan provides details on each of FEI's program areas and individual DSM programs, including cost-effectiveness test results. The information presented in the DSM Plan involved a collaborative working effort between FEI DSM program personnel and ICF Canada (ICF), an energy efficiency consulting firm that also assisted FEI with its previous 2012-2013 and 2014-2018 DSM Plans. More details on the approach undertaken to develop the DSM Plan can be found in section 1 of the DSM Plan (Appendix A).

FEI's proposed DSM expenditure schedule is also supported by FEI's 2017 Annual DSM Report included as Appendix B. The 2017 Annual DSM Report describes the results of FEI's 2017 programs, most of which FEI is proposing to continue. As indicated in the 2017 Annual DSM Report, FEI continues to deliver a cost-effective portfolio of DSM programs and activities.

As set out in the Application, FEI's proposed DSM expenditure schedule is consistent with the British Columbia's energy objectives and FEI's Long Term Resource Plan, meets the adequacy and cost-effectiveness requirements of the Demand-Side Measures Regulation, and responds to government policy encouraging an increase in DSM program incentives and support.

The Application demonstrates that the proposed DSM expenditures are in the public interest and FEI requests that they be accepted by the British Columbia Utilities Commission (BCUC or the Commission).

2. APPROVALS SOUGHT AND PROPOSED REGULATORY PROCESS

FEI seeks an order pursuant to section 44.2(3) of the UCA accepting the 2019 - 2022 DSM Expenditure Schedule set out in Table 6-1 of the Application, with total DSM expenditures of $324.6 million for 2019 through 2022.

In addition, FEI is seeking approval of the following:

1. Approval for funding transfers as set out in Section 9.1;
2. Approval of the forecast rate base additions accounting treatment as set out in Section 9.2; and
3. Approval to move to a 16-year amortization period for DSM expenditures as set out in Section 9.3.

A draft Order is attached as Appendix C.

The 2019-2022 DSM Expenditures Plan was developed with the help of information gathered through consultation with various program stakeholders and interested parties. Given the extensive consultation that provided multiple opportunities for review and feedback with key stakeholders as detailed in Section 6.1 of the Application and to accommodate a Commission decision on the Application before the end of the year, FEI believes that a written public hearing with one round of Information Requests is appropriate for the review of this Application and proposes the following regulatory timetable.

Table 2-1: Proposed Regulatory Timetable

Regulatory Timetable	Date (2018)
Registration of Interveners	Friday, July 6
BCUC Information Request No. 1	Friday, July 20
Intervener Information Request No. 1	Wednesday, July 25
FEI Response to Information Request No. 1 from BCUC and Interveners	Friday, August 10
FEI Final Submission	Thursday, August 30
Intervener Final Submission	Thursday, September 13
FEI Reply Submission	Friday, September 28

3. BACKGROUND AND REQUIRED CONSIDERATIONS

3.1 *DEMAND SIDE MANAGEMENT DRIVERS*

Government focus to reduce greenhouse gas (GHG) emissions is an important factor driving FEI's 2019-2022 DSM Plan. The Province of British Columbia has been committed to reducing GHG emissions since initial objectives were introduced in the 2007 BC Energy Plan. In recent years, BC Government policy has evolved and continued to support emissions reduction through increasing natural gas energy efficiency.

In 2016, British Columbia's Climate Leadership Plan set specific direction to FEI to "expand their incentives by at least 100 per cent, to encourage further adoption of technologies that reduce the emissions of gas fired equipment."[1] The BC Demand-Side Measures Regulation (DSM Regulation) was subsequently revised in 2017 to create the regulatory framework for FEI to meet the Climate Leadership Plan incentive expansion requirement. More recently, in May 2018, the BC Government introduced new targets for GHG emission reductions.[2]

Federal Government policy has also evolved in recent years with the introduction of the Pan Canadian Framework on Clean Growth and Climate Change in 2016. This includes a focus on improving building energy efficiency and increasing space and water heating equipment efficiency to reduce GHG emissions. The Province of British Columbia has committed to the Pan Canadian Framework.

As policy has continued to evolve, the market for energy efficiency in British Columbia has also continued to develop and demand for FEI natural gas efficiency programs is strong. FEI's DSM Plan proposes a significant increase in expenditures driven by the March 2017 changes in the DSM Regulation, implementing new measures, increasing incentives for certain measures and increasing participation in existing programs. More specifically, the DSM Regulation changes enable increased activity in support of the BC Energy Step Code[3], Low Income programs, codes and standards, and programs that require use of the Modified Total Resource Cost Test (MTRC – discussed in Section 7.1.3). FEI believes the DSM Plan supports the objectives set by policy through increasing DSM expenditures and associated natural gas energy savings.

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1 British Columbia's Climate Leadership Plan, August 2016, p 32.

2 New Bill Updates Targets for Reducing Carbon Pollution, https://news.gov.bc.ca/releases/2018ENV0021-000860

3 The BC Energy Step Code is a voluntary provincial standard within the BC Building Code that provides a consistent approach to achieve higher energy-efficiency in buildings that go beyond the requirements of the base BC Building Code, It does so by establishing a series of measurable, performance-based energy-efficiency requirements for construction that builders can choose to build to, and communities may voluntarily choose to adopt in bylaws and policies. Source: https://www2.gov.bc.ca/gov/content/industry/construction-industry/building-codes-standards/energy-efficiency/energy-step-code.

3.2 *LEGAL FRAMEWORK*

FEI is filing the Application pursuant to section 44.2(1)(a) of the UCA, which provides that a utility may file "a statement of the expenditures on demand-side measure the public utility has made or anticipates making during the period addressed by the utility". As shown in the DSM Plan (Appendix A), all proposed activity qualifies as "demand side measures" as defined under the UCA. Section 44.2(2) of the UCA provides that the Commission must accept an expenditure schedule of demand-side measure expenditures before including those expenditures in rates.

Pursuant to section 44.2(3) and (4), the Commission must accept the expenditure schedule if it considers the schedule to be in the public interest, or it may accept a part of the schedule. In considering whether a demand-side measure expenditure schedule put forward by a public utility other than BC Hydro and Power Authority (BC Hydro) is in the public interest, the Commission must consider the following criteria according to section 44.2(5):

- the applicable of British Columbia's energy objectives,
- the most recent long-term resource plan filed by the public utility under section 44.1, if any,
- the extent to which the schedule is consistent with the applicable requirements under sections 6 and 9 of the *Clean Energy Act*,[4]
- if the schedule includes expenditures on demand-side measures, whether the demand-side measures are cost-effective within the meaning prescribed by regulation, if any, and
- the interests of persons in British Columbia who receive or may receive service from the public utility.

The required considerations are addressed in Sections 3.3, 3.4, 3.7 and 7.

The consideration of "adequacy" as defined in section 2 of the DSM Regulation is discussed in Section 3.5 below, and a discussion of the consistency of FEI's DSM Plan with government climate policy is provided in Section 3.6 below.

3.3 *CONSISTENCY WITH BRITISH COLUMBIA ENERGY OBJECTIVES*

British Columbia's energy objectives are defined and set out in section 2 of the *Clean Energy Act* (CEA). The applicable energy objectives and how FEI's proposals support those objectives are set out in Table 3-1 below.

[4] The requirements of sections 6 and 9 of the Clean Energy Act relate to electricity self-sufficiency and BC Hydro domestic long-term sales contracts, respectively, and are not applicable to FEI or this Application.

Table 3-1: BC's Energy Objectives Met by FEI DSM Activity

Energy Objective	FEI DSM Portfolio
(b) to take demand-side measures and to conserve energy, including the objective of the authority reducing its expected increase in demand for electricity by the year 2020 by at least 66%;	FEI's proposed DSM expenditures are designed to implement cost-effective (as defined by the DSM Regulation) demand-side measures and conserve energy as a result. The estimated net present value of natural gas savings (net of free ridership) for the 2019 to 2022 period is projected to be a total of 36,160,900 gigajoules (GJ).
(d) to use and foster the development in British Columbia of innovative technologies that support energy conservation and efficiency and the use of clean or renewable resources;	FEI's Innovative Technologies Program Area, described in Section 8 of Appendix A meets this objective. This program area: evaluates innovative energy saving technologies; conducts pilot studies to validate manufacturers' claims related to equipment and system performance; and assesses actual energy savings and customer acceptance of these newer technologies or systems of technologies. Technologies that successfully emerge from the Innovative Technologies Program Area are considered for inclusion within the applicable sector programs.
(g) to reduce BC greenhouse gas emissions (i) by 2012 and for each subsequent calendar year to at least 6% less than the level of those emissions in 2007, (ii) by 2016 and for each subsequent calendar year to at least 18% less than the level of those emissions in 2007, (iii) by 2020 and for each subsequent calendar year to at least 33% less than the level of those emissions in 2007, (iv) by 2050 and for each subsequent calendar year to at least 80% less than the level of those emissions in 2007, and (v) by such other amounts as determined under the Greenhouse Gas Reduction Targets Act;	FEI's DSM programs will result in substantial natural gas savings. This will in turn lead to commensurate reductions in greenhouse gas emissions of 1,865,902 tonnes CO2e.
(i) to encourage communities to reduce greenhouse gas emissions and use energy efficiently;	All of FEI's DSM programs encourage communities to reduce greenhouse gas emissions and use energy efficiently.
(k) to encourage economic development and the creation and retention of jobs;	FEI's DSM Programs have a broad impact on the provincial economy as measured through employment, gross domestic product (GDP) and industrial output.

In FEI's view, the Commission's consideration of British Columbia's energy objectives must weigh heavily in favour of FEI's proposal to continue and expand investment in cost effective DSM programs.

3.4 *CONSISTENCY WITH LONG TERM GAS RESOURCE PLAN*

When considering whether to accept a utility's expenditure schedule under section 44.2 of the UCA, the Commission must consider the utility's most recent long-term resource plan filed under section 44.1 of the UCA.

FEI filed its most recent Long Term Gas Resource Plan (2017 LTGRP) with the Commission on December 14, 2017. The 2017 LTGRP is currently under review by the Commission and covers a planning horizon from its 2015 base year until 2036.

The 2017 LTGRP examines the impact of FEI's long-term forecast DSM activity on natural gas demand, projected natural gas delivery rates, and GHG emissions across three alternate future scenarios over the 20-year LTGRP planning horizon. In 2015, FEI, in collaboration with BC Hydro, FortisBC Inc. (FBC), and Pacific Northern Gas (PNG), initiated a province-wide conservation potential review (BC CPR). This project uses a 2014 base year to determine the technical, economic, and market energy savings potential for natural gas and electricity until 2035. The range of potential natural gas DSM measures from the BC CPR results informed the 2017 LTGRP DSM forecast. FEI's DSM Plan (Appendix A) is informed by both the results from the BC CPR (filed as Appendices D and E and Appendix C-1 of the 2017 LTGRP[5]) and the 2017 LTGRP.

The energy savings in FEI's DSM Plan are generally consistent with the 2017 LTGRP forecast Reference Case energy savings.[6] From 2019 until 2022, FEI's DSM Plan forecasts eight percent higher energy savings than FEI's 2017 LTGRP. FEI's DSM Plan indicates expenditures that average $81.14 million per year (including inflation). For the same period, the 2017 LTGRP Reference Case forecasts a theoretical estimate of DSM expenditures that average $42.80 million per year. However, energy savings and expenditure figures are not directly comparable in absolute terms. By virtue of representing a long term forecast and in contrast to FEI's DSM Plan, the 2017 LTGRP does not take into account the following factors:

- Non-incentive expenditures that support or enable DSM programs at the portfolio level, such as enabling activities and conservation education outreach;
- Operational program delivery considerations, such as changes in required DSM staffing levels, program eligibility requirements, or measure packaging and marketing; and
- Emergence of new technologies more than five years into the future or technologies which are currently unknown which may increase aggregate energy savings opportunities and thus enable greater actual DSM program expenditures.

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5 The BC CPR has been thoroughly canvassed in the 2017 LTGRP proceeding.

6 Pursuant to Order G-189-14, dated December 3, 2014, FEI confirmed that the 2017 LTGRP Action Plan is based on the Reference Case end-use annual demand forecast and the Traditional Peak Method Forecast. FEI compares the DSM Plan to the 2017 LTGRP Reference Case because the Action Plan describes activities that FEI intends to pursue over the next four years based on the information provided in the 2017 LTGRP. Action Plan item 7 indicates that FEI will pursue approval of DSM funding for the period beyond 2018.

The 2017 LTGRP provides a sensitivity analysis, sourced from the BC CPR's Bass Diffusion model, of how changes in the value of FEI's measure incentives, as a proportion of incremental measure cost, impact forecast energy savings and estimated DSM expenditures. This analysis showed that, directionally, energy savings increased at a lower rate than the estimated DSM expenditures when applying a limited set of increasing measure level incentive values. This directionally aligns with FEI's DSM Plan forecasting eight percent higher energy savings for the 2019-2022 period at 47 percent higher annual expenditures than the 2017 LTGRP.

The 2017 LTGRP projects that, as part of a long term plan for implementing DSM activities, FEI will continue to perform residential, commercial, industrial, low income, innovative technologies, conservation education and outreach as well as enabling DSM activities. FEI will implement this long-term plan via successive DSM plans which take into account the prevailing market, regulatory, and end-use technology conditions. Within this framework, FEI's proposed DSM expenditure schedule and attached DSM Plan are consistent with the 2017 LTGRP.

3.5 *ADEQUACY PURSUANT TO THE DSM REGULATION*

A public utility's plan portfolio is adequate for the purposes of Section 44.1 (8) (c) of the UCA regarding long-term resource plans, only if the plan portfolio includes the items listed in Table 3-2, as set out in section 3 of the DSM Regulation.

The DSM Regulation was amended in March 2017 to include adequacy updates that broaden the scope of the Low Income area, add expenditure requirements for codes and standards support, and requirements to provide one or more measures for BC Energy Step Code support.

While the DSM Regulation adequacy requirements are applicable to long-term resource plans, since they are related to the demand-side measures, FEI addresses how the DSM Plan is compliant with each of these considerations in Table 3-2 below:

Table 3-2: DSM Plan Compliance with DSM Regulation

DSM Regulation Adequacy	DSM Plan Compliance
a) a demand-side measure intended specifically i. to assist residents of low-income households to reduce their energy consumption, or ii. to reduce energy consumption in housing owned or operated by A. a housing provider that is a local government, a society as defined in section 1 of the Societies Act, other than a member-funded society as defined in section 190 of that Act, or an association as defined in section 1 (1) of the Cooperative Association Act, or B. the governing body of a first nation, if the benefits of the reduction primarily accrue to C. the low-income households occupying the housing, D. a housing provider referred to in clause (A), or E. a governing body referred to in clause (B) if the households in the governing body's housing are primarily low-income households	The Low Income section of the DSM Plan (Appendix A, Section 6) shows plans for FEI to continue to offer and expand the programs that help low-income households and First Nations housing save energy. This is, and will continue to be, executed through the Self Install Program (Appendix A, Section 6.4.2) and the Direct Install Program (Appendix A, section 6.4.1). FEI also has robust energy efficiency programs for housing societies and housing co-operatives that have multi-unit complexes as shown in the Prescriptive Program (Appendix A, Section 6.4.3) and the Support Program (Appendix A, Section 6.4.4).
b) if the plan portfolio is submitted on or after June 1, 2009, a demand-side measure intended specifically to improve the energy efficiency of rental accommodations	FEI will be continuing with the Rental Apartment Efficiency Program (RAP). As referenced in the Residential and Commercial sections of the DSM Plan (Appendix A, Sections 3.4.3 and 4.4.4), the RAP targets improving the energy efficiency only of rental apartment buildings.
c) an education program for students enrolled in schools in the public utility's service area	The Conservation Education and Outreach section of the DSM Plan (Appendix A, Section 7) includes continuation of the School Education Program (Appendix A, Section 7.4.4) which includes programming for schools in FEI's service area.
d) if the plan portfolio is submitted on or after June 1, 2009, an education program for students enrolled in post-secondary institutions in the public utility's service area.	The Conservation Education and Outreach section of the DSM Plan (Appendix A, Section 7) includes continuation of the School Education Program (Appendix A, Section 7.4.4) which includes programming for post-secondary institutions in FEI's service area.

DSM Regulation Adequacy	DSM Plan Compliance
e) one or more demand-side measures to provide resources as set out in paragraph (e) of the definition of "specified demand-side measure",[7] representing no less than i. an average of 1% of the public utility's plan portfolio's expenditures per year over the portfolio's period of expenditures, or ii. an average of $2 million per year over the portfolio's period of expenditures	The Enabling Activities section of the DSM Plan (Appendix A, Section 9) includes Codes & Standards (Appendix A, Section 9.2.2), which outlines that $3.674 million is forecast to be spent in total over the DSM Plan period to support standards-making government and regulatory bodies to support the development and compliance with specified energy conservation standards. This equates to 1.13 percent of the overall forecast portfolio spend over the DSM Plan period.
f) one or more demand-side measures intended to result in the adoption by local governments and first nations of a step code or more stringent requirements within a step code.	Step code support is included within the following programs listed in the DSM Plan (Appendix A): • Residential New Home Program (section 3.4.2) • Commercial Performance Program – New Buildings (section 4.4.3) • Innovative Technologies BC Energy Step Code Tier 5 Buildings Pilot (section 8.4) • Enabling Activities – Codes & Standards (section 9.2.2) • Enabling Activities – Community Energy Specialist Program (section 9.2.7)

3.6 *CONSISTENCY WITH GOVERNMENT POLICY*

The Government of British Columbia is focused on reducing GHG emissions with objectives to reduce GHG emissions in-line with its 2050 climate targets and support the Federal Government’s 2030 GHG emissions reductions targets in the Government of Canada’s Pan-Canadian Framework on Clean Growth and Climate Change.

[7] In section 1 of the DSM Regulation, Paragraph (e) of the definition of “specified demand side measure” is: “(e) financial or other resources provided (i) to a standards-making body to support the development of standards respecting energy conservation or the efficient use of energy, or (ii) to a government or regulatory body to support the development of or compliance with a specified standard or a measure respecting energy conservation or the efficient use of energy in the Province”.

In August 2016 British Columbia's Climate Leadership Plan stated the following with regards to expanding incentives to promote the adoption of higher efficiency natural gas equipment:

> Now the Province is taking action to amend the Demand-Side Measures Regulation and allow FortisBC to expand their incentives by at least 100 per cent, to encourage further adoption of technologies that reduce the emissions of gas fired equipment.[8]

FEI's DSM Plan (Appendix A) addresses this policy by increasing total incentive expenditures by over 100 percent compared to 2016 levels as illustrated in Table 3-3:

Table 3-3: FEI Incentive Expenditures: 2016 Actuals vs. DSM Plan

	Actual	Proposed			
	2016	2019	2020	2021	2022
Total incentive expenditures (thousands)	$ 21,045	$ 42,623	$ 47,957	$ 59,625	$ 65,411
Increase as a percentage of 2016	0%	103%	128%	183%	211%

In October 2017, the BC Government introduced the Climate Solutions and Clean Growth Advisory Council to provide strategic advice to government on climate action and clean economic growth. In December 2017, the Government of Canada announced a partnership with the Government of BC for energy efficiency and climate action in the province. This includes funding toward a Building Energy Retrofit Partnership that will provide financial incentives to households and businesses to undertake retrofits that reduce greenhouse gas emissions and energy bills. FEI is currently in discussion with the Ministry of Energy, Mines, and Petroleum Resources regarding the integration of the Retrofit Partnership with the current FEI program portfolio.

In May 2018, the BC Government announced the replacement of the 2007 Greenhouse Gas Reduction Targets Act with the Climate Change Accountability Act. It set new carbon emission reduction targets from 2007 levels of 40 percent by 2030, 60 percent by 2040 and retained the target of 80 percent by 2050.

Table 3-4 below displays the forecast energy savings and resulting greenhouse gas (GHG) emission reductions resulting from the DSM Plan.

8 British Columbia's Climate Leadership Plan, August 2016, page 32.

Table 3-4: DSM Plan Energy Savings & GHG Emission Reductions

Indicator	Year	Total Natural Gas Savings	GHG Emission Reductions*
Net Incremental Annual Gas Savings (GJ/yr.) and GHG Reductions (tonnes/year)	2019	859,729	44,362
	2020	913,134	47,118
	2021	1,093,421	56,421
	2022	1,181,761	60,979
Cumulative Net Annual Gas Savings (GJ) and GHG Reductions (tonnes)	2019-2022	**3,994,549**	**206,119**
NPV of Net Gas Savings (GJ) and Resulting GHG Reductions (tonnes)**		**36,160,900**	**1,865,902**

*Based on long run combustion emission factor of 0.0516 tonnes CO_2e/GJ for natural gas from Ministry of Enviroment & Climate Change Strategy

**NPV in this context refers to including the entire stream of savings into the future (by measure life) and annualizing that to present time to show the total value of the stream of savings

Through increasing the use of higher efficiency natural gas equipment and encouraging improved overall building energy efficiency, FEI's DSM Plan supports federal and provincial government policy to reduce carbon emissions. In FEI's view, the Commission's consideration of government direction and policy must weigh heavily in favour of FEI's proposal to increase investment in cost-effective DSM programs.

3.7 *INTERESTS OF PERSONS WHO MAY RECEIVE SERVICE*

FEI believes that the proposed DSM expenditures are in the interests of customers and potential customers as they encourage energy efficiency and conservation, reduce GHG emissions, are beneficial to the economy and are cost-effective. Individual customers that avail themselves of DSM measures will reduce their natural gas consumption and, all else equal, their natural gas bills.

4. RESPONSE TO COMMISSION DIRECTIVES

The Company has complied with the directives from the 2014-2018 Performance Based Ratemaking (PBR) Decision related to FEI's DSM expenditures (referred to as Energy Efficiency and Conservation or EEC in FEI's previous applications). Table 4-1 addresses each of the directives related to DSM and briefly describes how the Company has complied with these directives including references to where further information on this compliance can be found.

1 **Table 4-1: FEI Meets Commission Directives**

Directive Reference (s)	Commission Directives to EEC	Compliance Undertaken	Response Reference(s)
Directive 134, 2014-18 PBR Decision (Order G-138-14)	The Commission Panel accepts FEU's calculation of the cost of gas for the mTRC. However, the Panel directs FEU to include an update of the avoided cost of gas used for the mTRC in the next EEC Annual Report.	In 2014, FEI updated the avoided cost of gas used for the mTRC by using as a proxy the long-run marginal cost of acquiring electricity generated from clean or renewable resources in British Columbia.	DSM 2014 Annual Report, Section 2.1, Page 13, Footnote 4.
Directive 136, 2014-18 PBR Decision (Order G-138-14)	The Commission Panel directs FEU to provide an estimate of the effect of each of its simplifying assumptions on the avoided cost of gas used for the TRC in the next EEC Expenditure Request.	FEI developed an estimate of the effect of the simplifying assumptions on the avoided cost of gas used for the TRC in response to this directive and included it as Appendix F of the Application.	Appendix F.

Directive Reference (s)	Commission Directives to EEC	Compliance Undertaken	Response Reference(s)
Directive 138, 2014-18 PBR Decision (Order G-138-14)	The Commission Panel accepts, subject to the condition laid out below, FEU's request for funding for the New Technologies Program. FEU is directed to submit a detailed plan for each program for approval prior to the expenditure of any funds related to these programs.	During the 2014-18 PBR test period, FEI continues to explore New Technologies through the Innovative Technologies Program but has not yet introduced any programs within the New Technologies Program. If FEI intends to introduce any new programs within the New Technologies Program during the 2014-18 PBR test period, it will submit for BC Utilities Commission (BCUC, or Commission) approval a detailed program plan prior to the expenditure of any funds related to any such program. FEI has not included a residential New Technologies program in its DSM Plan (each program area where applicable explains in its respective section of the Plan how new measures will be incorporated).	DSM Annual Reports for 2014 to 2017, Section 5.4. Appendix A in this Application

Directive Reference (s)	Commission Directives to EEC	Compliance Undertaken	Response Reference(s)
Directive 140, 2014-18 PBR Decision (Order G-138-14)	The Commission Panel accepts, subject to the condition laid out below, FEU's request for funding for the low income space heating top-up, water heating top-up and the non-profit custom programs. The funding request appears reasonable and has the support of BCSEA. FEU is directed to submit a detailed plan for each program for approval prior to the expenditure of any funds related to these programs.	In 2016, FEI submitted to the BCUC detailed plans for four new programs which included the Low Income Space Heat Top Up, Low Income Water Heater Top Up, and Non-Profit Custom Program. The BCUC approved these programs. FEI has reported on the performance of these programs in its DSM Annual Reports.	Detailed Plans for New Energy Efficiency and Conservation (EEC) Programs, submitted January 11, 2016; approved via Order G-11-16, dated January 28, 2016. DSM Annual Reports for 2016 and 2017, Section 6.

Directive Reference (s)	Commission Directives to EEC	Compliance Undertaken	Response Reference(s)
Directive 142, 2014-18 PBR Decision (Order G-138-14)	The Commission Panel accepts, subject to the condition laid out below, FEU's request for funding for the both the [sic] new Mechanical Insulation Pilot program and the new Specialized Industrial Process Technology Program. FEU is directed to submit a detailed plan for each program for approval prior to the expenditure of any funds related to these programs.	In 2016, FEI submitted to the BCUC detailed plans for four new programs which included the Specialized Industrial Process Technology Program. The BCUC approved these programs. FEI has reported on the performance of this program in its DSM Annual Reports. The Mechanical Insulation Pilot program had originally been set to launch in 2013 but was subsequently cancelled as FEI was unable to conclude an agreement on terms satisfactory to FEI with a third-party contractor to deliver the project. In 2014, FEI indicated that it was no longer pursuing this pilot further.	Detailed Plans for New Energy Efficiency and Conservation (EEC) Programs, submitted January 11, 2016, and approved via Order G-11-16, dated January 28, 2016. DSM Annual Reports for 2016 and 2017. DSM 2014 Annual Report, Section 7.3.1.

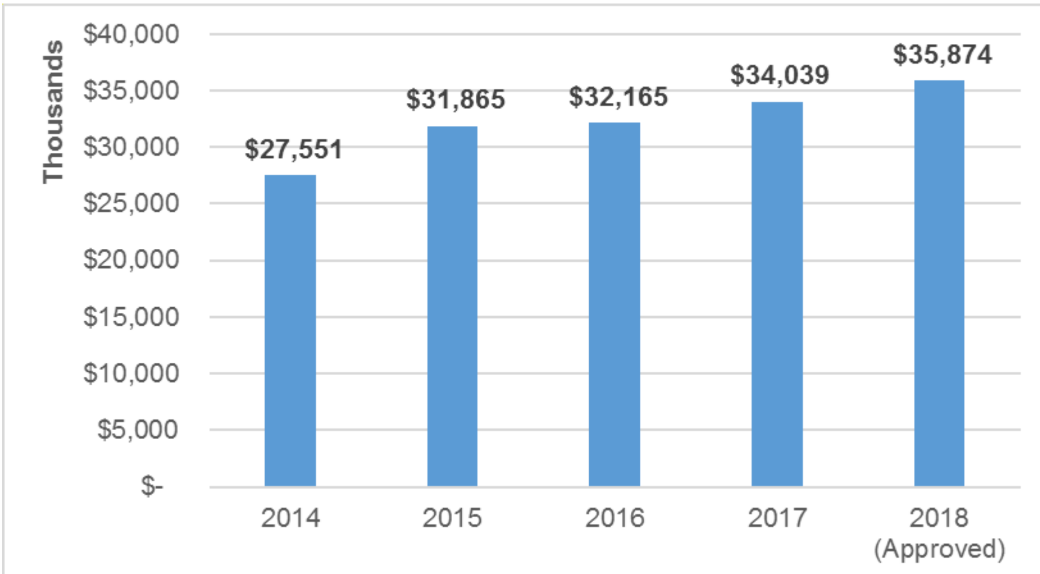
Directive Reference (s)	Commission Directives to EEC	Compliance Undertaken	Response Reference(s)
Directive 145, 2014-18 PBR Decision (Order G-138-14)	To aid transparency, FEU are directed to allocate 'FEU labour costs coded to EEC' to its EEC programs, with the exception of costs related to Evaluation, Measurement & Verification which should be shown separately. FEU should include in the next EEC Annual Report a description of the cost allocation methodology used, and any differences between the methodology proposed and that used in the 2012–2013 Application.	FEI has included labour costs coded to each DSM program in the reported Administration expenditures for each program within each DSM Program Area. Some administrative labour costs are still appropriately attributed to the Portfolio and not to specific programs. FEI explains this method and any differences to the method used in the 2012-2013 Application in its DSM 2014 Annual Report. Appendix A to this Application reports labour broken out into its own line item for each program. Notwithstanding, labour is considered an Administration expenditure for reporting purposes.	DSM 2014 Annual Report, Section 2.5.2.
Directive 146, 2014-18 PBR Decision (Order G-138-14)	FEU are directed in the next EEC Annual Report to explain how it ensures the focus of the contractor network program is on reducing overall gas consumption by customers.	FEI provided this explanation in its DSM 2014 Annual Report.	DSM 2014 Annual Report, Section 2.5.3.

Directive Reference (s)	Commission Directives to EEC	Compliance Undertaken	Response Reference(s)
Directive 148, 2014-18 PBR Decision (Order G-138-14)	The Commission Panel therefore directs FEU to, by the end of 2015 and within the existing EEC funding envelope, file with the Commission one or more EEC programs intended specifically to address the unique market barriers to energy efficiency faced by renters (for example, the landlord tenant split-incentive).	On August 12, 2015, FEI filed the Rental Apartment Efficiency Program Business Case with the BCUC. The BCUC accepted this business case to be in the public interest and to be funded as filed. FEI has reported on the performance of this program in its DSM Annual Reports.	Rental Apartment Efficiency Program Business Case, submitted August 12, 2015, and approved via Orders G-152-15 and G-152-15A, dated September 24, 2015. DSM Annual Reports for 2015 to 2017.
Directive 152, 2014-18 PBR Decision (Order G-138-14)	The Commission Panel directs FEU to include in the next FEU EEC Application an analysis of the rate impact of a reduction in the EEC amortization period to eight years and to five years. The Commission Panel approves FEU's request to (i) continue the EEC accounting treatment approved for 2012–2013 and (ii) to transfer any new amounts accumulated in the non-rate base EEC deferral account to FEU rate base EEC deferral account in the following year.	This Application provides FEI's sensitivity analysis on the duration of the amortization period. FEI has complied with the approved accounting and deferral account treatment and has detailed its deferral account treatment in its DSM Annual Reports.	Section 8.2 in this Application. DSM Annual Reports for 2014 to 2017, Section 2.

5. HISTORICAL EXPENDITURE LEVELS

FEI's DSM expenditures have continually increased year over year since 2014 to annual levels consistently in excess of $30 million. For historical reference, Table 5-1 shows total FEI DSM expenditures since 2014, the first year of the most recently approved DSM Plan.

Table 5-1: FEI Annual Total DSM Expenditures 2014 to 2018



The financial treatment of DSM expenditures approved in Commission Decision and Order G-44-12 in an Application by the FortisBC Energy Utilities (comprising FortisBC Energy Inc., FortisBC Energy Inc. Fort Nelson Service Area, FortisBC Energy (Whistler) Inc., and FortisBC Energy (Vancouver Island) Inc.) for Approval of 2012 and 2013 Natural Gas Rates (2012-13 RRA) was designed to mitigate Commission and stakeholder concerns regarding actual annual expenditure results below approved levels, as was the case in the early years of DSM programs.

6. DSM PLAN AND PROPOSED EXPENDITURES

FEI's proposed DSM expenditures for the 2019-2022 period reflect the DSM Plan in Appendix A which includes the following program areas: Residential, Low Income, Commercial, Conservation Education and Outreach, Industrial, Innovative Technologies, and Enabling Activities.

FEI requests acceptance of expenditures over a four-year period in order to maintain certainty in the market that FEI will be able to offer the programs listed in the DSM Plan over an extended time. This allows external parties such as contractors, manufacturers and other program partners to better support DSM initiatives knowing that they will be established for the long term. This approach also promotes regulatory efficiency, enabling FEI to take advantage of program momentum and allows DSM staff to focus their time and attention on program development and operation.

Many of the programs in the DSM Plan are continuations of previously-approved programs that FEI is currently running, and has reported on in its 2017 Annual DSM Report (Appendix B). The DSM Plan is intended to provide program details and projected cost-effectiveness results for FEI's proposed portfolio of DSM program area activity over the 2019-2022 time period.

The following subsections describe FEI's in-depth consultation with stakeholders undertaken as part of the development of the DSM Plan, FEI's DSM expenditures forecast by program area, FEI's new and previously approved programs, and FEI's DSM guiding principles.

6.1 *CONSULTATION*

A key input in the development of the DSM Plan was information gathered through consultation with various program stakeholders and interested parties. FEI undertook an in-depth and varied consultation process which followed these general guiding principles:

- Include any type of interaction (whether oral or written) that allows adequate expression and consideration of views;
- Make a genuine effort which allows sufficient time for feedback;
- Consultation involves the statement of a proposal not yet finally decided on, listening to what others have to say, considering their responses, and then deciding what to do;
- Make available sufficient information to enable parties who are consulted to be adequately informed and therefore able to make "intelligent and useful" responses;
- Agreement is not required (although consultation does require more than mere telling, or presenting);

- "Consultation" is not equated with "negotiation". Negotiation implies a process that has as its objective arriving at agreement. Strive for something mutually agreeable but not something which is expected to get agreement across the board;
- Approach the matter with an open mind, and be prepared to change or even start a process afresh; and
- Provide reasonable opportunity for interested parties to provide feedback.

FEI engaged in and documented over 110 interactions and consultations related to the DSM Plan. Examples of entities consulted with include: communities, customers, contractors, manufacturers, government, First Nations, vendors, interest groups, and the Energy Efficiency and Conservation Advisory Group (EECAG). The forms of consultations included workshops, surveys, in-person interviews, webinars, and conference calls. FEI also provided confidential draft versions of the DSM Plan to EECAG members for review and input.

Most of the key learning from these consultations was market data refinement which was then considered and assessed within program plans and profiles within the DSM Plan. The feedback also included ideas for program design and how to expand programs and program reach. A consistent piece of feedback received from the consultations was general endorsement for how DSM is managed and operated by FEI. Satisfaction appeared to be high for FEI in this area and none of the consultations suggested that any significant change in approach was required.

FEI also received directional feedback from the consultations. This feedback included the following:

- Expand alignment with industry influencers;
- Support BC Energy Step Code for new construction;
- Support deeper retrofits;
- Provide building envelope support;
- Consider upstream incentives;
- Support pre-commercial technologies;
- Do more in the Industrial program area;
- Pursue attribution for Codes & Standards; and
- Support Energy Advisors.

All of this feedback was taken into account in the development of the DSM Plan. Given this consultation process, FEI believes that the DSM Plan includes a fair representation of stakeholder and customer interests and is positioned well to achieve the energy savings forecast within.

6.2 *DSM EXPENDITURE FORECAST BY PROGRAM AREA*

FEI is requesting acceptance of DSM expenditures for 2019-2022 of $324.6 million. FEI is forecasting annual DSM expenditures in each of the program areas as outlined in Table 6-1. These expenditures are stated in "as-spent" dollars, including inflation. If accepted, these are the values that FEI will report actual spending against in each year's Annual DSM Report. These are the same values shown in Exhibit 1 of the DSM Plan (Appendix A). For simplicity, all other tables in Appendix A show proposed expenditures in 2019 dollars (uninflated).

Table 6-1: FEI DSM Expenditures - 2019-2022 Forecast, Shown in As Spent Dollars [9]

Program Area	Utility Expenditures ($000s)				
	All Spending				
	2019	2020	2021	2022	Total
Residential	23,521	25,722	28,476	31,383	109,101
Commercial	13,837	17,357	27,441	31,081	89,715
Industrial	3,103	3,152	3,644	3,708	13,607
Low Income	6,630	6,795	6,984	7,217	27,626
Conservation Education and Outreach	7,155	7,360	8,595	9,467	32,578
Innovative Technologies	2,043	2,202	2,631	3,062	9,938
Enabling Activities	8,426	8,321	9,230	8,918	34,895
Portfolio Level Activities	1,635	1,676	1,822	1,975	7,108
ALL PROGRAMS	**66,350**	**72,585**	**88,822**	**96,811**	**324,567**

It can be seen in the table above that the forecast DSM expenditures for most program areas are relatively stable from 2019 on, with three exceptions: the Residential, Commercial and Innovative Technologies program areas. The forecast increase in expenditures in the Residential program area is primarily due to expansion of the furnace and boiler incentives to become available year round, as well as BC Energy Step Code support. The forecast increase in expenditures in the Commercial program area is primarily due to new measures in the Prescriptive Program such as furnaces and roof insulation and by the Performance Program – New Buildings, which includes enhanced support for BC Energy Step Code and an additional program participation path for smaller commercial customers. The forecast increase in expenditures in the Innovative Technologies program area is primarily due to the BC Energy Step Code Tier 5 Buildings Pilot, for which FEI expects significant increased participation over the DSM Plan period.

Further details on the forecast expenditures for each program area can be found in the DSM Plan (Appendix A).

[9] Requested expenditures listed include inflation as indicated in Appendix A, Exhibit 2.

6.3 *NEW AND PREVIOUSLY APPROVED PROGRAMS*

Most of the programs listed in the DSM Plan are continuations of existing programs from the EEC 2014-2018 Plan period. In some cases, new measures have been added to existing programs. Any new measures are cited in the applicable program area section of the DSM Plan. In this Application, FEI requests funding for one new program and one new enabling activity for 2019-2022.

Table 6-2 below lists the programs and activities from the DSM Plan categorized by previously approved or new. In the Residential, Commercial, and Low Income program areas, multiple previously approved programs have been consolidated. The DSM Plan (Appendix A) provides further program details and program descriptions.

Table 6-2: Programs Classified by Previously Approved and New

Program Area	Previously Approved Programs		New Programs
	DSM 2017 Annual Report Name	DSM Plan Name	
Residential	Energy Efficient Home Performance (Home Renovation Rebate Program)	Home Renovation Program	N/A
	Furnace and Boiler Replacement Program		
	Appliance Service Program		
	Domestic Hot Water Conservation Program/Low Flow Fixtures and Washers		
	EnerChoice Fireplace Program	*Included in both the Home Renovation Program and the New Home Program*	
	ENERGY STAR® Water Heater Program		
	New Home Program	New Home Program	
	Customer Engagement Tool for Conservation Behaviors	*Moved to Conservation Education & Outreach under the name "Residential Customer Engagement Tool"*	
	New Technologies Program	N/A	
	Rental Apartment Efficiency Program (RAP) *Residential Portion*	*Ibid.*	
Commercial	Space Heating Program	Prescriptive Program	N/A
	Water Heating Program		
	Commercial Food Service Program		
	Continuous Optimization Program	Performance Program	N/A
	Commercial Energy Assessment Program		
	Customized Equipment Upgrade Program		

Program Area	Previously Approved Programs		New Programs
	DSM 2017 Annual Report Name	DSM Plan Name	
	Energy Specialist Program	*Moved to Enabling Activities under the name "Commercial Energy Specialist Program"*	
	Rental Apartment Efficiency Program (RAP) *Commercial Portion*	*Ibid.*	
Industrial	Industrial Optimization Program	Performance Program	N/A
	Specialized Industrial Process Technology Program	Prescriptive Program	
	N/A	N/A	Strategic Energy Management Program
Low Income	Energy Saving Kit (ESK)	Self Install Program	N/A
	Energy Conservation Assistance Program (ECAP)	Direct Install Program	
	Residential Energy Efficiency Works (REnEW)	Support Program	
	Low Income Space-Heat Top-Up	Prescriptive Program	N/A
	Low income Water-Heating Top-Up		
	Non-Profit Custom Program		
	Rental Apartment Efficiency Program (RAP) *Low Income Portion*[10]	N/A	
Conservation Education & Outreach	Residential Education Program	General Residential Education Program	N/A
	N/A	Residential Customer Engagement Tool	
	Commercial Education Program	*Ibid.*	
	School Education Program	*Ibid.*	
Innovative Technologies	Pilot/Demonstration Projects	Pilot Project Expenditures	N/A
	Studies	Technology Screening	

[10] Rental Apartment Efficiency Program (RAP) Low Income was introduced in 2016 as a means of addressing some of the objectives of the Non-Profit Custom program prior to the Non-Profit Custom program being fully developed and available to social housing providers. In the 2019-2022 period the Non-Profit Custom and the Energy Conservation Assistance program (ECAP) will together offer more benefit to social housing providers then RAP Low Income and thus it is anticipated there will be no participants in RAP Low Income in the 2019-2022 Plan.

Program Area	Previously Approved Programs		New Programs
	DSM 2017 Annual Report Name	DSM Plan Name	
Enabling Activities[11]	Trade Ally Network	*Ibid.*	N/A
	Codes and Standards	*Ibid.*	
	Conservation Potential Review	*Ibid.*	
	TrakSmart Maintenance	Reporting Tool & Customer Application Portal	
	Energy Management Education Funding	*Moved to School Program under Conservation Education & Outreach*	
	N/A	Commercial Energy Specialist Program	
	N/A	N/A	Community Energy Specialist Program

[11] Customer Research is also included in the Enabling Activities area in the DSM Plan and represents the end use studies that were previously included under Enabling Activities as well as other research projects that were previously expensed under Portfolio Level Activities. It is not listed in this table because no end use studies were expensed in 2017 and any other research items that would fall under this category were expensed under Portfolio Level Activities.

6.3 DSM GUIDING PRINCIPLES

FEI's DSM guiding principles are listed below. FEI's guiding principles have been updated from those presented in previous DSM applications to reflect the FEI and FBC Conservation & Efficiency Management (C&EM) department's[12] common guiding principles.

1. Programs will have a goal of being universal, offering access to energy efficiency and conservation for all residential, commercial and industrial customers, including low income customers.
2. C&EM expenditures will have a goal of incentive costs exceeding 50 percent of the expenditures in a given year.
3. C&EM expenditure schedule plans and results will be analyzed on a program, sector and portfolio level basis, with acceptance based at the portfolio level.
4. The combined Total Resource Benefit/Cost, including the Modified Total Resource Benefit/Cost where applicable, of the Portfolio will have a ratio of 1 or higher.
5. FEI will submit its annual DSM Report to the BCUC, by the end of the first quarter of each year that details the results of the previous year's activity.
6. The DSM Plan will be compliant with the applicable sections of the UCA and the Clean Energy Act, and with the DSM Regulation as amended from time to time.
7. FEI will seek collaboration for programs from other parties, such as governments, other utilities, and equipment suppliers and manufacturers in recognition of the broader societal benefits resulting from successful program development and implementation.
8. Conservation Education and Outreach will be an integral part of FEI's DSM activities.
9. DSM expenditure schedules will be multi-year so as to create the funding certainty necessary to support effective implementation in the marketplace – this Application requests funding for a four-year Portfolio of DSM programs.
10. Programs will support market transformation by incenting efficient measures through customers and/or trade allies (contractors, equipment manufacturers, distributors, retailers, etc.), developing trade ally capacity, and supporting codes and standards development and implementation.
11. FEI will retain a DSM stakeholder group, comprised of government, industry, trades, manufacturers, non-governmental organizations, advocacy groups, other utilities and customers to provide it with strategic advice. Additionally, FEI will undertake program area specific stakeholder consultation(s) on effective program design and implementation.

[12] The C&EM department is the combined and renamed DSM departments of FEI, previously EEC, and FBC, previously PowerSense.

FEI will continue to be guided by these principles in designing and carrying out its DSM program activities.

7. COST EFFECTIVENESS APPROACH

7.1 COST-EFFECTIVENESS UNDER THE DSM REGULATION

FEI's proposed DSM portfolio for the 2019-2022 funding period is cost-effective according to the currently approved approach to determining cost-effectiveness. As shown in Exhibit 3 of the DSM Plan (Appendix A) and in Table 7-1 below, the portfolio passes the cost-effectiveness tests as currently required by the Commission.

Table 7-1: 2019-2022 DSM Plan Portfolio Level Cost Effectiveness Results – All Tests

Benefit/Cost Ratios	TRC	**1.0**
	Portfolio	**1.8**
	Utility	**0.9**
	Participant	**1.7**
	RIM	**0.4**

Note: The cost effectiveness test result called 'Portfolio' in this Table reflects the use of the modified total resource cost test (MTRC) for up to 40% of the portfolio per the DSM regulation as explained in Section 7.1.3 below.

The following discussion explains these cost-effectiveness tests and shows that the DSM Plan meets the requirements of the provincial DSM Regulation. FEI submits that the current approach to determining the cost-effectiveness of its DSM programs is comprehensive, benefits customers and should be used for the 2019-2022 period. This section discusses the cost-effectiveness approach and the relevant parameters that FEI submits should be used in assessing its DSM activities.

7.1.1 Portfolio-Level Analysis

Section 4(1) of the DSM Regulation stipulates that the Commission, in determining the cost-effectiveness of a demand-side measure proposed in an expenditure portfolio or a plan portfolio, may compare the costs and benefits of (a) a demand-side measure individually, (b) with other demand-side measures in the portfolio or (c) the portfolio as a whole.

The portfolio-level analysis remains the appropriate method for testing the cost-effectiveness of the DSM Plan for the following reasons:

- The portfolio approach to measuring the cost-effectiveness of DSM expenditures has been in place for many years and remains an effective means of assessing the performance of DSM activities. The Commission first determined that assessment of cost-effectiveness be based on the portfolio as a whole in its decision on FEI's 2008 DSM Application[13] and, since then, has reached the same determination in each of its subsequent decisions on FEI's DSM expenditure applications. Continued use of the portfolio approach will provide more flexibility for FEI to implement programs that meet

[13] Order G-36-09

customer needs while addressing the requirements of the DSM Regulation and maintaining a cost-effective portfolio. Alternatively, implementing cost effectiveness at some level below the Portfolio, such as at the program area or individual program level, is likely to be more restrictive on programs for some customer groups (Residential customers, for example) due to more restrictive cost-effectiveness requirements. ;

- According to Sections 4(4) and 4(5) of the DSM Regulation, the Commission must, at a minimum, use the portfolio approach in assessing the cost effectiveness of "specified demand-side measures"[14] and "public awareness programs".[15]

- A portfolio approach to cost-effectiveness analysis promotes FEI's goal of making DSM accessible to all customers. Residential programs, for example, often have difficulty passing the Total Resource Cost test (TRC) and even the modified TRC test (MTRC) per the DSM Regulation on a program-by-program basis, and low income programs are especially challenged by the cost-effectiveness test. Moving away from a portfolio approach might result in fewer DSM programs being available to residential and low-income customers.

- The portfolio approach permits FEI to encourage increasing levels of efficiency in natural gas equipment. Equipment that is relatively new to the market may have a higher initial cost due to the fact that it has not yet reached economies of scale. A program based on such equipment is more likely to have low TRC and MTRC results. Although the near term results of such a program might be unfavourable, the long term prospects for such equipment to provide benefits to customers could be significant. The Portfolio level cost-effectiveness analysis can absorb some of these types of programs without failing the cost-effectiveness tests.

To ensure that the portfolio meets a combined TRC/MTRC of 1 on an annual basis, FEI will continue its practice of monitoring DSM programs on a monthly basis. This practice will allow FEI to identify trends in cost-effectiveness related to program and portfolio expenditures and make adjustments as needed. For information purposes, FEI will also continue to report on individual DSM program cost-effectiveness results in its DSM Annual Reports along with the individual program cost-effectiveness projections provided in the DSM Plan included as Appendix A.

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[14] "Specified demand-side measures" include: education programs for students, funding for energy efficiency training, funding for codes and standards development, funding to support development of or compliance with a specified standard, a community engagement program and a technology innovation program.

[15] A "public awareness program" means a program delivered by a public utility (a) to increase the awareness of the public, including the public utility's customers, to conserve energy or use energy efficiently, or (b) increase participation by the public utility's customers in other demand-side measure activities proposed by the public utility.

7.1.2 Total Resource Cost Test

The TRC is calculated at the Portfolio level by comparing the costs of the portfolio to the total value of the benefits of the programs contained in the portfolio. The DSM Regulation also includes special consideration for specified measures (Section 4(4)) and low income programs (Section 4(2)).

The cost-effectiveness of a specified demand-side measure must be determined by the cost effectiveness of the portfolio as a whole. Specified demand-side measures include education programs, energy efficiency training, community engagement programs, energy management programs, technology innovation programs and resources supporting the development of or compliance with energy efficiency standards.[16] FEI has specified demand-side measures within its Conservation Education and Outreach, Innovative Technologies and Enabling Initiatives program areas.

For a demand-side measure intended specifically to assist residents of low-income households (which would include the activity defined within FEI's Low Income program area) the Commission must use "in addition to any other analysis the Commission considers appropriate," the TRC test and in doing so for natural gas programs include the Zero Emission Energy Alternative (ZEEA - see Section 7.1.3.1 below) as the avoided cost and then consider the benefit of the demand-side measure to be 140 percent of its value. FEI has applied this approach in the cost-effectiveness analysis of the Low Income programs presented in the DSM Plan.

7.1.3 Modified Total Resource Cost Test

Subsections 4(1.1) and (1.5) of the DSM Regulation allow for the use of a MTRC for up to 40 percent of the natural gas DSM portfolio, excluding specified demand-side measures. FEI manages its activities carefully to stay within this MTRC Cap, as shown in Exhibit 4 of the DSM Plan (Appendix A). The MTRC includes two additional components described below: the use of a zero-emission energy supply alternative (ZEEA) in determining avoided cost of energy for DSM, and the inclusion of non-energy benefits (NEB) to customers and the utility. At the portfolio level, the combination of the MTRC benefits for those programs that require use of the MTRC and the TRC benefits for all other programs are compared to the portfolio costs in what is referred to as the 'Portfolio' test in Table 7-1 above and in Exhibit 3 of Appendix A. A 'Portfolio' test result of one or better means that the Portfolio as a whole passes the required cost effectiveness test under the current and applied for method discussed in Section 7.1.1.

7.1.3.1 Zero-Emission Energy Supply Alternative (ZEEA)

The benefits of demand side measures in the standard TRC calculation include the avoided cost of new energy transmission capacity and the avoided cost of the energy. In calculating the

[16] For a more detailed description of specified demand-side measures see Section 1 of the British Columbia Demand-side Measures Regulation.

MTRC, the ZEEA is applied to these standard benefits in determining the avoided cost of energy. Use of the ZEEA recognizes that avoiding natural gas use has similar GHG emission reduction benefits to that of employing clean electricity to meet that energy need. The ZEEA is defined in the DSM Regulation as BC Hydro's long run marginal cost (LRMC) of acquiring electricity generated from clean or renewable resources in British Columbia. At the time of writing, the ZEEA value used in the MTRC calculation is $106/MWh, or 29.45/GJ. The source for this number is BC Hydro's Waneta 2017 Transaction Application to the BCUC that established BC Hydro's LRMC at $106/MWh in F2018$.[17] This value is consistent with the value used to calculate the MTRC for FEI's DSM 2017 Annual Report. It was confirmed with BC Hydro that this value would be the appropriate value to use at this point in time. For Low Income programs the ZEEA is applied when calculating the TRC (see Section 7.1.2).

7.1.3.2 Inclusion of Non-Energy Benefits

Section 4(1.1)(c) of the DSM Regulation requires the Commission to allow the inclusion of NEBs, the amount of which may be determined either by the Commission based on evidence from the utility or by using a deemed 15 percent adder to the benefits side of the MTRC calculation. FEI has chosen to use the 15 percent NEB adder in its MTRC calculations for the DSM Plan.

7.2 *ELEMENTS OF THE STANDARD COST BENEFIT TESTS*

While the TRC and MTRC continue to be the cost-effectiveness tests that FEI is using for determining the portfolio cost-effectiveness, FEI has also historically reported on a range of other standard cost-effectiveness tests used by the industry to monitor programs, program areas and the portfolio as a whole. The standard cost-effectiveness tests are the TRC, the RIM, the UCT[18] and the Participant Cost Test (PCT) calculations at the program, program area and portfolio level. These are consistent with the California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects (California Manual), and will be applied consistent with past practice during the 2019-2022 period. Specific proposals regarding two elements of these tests are discussed below.

7.2.1 Net-to-Gross (NTG) Ratio: Spillover and Free Riders

In the majority of cases to date, FEI has calculated NTG by only adjusting the benefits downward for the presumed presence of "free riders", i.e. individuals who participate in an incentive program who would have upgraded their equipment even in the absence of an incentive. FEI believes that the NTG should also account for the benefit of customers that adopt efficiency measures because they are influenced by program-related information and marketing efforts, though they do not actually participate in the incentive program. Accounting for this effect, known as "spillover", in the NTG is a recognized approach that is used by many utilities

[17] Table 3 on Page 19 of 90, Appendix N, British Columbia Hydro and Power Authority Waneta 2017 Transaction Application ~ Project No.1598933, http://www.bcuc.com/ApplicationView.aspx?ApplicationId=604

[18] Referred to as Program Administrator Cost Test in the California Manual

including BC Hydro.[19] As "spillover" is the conceptual opposite of "free riders", including both effects presents a more complete and balanced view of program impacts.

In its decision on the 2014–2018 EEC funding approval as part of the 2014–2019 PBR approval[20] the Commission recognized both the difficult challenge of measuring spillover and the negative impact of not including spillover effects in the NTG calculation. The Commission Panel approved the Company's request for endorsement of the recognition of spillover effects on a case-by-case basis where evaluation shows that spillover is occurring[21]. FEI consistently includes the assessment of spillover in its evaluations. Due to the difficulty in confirming and quantifying spillover, FEI has so far only been able to quantify spillover for inclusion in the cost effectiveness for one of its DSM programs – that being the Residential EnerChoice Fireplace Program [22]. FEI will continue to include spillover identification and quantification on a program-by-program basis in its program evaluations. Where spillover can be quantified FEI will include it in program and portfolio cost-effectiveness calculations.

7.2.2 Attribution of Savings from the Introduction of Regulation

According to Section 4(1.4) of the DSM Regulation, in considering a demand-side measure that, in the Commission's opinion, will increase the use of a regulated item with respect to which there is either:

(a) a specified standard that has not yet commenced, or

(b) a specified proposal.

The Commission, after applying subsection (1.1), may increase the benefit of the demand-side measure by an amount that represents a portion of the avoided capacity and energy costs that, in the Commission's opinion, will result from the commencement and application of the specified standard, amendment or new bylaw proposed by the specified proposal, assuming that the standard, amendment or new bylaw comes into force.

FEI intends to attribute the benefit of savings from the introduction of codes and standards to the applicable Program Area where such an attribution can be supported. FEI will incorporate savings from the introduction of codes and standards on a case-by-case basis and report on this practice in the DSM Annual Reports.

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[19] FEU 2012-2013 RRA Exhibit B-9, BCUC IR 1.210.2.
[20] FEI 2014-2019 PBR Application Decision, page 264.
[21] Ibid.
[22] Appendix B – 2017 FEI DSM Annual Report, Section 5.3, Table 5.4.

8. EVALUATION, MEASUREMENT & VERIFICATION

FEI considers Evaluation, Measurement and Verification (EM&V) to be an important aspect of the overall DSM program lifecycle. Program evaluation is critical for assessing program performance in order to identify program improvements as well as assess the measure and program assumptions used to calculate program cost effectiveness. Evaluation plans are developed at the program design stage and re-examined later when more program information is available. As more programs reach maturity and enough program data becomes available, FEI will complete more program evaluations at appropriate times in the program life cycles. Two key aspects of FEI's EM&V activities are addressed in the following discussion: the 2019-2022 Evaluation Plan, and FEI's EM&V Framework.

8.1 *EVALUATION PLAN*

Appendix G contains FEI's 4 Year Evaluation Plan, covering the 2019 to 2022 period for its EM&V activities, including evaluations for process, impact, market analysis and communications, as well as measurement and verification activities for its current and planned DSM programs and pilots. Overall program expenditures reported in Section 6.2 include costs for EM&V activities: however, the EM&V costs are also reported in the Evaluation Plan to provide an easy-to-view summary of the evaluation expenditures together with the 4 Year Evaluation Plan. The total proposed expenditure for program evaluation and M&V activities to be conducted from 2019 to 2022 is approximately $9.2 million or 2.9 percent of FEI's overall planned portfolio expenditures. This proposed budget aligns with FEI's EM&V Framework, historical evaluation expenditures, and industry general practice for budget spending on EM&V activities.

In preparing the Application, FEI examined the results of more recent industry surveys on evaluation expenditures. Survey results obtained from E Source, an energy efficiency consultancy serving gas and electric utilities throughout North America, indicate that for utilities with DSM expenditures of between US$20 and US$55 million, DSM budgets are between 2 percent and 3 percent, and that the proportion of DSM expenditures on evaluation decreases as the size of the portfolio increases.[23] Utilities with expenditures greater than US$55 million tend to spend just under 2 percent on evaluation. The Consortium for Energy Efficiency (CEE) found that in 2014 US and Canadian natural gas utilities spent about 2 percent of their overall DSM budgets on evaluation and in 2015 this value dropped to 1 percent for Canadian Utilities.[24] According to these CEE Reports, the proportion of total DSM expenditures appears to be declining in recent years for Canadian natural gas utilities.

[23] E Source Poster: How Much do Utilities Spend on Evaluation? 2015. Prepared from data available in E Source DSM Insights 2015.

[24] CEE Annual Industry Report – State of the Efficiency Program Industry, Section 4. Consortium for Energy Efficiency, 2014, 2015 and 2016.

It is important to note the definitions that are used for what is and is not included in the EM&V budgets varies significantly between utilities and program administrators. FEI has carefully considered evaluation needs and submits that its evaluation plan is adequate to conduct the appropriate number of program evaluations and effective in keeping evaluation expenditures at a reasonable level consistent with its EM&V Framework and in comparison to other jurisdictions.

8.2 *EM&V FRAMEWORK*

FEI developed an EM&V Framework in 2012 documenting the background, objectives, principles and general practices that guide FEI's approach, resources and timeframes for EM&V activities. The framework addressed the Commission's directive from the 2012-2013 RRA Decision.[25] The EM&V Framework was finalized in 2013 taking into consideration feedback received from the EECAG and FEI's evaluation partners. FEI has since been conducting EM&V activities in keeping with the EM&V Framework. FEI will continue to review industry standards and best practices to ensure the EM&V Framework is up to date.[26] Appendix H contains the final EM&V Framework.

[25] https://www.fortisbc.com/About/RegulatoryAffairs/GasUtility/NatGasBCUCSubmissions/Documents/G-44-12_FEU-2012-13RR-Decision-WEB.pdf

[26] The Companies refer to the California Evaluation Framework. June 2004. TecMarket Works, IPMVP – Concepts and Options for Determining Energy and Water Savings. Efficiency Valuation Organization. January 2012. for guidance of the industry standards and best practices.

9. ADDITIONAL APPROVALS SOUGHT

9.1 *FUNDING TRANSFERS*

It should be noted that as with all plans, the DSM Plan is subject to change in response to changes in market conditions, customer responses to programs, input from stakeholders including program partners, and changes in government policy. Due to the length of the period the DSM Plan covers, FEI requires the flexibility to be able to adjust to new information, program results and opportunities through the test period without the need for a full Commission review.

FEI proposes that program funding transfer rules follow the same process as was directed by the Commission for the 2012-2013 test period and retained for the 2014-2018 test period. The existing program funding transfer rules are as follows:

- Funding transfers under 25 percent from one approved Program Area to another approved Program Area would be permitted without prior approval of the Commission;
- In cases where a proposed transfer out of an approved Program Area is greater than 25 percent of that approved Program Area, prior Commission approval would be required.
- In cases where a proposed transfer into an approved Program Area is greater than 25 percent of that approved Program Area, prior Commission approval would be required.
- The transfer of any amount of funds from an approved Program Area to Innovative Technologies would require prior Commission approval.

FEI's understanding of these rules is that, in effect, the Commission is accepting DSM expenditures that vary from forecast as being in the public interest if they reflect funding transfers under 25 percent of the Program Area being increased.

In addition, FEI proposes that starting with 2019 it be permitted to transfer or "rollover" unspent expenditures in a Program Area to the same Program Area in the following year. As noted above, FEI's DSM Plan is subject to change in response to various external factors. These factors may require FEI to respond by adjusting the timing of its planned expenditures. The flexibility to rollover unspent amounts would allow FEI to adjust to external factors and allow FEI to carry out its DSM Plan over the course of the four years, even if the timing of the expenditures varies from plan. In effect, FEI is requesting that the Commission accept the total expenditures per Program Area over the time period of the expenditure schedule. As the exact timing of the expenditure within the four-year period should not change the public interest in making the expenditures, FEI believes this is an appropriate approach.

9.2 *ACCOUNTING TREATMENT*

Further to Section 5 and consistent with the spirit of Order G-44-12, FEI is proposing to forecast rate base additions to the Energy Efficiency and Conservation deferral account (historically referred to as the EEC deferral account but hereinafter DSM deferral account) of $30 million, on a net-of-tax basis, for each of the years 2019 through 2022.

Under the current approved treatment, $15 million of expenditures are forecast in the rate base DSM Deferral account each forecast year and the difference between the $15 million forecast and actual expenditure levels, up to the approved amount, are accounted for in FEI's non-rate base DSM Deferral account, attracting a weighted average cost of capital (WACC) return, in the year they are expended. The closing balance of the non-rate base DSM Deferral account is then transferred to FEI's rate base DSM Deferral account at the beginning of the following forecast year.

FEI proposes that the $15 million limit be increased to $30 million per year as expenditures have been consistently greater than $30 million per year under the DSM portfolio over the past three years (2015 to 2017) as illustrated in Table 5-1. With the significant increase in expenditures proposed in Section 6, FEI submits that at least $30 million annually will continue to be spent over the 2019 to 2022 period proposed in the DSM Plan. Aligning the amount forecast in the rate base DSM Deferral account each year with the actual expenditures reduces the financing costs added to the deferral account, and overall costs to rate payers on the non-rate base portion of the DSM Plan expenditures. FEI will account for the balance of spending, up to the approved FEI funding amount, greater than $30 million in FEI's non-rate base DSM deferral account. Consistent with approved practice the ending balance of the non-rate base DSM deferral account will be transferred to FEI's rate base DSM deferral account at the beginning of the following year. FEI's rate base DSM deferral account will continue to be amortized in rates over the approved amortization period.

9.3 *AMORTIZATION PERIOD*

In the 2014-2018 PBR Decision the Commission directed FEI as follows (at page 280):

> The Commission Panel directs FEU to include in the next FEU EEC Application an analysis of the rate impact of a reduction in the EEC amortization period to eight years and to five years.

To comply with this directive, FEI has provided the requested analysis as Appendix I, summarized below, which includes all assumptions used for the analysis.

Table 9-1: FEI Incremental Delivery Rate Impacts

FEI Summary of Rate Impacts

Incremental Delivery Rate Impact Compared to Prior Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Current Treatment: Amortizing DSM Expenditures over 10 years	0.73%	0.90%	0.87%	0.99%	1.12%	1.13%	1.07%	0.84%	0.54%	0.43%
Scenario 1: Amortizing DSM Expenditures over 8 years	1.32%	0.94%	0.94%	1.04%	1.08%	1.15%	1.14%	0.84%	0.48%	0.16%
Scenario 2: Amortizing DSM Expenditures over 5 years	3.06%	0.90%	0.88%	0.73%	0.89%	1.21%	1.11%	0.59%	0.05%	-0.36%
Scenario 3: Amortizing DSM Expenditures over 16 years	-0.15%	0.75%	0.82%	0.84%	0.99%	1.00%	0.98%	0.79%	0.52%	0.50%

Incremental Delivery Rate Impact Compared to Prior Year	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Current Treatment: Amortizing DSM Expenditures over 10 years	0.29%	0.00%	-0.12%	-0.19%	-0.48%	-0.61%	-0.67%	-0.59%	-0.41%	-0.37%
Scenario 1: Amortizing DSM Expenditures over 8 years	-0.06%	-0.18%	-0.38%	-0.46%	-0.71%	-0.71%	-0.51%	-0.45%	-0.38%	-0.33%
Scenario 2: Amortizing DSM Expenditures over 5 years	-0.60%	-0.81%	-0.69%	-0.31%	-0.49%	-0.54%	-0.50%	-0.43%	-0.47%	-0.26%
Scenario 3: Amortizing DSM Expenditures over 16 years	0.39%	0.30%	0.32%	0.19%	0.08%	0.04%	-0.11%	-0.23%	-0.29%	-0.31%

As demonstrated by the results shown in the table above, shortening amortization from the existing approved duration of ten years, to eight or five years, produces a rate spike in the first year as the amount of expenditures expensed through amortization is increased from current levels. Switching to an eight year amortization period causes an approximate 1.3 percent increase in delivery rates in the first year and switching to a five year amortization causes a 3.1 percent increase in delivery rates in the first year.

Further to the Commission directive referenced above, FEI has also provided the analysis for an amortization period (see Appendix I) that is in line with the average weighted measure life of all the measures in the DSM Plan, which is more appropriate from a cost/benefit matching perspective. FEI has determined the average weighted measure life to be 16 years (see Appendix J for how this was calculated), meaning that customers benefit from FEI's DSM measures for an average time period of 16 years. It is therefore appropriate that the costs be amortized over this same period.

FEI provides the incremental rate change from switching to a 16 year amortization period as scenario 3 in the above table. A 16 year amortization period results in lower rate impacts for customers.

For the above reasons, FEI is requesting approval to move to a 16 year amortization period for DSM expenditures.

Appendix A

FEI 2019-2022 DSM PLAN

FORTISBC ENERGY INC. DSM PLAN 2019-2022 FINAL REPORT

Program Description and Cost-Effectiveness Results

June 7, 2018

Submitted to:
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Table of Contents

1 Introduction

1.1 Background and Objectives

This Demand Side Management (DSM) Plan covers the 2019-2022 FortisBC Energy Inc. (FEI) Conservation and Energy Management (C&EM) funding request for the following previously approved program areas:

- Residential Energy Efficiency Program Area
- Commercial Energy Efficiency Program Area
- Industrial Energy Efficiency Program Area
- Low Income Energy Efficiency Program Area
- Conservation Education and Outreach Initiatives
- Innovative Technologies Program Area
- Enabling Activities

This DSM Plan covers all of FEI's natural gas service territory. In addition, this plan provides program details and planned cost-effectiveness results for FEI's proposed portfolio of DSM program area activity.

Many of the programs in this DSM Plan are continuations of programs that FEI is currently operating, and has reported on in their 2017 DSM Annual Report. However, the DSM Plan also includes some new initiatives within the approved program areas; these new initiatives reflect FEI's on-going efforts to respond to changing market conditions and to integrate operational lessons learned from current implementation activities.

As with all long-term plans, it should be noted that this DSM Plan is subject to changes in market conditions, customer responses to programs, consultation input from stakeholders, including program partners, and changes in government direction and policy. Therefore, information and forecasts listed in the Program Profiles represent best estimates as of the filing of this DSM Plan and are subject to adjustments, as required.

1.2 Approach

The information presented in this report was compiled in a similar manner as the FEI 2014-2018 and 2012-2013 Energy Efficiency and Conservation (EEC) Plans filed in 2013 and 2011, respectively. The process involved a collaborative working effort between FEI DSM program personnel and staff from ICF, an energy efficiency consulting firm that also assisted FEI with the previous two rounds of DSM planning. ICF staff have broad experience in the entire energy efficiency program cycle, from conservation potential studies and technology assessments to DSM planning, program design, and program implementation. This includes supporting DSM programs in Ontario, turn-key implementation of commercial energy efficiency programs in Alberta and Saskatchewan and an industrial program in Saskatchewan, and turn-key implementation of more than 30 programs in various jurisdictions in the US.

The approach employed for DSM planning included the following steps:

- FEI program managers identified and provided a description of the individual programs included within their respective portfolios, including eligible measures, target markets and potential delivery partners.
- Drawing on a combination of previous FEI DSM market experience, relevant technology and market studies,[1] and, in some cases, professional estimates, FEI DSM managers completed Profiles for each program within their portfolio. Individual Profiles are included in the body of this report.
- ICF staff worked from the Program Profiles provided by FEI staff and populated the cost-effectiveness model. Initial results were generated at the level of total DSM program portfolio, program area (e.g., Residential, Commercial, etc.) and individual program.
- The initial results were reviewed collaboratively and revisions were made, as necessary; and
- The final results were compiled into the current report.

1.3 Report Organization

The remainder of this report is presented in the following sections:

- Section 2 provides an overview of the **DSM Program Portfolio Results**
- Section 3 provides a description of the individual programs and cost-effectiveness results for the **Residential Energy Efficiency Program Area**
- Section 4 provides a description of the individual programs and cost-effectiveness results for the **Commercial Energy Efficiency Program Area**
- Section 5 provides a description of the individual programs and cost-effectiveness results for the **Industrial Energy Efficiency Program Area**
- Section 6 provides a description of the individual programs and cost-effectiveness results for the **Low Income Energy Efficiency Program Area**
- Section 7 provides a description of the individual programs and cost-effectiveness results for the **Conservation Education and Outreach Initiatives**
- Section 8 provides a description of the individual programs and cost-effectiveness results for the **Innovative Technologies Program Area**
- Section 9 provides a description of the **Enabling Activities** that are required over the 4-year period to support the overall program effort
- Section 10 provides a **Summary** of the findings of this report, together with some commentary that puts these results into perspective
- Appendix A-1 provides details regarding the **Sources for the Measure Assumptions**

[1] Specific reference sources for each measure are provided in Appendix A-1.

1.4 Notes

The following general notes apply to all the program areas:

- Totals in Exhibits may not add exactly; any differences are due to rounding.
- A "Non-Program Specific Expense" line item has been included in Exhibits for each program area. These planned expenditures represent the costs that are attributable to that program area but support multiple programs and, therefore, are not specific to only one program. Generally, these expenditures represent items such as training, travel, marketing materials and consulting services that support the overall program area. The amounts in this plan are based primarily on past reported non-program specific expenses with scaling up factored in as deemed appropriate.

2 Overall DSM Program Portfolio Results

2.1 Introduction

This section provides a summary of the total expenditures, estimated natural gas savings, and associated cost-effectiveness for FEI's proposed portfolio of Demand Side Management (DSM) programs for the 2019-2022 period. The DSM portfolio has been organized into the following program areas:

- Residential Energy Efficiency Program Area
- Commercial Energy Efficiency Program Area
- Industrial Energy Efficiency Program Area
- Low Income Energy Efficiency Program Area
- Conservation Education and Outreach Initiatives
- Innovative Technologies Program Area
- Enabling Activities

2.2 Overall Portfolio Results

The overall DSM program results are summarized in the following exhibits:

- Exhibit 1 provides a summary of expenditures, including inflation, and represents the total budget requested by FEI for the 2019-2022 DSM plan. The assumed inflation rates are summarized in Exhibit 2. It should be noted that these inflation rates were only applied to non-incentive spending (i.e., incentives are already assumed to be year of spending). It should also be noted that inflation is only accounted for in Exhibit 1. All other exhibits presented in this document present non-incentive expenditures in 2019 dollars.
- Exhibit 3 presents the results for the total DSM program portfolio
- Exhibit 4 summarizes the annual expenditures for the programs that require the Modified TRC (MTRC) adder and compares these expenses to those for the entire portfolio
- Exhibit 5 and Exhibit 6 present the results for each individual program area and for the total DSM program portfolio

Exhibit 1 - Summary of Annual Expenditures Including Inflation

Program Area	Total Utility Expenditures ($000s)				
	2019	2020	2021	2022	Total
Residential	23,521	25,722	28,476	31,383	109,101
Commercial	13,837	17,357	27,441	31,081	89,715
Industrial	3,103	3,152	3,644	3,708	13,607
Low Income	6,630	6,795	6,984	7,217	27,626
Conservation Education and Outreach	7,155	7,360	8,595	9,467	32,578
Innovative Technologies	2,043	2,202	2,631	3,062	9,938
Enabling Activities	8,426	8,321	9,230	8,918	34,895
*Portfolio Level Activities	1,635	1,676	1,822	1,975	7,108
ALL PROGRAMS	**66,350**	**72,585**	**88,822**	**96,811**	**324,567**

*Portfolio Level Activities are those activities for which the costs cannot be assigned to individual DSM programs. It should be noted that these activities are distinct from Enabling Activities. These distinct Portfolio Level Activities include expenditures such as DSM support and portfolio level staff labour, some staff training and conferences, facilities and equipment, some industry association memberships, regulatory work, and EECAG[2] activities.

Exhibit 2 - Summary of Applied Inflation Rates

	Annual Inflation Rate (%)			
Inflation Category	***2019***	***2020***	***2021***	***2022***
Consumer Price Index (Non-Labour)	2.1%	2.0%	2.0%	2.0%
Average Weekly Earnings (Labour)	2.4%	2.6%	2.6%	2.8%

[2] The Energy Efficiency and Conservation Advisory Group (EECAG) provides insight and feedback on FEI's portfolio of DSM activities and related issues.

Exhibit 3 - Results for the Total DSM Program Portfolio

Indicator	Year	Total
Utility Expenditures, Incentives ($000s)	2019	42,623
	2020	47,957
	2021	59,625
	2022	65,411
	Total	**215,615**
Utility Expenditures, Non-Incentives ($000s)	2019	23,727
	2020	24,101
	2021	27,962
	2022	29,411
	Total	**105,201**
Utility Expenditures, Total ($000s)	2019	66,350
	2020	72,057
	2021	87,587
	2022	94,821
	Total	**320,816**
Net Incremental Annual Gas Savings (GJ/yr.)	2019	859,729
	2020	913,134
	2021	1,093,421
	2022	1,181,761
*Cumulative Net Annual Gas Savings (GJ)	2019-2022	**3,994,549**
NPV of Net Gas Savings (GJ)		**36,160,900**
Benefit/Cost Ratios	TRC	**1.0**
	Portfolio**	**1.8**
	Utility	**0.9**
	Participant	**1.7**
	RIM	**0.4**

*Only includes gas savings persisting until 2022, and therefore may be less than the sum of net incremental annual gas savings from individual program years

**Includes the MTRC adder for programs that require it (i.e., TRC/MTRC hybrid)

Exhibit 4 - Summary of the Expenditures for Programs that Require the MTRC Adder

Program	Total Utility Expenditures ($000s)				
	2019	2020	2021	2022	Total
Home Renovation Program (Residential)	16,300	17,193	18,420	20,030	71,942
New Home Program (Residential)	6,094	7,279	8,661	9,785	31,819
Performance Program - New Building (Commercial)	1,028	1,037	7,481	7,755	17,301
ALL MTRC PROGRAMS	**23,421**	**25,509**	**34,561**	**37,571**	**121,062**
ENTIRE PORTFOLIO	**66,350**	**72,057**	**87,587**	**94,821**	**320,816**
PORTFOLIO UTILIZING MTRC (%)	**35.3%**	**35.4%**	**39.5%**	**39.6%**	**37.7%**

Exhibit 5 - Expenditures for Each of the Program Areas and the Total DSM Portfolio

Program Area	Utility Expenditures ($000s)														
	Incentives					Non-Incentives					Total Expenditures				
	2019	2020	2021	2022	Total	2019	2020	2021	2022	Total	2019	2020	2021	2022	Total
Residential	20,583	23,002	25,631	28,286	97,502	2,938	2,662	2,726	2,904	11,229	23,521	25,664	28,357	31,190	108,732
Commercial	10,194	13,193	21,123	23,803	68,312	3,643	4,075	6,050	6,815	20,583	13,837	17,268	27,173	30,618	88,896
Industrial	2,261	2,261	2,732	2,732	9,985	842	872	872	912	3,498	3,103	3,133	3,604	3,644	13,483
Low Income	4,966	5,071	5,180	5,292	20,509	1,664	1,688	1,728	1,804	6,883	6,630	6,759	6,908	7,096	27,392
Conservation Education and Outreach	0	0	0	0	0	7,155	7,203	8,233	8,868	31,459	7,155	7,203	8,233	8,868	31,459
Innovative Technologies	756	886	1,286	1,686	4,614	1,287	1,287	1,287	1,287	5,148	2,043	2,173	2,573	2,973	9,762
Enabling Activities	3,863	3,544	3,673	3,612	14,692	4,563	4,679	5,332	4,986	19,560	8,426	8,223	9,005	8,598	34,252
Portfolio Level Activities	0	0	0	0	0	1,635	1,635	1,735	1,835	6,840	1,635	1,635	1,735	1,835	6,840
ALL PROGRAMS	**42,623**	**47,957**	**59,625**	**65,411**	**215,615**	**23,727**	**24,101**	**27,962**	**29,411**	**105,201**	**66,350**	**72,057**	**87,587**	**94,821**	**320,816**

Exhibit 6 - Gas Savings and Cost-Effectiveness Results for Each of the Program Areas and the Total DSM Portfolio

Program Area	Incremental Annual Gas Savings, Net (GJ)				Cumulative Annual Gas Savings, Net (GJ)*	NPV Gas Savings, Net (GJ)	Benefit/Cost Ratios				
	2019	2020	2021	2022			TRC	Portfolio**	Utility	Participant	RIM
Residential	233,529	271,677	294,328	322,297	1,121,831	11,740,131	0.6	2.2	0.9	1.3	0.4
Commercial	280,314	295,004	418,482	478,288	1,418,592	14,431,099	1.0	1.5	1.4	1.8	0.5
Industrial	269,863	269,863	303,470	303,470	1,146,666	7,382,117	3.3	3.3	4.3	4.7	0.8
Low Income	76,022	76,590	77,141	77,707	307,459	2,607,693	4.5***	4.5	0.8	2.6	0.4
Conservation Education and Outreach	Savings Not Estimated						Savings Not Estimated				
Innovative Technologies	Savings Not Estimated						Savings Not Estimated				
Enabling Activities	Savings Not Estimated						Savings Not Estimated				
Portfolio Level Activities	Savings Not Estimated						Savings Not Estimated				
ALL PROGRAMS	**859,729**	**913,134**	**1,093,421**	**1,181,761**	**3,994,549**	**36,160,900**	**1.0**	**1.8**	**0.9**	**1.7**	**0.4**

*Only includes gas savings persisting until 2022, and therefore may be less than the sum of net incremental annual gas savings from individual program years

**Includes the MTRC adder for programs that require it (i.e., TRC/MTRC hybrid)

***Section 4 of the BC Demand-Side Measures Regulation, as amended in March 2017, requires the use of the Zero Emission Energy Alternative and a 40 percent benefit adder in calculating the TRC for Low Income programs.

3 Residential Energy Efficiency Program Area

3.1 Introduction

For the 2019-2022 DSM plan, the customer offerings for the Residential Energy Efficiency Program Area consist of consolidating measures within three overarching programs:

- Home Renovation Program
- New Home Program
- Rental Apartment Efficiency Program

This approach is intended to simplify customer understanding of our programs and to streamline the customer experience. This is also expected to enable FEI to efficiently scale-up program offerings in order to optimize energy savings opportunities and integrate partner offers. In addition, the Customer Engagement Tool (please refer to Section 7.4.2) will provide a communications platform intended to extend the reach of programs and encourage conservation activities and energy literacy.

The proposed programs are described below:

- **Home Renovation Program:** This program encourages customers to take a whole home approach to their energy efficiency upgrades by consolidating space heating, water heating, and building envelope measures into one overarching program. By design, the program enables partnerships with BC Hydro, FortisBC Inc., and all levels of government. At the time of writing, the current program partners are in discussion with the Ministry of Energy, Mines, and Petroleum Resources (MEMPR) regarding program design for the upcoming Retrofit Partnership Program. Deep retrofits will be encouraged through Bonus Offers while EnerGuide home labeling initiatives will be encouraged through energy advisor supported upgrades. FEI and its program partners[3] will continue to support[4] BC's evolving home performance industry. Activities include trades outreach, training, development of program registered contractor directories, site visits for program compliance, quality installation, and contractor accreditation initiatives. These activities provide value to participating customers through increased performance and longevity of installed equipment and improved comfort of their homes.
- **New Home Program:** This program, which is being run in partnership with FortisBC Inc., will support local governments in their adoption of the BC Energy Step Code, as part of an ongoing initiative for market transformation to high performance homes. High efficiency natural gas appliance incentives will be available for further energy savings, and new measures may be added over time from the Innovative Technologies research area. FEI

[3] These initiatives may be partially co-funded by program partners FortisBC Inc., BC Hydro, the BC Ministry of Energy, Mines and Petroleum Resources and BC Housing.
[4] Industry support funds may be provided through the Program funding envelope, or where appropriate, Enabling Activities funding envelope.

and its program partners[5] will continue to support[6] the BC Energy Step Code adoption through builder and trades outreach, training, and customer education about the benefits of high performance homes and other initiatives.

- **Rental Apartment Efficiency Program**: There are three components to this program. To start, participants are provided with direct install in-suite energy efficiency upgrades completed by an agent of FortisBC. Secondly, participants are provided with energy assessments, which may recommend building-level energy efficiency upgrades such as condensing boilers, high efficiency water heaters and control upgrades. Lastly, participants are provided with support in implementing the energy efficiency recommendations and applying for rebates. All of the in-suite related expenses are included in the Residential Program Area, while the common area related expenses, including the energy assessment, implementation support, and common area upgrades, are included in the Commercial Program Area (see Section 4).

These Home Renovation, New Home, and Rental Apartment programs enable FEI customers to reduce their energy consumption and support industry to improve overall home performance. The combination of rebates, policy support, customer and industry engagement is instrumental in promoting BC's culture of conservation and fostering market transformation in the residential sector.

3.2 Selected Highlights

There are no significant changes being proposed to the previously approved programs from the 2014-2018 EEC Plan other than:

- Expanding the Furnace and Boiler initiative to a full year program. Furnace replacements represent a large opportunity for energy savings, as there are an estimated 325,000 standard and mid-efficiency furnaces across BC[7] that could benefit from a high efficiency upgrade.
- Expanding the Appliance Maintenance initiative, which currently services furnaces, boilers and fireplaces to include services for new water heater technologies such as tankless water heaters.

The 2019-2022 DSM plan includes several new measures that will be added to one or both of the Home Renovation or New Home programs. This includes the following measures:

- Combination systems
- Direct vent wall furnaces
- Drain water heat recovery systems
- HVAC zone controls
- Communicating thermostats

[5] These initiatives may be partially co-funded by program partners FortisBC Inc., BC Hydro, the BC Ministry of Energy, Mines and Petroleum Resources and BC Housing.
[6] Industry support funds may be provided through the Program funding envelope, or where appropriate, the Enabling Activities or Innovative Technologies funding envelopes.
[7] FEI, "2012 Residential End Use Study", Sampson Research Inc., July 2014

Collaborations with Utility Partners, Government and Industry

The Residential Energy Efficiency Program area will continue to partner with electric utilities, government, trade associations, and other partners to increase program awareness and expand activities to support the home performance sector to build capacity and deliver quality workmanship. The programs support the provincial government's objectives to reduce GHG emissions in-line with its 2050 climate targets and the federal government's 2030 GHG emissions reductions targets in the Pan-Canadian Framework on Clean Growth and Climate Change.

Codes and Standards

The 2019-2022 forecasts do not include baseline adjustments for potential future announcements of updates on minimum efficiency standards for regulated items. FortisBC will continue to monitor evolving codes and standards regulation and incorporate impacts to minimum efficiencies of regulated items once proposed codes and standards regulation becomes effective. This approach is due to the uncertain nature of when an effective date of proposed codes and standards regulation will come into force, and quantifying its impact within the BC market before public consultation has taken place. Additionally the approach of claiming savings after the effective date of regulation change provides a greater level of accuracy on claiming attribution savings from codes and standards.

Attributed savings will be estimated from the date of the proposed regulation change to the effective date of the regulation, as per the Demand-Side Measures Regulation (DSM Regulation). Attributed savings will then be claimed and reported on within the year of the effective date of the proposed codes and standards regulation. An assumed delay period will be applied to the effective date to account for market transition to the new regulation and existing non-compliance product stock.

When effective dates and the impact of new standards are known with certainty, FEI will make the appropriate adjustments to program design and note changes to the cost-effectiveness inputs. The approach to reporting code and standards attribution savings, similar to reporting DSM program savings will be done through the annual DSM report.

3.3 Overview of Results

Exhibit 7 and Exhibit 8 provide a summary of the estimated savings, program expenditures and cost-effectiveness results for each of the programs noted above and for the Residential Energy Efficiency Program Area as a whole.

Exhibit 7 - Summary of Expenditures for the Residential Sector Program Portfolio

Program	Utility Expenditures ($000s)														
	Incentives					Non-Incentives					Total Expenditures				
	2019	2020	2021	2022	Total	2019	2020	2021	2022	Total	2019	2020	2021	2022	Total
* Home Renovation Rebate Program	14,713	15,911	17,123	18,653	66,399	1,587	1,282	1,297	1,377	5,543	16,300	17,193	18,420	20,030	71,942
* New Home Program	5,622	6,843	8,259	9,383	30,106	472	437	402	402	1,713	6,094	7,279	8,661	9,785	31,819
Rental Apartment Efficiency Program	249	249	249	249	997	182	182	182	182	729	432	432	432	432	1,726
Non-Program Specific Expenses	0	0	0	0	0	696	760	844	943	3,244	696	760	844	943	3,244
ALL PROGRAMS	**20,583**	**23,002**	**25,631**	**28,286**	**97,502**	**2,938**	**2,662**	**2,726**	**2,904**	**11,229**	**23,521**	**25,664**	**28,357**	**31,190**	**108,732**

* Program requires the MTRC in order to pass the economic screen

Exhibit 8 - Summary of Savings and Cost-Effectiveness Results for the Residential Sector Program Portfolio

Program	Incremental Annual Gas Savings, Net (GJ)				Cumulative Annual Gas Savings, Net (GJ)	NPV Gas Savings, Net (GJ)	Benefit/Cost Ratios				
	2019	2020	2021	2022			TRC	MTRC	Utility	Participant	RIM
* Home Renovation Rebate Program	170,923	200,138	213,961	235,276	820,299	8,678,816	0.7	2.7	1.0	1.5	0.4
* New Home Program	38,921	47,854	56,682	63,336	206,792	2,367,570	0.3	1.4	0.6	0.8	0.3
Rental Apartment Efficiency Program	23,685	23,685	23,685	23,685	94,740	693,605	3.1	-	3.1	8.3	0.6
Non-Program Specific Expenses	Savings Not Estimated						Savings Not Estimated				
ALL PROGRAMS	**233,529**	**271,677**	**294,328**	**322,297**	**1,121,831**	**11,739,991**	**0.6**	**2.2****	**0.9**	**1.3**	**0.4**

* Program requires the MTRC in order to pass the economic screen

** Only includes the MTRC adder for programs that require it (i.e., TRC/MTRC hybrid)

3.4 Program Profiles

The following pages provide profiles for each of the programs shown above in Exhibit 7 and Exhibit 8.

3.4.1 Home Renovation Program

Program Description	The program will promote energy-efficiency home retrofits in collaboration with Utility Partners, as well as federal, provincial, and municipal governments. In addition to rebates, initiatives include capacity building for trades, ensuring high quality installations and providing opportunities to promote home labeling through EnerGuide home evaluations.
Target Sub-Market	Residential
New vs. Retrofit	Retrofit
Partners	BC Hydro, FortisBC Inc., Municipal, Provincial and Federal Government
Sources	Sources for measure assumptions included in Appendix A-1

Forecasted Measure Participation					
Measure	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Space Heating					
Furnace	7,000	7,000	7,000	8,000	**29,000**
Boiler	500	500	500	500	**2,000**
Combination System	500	540	610	650	**2,300**
Secondary Heating					
EnerChoice Fireplace	6,760	7,440	8,190	8,410	**30,800**
Direct Vent Wall Furnace	180	200	220	240	**840**
Water Heating					
0.67 EF Storage Tank Water Heater	3,680	4,050	4,450	4,900	**17,080**
Condensing Tankless Water Heater	1,700	1,870	2,060	2,260	**7,890**
Condensing Storage Tank Water Heater	530	580	640	700	**2,450**
Building Envelope					
Attic Insulation	2,250	2,475	2,720	3,000	**10,445**
Wall Insulation	240	265	290	320	**1,115**
Crawlspace and Basement Insulation	265	290	320	350	**1,225**
Other Insulation	110	120	130	150	**510**
Bonus Offers	600	650	700	750	**2,700**
Water Conservation					
Aerators & Showerheads	650	650	650	650	**2,600**
ENERGY STAR Washer	2,250	2,500	2,750	3,025	**10,525**
ENERGY STAR Dryer	100	100	100	100	**400**
Other					
Drain Water Heat Recovery	100	200	300	400	**1,000**
Communicating Thermostat	2,800	5,600	5,600	6,400	**20,400**
HVAC Zone Controls	0	100	560	640	**1,300**
Appliance Maintenance	50,000	50,000	50,000	50,000	**200,000**
TOTAL	**80,215**	**85,130**	**87,790**	**91,445**	**344,581**

Home Renovation Program (cont'd…)

Expenditures ($000's)					
Expenditure Type	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Incentives	$14,713	$15,911	$17,123	$18,653	**$66,399**
Admin	$574	$334	$334	$334	**$1,576**
Communication	$100	$100	$100	$100	**$400**
Evaluation	$430	$365	$380	$460	**$1,635**
Labour[8]	$483	$483	$483	$483	**$1,932**
TOTAL	**$16,300**	**$17,193**	**$18,420**	**$20,030**	**$71,942**

Measure Details								
Measure	**Incremental Cost ($)**	**Incentive ($)**	**Contractor Incentive ($)**	**Annual Gas Savings (GJ)**	**Annual Elec. Savings (kWh)**	**Measure Lifetime (yrs)**	**Free Rider Rate (%)**	**Spillover Rate (%)**
Space Heating								
Furnace	$1,737	$500	$100	6.2	280	18	-[9]	0%
Boiler	$3,200	$500	$100	8.7	0	18	-[9]	0%
Combination System	$5,486	$1,200	$50	17.7	0	18	20%	0%
Secondary Heating								
EnerChoice Fireplace	$132	$300	$50	9.5	0	15	28%	0%
Direct Vent Wall Furnace	$1,245	$300	$0	4.6	0	20	1%	0%
Water Heating								
0.67 EF Storage Tank Water Heater	$246	$200	$50	3.0	0	13	26%	0%
Condensing Tankless Water Heater	$2,561	$1,000	$50	9.5	0	20	31%	0%
Condensing Storage Tank Water Heater	$2,273	$1,000	$50	6.9	0	13	11%	0%
Building Envelope								
Attic Insulation	$1,326	$550	$0	8.5	0	30	20%	0%
Wall Insulation	$2,714	$625	$0	28.9	0	30	20%	0%
Crawlspace and Basement Insulation	$838	$543	$0	6.6	0	30	20%	0%
Other Insulation	$1,167	$350	$0	5.7	0	30	20%	0%
Bonus Offers	$0	$1,000	$0	0.0	0	-	-	-
Water Conservation								
Aerators & Showerheads	$3	$3	$0	1.0	0	10	0%	0%
ENERGY STAR Washer	$77	$75	$0	1.0	69	14	20%	0%
ENERGY STAR Dryer	$50	$100	$0	0.7	0	12	0%	0%
Other								
Drain Water Heat Recovery	$738	$250	$0	4.3	0	25	3%	0%
Communicating Thermostat	$250	$100	$0	6.5	0	15	0%	0%
HVAC Zone Controls	$896	$500	$0	5.5	0	16	0%	0%
Appliance Maintenance	$0	$25	$0	0.0	0	-	-	-
Weighted Average per Participant	**$380**	**$175**	**$18**	**2.8**	**26**	**17**	**19%**	**0%**

[8] Labour is considered to be an Admin expenditure and has been listed separately throughout all program profiles in this DSM Plan in order to clearly identify FEI's estimated labour expenditures.
[9] Based on early replacement methodology

3.4.2 New Home Program

Program Description	The New Home Program will provide financial incentives in support of energy-efficient building practices for the Residential sector. The program supports the BC Energy Step Code, and educates builders and consumers about the benefits of energy-efficient new homes.
Target Sub-Market	Residential
New vs. Retrofit	New
Partners	BC Hydro, FortisBC Inc., Municipal, Provincial and Federal Government
Sources	Sources for measure assumptions included in Appendix A-1

Forecasted Measure Participation

Measure	2019	2020	2021	2022	2019-2022
BC Energy Step Code - Whole Home[10]					
STEP 2 (Single Family Dwelling)	175	350	500	600	**1,625**
STEP 2 (Townhome/Rowhome)	55	110	165	200	**530**
STEP 3 (Single Family Dwelling)	770	960	1,200	1,400	**4,330**
STEP 3 (Townhome/Rowhome)	330	410	575	700	**2,015**
STEP 4 (Single Family Dwelling)	60	115	150	200	**525**
STEP 4 (Townhome/Rowhome)	25	50	75	100	**250**
Space and Water Heating Systems					
0.67 EF Storage Tank Water Heater	210	210	210	210	**840**
Tankless Water Heater	950	860	810	760	**3,380**
Condensing Storage Tank Water Heater	320	290	270	255	**1,135**
Combination System	600	700	800	800	**2,900**
Secondary Heating					
EnerChoice Fireplace	1,730	1,850	1,990	2,140	**7,710**
Direct Vent Wall Furnace	100	150	200	250	**700**
Other					
Drain Water Heat Recovery	100	200	300	400	**1,000**
Communicating Thermostat	500	750	800	900	**2,950**
HVAC Zone Controls	0	50	80	90	**220**
ENERGY STAR Dryer	50	50	55	60	**215**
TOTAL	**5,975**	**7,105**	**8,180**	**9,065**	**30,325**

Expenditures ($000's)

Expenditure Type	2019	2020	2021	2022	2019-2022
Incentives	$5,622	$6,843	$8,259	$9,383	**$30,106**
Admin	$144	$84	$84	$84	**$396**
Communication	$50	$50	$50	$50	**$200**
Evaluation	$50	$75	$40	$40	**$205**
Labour	$228	$228	$228	$228	**$912**
TOTAL	**$6,094**	**$7,280**	**$8,661**	**$9,785**	**$31,819**

[10] STEP 5 expenditures are allocated to the Innovative Technologies Program Area due to the current lack of industry knowledge and low market adoption of gas-heated net zero ready homes.

New Home Program (cont'd…)

Measure Details								
Measure	**Incremental Cost ($)**	**Incentive ($)**	**Contractor Incentive ($)**	**Annual Gas Savings (GJ)**	**Annual Elec. Savings (kWh)**	**Measure Lifetime (yrs)**	**Free Rider Rate (%)**	**Spillover Rate (%)**
BC Energy Step Code - Whole Home								
STEP 2 (Single Family Dwelling)	$2,632	$1,000	$0	6.2	-1	25	23%	0%
STEP 2 (Townhome/Rowhome)	$5,204	$1,000	$0	9.5	61	25	23%	0%
STEP 3 (Single Family Dwelling)	$4,955	$2,000	$0	11.1	18	25	14%	0%
STEP 3 (Townhome/Rowhome)	$6,928	$2,000	$0	12.9	-71	25	14%	0%
STEP 4 (Single Family Dwelling)	$9,342	$4,000	$0	21.0	43	25	10%	0%
STEP 4 (Townhome/Rowhome)	$7,761	$4,000	$0	16.6	-89	25	10%	0%
Space and Water Heating Systems								
0.67 EF Storage Tank Water Heater	$210	$200	$50	3.0	0	13	26%	0%
Tankless Water Heater	$1,790	$1,000	$50	9.5	0	20	31%	0%
Condensing Storage Tank Water Heater	$1,590	$1,000	$50	6.9	0	13	11%	0%
Combination System	$5,205	$1,200	$50	14.0	0	19	20%	0%
Secondary Heating								
EnerChoice Fireplace	$132	$300	$50	5.0	0	15	29%	0%
Direct Vent Wall Furnace	$1,245	$300	$0	4.6	0	20	1%	0%
Other								
Drain Water Heat Recovery	$581	$250	$0	3.4	0	30	5%	0%
Communicating Thermostat	$250	$100	$0	6.5	0	15	0%	0%
HVAC Zone Controls	$896	$500	$0	5.5	0	16	0%	0%
ENERGY STAR Dryer	$50	$100	$0	0.7	0	12	0%	0%
Weighted Average per Participant	**$2,501**	**$966**	**$26**	**8.3**	**-1.1**	**19**	**19%**	**0%**

3.4.3 Rental Apartment Efficiency Program (RAP)

Program Description	There are three components to this program. To start, participants are provided with direct install of in-suite energy efficiency upgrades completed by an agent of FortisBC. Next, participants are provided with energy assessments, which may recommend building-level energy efficiency upgrades such as condensing boilers, high efficiency water heaters and control upgrades. Lastly, participants are provided with support in implementing the energy efficiency recommendations and applying for rebates. All of the in-suite related expenses are included in the Residential Program Area, while the common area related expenses, including the energy assessment, implementation support, and common area upgrades, are included in the Commercial Program Area.
Target Sub-Market	Rental Apartment Buildings
New vs. Retrofit	Retrofit
Partners	N/A
Sources	Sources for measure assumptions included in Appendix A-1

Forecasted Measure Participation					
Measure	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Aerators & Showerheads	24,450	24,450	24,450	24,450	**97,800**

Expenditures ($000's)					
Expenditure Type	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Incentives	$249	$249	$249	$249	**$997**
Admin	$105	$105	$105	$105	**$422**
Communication	$39	$39	$39	$39	**$156**
Evaluation	$23	$23	$23	$23	**$90**
Labour	$15	$15	$15	$15	**$61**
TOTAL	**$432**	**$432**	**$432**	**$432**	**$1,726**

Measure Details								
Measure	**Incremental Cost ($)**	**Incentive ($)**	**Contractor Incentive ($)**	**Annual Gas Savings (GJ)**	**Annual Elec. Savings (kWh)**	**Measure Lifetime (yrs)**	**Free Rider Rate (%)**	**Spillover Rate (%)**
Aerators & Showerheads	$10	$10	$0	1.0	0	10	0%	0%

4 Commercial Energy Efficiency Program Area

4.1 Introduction

For the 2019-2022 DSM plan, energy conservation measures for commercial customers have been grouped into the following program areas, which encompass measures that are broadly similar both in terms of what they offer customers and how they are delivered to the market:

- Prescriptive Program
- Performance Program - Existing Buildings
- Performance Program - New Buildings
- Rental Apartment Efficiency Program

The commercial market encompasses significant diversity in customer types, wants, needs, and degrees of sophistication. The proposed groupings provide administrative simplicity, but also enable a non-measure specific approach that FEI will employ to deliver its energy efficiency offers to the commercial market. In this approach, the market-facing aspects of each program will be adapted to suit the specific needs of the various target submarkets.

Each of the proposed programs is described below:

- **Prescriptive Program:** Rebate offers for the purchase and installation of specific qualifying measures are grouped under the umbrella of the Prescriptive Program. All such rebates conform to a simple archetype: market participants are informed of the fixed rebate amounts, qualifying measures are installed at a customer's location, and the rebates are provided to reduce the capital cost of the higher efficiency measures. Program delivery will include various adaptations of the archetype to suite the specific nature of both the measures and the target markets. For example, some rebates may be delivered directly to the end user, whereas others may see the rebate provided to midstream market actors, such as a product supplier. Communication materials and channels will also be adapted to suit the requirements of different target markets, and for the purpose of customer engagement some rebates will be grouped in ways that are logical for a particular target market.
- **Performance Program - Existing Buildings**: Incentive support for non-specific energy saving measures is provided under the Performance Program for existing buildings. Often requiring engineering analysis, these measures are not predefined in any way, but are adapted to suit the specific nature of customers' facilities. This program is focused on larger commercial customers with more complex building systems and most customer outreach and engagement will be performed directly by FEI Energy Solutions staff. Smaller commercial customers will also be provided with energy assessments.
- **Performance Program - New Buildings:** This program includes support for commercial new construction, which is centred on encouraging the integration of the BC Energy Step Code objectives into the design of high performance commercial buildings. Subject to further investigation, it may also include a new construction offer similar to that of the

residential New Home Program to support high efficiency new construction for commercial buildings subject to part 9 of the building code.

- **Rental Apartment Efficiency Program**: There are three components to this program. To start, participants are provided with direct install in-suite energy efficiency upgrades completed by an agent of FortisBC. Secondly, participants are provided with energy assessments, which may recommend building-level energy efficiency upgrades such as condensing boilers, high efficiency water heaters and control upgrades. Lastly, participants are provided with support in implementing the energy efficiency recommendations and applying for rebates. All of the in-suite related expenses are included in the Residential Program Area (see Section 3), while the common area related expenses, including the energy assessment, implementation support, and common area upgrades, are included in the Commercial Program Area.

4.2 Selected Highlights

Summary of Proposed Refinements

The Prescriptive Program will see its suite of measures expanded to include rebates for the following new measures:

- High efficiency furnaces
- HVAC Controls
- Condensing Unit Heaters
- Roof insulation
- Vortex Deaerators
- Underfired Broilers

Meanwhile, rebates for mid-efficiency water heating appliances will be discontinued. The availability of water heating equipment with efficiencies between 85% and 90% is limited, and the market has not shown interest in theses rebates for mid-efficiency equipment.

In the Performance Program, FEI’s support for high efficiency Commercial New Construction will be completely rebuilt, centered on supporting the adoption of the BC Energy Step Code, and designed to incorporate the input of industry stakeholders. Support may also be added for small new commercial construction if FEI can demonstrate via a pilot that the costs and savings suggest such a program would be cost-effective. Building retrofit projects will have an alternative and simplified program path based on a specified performance objective.

The Rental Apartment Program will include support for any new prescriptive offers that are applicable to rental accommodations, such as HVAC controls and roof insulation. In addition, the program will provide rebates for the installation of domestic hot water pump recirculation controls.

Innovative Technology Measures

At the time of writing, support is not included for measures that the Innovative Technologies program area has yet to fully evaluate. The absence of final study results combined with the significant diversity among commercial customers makes it difficult to reasonably predict the potential program costs, savings, incentive amounts, and participation associated with these potential measures when applied to commercial customers. Should any of these measures prove to be both cost-effective and significant in terms of natural gas savings, FEI will seek to provide incentive support. If possible, any such incentives will be provided within the approved funding envelope; should this not prove possible, a separate request for additional funding will be submitted to the Commission.

Collaborations with Utility Partners, Government and Industry

The Commercial Energy Efficiency Program area will continue to seek out and develop partnerships with electric utilities, government, trade associations, and others to increase program awareness and expand activities in support of its objective to maximize natural gas efficiency in the commercial market. The programs support the provincial government's objectives to reduce GHG emissions in-line with its 2050 climate targets and the federal government's 2030 GHG emissions reductions targets in the Pan-Canadian Framework on Clean Growth and Climate Change.

Codes and Standards

The 2019-2022 forecasts do not include baseline adjustments for potential future announcements of updates on minimum efficiency standards for regulated items. FortisBC will continue to monitor evolving codes and standards regulation and incorporate impacts to minimum efficiencies of regulated items once proposed codes and standards regulation becomes effective. This approach is due to the uncertain nature of when an effective date of proposed codes and standards regulation will come into force, and quantifying its impact within the BC market before public consultation has taken place. Additionally the approach of claiming savings after the effective date of regulation change provides a greater level of accuracy on claiming attribution savings from codes and standards.

Attributed savings will be estimated from the date of the proposed regulation change to the effective date of the regulation, as per the DSM Regulation. Attributed savings will then be claimed and reported on within the year of the effective date of the proposed codes and standards regulation. An assumed delay period will be applied to the effective date to account for market transition to the new regulation and existing non-compliance product stock.

When effective dates and the impact of new standards are known with certainty, FEI will make the appropriate adjustments to program design and note changes to the cost-effectiveness inputs. The approach to reporting code and standards attribution savings, similar to reporting DSM program savings will be done through the annual DSM report.

4.3 Overview of Results

Exhibit 9 and Exhibit 10 provide a summary of the estimated savings, program expenditures and cost-effectiveness results for each of the programs noted above and for the Commercial Energy Efficiency Program Area as a whole.

Exhibit 9 - Summary of Expenditures for the Commercial Sector Program Portfolio

Program	Utility Expenditures ($000s)														
	Incentives					Non-Incentives					Total Expenditures				
	2019	2020	2021	2022	Total	2019	2020	2021	2022	Total	2019	2020	2021	2022	Total
Prescriptive Program	6,459	9,385	11,913	14,182	41,939	1,959	2,335	3,013	3,655	10,962	8,418	11,720	14,926	17,837	52,900
Performance Program - Existing Buildings	1,931	1,996	2,146	2,332	8,405	498	504	559	583	2,145	2,429	2,499	2,706	2,916	10,550
* Performance Program - New Buildings	801	808	6,060	6,285	13,954	227	229	1,420	1,470	3,347	1,028	1,037	7,481	7,755	17,301
Rental Apartment Efficiency Program	1,004	1,004	1,004	1,004	4,014	253	253	253	253	1,011	1,256	1,256	1,256	1,256	5,025
Non-Program Specific Expenses	0	0	0	0	0	706	755	804	854	3,119	706	755	804	854	3,119
ALL PROGRAMS	**10,194**	**13,193**	**21,123**	**23,803**	**68,312**	**3,643**	**4,075**	**6,050**	**6,815**	**20,583**	**13,837**	**17,268**	**27,173**	**30,618**	**88,896**

* Program requires the MTRC in order to pass the economic screen

Exhibit 10 - Summary of Savings and Cost-Effectiveness Results for the Commercial Sector Program Portfolio

Program	Incremental Annual Gas Savings, Net (GJ)				Cumulative Annual Gas Savings, Net (GJ)**	NPV Gas Savings, Net (GJ)	Benefit/Cost Ratios				
	2019	2020	2021	2022			TRC	MTRC	Utility	Participant	RIM
Prescriptive Program	145,236	187,462	238,365	290,206	861,269	9,104,089	1.1	-	1.4	2.0	0.5
Performance Program - Existing Buildings	53,840	55,050	59,708	64,365	226,033	1,960,032	1.0	-	1.5	1.7	0.6
* Performance Program - New Buildings	43,501	14,755	82,672	85,979	226,907	2,406,864	0.7	2.7	1.2	1.2	0.5
Rental Apartment Efficiency Program	37,738	37,738	37,738	37,738	104,384	960,114	1.6	-	1.5	3.0	0.6
Non-Program Specific Expenses	Savings Not Estimated						Savings Not Estimated				
ALL PROGRAMS	**280,314**	**295,004**	**418,482**	**478,288**	**1,418,592**	**14,431,099**	**1.0**	**1.5*** **	**1.4**	**1.8**	**0.5**

* Program requires the MTRC in order to pass the economic screen

** Only includes gas savings persisting until 2022, and therefore may be less than the sum of net incremental annual gas savings from individual program years

*** Only includes the MTRC adder for programs that require it (i.e., TRC/MTRC hybrid)

4.4 Program Profiles

The following pages provide profiles for each of the programs shown above in Exhibit 9 and Exhibit 10.

4.4.1 Prescriptive Program

Program Description	This program provides rebates for the installation of high efficiency natural gas burning appliances in various applications including space heating, water heating, and commercial food service. Simple rebates are provided for equipment that meet specific performance standards, as opposed to the Performance Program which requires more detailed analysis of measures as installed. The program will make use of midstream and downstream rebate delivery approaches, as warranted by the particularities of each appliance type and the market it is intended to serve.
Target Sub-Market	All commercial sub-sectors
New vs. Retrofit	New construction and retrofit
Partners	FortisBC Inc.
Sources	Sources for measure assumptions included in Appendix A-1

Forecasted Measure Participation					
Measure	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Condensing Boiler	280	280	280	280	**1,121**
Mid Efficiency Boiler	15	15	15	15	**60**
Condensing Storage Water Heater	52	87	131	175	**445**
Condensing Volume Boiler	27	45	68	90	**230**
Condensing Tankless Water Heater	69	115	172	230	**586**
Deep Fryer	44	73	121	182	**420**
Large Vat Deep Fryer	5	8	14	21	**48**
Griddle	19	31	51	77	**177**
Combination Oven	6	10	17	26	**60**
Convection Oven	33	54	90	135	**312**
Rack Oven	2	4	6	9	**21**
Conveyor Oven	5	8	14	21	**48**
Steam Cooker	4	6	10	14	**33**
Low Flow Spray Valve	100	100	100	100	**400**
Condensing Make Up Air Unit	47	109	200	269	**625**
Furnace Replacement (Baseline: Std.)	700	1,100	1,300	1,439	**4,539**
Furnace Replacement (Baseline: Mid)	700	1,100	1,300	1,439	**4,539**
Roof Insulation	45	136	200	250	**631**
HVAC Controls	0	20	40	60	**120**
Condensing Unit Heaters	44	102	187	251	**584**
Vortex Deaerators	3	12	28	47	**90**
Gas Underfired Broilers	31	51	85	127	**293**
TOTAL	**2,232**	**3,466**	**4,429**	**5,256**	**15,383**

Prescriptive Program (cont'd…)

Expenditures ($000's)					
Expenditure Type	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Incentives	$6,459	$9,385	$11,913	$14,182	**$41,939**
Admin	$851	$1,055	$1,393	$1,638	**$4,938**
Communication	$351	$436	$575	$677	**$2,039**
Evaluation	$165	$110	$75	$200	**$550**
Labour	$592	$734	$969	$1,140	**$3,435**
TOTAL	**$8,418**	**$11,720**	**$14,926**	**$17,837**	**$52,900**

Measure Details								
Measure	**Incremental Cost ($)**	**Incentive ($)**	**Contractor Incentive ($)**	**Annual Gas Savings (GJ)**	**Annual Elec. Savings (kWh)**	**Measure Lifetime (yrs)**	**Free Rider Rate (%)**	**Spillover Rate (%)**
Condensing Boiler	$19,283	$12,488	$100	396	0	20	18%	0%
Mid Efficiency Boiler	$25,922	$10,528	$100	894	0	20	18%	0%
Condensing Storage Water Heater	$3,705	$2,161	$100	93	0	15	38%	9%
Condensing Volume Boiler	$22,230	$4,033	$100	183	0	20	38%	9%
Condensing Tankless Water Heater	$2,966	$924	$100	85	0	20	38%	9%
Deep Fryer	$3,715	$2,064	$300	140	0	12	20%	0%
Large Vat Deep Fryer	$6,434	$3,467	$300	196	0	12	20%	0%
Griddle	$8,533	$2,024	$300	66	0	12	20%	0%
Combination Oven	$8,303	$4,014	$300	74	0	12	20%	0%
Convection Oven	$2,657	$2,354	$300	53	0	12	20%	0%
Rack Oven	$9,705	$5,353	$300	327	0	12	20%	0%
Conveyor Oven	$6,750	$2,797	$300	231	0	12	20%	0%
Steam Cooker	$2,000	$1,000	$300	220	0	12	20%	0%
Low Flow Spray Valve	$115	$115	$0	16	0	5	20%	0%
Condensing Make Up Air Unit	$3,900	$1,500	$100	80	3,720	18	5%	0%
Furnace Replacement (Baseline: Std.)	$1,840	$800	$100	7	280	18	0%	0%
Furnace Replacement (Baseline: Mid)	$1,840	$800	$100	5	280	18	0%	0%
Roof Insulation	$20,175	$15,131	$100	84	67	20	10%	0%
HVAC Controls	$22,885	$7,500	$0	293	33,393	8	0%	0%
Condensing Unit Heaters	$1,548	$900	$100	15	-223	18	0%	0%
Vortex Deaerators	$35,080	$10,000	$0	330	22,500	25	0%	0%
Gas Underfired Broilers	$1,900	$1,200	$300	128	0	12	20%	0%
Weighted Average per Participant	**$4,957**	**$2,612**	**$114**	**67**	**703**	**17**	**7.5%**	**0.7%**

4.4.2 Performance Program - Existing Buildings

Program Description	The program provides incentives to encourage participants in the target submarket to pursue a performance based approach to achieving natural gas savings. The program encourages detailed analysis of integrated energy saving measures to help identify all technically feasible and cost effective energy savings, and then follows up by providing support for the implementation of those measures.
Target Sub-Market	Medium to large commercial, institutional and multifamily residential
New vs. Retrofit	Retrofit
Partners	FortisBC Inc.
Sources	Sources for measure assumptions included in Appendix A-1

Forecasted Measure Participation

Measure	2019	2020	2021	2022	2019-2022
Studies - Retrofit	35	35	35	35	**138**
Capital Upgrades - Retrofit	19	18	18	18	**73**
Recommissioning - Studies	9	18	26	38	**91**
Recommissioning - O&M	4	8	13	18	**43**
Commercial Energy Assessments	35	35	35	35	**140**
TOTAL	**102**	**114**	**127**	**144**	**485**

Expenditures ($000's)

Expenditure Type	2019	2020	2021	2022	2019-2022
Incentives	$1,931	$1,996	$2,146	$2,332	**$8,405**
Admin	$289	$299	$321	$349	**$1,258**
Communication	$10	$10	$11	$12	**$43**
Evaluation	$40	$30	$50	$30	**$150**
Labour	$159	$165	$177	$193	**$694**
TOTAL	**$2,429**	**$2,499**	**$2,706**	**$2,916**	**$10,550**

Measure Details

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (yrs)	Free Rider Rate (%)	Spillover Rate (%)
Studies - Retrofit	$16,195	$8,097	$0	0	0	-	-	-
Capital Upgrades - Retrofit	$201,130	$76,561	$0	3700	0	15	32%	0%
Recommissioning - Studies	$10,900	$8,176	$0	0	0	-	-	-
Recommissioning - O&M	$22,675	$17,010	$0	1035	0	5	10%	0%
Commercial Energy Assessments	$1,754	$1,595	$0	100	0	1	34%	0%
Weighted Average per Participant	**$39,443**	**$17,330**	**$0**	**678**	**0**	**5.7**	**29%**	**0%**

4.4.3 Performance Program - New Buildings

Program Description	The program provides incentives to encourage participants in the target submarkets to pursue a performance based approach to achieving natural gas savings. The program encourages detailed analysis of integrated energy saving measures to help identify all technically feasible and cost effective energy savings, and then follows up by providing support for the implementation of those measures.
Target Sub-Market	Medium to large commercial, institutional and multifamily residential
New vs. Retrofit	New construction
Partners	FortisBC Inc.
Sources	Sources for measure assumptions included in Appendix A-1

Forecasted Measure Participation

Measure	2019	2020	2021	2022	2019-2022
BC Energy Step Code - Whole Building	0	0	11	11	**22**
Non-BC Energy Step Code - Whole Building	0	0	5	5	**10**
Early Engagement	20	20	20	20	**80**
Non-BC Energy Step Code - Engineered	0	15	45	50	**110**
BC Energy Step Code Capacity Building - Charrettes	0	0	2	2	**4**
Existing Program Participants	9	1	0	0	**10**
TOTAL	**29**	**36**	**83**	**88**	**236**

Expenditures ($000's)

Expenditure Type	2019	2020	2021	2022	2019-2022
Incentives	$801	$808	$6,060	$6,285	**$13,954**
Admin	$112	$113	$845	$876	**$1,946**
Communication	$4	$4	$29	$30	**$67**
Evaluation	$50	$50	$80	$80	**$260**
Labour	$62	$62	$466	$484	**$1,074**
TOTAL	**$1,028**	**$1,037**	**$7,481**	**$7,755**	**$17,301**

Measure Details

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (yrs)	Free Rider Rate (%)	Spillover Rate (%)
BC Energy Step Code - Whole Building	$483,945	$241,973	$0	4,012	-203,000	17	0%	0%
Non-BC Energy Step Code - Whole Building	$493,372	$246,686	$0	2,566	1,119,249	17	32%	0%
Early Engagement	$2,500	$2,500	$0	0	0	-	-	-
Non-BC Energy Step Code - Engineered	$90,000	$45,000	$0	967	-8,494	20	32%	0%
BC Energy Step Code Capacity Building - Charrettes	$50,000	$45,000	$0	0	0	-	-	-
Existing Program Participants	$1,464,285	$83,411	$0	7,108	0	17	32%	0%
Weighted Average per Participant	**$171,709**	**$59,129**	**$0**	**1,235**	**24,543**	**19**	**27%**	**0%**

4.4.4 Rental Apartment Efficiency Program (RAP)

Program Description	There are three components to this program. To start, participants are provided with direct install of in-suite energy efficiency upgrades completed by an agent of FortisBC. Next, participants are provided with energy assessments, which may recommend building-level energy efficiency upgrades such as condensing boilers, high efficiency water heaters and control upgrades. Lastly, participants are provided with support in implementing the energy efficiency recommendations and applying for rebates. All of the in-suite related expenses are included in the Residential Program Area, while the common area related expenses, including the energy assessment, implementation support, and common area upgrades, are included in the Commercial Program Area.
Target Sub-Market	Rental Apartment Buildings
New vs. Retrofit	Retrofit
Partners	
Sources	Sources for measure assumptions included in Appendix A-1

Forecasted Measure Participation

Measure	2019	2020	2021	2022	2019-2022
Energy Assessments	120	120	120	120	**480**
Implementation Support Partial	5	5	5	5	**20**
Implementation Support Full	25	25	25	25	**100**
Condensing Boilers	25	25	25	25	**100**
Water Heaters	5	5	5	5	**20**
Recirculation Controls	100	100	100	100	**400**
TOTAL	**280**	**280**	**280**	**280**	**1,120**

Expenditures ($000's)

Expenditure Type	2019	2020	2021	2022	2019-2022
Incentives	$1,004	$1,004	$1,004	$1,004	**$4,014**
Admin	$152	$152	$152	$152	**$608**
Communication	$56	$56	$56	$56	**$225**
Evaluation	$23	$23	$23	$23	**$90**
Labour	$22	$22	$22	$22	**$88**
TOTAL	**$1,256**	**$1,256**	**$1,256**	**$1,256**	**$5,025**

Measure Details

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (yrs)	Free Rider Rate (%)	Spillover Rate (%)
Energy Assessments	$1,863	$1,863	$0	199	0	1	35%	0%
Implementation Support Partial	$740	$740	$0	0	0	-	-	-
Implementation Support Full	$4,585	$4,585	$0	0	0	-	-	-
Condensing Boilers	$12,334	$9,115	$0	281	0	20	18%	0%
Water Heaters	$20,639	$2,749	$0	180	0	12	5%	0%
Recirculation Controls	$4,200	$4,200	$0	156	1,305	15	0%	0%
Weighted Average per Participant	**$4,191**	**$3,584**	**$0**	**169**	**466**	**8.7**	**19%**	**0%**

5 Industrial Energy Efficiency Program Area

5.1 Introduction

For the 2019-2022 DSM plan, the customer offerings for the Industrial Energy Efficiency Program Area have been organized into the following programs:

- **Performance program:** Previously submitted as the Industrial Optimization Program, this program includes measures that allow customers to identify, assess and implement custom designed energy efficiency projects.
- **Prescriptive program:** Previously submitted as the Specialized Industrial Process Technology program, this program includes prescriptive initiatives to encourage the implementation of technologies and best practices targeted at specific industrial processes.
- **Strategic Energy Management program:** This is a comprehensive program offering for large natural gas industrial customers to provide energy modeling, energy efficiency coaching and strategic planning support to promote both operational savings projects and larger capital retrofits.

5.2 Selected Highlights

There are no major changes being proposed to the previously approved programs from the 2014-2018 EEC Plan. However, the 2019-2022 DSM plan includes new measures and a new program.

New measures being added to the Prescriptive program include:

- **Pipe and Tank Insulation:** This prescriptive measure, targeted at facilities using steam and hot water for industrial processes, will encourage customers to reduce thermal losses from pipes and tanks by installing appropriate insulation
- **Air Curtains:** This prescriptive measure, targeted at industrial facilities with large openings or bay doors between natural gas-conditioned and unconditioned spaces, will encourage customers to reduce heating losses through the installation of air curtains
- **Direct Contact Water Heaters:** This prescriptive measure, targeted at industrial customers using hot water for industrial processes, will encourage customers to increase the efficiency of their water heaters through retrofits or complete replacements
- **Other Measures:** Additional prescriptive measures targeted at industrial customers will be developed. This may include greenhouse envelope measures, high efficiency unit heaters and other industrial-focused measures that are determined to be cost-effective.

The Strategic Energy Management (SEM) program is a new program to encourage larger industrial customers to use natural gas more efficiency. The SEM program will provide customers with tools and coaching to encourage them to implement both operational savings projects and larger capital retrofits. FortisBC may run the SEM program jointly or in partnership with the existing BC Hydro industrial SEM program. Two separate tracks are planned to be available:

- **Individual Support (Large Customers):** FEI will look to provide individual incentives and support for energy modeling, monitoring, targeting, reporting and coaching for industrial customers that have an existing energy manager.
- **Cohort Support (Medium Customers):** For industrial customers without dedicated energy managers, FEI will bring together a group of industrial customers to work together and share

knowledge related to building energy management in their facilities and receive group energy coaching and training.

5.3 Overview of Results

Exhibit 11 and Exhibit 12 provide a summary of the estimated savings, program expenditures and cost-effectiveness results for each of the programs noted above and for the Industrial Energy Efficiency Program Area as a whole.

Exhibit 11 - Summary of Expenditures for the Industrial Sector Program Portfolio

Program	Utility Expenditures ($000s) Incentives					Non-Incentives					Total Expenditures				
	2019	2020	2021	2022	Total	2019	2020	2021	2022	Total	2019	2020	2021	2022	Total
Performance Program	1,444	1,444	1,796	1,796	6,480	387	387	387	387	1,548	1,831	1,831	2,183	2,183	8,028
Prescriptive Program	417	417	486	486	1,805	95	115	95	115	420	512	532	581	601	2,225
Strategic Energy Management Program	400	400	450	450	1,700	210	210	210	210	840	610	610	660	660	2,540
Non-Program Specific Expenses	0	0	0	0	0	150	160	180	200	690	150	160	180	200	690
ALL PROGRAMS	**2,261**	**2,261**	**2,732**	**2,732**	**9,985**	**842**	**872**	**872**	**912**	**3,498**	**3,103**	**3,133**	**3,604**	**3,644**	**13,483**

Exhibit 12 - Summary of Savings and Cost-Effectiveness Results for the Industrial Sector Program Portfolio

Program	Incremental Annual Gas Savings, Net (GJ)				Cumulative Annual Gas Savings, Net (GJ)	NPV Gas Savings, Net (GJ)	Benefit/Cost Ratios				
	2019	2020	2021	2022			TRC	MTRC	Utility	Participant	RIM
Performance Program	90,189	90,189	115,957	115,957	412,291	2,997,976	2.3	-	2.9	3.4	0.8
Prescriptive Program	86,875	86,875	91,513	91,513	356,775	2,816,862	5.1	-	10.0	5.7	0.9
Strategic Energy Management Program	92,800	92,800	96,000	96,000	377,600	1,567,279	5.3	-	4.6	9.2	0.8
Non-Program Specific Expenses	Savings Not Estimated						Savings Not Estimated				
ALL PROGRAMS	**269,863**	**269,863**	**303,470**	**303,470**	**1,146,666**	**7,382,117**	**3.3**	**3.3***	**4.3**	**4.7**	**0.8**

* MTRC is equal to TRC since there are no Industrial MTRC programs

5.4 Program Profiles

The following pages provide profiles for each of the programs shown above in Exhibit 11 and Exhibit 12.

5.4.1 Performance Program

Program Description	The Performance Program is a custom program to help industrial customers use natural gas more efficiently for process-related activities. The program provides funding for walkthrough-level plant wide audits, detailed engineering feasibility studies and custom capital incentives to implement cost effective energy conservation measures (ECMs). Formerly submitted as the Industrial Optimization Program.
Target Sub-Market	Industrial Customers
New vs. Retrofit	New construction and retrofit
Partners	FortisBC Inc.
Sources	Sources for measure assumptions included in Appendix A-1

Forecasted Measure Participation					
Measure	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Technology Implementation	7	7	9	9	**32**
Feasibility Study	10	10	11	11	**42**
Plant Wide Audit	6	6	8	8	**28**
TOTAL	**23**	**23**	**28**	**28**	**102**

Expenditures ($000's)					
Expenditure Type	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Incentives	$1,444	$1,444	$1,796	$1,796	**$6,480**
Admin	$54	$54	$54	$54	**$216**
Communication	$18	$18	$18	$18	**$72**
Evaluation	$45	$45	$45	$45	**$180**
Labour	$270	$270	$270	$270	**$1,080**
TOTAL	**$1,831**	**$1,831**	**$2,183**	**$2,183**	**$8,028**

Measure Details								
Measure	**Incremental Cost ($)**	**Incentive ($)**	**Contractor Incentive ($)**	**Annual Gas Savings (GJ)**	**Annual Elec. Savings (kWh)**	**Measure Lifetime (yrs)**	**Free Rider Rate (%)**	**Spillover Rate (%)**
Technology Implementation	$217,391	$150,000	$0	14,316	0	10	10%	0%
Feasibility Study	$45,000	$33,750	$0	0	0	-	-	-
Plant Wide Audit	$12,500	$9,375	$0	0	0	-	-	-
Weighted Average per Participant	**$90,162**	**$63,529**	**$0**	**4,491**	**0**	**10**	**10%**	**0%**

5.4.2 Prescriptive Program

Program Description	Prescriptive initiatives to encourage the implementation of technologies for specific industrial processes using natural gas as an energy source. Formerly submitted as Specialized Industrial Process Technology Program.
Target Sub-Market	Large, medium and small industrial facilities
New vs. Retrofit	All measures available for both new construction and retrofit, except for the steam trap surveys and steam trap replacement (retrofit only)
Partners	FortisBC Inc.
Sources	Sources for measure assumptions included in Appendix A-1

Forecasted Measure Participation

Measure	2019	2020	2021	2022	2019-2022
Process Boiler (Hot Water and Steam)	10	10	12	12	**44**
Air Curtains - Small Door	2	2	2	2	**8**
Air Curtains - Medium Door	2	2	2	2	**8**
Air Curtains - Large Door	2	2	2	2	**8**
Direct Contact Water Heater	3	3	5	5	**16**
Steam Traps Survey	10	10	13	13	**46**
Steam Traps Replacement	10	10	13	13	**46**
1" insulation 0.5-1" HW pipe	3	3	3	3	**12**
1" insulation ≥ 1" HW pipe	3	3	3	3	**12**
1" insulation 0.5-1" LPS pipe	3	3	3	3	**12**
1" insulation ≥ 1" LPS pipe	3	3	3	3	**12**
1" insulation 0.5-1" HPS pipe	3	3	3	3	**12**
1" insulation ≥ 1" HPS pipe	3	3	3	3	**12**
Tank Insulation 1" Low Temp	1	1	1	1	**4**
Tank Insulation 1" High Temp	1	1	1	1	**4**
Tank Insulation 2" High Temp	1	1	1	1	**4**
Other Prescriptive Measures	4	4	5	5	**18**
TOTAL	**64**	**64**	**75**	**75**	**278**

Expenditures ($000's)

Expenditure Type	2019	2020	2021	2022	2019-2022
Incentives	$417	$417	$486	$486	**$1,805**
Admin	$20	$20	$20	$20	**$80**
Communication	$20	$20	$20	$20	**$80**
Evaluation	$5	$25	$5	$25	**$60**
Labour	$50	$50	$50	$50	**$200**
TOTAL	**$512**	**$532**	**$581**	**$601**	**$2,225**

Industrial Process Technology Program (cont'd…)

Measure Details								
Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (yrs)	Free Rider Rate (%)	Spillover Rate (%)
Process Boiler (Hot Water and Steam)	$20,939	$14,451	$50	912	0	20	18%	0%
Air Curtains - Small Door	$2,019	$1,300	$50	46	-204	15	18%	0%
Air Curtains - Medium Door	$5,121	$1,800	$50	184	-1,221	15	18%	0%
Air Curtains - Large Door	$11,720	$2,000	$50	1,094	-6,188	15	18%	0%
Direct Contact Water Heater	$3,898	$2,700	$50	186	0	20	18%	0%
Steam Traps Survey	$1,500	$750	$50	0	0	-	-	-
Steam Traps Replacement	$10,432	$4,000	$50	1,153	0	6	18%	0%
1" insulation 0.5-1" HW pipe	$8,150	$3,260	$50	269	0	11	18%	0%
1" insulation ≥ 1" HW pipe	$8,150	$3,260	$50	522	0	11	18%	0%
1" insulation 0.5-1" LPS pipe	$8,150	$3,260	$50	603	0	11	18%	0%
1" insulation ≥ 1" LPS pipe	$8,150	$3,260	$50	1,174	0	11	18%	0%
1" insulation 0.5-1" HPS pipe	$8,150	$3,260	$50	1,051	0	11	18%	0%
1" insulation ≥ 1" HPS pipe	$10,188	$3,260	$50	2,038	0	11	18%	0%
Tank Insulation 1" Low Temp	$134,968	$16,145	$50	14,530	0	11	18%	0%
Tank Insulation 1" High Temp	$134,968	$16,145	$50	25,724	0	11	18%	0%
Tank Insulation 2" High Temp	$189,536	$32,289	$50	24,863	0	11	18%	0%
Other Prescriptive Measures	$37,333	$20,000	$50	3,289	0	10	18%	0%
Weighted Average per Participant	**$17,283**	**$6,444**	**$50**	**1,778**	**-219**	**13**	**18%**	**0%**

5.4.3 Strategic Energy Management Program

Program Description	A comprehensive approach to energy management to achieve sustainable energy and cost savings over the long term for larger FEI natural gas industrial customers. Components may include operation energy analytics, energy expert expertise and support, assistance with applications for other program offers, industry collaboration and support for conservation initiatives. May include pay-for-performance aspect for verified energy savings at the end of the program period or for achieving identified milestones.
Target Sub-Market	Large and medium industrial facilities
New vs. Retrofit	Retrofit
Partners	BC Hydro
Sources	Sources for measure assumptions included in Appendix A-1

Forecasted Measure Participation

Measure	2019	2020	2021	2022	2019-2022
Individual, Large Customer	5	5	5	5	**20**
Cohort, Medium Customers	8	8	10	10	**36**
TOTAL	**13**	**13**	**15**	**15**	**56**

Expenditures ($000's)

Expenditure Type	2019	2020	2021	2022	2019-2022
Incentives	$400	$400	$450	$450	**$1,700**
Admin	$75	$75	$75	$75	**$300**
Communication	$30	$30	$30	$30	**$120**
Evaluation	$45	$45	$45	$45	**$180**
Labour	$60	$60	$60	$60	**$240**
TOTAL	**$610**	**$610**	**$660**	**$660**	**$2,540**

Measure Details

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (yrs)	Free Rider Rate (%)	Spillover Rate (%)
Individual, Large Customer	$40,000	$40,000	$0	20,000	0	5	20%	0%
Cohort, Medium Customers	$25,000	$25,000	$0	2,000	0	5	20%	0%
Weighted Average per Participant	**$30,357**	**$30,357**	**$0**	**8,429**	**0.0**	**5**	**20%**	**0%**

6 Low Income Energy Efficiency Program Area

6.1 Introduction

This program area specifically focuses on creating opportunities for energy savings for low income customers both directly through programs that low income customers can apply to and indirectly through programs that serve social housing providers which in turn benefits FEI's low income customers.

This program area also contributes to meeting the "adequacy" component of the DSM Regulation whereby a utilities' DSM portfolio is considered adequate when there is "a demand side measure intended specifically to assist residents of low income households to reduce their energy consumption".[11]

Furthermore, one of the guiding principles of conservation and energy management is that "programs have a goal of being universal, offering access to energy efficiency and conservation for all residential and commercial customers, including low income...".[12] FEI maintains its commitment to this principle by offering a set of no-cost, low-cost, and rebate programs to low income participants and an expanding array of programs that assist social housing providers.

For the 2019-2022 DSM plan, the suite of Low Income Energy Efficiency Program Area customer offerings has been organized into the following programs:

- Self Install Program
- Direct Install Program
- Prescriptive Rebate Program
- Support Program

6.2 Selected Highlights

All of the energy efficiency programs from the previous plan are being maintained and/or expanded within this plan. FEI also continues to evolve programs in order to benefit a greater audience and enable additional energy savings. Some work that has either already begun or will begin in the short term includes:

- Expanding the Direct Install program to enable deeper energy saving opportunities in manufactured homes, such as duct sealing and repair, insulation upgrades, and high efficiency furnaces
- Creating rebate offers to low income customers and social housing providers and thereby enabling greater participation in previously approved programs such as the Furnace Early Replacement program

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[11] BC Utilities Commission Act, Demand Side Measures Regulation (BC Reg. 326/2008), Section 3.a, amended March 24, 2017.
[12] Energy Efficiency and Conservation Programs Application, pg. 47, May 28, 2008.

These enhancements create considerable opportunity to further energy efficiency for FEI’s low income customers and social housing providers.

6.3 Overview of Results

Exhibit 13 and Exhibit 14 provide a summary of the estimated savings, program expenditures and cost-effectiveness results for each of the programs noted above and for the Low Income Program Area as a whole.

Exhibit 13 - Summary of Expenditures for the Low Income Program Portfolio

Program	Utility Expenditures ($000s)														
	Incentives					Non-Incentives					Total Expenditures				
	2019	2020	2021	2022	Total	2019	2020	2021	2022	Total	2019	2020	2021	2022	Total
Direct Install Program	1,610	1,680	1,750	1,820	6,860	550	550	550	580	2,230	2,160	2,230	2,300	2,400	9,090
Self Install Program	325	325	325	325	1,300	170	170	170	175	686	495	495	495	500	1,986
Prescriptive Program	2,771	2,806	2,845	2,887	11,309	254	248	252	249	1,002	3,024	3,053	3,097	3,137	12,311
Support Program	260	260	260	260	1,040	540	540	540	540	2,160	800	800	800	800	3,200
Non-Program Specific Expenses	0	0	0	0	0	150	180	216	259	805	150	180	216	259	805
ALL PROGRAMS	**4,966**	**5,071**	**5,180**	**5,292**	**20,509**	**1,664**	**1,688**	**1,728**	**1,804**	**6,883**	**6,630**	**6,759**	**6,908**	**7,096**	**27,392**

Exhibit 14 - Summary of Savings and Cost-Effectiveness Results for the Low Income Program Portfolio

Program	Incremental Annual Gas Savings, Net (GJ)				Cumulative Annual Gas Savings, Net (GJ)	NPV Gas Savings, Net (GJ)	Benefit/Cost Ratios				
	2019	2020	2021	2022			TRC*	MTRC	Utility	Participant	RIM
Direct Install Program	10,120	10,560	11,000	11,440	43,120	359,738	1.8	-	0.3	1.6	0.2
Self Install Program	35,100	35,100	35,100	35,100	140,400	1,027,888	23.1	-	4.0	9.3	0.6
Prescriptive Program	30,802	30,930	31,041	31,167	123,939	1,220,066	4.6	-	0.8	2.3	0.4
Support Program	Savings Not Estimated						Savings Not Estimated				
Non-Program Specific Expenses	Savings Not Estimated						Savings Not Estimated				
ALL PROGRAMS	**76,022**	**76,590**	**77,141**	**77,707**	**307,459**	**2,607,693**	**4.5**	**-**	**0.8**	**2.6**	**0.4**

* Section 4 of the BC DSM Regulation, as amended in March 2017, requires the use of the Zero Emission Energy Alternative and a 40 percent benefit adder in calculating the TRC for Low Income programs.

6.4 Program Profiles

The following pages provide profiles for each of the programs shown above in Exhibit 13 and **Error! Reference source not found.**.

6.4.1 Direct Install Program

Program Description	Recognizing that some low income customers do not have the expertise and/or physical capabilities to install energy efficient measures, these programs aim to remove that barrier by having a program delivery agent/contractor perform the installation.
Target Sub-Market	Low income single family dwellings, townhomes, row homes and apartments
New vs. Retrofit	Retrofit
Partners	BC Hydro, FortisBC Inc.
Sources	Sources for measure assumptions included in Appendix A-1

Forecasted Measure Participation					
Measure	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Energy Conservation Assistance	2,300	2,400	2,500	2,600	**9,800**

Expenditures ($000's)					
Expenditure Type	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Incentives	$1,610	$1,680	$1,750	$1,820	**$6,860**
Admin	$100	$100	$100	$100	**$400**
Communication	$175	$175	$175	$125	**$650**
Evaluation	$100	$100	$100	$180	**$480**
Labour	$175	$175	$175	$175	**$700**
TOTAL	**$2,160**	**$2,230**	**$2,300**	**$2,400**	**$9,090**

Measure Details								
Measure	**Incremental Cost ($)**	**Incentive ($)**	**Contractor Incentive ($)**	**Annual Gas Savings (GJ)**	**Annual Elec. Savings (kWh)**	**Measure Lifetime (yrs)**	**Free Rider Rate (%)**	**Spillover Rate (%)**
Energy Conservation Assistance	$700	$700	$0	4.4	0	12	0%	0%

6.4.2 Self Install Program

Program Description	Participants that have the capabilities to perform basic installations on their own can receive a bundle of basic energy efficiency measures delivered to their home address.
Target Sub-Market	Low income home owners, low income customers living in private rental suites
New vs. Retrofit	Retrofit
Partners	BC Hydro, FortisBC Inc.
Sources	Sources for measure assumptions included in Appendix A-1

Forecasted Measure Participation

Measure	2019	2020	2021	2022	2019-2022
Energy Savings Kit	13,000	13,000	13,000	13,000	**52,000**

Expenditures ($000's)

Expenditure Type	2019	2020	2021	2022	2019-2022
Incentives	$325	$325	$325	$325	**$1,300**
Admin	$18	$18	$18	$18	**$70**
Communication	$105	$105	$105	$105	**$420**
Evaluation	$4	$4	$4	$9	**$21**
Labour	$44	$44	$44	$44	**$175**
TOTAL	**$495**	**$495**	**$495**	**$500**	**$1,986**

Measure Details

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (yrs)	Free Rider Rate (%)	Spillover Rate (%)
Energy Savings Kit	$25	$25	$0	2.7	0	10	0%	0%

6.4.3 Prescriptive Program

Program Description	The prescriptive program is to enable a straight forward path towards a rebate for specific residential and commercial energy efficiency measures.
Target Sub-Market	Residential low Income customers and social housing multi-unit buildings
New vs. Retrofit	New construction and retrofit
Partners	
Sources	Sources for measure assumptions included in Appendix A-1

Forecasted Measure Participation

Measure	2019	2020	2021	2022	2019-2022
Space Heat Top Up	30	30	30	30	**120**
Water Heating Top Up	15	15	15	15	**60**
Furnace Replacement Top Up (Baseline: Mid)	228	245	280	315	**1,068**
Furnace Replacement Top Up (Baseline: Std)	438	420	385	350	**1,593**
0.67 EF Storage Tank Water Heater Top Up	258	284	312	343	**1,196**
Tankless Water Heater Top Up	85	94	103	113	**395**
Condensing Storage Tank Water Heater Top Up	27	29	32	35	**123**
Non-Profit (Bundled) Rebates	25	25	25	25	**100**
TOTAL	**1,104**	**1,141**	**1,182**	**1,226**	**4,653**

Expenditures ($000's)

Expenditure Type	2019	2020	2021	2022	2019-2022
Incentives	$2,771	$2,806	$2,845	$2,887	**$11,309**
Admin	$25	$25	$25	$25	**$100**
Communication	$38	$38	$38	$38	**$150**
Evaluation	$16	$10	$14	$12	**$52**
Labour	$175	$175	$175	$175	**$700**
TOTAL	**$3,024**	**$3,053**	**$3,097**	**$3,137**	**$12,311**

Measure Details

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (yrs)	Free Rider Rate (%)	Spillover Rate (%)
Space Heat Top Up	$7,700	$7,700	$0	125	0	20	0%	0%
Water Heating Top Up	$4,500	$4,500	$0	34	0	12	0%	0%
Furnace Replacement Top Up (Baseline: Mid)	$1,737	$1,700	$50	5	280	18	0%	0%
Furnace Replacement Top Up (Baseline: Std)	$1,737	$1,700	$50	7	280	18	0%	0%
0.67 EF Storage Tank Water Heater Top Up	$246	$250	$50	3	0	17	0%	0%
Tankless Water Heater Top Up	$2,561	$2,500	$50	8	0	17	0%	0%
Condensing Storage Tank Water Heater Top Up	$2,273	$2,200	$50	5	0	17	0%	0%
Non-Profit (Bundled) Rebates	$38,200	$38,200	$0	831	0	14	0%	0%
Weighted Average per Participant	**$2,411**	**$2,384**	**$47**	**27**	**160**	**18**	**0%**	**0%**

6.4.4 Support Program

Program Description	Support program measures seek to enhance energy efficiency retrofit skills, provide direction to Non-Profit Housing providers seeking to enhance the energy efficiency of their housing complexes, and motivate behavioural change through education and engagement.
Target Sub-Market	Low income customers and social housing providers
New vs. Retrofit	New construction and retrofit
Partners	
Sources	Sources for measure assumptions included in Appendix A-1

Forecasted Measure Participation

Measure	2019	2020	2021	2022	2019-2022
REnEW	25	25	25	25	**100**
Non-Profit Custom Studies and Implementation Support	20	20	20	20	**80**
TOTAL	**45**	**45**	**45**	**45**	**180**

Expenditures ($000's)

Expenditure Type	2019	2020	2021	2022	2019-2022
Incentives	$260	$260	$260	$260	**$1,040**
Admin	$300	$300	$300	$300	**$1,200**
Communication	$75	$75	$75	$75	**$300**
Evaluation	$65	$65	$65	$65	**$260**
Labour	$100	$100	$100	$100	**$400**
TOTAL	**$800**	**$800**	**$800**	**$800**	**$3,200**

Measure Details

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (yrs)	Free Rider Rate (%)	Spillover Rate (%)
REnEW	-	-	-	-	-	-	-	-
Non-Profit Custom Studies and Implementation Support	$0	$13,000	$0	0	0	-	-	-
Weighted Average per Participant	**$0**	**$13,000**	**$0**	**0**	**0**	**-**	**-**	**-**

7 Conservation Education and Outreach Initiatives

7.1 Introduction

The Conservation Education and Outreach (CEO) initiatives provide general conservation and non-program specific communications. CEO Initiatives support the provincial government's objectives to reduce GHG emissions in-line with its 2050 climate targets and the federal government's 2030 GHG emissions reductions targets in the Pan-Canadian Framework on Clean Growth and Climate Change.

This program area is also intended to foster a culture of conservation within the province by providing education to a broad range of customers, including residential and commercial customers and students. The goal of these programs is to ensure that customers learn about taking steps towards energy conservation so that they will also be receptive to incentive programs when they are proposed.

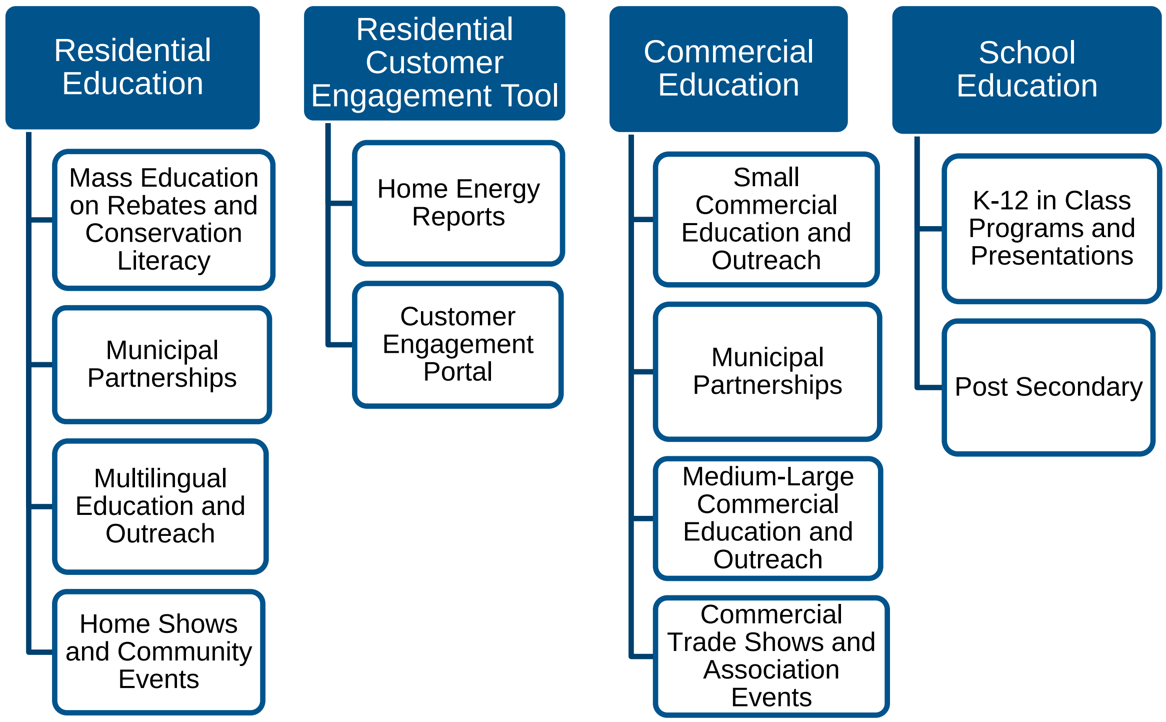
The CEO initiatives are designed to meet the DSM Regulation requirements in s.4(4) and (5), in particular, supporting specified demand-side measures and public awareness programs. Specified demand-side measures include education programs for schools and post-secondary institutions, funding of energy-efficiency training and community engagement programs.

For the 2019-2022 DSM plan, the suite of Conservation Education and Outreach customer offerings will be organized into the following programs:

- Residential Education program
- Residential Customer Engagement Tool
- Commercial Education program
- School Education program

All of the 2019-2022 programs noted above are a continuation and expansion of those presented in the 2014-2018 DSM Plan. Exhibit 15 provides a graphic representation of the organization of the CEO customer offerings.

Exhibit 15 - CEO Program Organization (2019-2022)



7.2 Selected Highlights

In addition to the program organization noted above, additional highlights to note include:

- CEO programs are not individually run through the DSM cost effectiveness tests at a program level, and FEI has historically not associated direct energy savings with CEO programs. However, some consulting and academic studies estimate that the impact of behaviour change campaigns range from 0-15%. FEI will continue to explore behavioural change opportunities that may result in energy savings in the Residential and Commercial sectors and will report on this as appropriate in the DSM Annual Reports.
- The Residential Customer Engagement Tool initiative will provide home energy reporting and other tools that will provide energy consumption analysis to customers, increase customer awareness of energy efficiency and conservation and foster conservation behaviours. The 2014-2018 DSM Plan housed this program under the Residential Program Area but, after further refinement and development, it was determined this program would be more appropriately placed within the CEO program area for the 2019-2022 period. This initiative is being run in partnership with FortisBC Inc. and the funding envelope will include the development of an online portal where customers can access targeted energy conservation content and potentially rebates and other offers.

  Based on industry research, gas savings for this type of initiative are estimated at approximately 1% of total participant natural gas consumption. However, since these savings are primarily based on behavior changes and there is uncertainty on their relative magnitude, they cannot be effectively forecast at this time and have not been included in this DSM Plan. Once savings are realized, they will be reported in the DSM Annual

Reports. FEI considers this to be an energy management program, and hence a specified demand-side measure, as defined in the DSM Regulation.

- A key development in the CEO program area since 2014 is the curriculum-connected online resource for BC elementary and secondary school teachers, called Energy Leaders. Teachers can download lesson plans to assist them with the energy related sections of the curriculum.
- To support a significant increase in all C&EM program participation and general rebate awareness, an overarching communications strategy has been developed for the plan period.

7.3 Overview of Results

Exhibit 16 provides a summary of the estimated program expenditures for each of the programs noted above and for the CEO portfolio as a whole.

Exhibit 16 - Summary of Expenditures for the CEO Program Portfolio

Program	Utility Expenditures ($000s)														
	Incentives					Non-Incentives					Total Expenditures				
	2019	2020	2021	2022	Total	2019	2020	2021	2022	Total	2019	2020	2021	2022	Total
General Residential Education Program	0	0	0	0	0	2,991	2,999	3,019	3,022	12,031	2,991	2,999	3,019	3,022	12,031
Residential Customer Engagement Tool	0	0	0	0	0	2,434	2,472	3,019	3,718	11,643	2,434	2,472	3,019	3,718	11,643
Commercial Education Program	0	0	0	0	0	673	673	854	854	3,054	673	673	854	854	3,054
School Education Program	0	0	0	0	0	957	959	1,241	1,174	4,331	957	959	1,241	1,174	4,331
Non-Program Specific Expenses	0	0	0	0	0	100	100	100	100	400	100	100	100	100	400
ALL PROGRAMS	**0**	**0**	**0**	**0**	**0**	**7,155**	**7,203**	**8,233**	**8,868**	**31,459**	**7,155**	**7,203**	**8,233**	**8,868**	**31,459**

7.4 Program Profiles

The following pages provide profiles for each of the programs shown above in Exhibit 16.

7.4.1 General Residential Education Program

Program Description	The program will provide information to Residential customers and the general public on natural gas conservation and energy literacy by seeking opportunities to engage with customers directly (either face-to-face or through online tools). This audience will also include low income and multilingual customers. Promotional activities will include a multimedia general rebates awareness campaign, engagement campaigns, educational seminars, and participation in home shows and community events. The Program also includes the cost of production of materials for events and prizing for audience engagement such as draft proofing kits that are utilized at events targeting Residential customers and children. In addition, continuing partnerships with Canadian Home Builders Associations and local sports organizations will expand outreach opportunities to engage with Residential customers while our partnership with Community Power continues to increase awareness among multilingual customers. Collaborations between internal departments and FortisBC Inc. will continue to be sought to achieve cost efficiencies in the budget, particularly for advertising and outreach events. FEI will continue to focus on behavioural change opportunities that may result in energy savings.
Target Sub-Market	Residential, municipal and general public
New vs. Retrofit	New construction and retrofit
Partners	Community Power, FortisBC Inc., municipalities

General Residential Education Program (cont'd…)

Expenditures ($000's)					
Expenditure Type	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Incentives	$0	$0	$0	$0	**$0**
Admin	$470	$470	$490	$490	**$1,920**
Communication	$2,123	$2,123	$2,123	$2,123	**$8,492**
Evaluation	$98	$106	$106	$109	**$419**
Labour	$300	$300	$300	$300	**$1,200**
TOTAL	**$2,991**	**$2,999**	**$3,019**	**$3,022**	**$12,031**

7.4.2 Residential Customer Engagement Tool

Program Description	This program will provide customers with an online portal and home energy reports where customers can access targeted energy conservation content. Other engagement measures may be included in future years to foster behavior change.
Target Sub-Market	Residential
New vs. Retrofit	Both
Partners	FortisBC Inc.

Expenditures ($000's)					
Expenditure Type	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Incentives	$0	$0	$0	$0	**$0**
Admin	$2,070	$2,110	$2,550	$3,120	**$9,850**
Communication	$150	$150	$200	$250	**$750**
Evaluation	$34	$32	$39	$48	**$153**
Labour	$180	$180	$230	$300	**$890**
TOTAL	**$2,434**	**$2,472**	**$3,019**	**$3,718**	**$11,643**

7.4.3 Commercial Education Program

Program Description	This program will provide ongoing communication and education about energy conservation initiatives as well as encouraging behavioural changes that help Commercial customers reduce their organization's energy consumption. The Commercial sector is made up of small and larger businesses in a variety of sub sectors such as retail, offices, multi-family residences, schools, hospitals, hospitality services and municipal/institutions. Promotional activities will include face-to-face, print and online communications, and industry association meetings and tradeshows. FEI will continue the Efficiency in Action Awards, which recognizes Commercial customers for their innovation in energy efficiency and achieved natural gas savings. In addition, FEI will further partnerships with organizations such as Business Improvement Association BC and BC Non-Profit Housing Association, which work with small to medium-sized businesses and organizations. Lastly, this area will also guide and support behavior education campaigns delivered by energy specialists (or an energy manager) in their respective organizations. Collaborations between internal departments, FortisBC Inc. as well as other utilities, will be pursued to achieve cost efficiencies such as the Energy Wise Network joint initiative with BC Hydro.
Target Sub-Market	Commercial customers, multi-family, energy specialists, energy management staff, municipalities
New vs. Retrofit	New construction and retrofit
Partners	BC Hydro, Community Power, municipal, FortisBC Inc.

Expenditures ($000's)					
Expenditure Type	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Incentives	$0	$0	$0	$0	**$0**
Admin	$260	$260	$385	$385	**$1,290**
Communication	$212	$212	$212	$212	**$848**
Evaluation	$51	$51	$57	$57	**$216**
Labour	$150	$150	$200	$200	**$700**
TOTAL	**$673**	**$673**	**$854**	**$854**	**$3,054**

7.4.4 School Education Program

Program Description	This program responds to meeting the "adequacy" component on of the Demand-Side Measures Regulation whereby a utilities' DSM portfolio is considered adequate if it includes an education program for students enrolled in [K-12] schools and post-secondary schools in the Company's service area. Activities will include supporting FEI's corporate school initiatives, including but not limited to Energy is Awesome and the kindergarten to grade 12 curriculum-connected resource Energy Leaders. Additionally, the assembly style presentation, Energy Champions, which is currently partnering with the BC Lions, will continue. Partnerships and funding support for post-secondary initiatives could include in-class programs, in-residence and on-campus education campaigns, as well as supporting education campaigns delivered by energy specialists (or an energy manager).
Target Sub-Market	Students and teachers
New vs. Retrofit	New Construction and Retrofit
Partners	FortisBC Inc.

Expenditures ($000's)					
Expenditure Type	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Incentives	$0	$0	$0	$0	**$0**
Admin	$520	$520	$720	$650	**$2,410**
Communication	$200	$200	$250	$250	**$900**
Evaluation	$47	$49	$51	$54	**$201**
Labour	$190	$190	$220	$220	**$820**
TOTAL	**$957**	**$959**	**$1,241**	**$1,174**	**$4,331**

8 Innovative Technologies Program Area

8.1 Introduction

The Innovative Technologies[13] Program Area evaluates both pre-commercial and commercially available technologies and conducts pilot studies to validate manufacturers' claims related to equipment and system performance. The program area also assesses actual savings and customer acceptance of these newer technologies or systems of technologies. Technologies that successfully emerge from the Innovative Technologies Program Area are considered for inclusion within the applicable sector programs within the larger C&EM portfolio.

Innovative Technologies are considered to be a specified demand-side measure, which means that the program and the technologies are only subject to the cost-benefit test at the program area level. As such, the expenditures are evaluated as part of the DSM portfolio as a whole. Also, per Section 4(4) of the DSM Regulation, Innovative Technologies are not subject to the 40% portfolio MTRC cap. Furthermore, due to the preliminary and investigative nature of Innovative Technologies, it is challenging to effectively forecast energy savings from related pilot studies. As such, projected savings from the Innovative Technology program area have not been included in this DSM Plan. When results become available via evaluation activities, any energy savings will be reported in DSM Annual Reports.

8.2 Selection and Implementation Process

Exhibit 17 shows the main steps employed in the selection and implementation process for candidate technologies included in the Innovative Technologies program. As illustrated, the process is organized into four main steps:

- **Step 1: Technology Screening**

  The process begins with the screening of candidate technologies. This step includes conducting prefeasibility studies, small demonstrations or lab tests in order understand the availability of the technology, applicable codes and testing standards, estimate the current adoption rate, evaluate any technical barriers, gather measure assumption data, determine the target customers and assess the market opportunity. The data is used to determine whether the technology meets the requirements of a technology innovation program as defined in the DSM Regulation. Candidate technologies that do not pass the DSM screen are

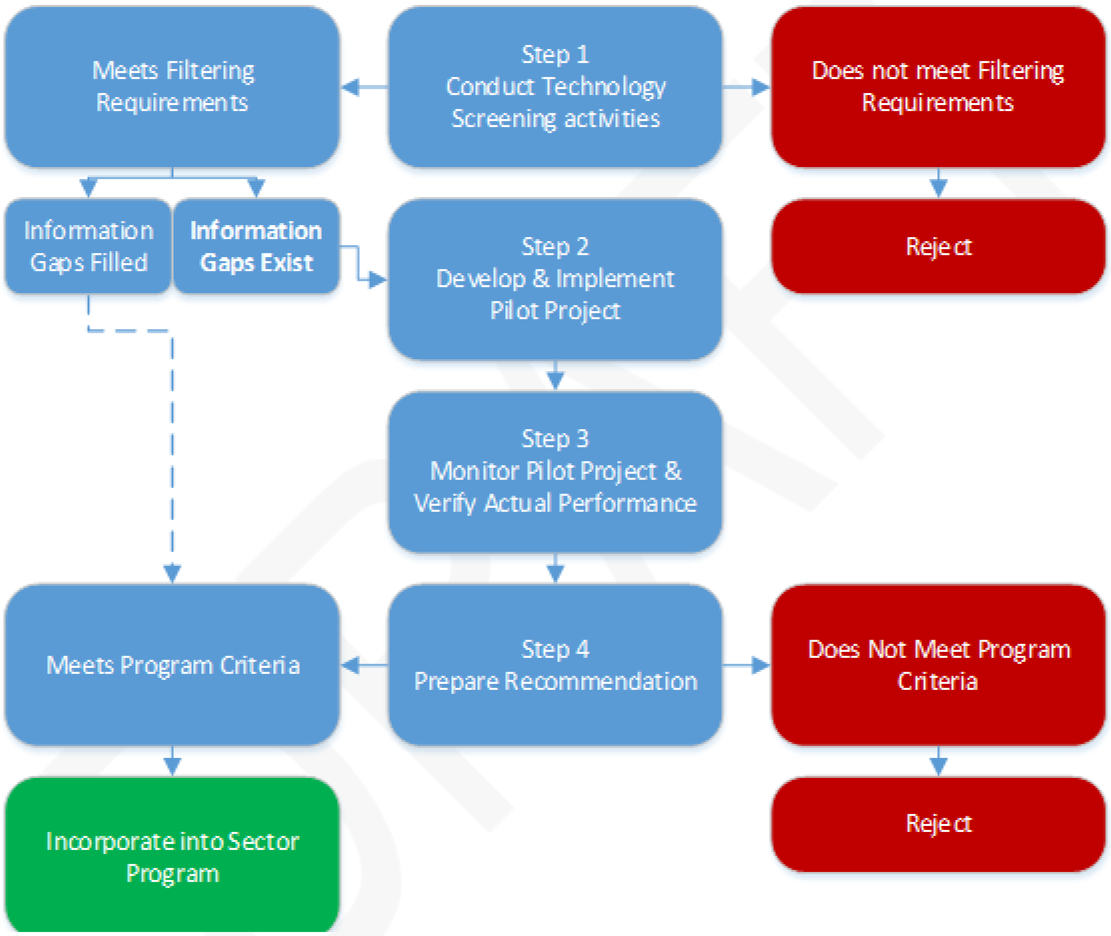
[13] The Demand Side Measure Regulation defines a technology innovation program as:
(a) to develop, use or support the increased use of a technology, a system of technologies, a building design or an industrial facility design that is:
(i) not commonly used in British Columbia, and
(ii) the use of which could directly or indirectly result in significant reductions of energy use or significantly more efficient use of energy,
(b) to do what is described in paragraph (a) and to give demonstrations to the public of any results of doing what is described in paragraph (a), or
(c) to gather information about a technology, a system of technologies, a building design or an industrial design referred to in paragraph (a).

rejected; those that do pass are considered further through the development of a pilot project if information gaps exist and are incorporated into a sector program if the information gaps are filled.

- **Step 2: Develop and Implement Pilot Project**

Pilot projects are used to gather actual operational experience with the candidate technologies. The development and implementation of a typical pilot project for those technologies that pass Step 1 takes approximately two to three years, depending on the complexities of the pilot design, program controls and participation requirements.

Exhibit 17 - Innovative Technology Selection & Implementation Process



- **Step 3: Monitor Pilot Project and Verify Actual Performance**

A measurement and verification (M&V) plan is developed for each pilot project. The plan includes details on the monitoring responsibilities, measurement equipment and meter specifications, procedures for establishing and monitoring the baseline conditions of the site, procedures for measuring the candidate technology performance, establishing the analysis procedure, and highlighting the reporting period. This step includes the procurement and installation of monitoring equipment, data analysis, and results reporting. Plans are compliant with the International Performance Measurement & Verification protocol (IPMVP) requirements.

Once performance data have been compiled over an acceptable period, it is analyzed to determine actual costs and savings as well as any other relevant operational considerations defined in the M&V plan.

- **Step 4: Prepare Recommendation**

A recommendation is prepared based on the results of Step 3. Pilot technologies that demonstrate acceptable levels of technical performance and cost-effective energy savings are typically considered favourably for inclusion into the applicable sector programs. Technologies that do not meet those criteria are typically rejected.

8.3 Expenditure Overview

The funding proposed for Innovative Technologies will be allocated primarily among:

1. Conducting technology screening activities such as prefeasibility studies, small demonstration and lab testing to screen candidate technologies
2. Development, implementation and M&V of pilot projects deemed to be feasible pursuant to screening study outcomes

Exhibit 18 shows the proposed annual expenditure by activity area over the four-year period.

Exhibit 18 - Expenditure by Activity Area

	Expenditures ($000's)				
Activity Area	***2019***	***2020***	***2021***	***2022***	***TOTAL***
Technology Screening	643	643	643	643	2,572
Pilot Project Expenditures	1,280	1,410	1,810	2,210	6,710
Non-Program Admin	120	120	120	120	480
TOTAL[14]	**2,043**	**2,173**	**2,573**	**2,973**	**9,762**

8.4 Planned Activities

The following table provides a brief description of the technologies that are being evaluated for pilot projects over the period 2019-2022.

#	Technology	Description
1	Gas-fired Heat Pumps	A Gas Fired Heat Pump is a machine or device that moves heat from one place to another whether for space heating, space cooling or domestic hot water (DHW). Essentially it is a variation of a refrigeration machine. The heat pump basically takes heat from the outdoor air and moves it into your house in winter (space heating), and then takes heat from your house and moves it outdoors during summer (space cooling). The technology is suited for both residential and commercial applications and is expected to reduce natural gas consumption by approximately 25-33%.

[14] Annual labour expenditures for the Innovative Technology program area are estimated at approximately $450,000

#	Technology	Description
2	Transpired Air Collectors	Transpired air collectors are solar air heating systems that pre-heat ventilation supply air by using solar energy. They work by transforming the exterior façade of a building into a solar absorber. The main components include an absorber plate, a perforated exterior surface, an air space, and an intake fan. These components are typically located on the roof or south-facing surfaces (in the Northern hemisphere) to maximize exposure to incidental solar energy. The perforated plate acts as a means for air to pass through the exterior surface and into the air space, which is in contact with the solar absorber. The absorber is typically painted black and is heated by incoming solar energy. This heat is then transferred to the supply air in the air space. This pre-heated air is ducted into the supply air intake of the building's mechanical system to provide tempered outdoor air. The technology can be applied to new or retrofit conditions.
3	Direct Vent Wall Furnace	Direct Vent Wall Furnaces (DVWFs) are compact self-contained combustion units that are installed on walls that are directly adjacent to the exterior so that combustion by-products are discharged outside through a vent. Typically installed to provide supplemental heating for residential applications in a space which is difficult to serve with ductwork. In new construction, they can be installed in place of central furnaces to avoid installing ductwork.
4	Recirculation Demand Controls	Domestic hot water (DHW) recirculation systems, in commercial buildings reduce the waiting time that building occupants experience when they make a hot water draw far away from the water heater. The purpose of demand controls is to operate the recirculation pump only in response to DHW demand. This results in lower temperatures in the DHW loops and less pump operation, leading to natural gas and electricity savings. Estimated gas energy savings range from 8 to 18% and vary by building type.
5	Residential HVAC Zoning	Most residential HVAC systems treat the home as a single zone. Single zone control consists of one thermostat located in a central area of the house that controls HVAC operation. In a single zone system, all of the vent registers are open, distributing air into all areas of the house at once. Single zone control wastes energy because all rooms are being conditioned even when they are not occupied and individual rooms may not be kept at a temperature comfortable for their occupants. Incorporating zoning controls are estimated to save between 5-15% energy.
6	Boiler Cycling/Zoning Controls	Boiler cycling controls increase a boiler's seasonal efficiency by reducing unnecessary cycling. Boiler zoning controls reduce a boiler's consumption by providing a more even distribution of heat throughout the building and by eliminating overheating of spaces. Packaged cycling and zoning controls provide the benefits of both types of boiler controls as an integrated solution. Boiler controls can be installed in both existing and new construction commercial buildings. Gas savings are estimated to be between 8 and 18%, depending on building type and baseline equipment.
7	Commercial Web-Enabled Thermostat	For Commercial applications web-enabled programmable thermostats can be used as a cost effective solution alternative to incorporating a building automation system. The thermostats include Wi-Fi or wireless capabilities to connect to the internet. This enables users to control HVAC functions to maintain zone temperatures via the internet and receive internet access to alerts, monitoring, and the ability to program the thermostat from a remote location. Web-enabled programmable thermostats are able to control the HVAC equipment to meet the mechanical requirements of the building while also minimizing energy use. This is done by programming operating schedules, temperature set-points, and supply fan operation during non-occupied periods. Energy savings are estimated to be between 6 and 20%, depending on building type and baseline equipment.

#	Technology	Description
8	Thermal Bridging Measures	Design and/or installation measures that reduce thermal bridges in building envelopes.
9	Rooftop Unit Controls	Energy management systems such as Building Energy Management Systems (BEMS) and Automated fault detection and diagnosis systems (AFDDS) enable building operators to minimize energy waste while providing comfortable, healthy and safe conditions for the occupants. These systems are primarily installed in large commercial buildings or big box retail buildings equipped with rooftop units. Estimated energy savings from increased BEMS functionality and innovative features range from 20 to 30%.
10	BC Energy Step Code STEP 5 Buildings Pilot	The BC Energy Step Code requires builders to use energy modelling software and on-site testing to demonstrate that both their design and the constructed building meet the requirements of the BC Energy Step Code. STEP 5 of the BC Energy Step Code represents a building design that combines a system of technologies that are innovative in nature and can directly or indirectly result in energy reductions of 50% or more when compared to a reference house. Some of these technologies can include gas-fired heat pumps, direct vent wall furnaces as well as innovative building design elements. The BC Energy Step Code STEP 5 Buildings Pilot will provide incentives to builders to adopt to STEP 5 of the BC Energy Step Code and be evaluated through participant surveys and billing analysis. Case studies will also be developed to showcase the results and provide an educational resource to be shared with builders across the province.

9 Enabling Activities

9.1 Introduction

Enabling Activities are initiatives that support and supplement FEI's C&EM program development and delivery. These programs, activities and projects provide resources common to the support and delivery of all program area activities.

Most of the activities listed are a continuation from 2018 or a re-application of a study previously conducted in order to gather up-to-date information. The Commercial Energy Specialist Program has been moved from the Commercial program area to Enabling Activities to better represent its role as an enabling program. The Community Energy Specialist Program is a new activity, in that it is a municipality focused version of the Commercial Energy Specialist Program. Further details on these activities can be found in the activity profiles section below. Projected FEI labour costs are cited in the activity descriptions as applicable and are included within the overall estimated costs listed.

Note that the activities listed are not individually run through the DSM cost effectiveness tests and do not have energy savings directly associated with them. However, costs are included at the portfolio level in the overall C&EM portfolio TRC.

The suite of Enabling Activities included in this 2019-2022 DSM Plan are:

- Trade Ally Network
- Codes & Standards
- Reporting Tool & Customer Application Portal
- Conservation Potential Review
- Customer Research
- Commercial Energy Specialist Program
- Community Energy Specialist Program

9.2 Activity Profiles

The following pages provide profiles for each of the programs shown above in Exhibit 16.

9.2.1 Trade Ally Network

Activity Description	This Trade Ally Network program develops and manages a contractor network to promote the company's C&EM programs and energy efficiency messaging. The current program, as of time of writing, is comprised largely of residential gas service contractors. FEI recognizes that other industry representatives such as commercial service contractors, equipment manufacturers, distributors and retailers also play a role in influencing natural gas end-use and energy efficiency decisions and as such incremental funding to support the expansion of this program is planned. This program also supports funding energy efficiency training as outlined in the DSM Regulation.

Expenditures ($000's)					
Expenditure Type	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Incentives	$0	$0	$0	$0	**$0**
Admin	$600	$500	$400	$400	**$1,900**
Communication	$700	$750	$850	$850	**$3,150**
Evaluation	$600	$600	$600	$600	**$2,400**
Labour	$400	$400	$400	$400	**$1,600**
TOTAL	**$2,300**	**$2,250**	**$2,250**	**$2,250**	**$9,050**

9.2.2 Codes & Standards

Activity Description	Utilities have a unique understanding of energy supply and customer demand cycles, which can be of assistance in the development and advancement of energy efficiency codes and standards. The content and timing of code and standard implementation directly affects market transformation in all program areas. FEI's level of regulatory involvement typically includes one of three involvement classifications: monitoring, stakeholder engagement and consultation/guidance in the development of standards and regulations. Compared to previous years, FEI will increase activity in this area to support development and advancement of provincial and federal energy efficiency building codes and appliance standards. Along with planned expansion of activities for codes and standards and in compliance with the DSM Regulation, investment equivalent to or more than 1% of the entire DSM portfolio expenditures has been included to be provided to a standards-making body, a regulator body and/or government to assist with the development of energy conservation standards or the efficient use of energy. The relevant financial investment planned to meet the 1% adequacy requirement will be $732,000 in 2019, $808,000 in 2020, $1,025,000 in 2021 and $1,109,000 in 2022, totalling $3,674,000 over a four year period. Included in the 1% planned adequacy funding is resources dedicated to standards making bodies which are advancing new testing and evaluation standards of natural gas fired equipment. Planned funding for provincial government towards activities on providing guidance and technical support for natural gas related energy efficiency initiatives is included. On a federal level planned funding is included for development of national building codes or measures to enhance energy efficiency of natural gas heated homes. Furthermore, with introduction of the BC Energy Step Code in 2016, FEI will support the education and awareness of this new voluntary building standard. The BC Energy Step Code is a provincial standard that aims to encourage increased energy efficiency for new buildings. It does so by establishing measurable performance-based energy-efficiency requirements for new construction. Local governments interested in better-than-code building energy efficiency have the option to reference the BC Energy Step Code in their policies and bylaws, but are not required to do so. A significant proportion of the adequacy funding is dedicated to advancing the provincial government compliance mechanism behind building to BC Energy Step Codes. Activities to expand education support to become certified energy advisors, along with supporting energy modelling and blower door testing compliance throughout the province are included. FEI's contributions to the advancement of codes and standards will result in energy savings and FEI will explore ways to measure and claim the energy savings resulting from this activity. Any such savings claims would accrue to the programs supporting the codes and standards. When effective dates and the impact of new building codes and appliance efficiencies are known with certainty, FEI will make the appropriate calculations to determine attributed savings. The approach to reporting code and standards attribution savings, similar to reporting DSM program savings will be done through the DSM Annual Report for each respective measure.

Expenditures ($000's)					
Expenditure Type	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Incentives	$713	$394	$523	$462	**$2,092**
Admin	$868	$944	$1,167	$1,251	**$4,230**
Communication	$100	$150	$150	$150	**$550**
Evaluation	$105	$135	$185	$185	**$610**
Labour	$75	$150	$150	$150	**$525**
TOTAL	**$1,861**	**$1,773**	**$2,175**	**$2,198**	**$8,007**

9.2.3 Reporting Tool & Customer Application Portal

Activity Description	The Demand-side Management Tracking System ("DSMS") Project will transition FortisBC Inc. and FEI from their existing DSM tracking systems onto a new, joint system. These tracking systems are used to manage DSM rebates from the application stage through to payment, including application review, reporting, and customer communications. The primary reasons for transitioning both utilities to a new system are: an improved ability to operate joint programs by sharing a platform, the introduction of online application forms for gas customers, improved reporting via integrated dashboards, and a powerful communications management system. In addition, the vendor has ceased any further development of the system currently in use by FEI. The DSMS project implementation is expected to kick off in Q4 2017 and conclude by Q2 2019.

Expenditures ($000's)					
Expenditure Type	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Incentives	$0	$0	$0	$0	**$0**
Admin	$350	$100	$400	$400	**$1,250**
Communication	$0	$0	$0	$0	**$0**
Evaluation	$0	$0	$0	$0	**$0**
Labour	$240	$140	$140	$140	**$660**
TOTAL	**$590**	**$240**	**$540**	**$540**	**$1,910**

9.2.4 Conservation Potential Review

Activity Description	FEI considers the CPR to be an important tool for use in developing, supporting, and assessing current and future C&EM expenditure applications, as well as for directional input into program development. The purpose of a CPR study is to examine available technologies and determine their conservation potential, which includes the amount of energy savings that can be explored through conservation and energy management programs over the study period. The CPR does this by comparing the economic and market potential of viable measures to a base case scenario.

Expenditures ($000's)					
Expenditure Type	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Incentives	$0	$0	$0	$0	**$0**
Admin	$0	$300	$300	$0	**$600**
Communication	$0	$0	$0	$0	**$0**
Evaluation	$0	$0	$0	$0	**$0**
Labour	$0	$50	$50	$0	**$100**
TOTAL	**$0**	**$350**	**$350**	**$0**	**$700**

9.2.5 Customer Research

Activity Description	This budget includes residential and commercial end use studies, ongoing research to track the impact of C&EM communications, communications testing, web site user experience testing, and customer segmentation research. The commercial end use study and residential end use study are projected to take place in 2019 and 2021 respectively hence the difference in total forecasted expenditures for those years.

Expenditures ($000's)					
Expenditure Type	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Incentives	$0	$0	$0	$0	**$0**
Admin	$150	$120	$150	$120	**$540**
Communication	$0	$0	$0	$0	**$0**
Evaluation	$20	$20	$20	$20	**$80**
Labour	$0	$0	$0	$0	**$0**
TOTAL	**$170**	**$140**	**$170**	**$140**	**$620**

9.2.6 Commercial Energy Specialist Program

Activity Description	This program funds Energy Specialist positions in large commercial organizations, up to $60,000 per year based on an annual contract. Funded Energy Specialists' key priority is to identify and implement opportunities for their organization to participate in FEI's C&EM programs, while also identifying and implementing non-program specific opportunities to use natural gas more efficiently. The estimated cost here includes an assumption of 40 participants per year. This program is funded as an enabling activity but claims natural gas savings for those projects completed by energy specialists that are not claimed by another FEI DSM program. Although energy savings will be reported from this program, these energy savings come from unique ad hoc projects undertaken by energy specialists and therefore cannot be forecast. FEI considers this to be an energy management program, and hence a specified demand-side measure, as defined in the DSM Regulation.

Expenditures ($000's)					
Expenditure Type	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Incentives	$2,400	$2,400	$2,400	$2,400	**$9,600**
Admin	$100	$100	$100	$100	**$400**
Communication	$0	$0	$0	$0	**$0**
Evaluation	$60	$25	$65	$25	**$175**
Labour	$135	$135	$135	$135	**$540**
TOTAL	**$2,695**	**$2,660**	**$2,700**	**$2,660**	**$10,715**

9.2.7 Community Energy Specialist Program

Activity Description	This program funds Senior Energy Specialist positions in municipalities and regional districts, up to $100,000 per year based on an annual contract. C&EM contributes $50,000 of this funding amount with the other $50,000 coming from FEI's External Relations department. Senior Energy Specialists lead policy development and implementation as communities develop or refresh their sustainability and energy plans including BC Energy Step Code support where applicable and raise awareness of and participate in FEI's C&EM programs. The estimated cost here includes assumption of 15 participants per year. FEI considers this to be an energy management program, and hence a specified demand-side measure, as defined in the DSM Regulation.

Expenditures ($000's)					
Expenditure Type	**2019**	**2020**	**2021**	**2022**	**2019-2022**
Incentives	$750	$750	$750	$750	**$3,000**
Admin	$10	$10	$10	$10	**$40**
Communication	$0	$0	$0	$0	**$0**
Evaluation	$25	$25	$35	$25	**$110**
Labour	$25	$25	$25	$25	**$100**
TOTAL	**$810**	**$810**	**$820**	**$810**	**$3,250**

10 Summary

The information presented in this DSM Plan provides:

- A comprehensive suite of programs for each of the previously approved DSM activity areas
- Descriptions of each of the programs, including target markets, eligible measures, expected levels of participation, energy savings and forecast expenditures by administrative category
- A full reporting of the cost-effectiveness of those programs at the level of individual program, program area and total portfolio

The DSM plan illustrates that there remain significant cost-effective opportunities for energy efficiency within FEI's service territory, which is consistent with the results provided in FEI's BC Conservation Potential Review[15] and the previous EEC Plan Report for 2014-2018. This remaining opportunity reflects, in part, how the continued technology cost and performance improvements have increased the availability of energy-efficiency options.

However, some markets are challenged. More specifically:

- The scope for program-induced natural gas savings in the Residential sector are challenged by the impacts of new space and water heating equipment performance standards, as well as those due to new residential construction standards. Consequently, the residential program portfolio has a TRC value of 0.6.
- The Commercial sector is somewhat challenged as well, with a TRC of 1.0. This is also partly related to new equipment performance standards and new construction standards. The cost-effectiveness of this program area is also challenged as its programs dig deeper to include a broader array of measures.

Overall, the portfolio of programs contained in the DSM Plan provide a TRC value of 1.0. Based on the DSM Regulation as amended on March 24, 2017 pursuant to B.C. Reg. 117/2017 (the March 2017 Amendment), the MTRC has been calculated for the measures with a TRC below 1.0. Section 4(1.5) of the DSM Regulation limits expenditures on measures that require the MTRC to be cost-effective to 40% of the total DSM portfolio expenditure. Based on the cost-effectiveness results presented herein, the expenditures for these programs total $121,062,000[16] over the test period, which represents 37.7% of the total DSM portfolio expenditures. Considering the MTRC adder only for the programs that require it, the portfolio cost-effectiveness was calculated at 1.8.

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[15] The annual energy savings reported in CPR 2016 include the cumulative effects of technologies implemented in prior years, which provides an accurate comparison with FEI's load forecast. However, the annual savings calculation method used for the purpose of this DSM Plan does not include the effects of those prior year technologies. Consequently, the reported savings from each approach are not directly comparable.

[16] All non-incentive expenditures are based on 2019 dollars, and do not account for inflation.

Appendix A-1 Sources for Measure Assumptions

Residential Energy Efficiency Program Area

Furnace	
Gas Savings per Participant	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018* *Based on evaluation reports* *Furnace Replacement Pilot Program – Preliminary Evaluation Results, Sampson Research, May 2014* *Furnace Early Replacement Program – Preliminary Evaluation Year 1 Pilot, Habart & Associates Inc. May 2013*
Electricity Savings per Participant	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018* *Based on evaluation report* *Furnace Early Replacement Program – Preliminary Evaluation Year 1 Pilot, Habart & Associates Inc. May 2013*
Incremental Cost	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, April 2018 based on Program Participant data 2017*
Measure Life	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018* *Based on reviews of Measure Life studies* *MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING, Appendix C: Substantiation Sheets by Navigant Consulting, High Efficiency (Condensing) Furnace – Residential”* *KEMA Measure Life Study: HVAC, 4.1697.190 Furnace (90% AFUE or greater)*
Free Rider Rate	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018 based on Program Participant data 2017*
Spillover Rate	*n/a*

Boiler	
Gas Savings per Participant	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018* *Based on evaluation reports* *Furnace Replacement Pilot Program – Preliminary Evaluation Results, Sampson Research, May 2014* *Furnace Early Replacement Program – Preliminary Evaluation Year 1 Pilot, Habart & Associates Inc. May 2013*
Electricity Savings per Participant	*n/a No electricity savings associated with boilers*
Incremental Cost	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, April 2018 based on Program Participant data 2017*
Measure Life	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018* *based on reviews of Measure Life studies* *MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING, Appendix C: Substantiation Sheets by Navigant Consulting, High Efficiency (Condensing) Furnace – Residential"* *KEMA Measure Life Study: HVAC, 4.1697.190 Furnace (90% AFUE or greater)*
Free Rider Rate	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018 based on Program Participant data 2017*
Spillover Rate	*n/a*

Combination System	
Gas Savings per Participant	*Combined Space and Water Heating Program Evaluation, Sampson Research, July 2017*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Review of 2015-16 Pilot Program Participation Costing Data, FEI, 2017*
Measure Life	*Combination Unit Pre-Feasibility Study, Posterity Group, April 2014*
Free Rider Rate	*Combined Space and Water Heating Program Evaluation, Sampson Research, July 2017*
Spillover Rate	*Combined Space and Water Heating Program Evaluation, Sampson Research, July 2017*

EnerChoice Fireplace	
Gas Savings per Participant	*2010 Conservation Potential Review, ICF Marbek, 2010* *Fireplace Impact Evaluation, Sampson Research, 2015, AFER Study, Apartment Fireplace Efficiency Retrofit (AFER) Project, Building Energy Solutions, April 2017*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Regulatory Proposal (September 2016), Prepared by: Energy Efficiency Branch, BC Ministry of Energy and Mines*
Measure Life	*Regulatory Proposal (September 2016), Prepared by: Energy Efficiency Branch, BC Ministry of Energy and Mines,* *Pre-Feasibility Study: Upgrades for Decorative Fireplaces-Ref: P132144JGW*
Free Rider Rate	*Analysis of 2017 Participant Data* *Pre-Feasibility Study: Upgrades for Decorative Fireplaces-Ref: P132144JGW*
Spillover Rate	*John Sampson Analysis, February 2017*

Direct Vent Wall Furnace	
Gas Savings per Participant	*Pre-feasibility Study – Direct Vent Wall Furnaces, ICF Consultants, June 2017*
Electricity Savings per Participant	*Pre-feasibility Study – Direct Vent Wall Furnaces, ICF Consultants, June 2017*
Incremental Cost	*Pre-feasibility Study – Direct Vent Wall Furnaces, ICF Consultants, June 2017*
Measure Life	*Pre-feasibility Study – Direct Vent Wall Furnaces, ICF Consultants, June 2017*
Free Rider Rate	*Pre-feasibility Study – Direct Vent Wall Furnaces, ICF Consultants, June 2017*
Spillover Rate	*n/a*

0.67 EF Storage Tank Water Heater	
Gas Savings per Participant	*Energy Savings Assumptions Review (of multiple energy savings data sources), FEI, November 2014, revisited February 2018 including* *Final Report 0.67 Energy Star Water Heater Pilot Project, June 2014* *Deemed savings review of other jurisdictions*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Review of program participant data from 2017, FEI, April 2018*
Measure Life	*Review of Technical Reference Manuals from other jurisdictions applied to actual program measure installation data from 2017. FEI, February 2018 including BC Hydro Powersmart F13 Effective Measure Life and Persistence*
Free Rider Rate	*Analysis of 2017 Participant Feedback, FEI, February 2018*
Spillover Rate	*n/a*

Tankless Water Heater	
Gas Savings per Participant	*Energy Savings Assumptions Review (of multiple energy savings data sources), FEI, November 2014, revisited February 2018 including* *Deemed savings review of other jurisdictions* *A Canadian High-Efficiency Natural Gas Water Heater Pilot Project, Natural Gas Technologies Centre, July 2014*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Review of actual program measure installations from 2017, FEI, April 2018 based on Program Participant data 2017*
Measure Life	*Review of Technical Reference Manuals from other jurisdictions applied to actual program measure installation data from 2017. FEI, February 2018 including* *MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING, Appendix C: Substantiation Sheets by Navigant Consulting, page C-85*
Free Rider Rate	*Analysis of 2017 Participant Feedback, FEI, February 2018*
Spillover Rate	*n/a*

Condensing Storage Tank Water Heater	
Gas Savings per Participant	*Energy Savings Assumptions Review (of multiple energy savings data sources), FEI, November 2014, revisited February 2018 including* *Deemed savings review of other jurisdictions* *A Canadian High-Efficiency Natural Gas Water Heater Pilot Project, Natural Gas Technologies Centre, July 2014*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Review of program measure installations from 2017, FEI, April 2018 based on Program Participant data 2017*
Measure Life	*Review of Technical Reference Manuals from other jurisdictions applied to actual program measure installation data from 2017. FEI, February 2018 including BC Hydro Powersmart F13 Effective Measure Life and Persistence*
Free Rider Rate	*Analysis of 2017 Participant Feedback, FEI, February 2018*
Spillover Rate	*n/a*

Attic Insulation	
Gas Savings per Participant	*Dunsky Energy Consulting analysis, 2013, 2015 – 2016 and 2018*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Dunsky Energy Consulting analysis update, 2018.*
Measure Life	*Dunsky Energy Consulting analysis update, 2018.*
Free Rider Rate	*Review of 2017 participant data and Analysis of Net-to-gross Survey Results for the ecoENERGY Retrofit for Homes program, Bronson Consulting Group, August 2010;*
Spillover Rate	*n/a*

Wall Insulation	
Gas Savings per Participant	*Dunsky Energy Consulting analysis, 2013, 2015 – 2016 and 2018.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Dunsky Energy Consulting analysis update, 2018.*
Measure Life	*Dunsky Energy Consulting analysis update, 2018.*
Free Rider Rate	*Review of 2017 participant data and Analysis of Net-to-gross Survey Results for the ecoENERGY Retrofit for Homes program, Bronson Consulting Group, August 2010;*
Spillover Rate	*n/a*

Crawlspace and Basement Insulation	
Gas Savings per Participant	*Dunsky Energy Consulting analysis, 2013, 2015 – 2016 and 2018.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Dunsky Energy Consulting analysis update, 2018.*
Measure Life	*Dunsky Energy Consulting analysis update, 2018.*
Free Rider Rate	*Review of 2017 participant data and Analysis of Net-to-gross Survey Results for the ecoENERGY Retrofit for Homes program, Bronson Consulting Group, August 2010;*
Spillover Rate	*n/a*

Other Insulation	
Gas Savings per Participant	*Dunsky Energy Consulting analysis, 2013, 2015 – 2016 and 2018*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Dunsky Energy Consulting analysis update, 2018.*
Measure Life	*Dunsky Energy Consulting analysis update, 2018.*
Free Rider Rate	*Review of 2017 participant data and Analysis of Net-to-gross Survey Results for the ecoENERGY Retrofit for Homes program, Bronson Consulting Group, August 2010;*
Spillover Rate	*n/a*

Bonus Offers	
Gas Savings per Participant	*n/a – under development with program partners*
Electricity Savings per Participant	*n/a – under development with program partners*
Incremental Cost	*n/a – under development with program partners*
Measure Life	*n/a – under development with program partners*
Free Rider Rate	*n/a – under development with program partners*
Spillover Rate	*n/a – under development with program partners*

Aerators & Showerheads	
Gas Savings per Participant	*Terasen Gas TRC model RES, 3/4/2013, reviewed by FEI in February, 2017*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Analysis of actual installation costs, FEI, November 2016*
Measure Life	*Terasen Gas TRC model RES, 3/4/2013, reviewed by FEI in February 2017*
Free Rider Rate	*Dunsky Consulting analysis, 2013*
Spillover Rate	*n/a*

ENERGY STAR Washer	
Gas Savings per Participant	*Review of Clothes Washer Technology Analysis, BC Hydro, 2010, 2010 Conservation Potential Review, ICF Marbek, 2010 and Technical Reference Manuals from other jurisdictions.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Consultation with program partners*
Measure Life	*2010 Conservation Potential Review, ICF Marbek, 2010 and Ontario Power Authority "2010 Prescriptive Measures and Assumptions: Release 1"*
Free Rider Rate	*BC Hydro and FortisBC based on market share of eligible washers.*
Spillover Rate	*n/a*

ENERGY STAR Dryer	
Gas Savings per Participant	*Market Review, ESource, December 2014 and High Efficiency Natural Gas Laundry Dryers, Posterity Group and Sampson Research, December 2014*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Market Review, ESource, December 2014 and High Efficiency Natural Gas Laundry Dryers, Posterity Group and Sampson Research, December 2014*
Measure Life	*Market Review, ESource, December 2014 and High Efficiency Natural Gas Laundry Dryers, Posterity Group and Sampson Research, December 2014*
Free Rider Rate	*Market Review, ESource, December 2014 and High Efficiency Natural Gas Laundry Dryers, Posterity Group and Sampson Research, December 2014*
Spillover Rate	*n/a*

Drain Water Heat Recovery	
Gas Savings per Participant	*Pre-Feasibility Study – Drain Water Heat Recovery Systems, ICF Consultants, January 2016*
Electricity Savings per Participant	*Pre-Feasibility Study – Drain Water Heat Recovery Systems, ICF Consultants, January 2016*
Incremental Cost	*Pre-Feasibility Study – Drain Water Heat Recovery Systems, ICF Consultants, January 2016*
Measure Life	*Pre-Feasibility Study – Drain Water Heat Recovery Systems, ICF Consultants, January 2016*
Free Rider Rate	*Pre-Feasibility Study – Drain Water Heat Recovery Systems, ICF Consultants, January 2016*
Spillover Rate	*n/a*

Communicating Thermostat	
Gas Savings per Participant	*Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, ICF Consultants, July 2014*
Electricity Savings per Participant	*Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, ICF Consultants, July 2014*
Incremental Cost	*Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, ICF Consultants, July 2014*
Measure Life	*Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, ICF Consultants, July 2014*
Free Rider Rate	*Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, ICF Consultants, July 2014*
Spillover Rate	*n/a*

HVAC Zone Controls	
Gas Savings per Participant	*Residential Forced Air HVAC Zone Control Pre-Feasibility Study, Posterity Group, March 2017*
Electricity Savings per Participant	*Residential Forced Air HVAC Zone Control Pre-Feasibility Study, Posterity Group, March 2017*
Incremental Cost	*Residential Forced Air HVAC Zone Control Pre-Feasibility Study, Posterity Group, March 2017*
Measure Life	*Residential Forced Air HVAC Zone Control Pre-Feasibility Study, Posterity Group, March 2017*
Free Rider Rate	*Residential Forced Air HVAC Zone Control Pre-Feasibility Study, Posterity Group, March 2017*
Spillover Rate	*n/a*

Appliance Maintenance	
Gas Savings per Participant	*n/a – no savings attributed*
Electricity Savings per Participant	*n/a*
Incremental Cost	*n/a*
Measure Life	*n/a*
Free Rider Rate	*n/a*
Spillover Rate	*n/a*

STEP 2 (Single Family Dwelling)	
Gas Savings per Participant	*Preliminary Consulting Analysis, RDH Consultants – Understanding the BC Energy Step Code, 2017-2018*
Electricity Savings per Participant	*Preliminary Consulting Analysis, RDH Consultants – Understanding the BC Energy Step Code, 2017-2018*
Incremental Cost	*Preliminary Consulting Analysis, RDH Consultants – Understanding the BC Energy Step Code, 2017-2018*
Measure Life	*Preliminary Consulting Analysis, RDH Consultants – Understanding the BC Energy Step Code, 2017-2018*
Free Rider Rate	*New Home Program Analysis, ISE Consulting Group, 2014and program experience*
Spillover Rate	*n/a*

STEP 2 (Townhome/Rowhome)	
Gas Savings per Participant	*Preliminary Consulting Analysis, RDH Consultants, November 2017*
Electricity Savings per Participant	*Preliminary Consulting Analysis, RDH Consultants, November 2017*
Incremental Cost	*Preliminary Consulting Analysis, RDH Consultants, November 2017*
Measure Life	*Preliminary Consulting Analysis, RDH Consultants, November 2017*
Free Rider Rate	*New Home Program Analysis, ISE Consulting Group, 2014 and program experience*
Spillover Rate	*n/a*

STEP 3 (Single Family Dwelling)	
Gas Savings per Participant	*Preliminary Consulting Analysis, RDH Consultants, 2017-18*
Electricity Savings per Participant	*Preliminary Consulting Analysis, RDH Consultants, 2017-18*
Incremental Cost	*Preliminary Consulting Analysis, RDH Consultants, 2017-18*
Measure Life	*Preliminary Consulting Analysis, RDH Consultants, 2017-18*
Free Rider Rate	*New Home Program Analysis, ISE Consulting Group, 2014 and program experience*
Spillover Rate	*n/a*

STEP 3 (Townhome/Rowhome)	
Gas Savings per Participant	*Preliminary Consulting Analysis, RDH Consultants, November 2017*
Electricity Savings per Participant	*Preliminary Consulting Analysis, RDH Consultants, November 2017*
Incremental Cost	*Preliminary Consulting Analysis, RDH Consultants, November 2017*
Measure Life	*Preliminary Consulting Analysis, RDH Consultants, November 2017*
Free Rider Rate	*New Home Program Analysis, ISE Consulting Group, 2014 and program experience*
Spillover Rate	*n/a*

STEP 4 (Single Family Dwelling)	
Gas Savings per Participant	*Preliminary Consulting Analysis, RDH Consultants, November 2017*
Electricity Savings per Participant	*Preliminary Consulting Analysis, RDH Consultants, November 2017*
Incremental Cost	*Preliminary Consulting Analysis, RDH Consultants, November 2017*
Measure Life	*Preliminary Consulting Analysis, RDH Consultants, November 2017*
Free Rider Rate	*Estimation based on market assessment, FEI, February 2018*
Spillover Rate	*n/a*

STEP 4 (Townhome/Rowhome)	
Gas Savings per Participant	*Preliminary Consulting Analysis, RDH Consultants, November 2017*
Electricity Savings per Participant	*Preliminary Consulting Analysis, RDH Consultants, November 2017*
Incremental Cost	*Preliminary Consulting Analysis, RDH Consultants, November 2017*
Measure Life	*Preliminary Consulting Analysis, RDH Consultants, November 2017*
Free Rider Rate	*Estimation based on market assessment, FEI, February 2018*
Spillover Rate	*n/a*

Commercial Energy Efficiency Program Area

Condensing Boiler	
Gas Savings per Participant	*EBP Deemed Savings Analysis by FEI applying results from Update of Energy Savings Analysis From FortisBC Efficient Boiler Program – Final Report, August 2013, Prism Engineering.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Analysis of 2016 Program Participant Data, FEI, November, 2017 for Efficient Boiler, and Vendor Costing Survey, FEI, 2015 for Base Efficiency Boiler*
Measure Life	*Review of Technical Reference Manuals from other jurisdictions, FEI, 2017 including* *KEMA: Boilers & Burners 1.2796.040 High Efficiency Modulating Hot Water Boiler* *ASHRAE Equipment Life Tables*
Free Rider Rate	*Efficient Boiler Program Impact Evaluation, June 2003*
Spillover Rate	*n/a*

Mid Efficiency Boiler	
Gas Savings per Participant	*EBP Deemed Savings Analysis by FEI applying results from Update of Energy Savings Analysis From FortisBC Efficient Boiler Program – Final Report, August 2013, Prism Engineering*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Analysis of 2016 Program Participant Data, FEI, November, 2017 for Efficient Boiler, and Vendor Costing Survey, FEI, 2015 for Base Efficiency Boiler*
Measure Life	*Review of Technical Reference Manuals from other jurisdictions, FEI, 2017 including* *KEMA: Boilers & Burners 1.2796.040 High Efficiency Modulating Hot Water Boiler* *ASHRAE Equipment Life Tables*
Free Rider Rate	*Efficient Boiler Program Impact Evaluation, June 2003*
Spillover Rate	*n/a*

Condensing Storage Water Heater	
Gas Savings per Participant	*Efficient Commercial Water Heater Evaluation – Final Report, Prism Engineering, February 2017*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Analysis of 2016 Program Participant Data, FEI, November, 2017 for Efficient Boiler, and Vendor Costing Survey, FEI, 2016 for Base Efficiency Boiler*
Measure Life	*Review of Technical Reference Manuals from other jurisdictions, FEI, 2017*
Free Rider Rate	*Efficient Commercial Water Heater Evaluation – Final Report, Prism Engineering, February 2017*
Spillover Rate	*n/a*

Condensing Volume Boiler	
Gas Savings per Participant	*Efficient Commercial Water Heater Evaluation – Final Report, Prism Engineering, February 2017*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Analysis of 2016 Program Participant Data, FEI, November, 2017 for Efficient Boiler, and Vendor Costing Survey, FEI, 2016 for Base Efficiency Boiler*
Measure Life	*Review of Technical Reference Manuals from other jurisdictions, FEI, 2017 including* *MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING, Appendix C: Substantiation Sheets by Navigant Consulting* *KEMA Measure Life Study*
Free Rider Rate	*Efficient Commercial Water Heater Evaluation – Final Report, Prism Engineering, February 2017*
Spillover Rate	*n/a*

Condensing Tankless Water Heater	
Gas Savings per Participant	*Efficient Commercial Water Heater Evaluation – Final Report, Prism Engineering, February 2017*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Analysis of 2016 Program Participant Data, FEI, November, 2017 for Efficient Boiler, and Vendor Costing Survey, FEI, 2016 for Base Efficiency Boiler*
Measure Life	*Review of Technical Reference Manuals from other jurisdictions, FEI, 2017 including* *MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING, Appendix C: Substantiation Sheets by Navigant Consulting* *KEMA Measure Life Study*
Free Rider Rate	*Efficient Commercial Water Heater Evaluation – Final Report, Prism Engineering, February 2017*
Spillover Rate	*n/a*

Deep Fryer	
Gas Savings per Participant	*Commercial Food Service Incentive Program Evaluation, Final Report, Fish and River Consultants, February 2018*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Program Cost Data Review, FEI, 2017 and Vendor costing survey 2017 & 2018*
Measure Life	*Review of TRMs from other jurisdictions, FEI, 2017 including KEMA Measure Life Study*
Free Rider Rate	*Commercial Food Service Incentive Program Evaluation, Final Report, Fish and River Consultants, February 2018*
Spillover Rate	*n/a*

Large Vat Deep Fryer	
Gas Savings per Participant	*Commercial Food Service Incentive Program Evaluation, Final Report, Fish and River Consultants, February 2018*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Actual Program Cost Data Review, FEI, 2017 and Vendor costing survey 2017 & 2018*
Measure Life	*Review of TRMs from other jurisdictions, FEI, 2017 including KEMA Measure Life Study*
Free Rider Rate	*Commercial Food Service Incentive Program Evaluation, Final Report, Fish and River Consultants, February 2018*
Spillover Rate	*n/a*

Griddle	
Gas Savings per Participant	*Commercial Food Service Incentive Program Evaluation, Final Report, Fish and River Consultants, February 2018*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Actual Program Cost Data Review, FEI, 2017 and Vendor costing survey 2017 & 2018*
Measure Life	*Review of TRMs from other jurisdictions, FEI, 2017 including KEMA Measure Life Study*
Free Rider Rate	*Commercial Food Service Incentive Program Evaluation, Final Report, Fish and River Consultants, February 2018*
Spillover Rate	*n/a*

Combination Oven	
Gas Savings per Participant	*Commercial Food Service Incentive Program Evaluation, Final Report, Fish and River Consultants, February 2018*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Actual Program Cost Data Review, FEI, 2017 and Vendor costing survey 2017 & 2018*
Measure Life	*Review of TRMs from other jurisdictions, FEI, 2017 including KEMA Measure Life Study*
Free Rider Rate	*Commercial Food Service Incentive Program Evaluation, Final Report, Fish and River Consultants, February 2018*
Spillover Rate	*n/a*

Convection Oven	
Gas Savings per Participant	*Commercial Food Service Incentive Program Evaluation, Final Report, Fish and River Consultants, February 2018*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Actual Program Cost Data Review, FEI, 2017 and Vendor costing survey 2017 & 2018*
Measure Life	*Food Service Final Report, February 2018*
Free Rider Rate	*Commercial Food Service Incentive Program Evaluation, Final Report, Fish and River Consultants, February 2018*
Spillover Rate	*n/a*

Rack Oven	
Gas Savings per Participant	*Commercial Food Service Incentive Program Evaluation, Final Report, Fish and River Consultants, February 2018*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Actual Program Cost Data Review, FEI, 2017 and Vendor costing survey 2017 & 2018*
Measure Life	*Review of TRMs from other jurisdictions, FEI, 2017 including KEMA Measure Life Study*
Free Rider Rate	*Commercial Food Service Incentive Program Evaluation, Final Report, Fish and River Consultants, February 2018*
Spillover Rate	*n/a*

Conveyor Oven	
Gas Savings per Participant	*Commercial Food Service Incentive Program Evaluation, Final Report, Fish and River Consultants, February 2018*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Actual Program Cost Data Review, FEI, 2017 and Vendor costing survey 2017 & 2018*
Measure Life	*Review of TRMs from other jurisdictions, FEI, 2017 including KEMA Measure Life Study*
Free Rider Rate	*Commercial Food Service Incentive Program Evaluation, Final Report, Fish and River Consultants, February 2018*
Spillover Rate	*n/a*

Steam Cooker	
Gas Savings per Participant	*Food Service Incentive Program Study, Fisher Nickel, Inc. (FNi), November 2011*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Food Service Incentive Program Study, Fisher Nickel, Inc. (FNi), November 2011*
Measure Life	*Food Service Incentive Program Study, Fisher Nickel, Inc. (FNi), November 2011*
Free Rider Rate	*Commercial Food Service Incentive Program Evaluation, Final Report, Fish and River Consultants, February 2018*
Spillover Rate	*n/a*

Low Flow Spray Valve	
Gas Savings per Participant	*Review of actual program data 2010 - 2016, FEI, February 2018*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Review of actual program data 2010 - 2016, FEI, February 2018*
Measure Life	*Ontario Energy Board: OEB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge*
Free Rider Rate	*Commercial Food Service Incentive Program Evaluation, Final Report, Fish and River Consultants, February 2018*
Spillover Rate	*n/a*

Condensing Make Up Air Unit	
Gas Savings per Participant	*Condensing Gas-Fired Ventilation Unit Pilot Program, FortisBC, SES Consulting Inc. and FRESCo Ltd., November 2015 and Ontario Energy Board: OEB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge*
Electricity Savings per Participant	*Condensing Gas-Fired Ventilation Unit Pilot Program, FortisBC, SES Consulting Inc. and FRESCo Ltd., November 2015 and Ontario Energy Board: OEB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge*
Incremental Cost	*Ontario Energy Board: OEB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge*
Measure Life	*Ontario Energy Board: OEB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge*
Free Rider Rate	*Ontario Energy Board: OEB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge, Pre-Feasibility Study, Condensing Rooftop Units, Prism Engineering, January 2012*
Spillover Rate	*n/a*

Furnace Replacement (Baseline: Std. Eff.)	
Gas Savings per Participant	*Residential Furnace Early replacement methodology applied using commercial sector GJ savings estimation from Ontario Energy Board: OEB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge, adjusted to BC climate conditions by FEI, February 2018*
Electricity Savings per Participant	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018* *Based on evaluation report* *Furnace Early Replacement Program – Preliminary Evaluation Year 1 Pilot, Habart & Associates Inc. May 2013*
Incremental Cost	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018 based on Program Participant data 2017*
Measure Life	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018* *based on reviews of Measure Life studies* *MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING, Appendix C: Substantiation Sheets by Navigant Consulting, High Efficiency (Condensing) Furnace – Residential"* *KEMA Measure Life Study: HVAC, 4.1697.190 Furnace (90% AFUE or greater)*
Free Rider Rate	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018 based on Program Participant data 2017*
Spillover Rate	*n/a*

Furnace Replacement (Baseline: Mid Eff.)	
Gas Savings per Participant	*Residential Furnace Early replacement methodology applied using commercial sector GJ savings estimation from Ontario Energy Board: EB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge, adjusted to BC climate conditions by FEI, February 2018*
Electricity Savings per Participant	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018* *Based on evaluation report* *Furnace Early Replacement Program – Preliminary Evaluation Year 1 Pilot, Habart & Associates Inc. May 2013*
Incremental Cost	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018 based on Program Participant data 2017*
Measure Life	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018* *based on reviews of Measure Life studies* *MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING, Appendix C: Substantiation Sheets by Navigant Consulting, High Efficiency (Condensing) Furnace – Residential"* *KEMA Measure Life Study: HVAC, 4.1697.190 Furnace (90% AFUE or greater)*
Free Rider Rate	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018 based on Program Participant data 2017*
Spillover Rate	*n/a*

Roof Insulation	
Gas Savings per Participant	*Advice from RDH Consultants, January 2018*
Electricity Savings per Participant	*Advice from RDH Consultants, January 2018*
Incremental Cost	*Advice from RDH Consultants, January 2018*
Measure Life	*Market based advice from RDH Consultants, January 2018*
Free Rider Rate	*Market based advice from RDH Consultants, January 2018*
Spillover Rate	*n/a*

HVAC Controls	
Gas Savings per Participant	*Review of actual custom program data 2013-2017, FEI, January 2018*
Electricity Savings per Participant	*Review of actual custom program data 2013-2017, FEI, January 2018*
Incremental Cost	*Review of actual custom program data 2013-2017, FEI, January 2018*
Measure Life	*Review of TRM and Measure Life Study references including* *BC Hydro F13 Measure Life and Persistency: 2.6.4 - Exhaust hood demand ventilation controls* *KEMA: 14.6000.085 - Kitchen Exhaust Hood Demand Control Ventilation*
Free Rider Rate	*Ontario Energy Board: EB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge, adjusted to BC climate conditions by FEI, February 2018*
Spillover Rate	*n/a*

Condensing Unit Heaters	
Gas Savings per Participant	*Pre-Feasibility Study – Condensing Unit & Infrared Radiant Tube Heating, ICF Marbek, November 2013*
Electricity Savings per Participant	*Pre-Feasibility Study – Condensing Unit & Infrared Radiant Tube Heating, ICF Marbek, November 2013*
Incremental Cost	*Pre-Feasibility Study – Condensing Unit & Infrared Radiant Tube Heating, ICF Marbek, November 2013*
Measure Life	*Pre-Feasibility Study – Condensing Unit & Infrared Radiant Tube Heating, ICF Marbek, November 2013*
Free Rider Rate	*Ontario Energy Board: EB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge, adjusted to BC climate conditions by FEI, February 2018, and Pre-Feasibility Study – Condensing Unit & Infrared Radiant Tube Heating, ICF Marbek, November 2013*
Spillover Rate	*n/a*

Vortex Deaerators	
Gas Savings per Participant	*Ice Rink Resurfacing Efficiency Pilot Measurement and Verification Result, FEI, June 2014 and discussions from product vendor*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Pilot data*
Measure Life	*BC Hydro F13 Measure Life and Persistency: 2.3.10 Water Distribution Piping Retrofit*
Free Rider Rate	*Ice Rink Resurfacing Efficiency Pilot Measurement and Verification Result, FEI, June 2014 and discussions from product vendor*
Spillover Rate	*n/a*

Gas Underfired Broilers	
Gas Savings per Participant	*Ontario Energy Board: EB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge*
Electricity Savings per Participant	*Ontario Energy Board: EB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge*
Incremental Cost	*Ontario Energy Board: EB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge*
Measure Life	*Ontario Energy Board: EB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge*
Free Rider Rate	*Ontario Energy Board: EB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge*
Spillover Rate	*n/a*

Studies – Retrofit	
Gas Savings per Participant	*n/a – no savings attributed to study*
Electricity Savings per Participant	*n/a – no savings attributed to study*
Incremental Cost	*Review of past program data 2013-2018, FEI, February 2018*
Measure Life	*n/a*
Free Rider Rate	*Review of Technical Reference Manuals from other jurisdictions, FEI, January 2010. Updated on a project by project basis for actual projects.*
Spillover Rate	*n/a*

Capital Upgrades - Retrofit	
Gas Savings per Participant	*Review of actual program measure implementation 2011 – 2017, FEI, February 2018*
Electricity Savings per Participant	*Review of actual program measure implementation 2011 – 2017, FEI, February 2018*
Incremental Cost	*Review of actual program measure implementation 2011 – 2017, FEI, February 2018*
Measure Life	*Review of actual program measure implementation 2011 – 2017, FEI, Program Manager market knowledge*
Free Rider Rate	*Review of Technical Reference Manuals from other jurisdictions, FEI, January 2010. Updated on a project by project basis for actual projects.*
Spillover Rate	*n/a*

Recommissioning - Studies	
Gas Savings per Participant	*Review of Continuous Optimization Program Data provided by BC Hydro as contained in Continuous Optimization Business Case, FEI, 2016*
Electricity Savings per Participant	*Review of Continuous Optimization Program Data provided by BC Hydro as contained in Continuous Optimization Business Case, FEI, 2016*
Incremental Cost	*Review of Continuous Optimization Program Data provided by BC Hydro as contained in Continuous Optimization Business Case, FEI, 2016*
Measure Life	*Review of Continuous Optimization Program Data provided by BC Hydro as contained in Continuous Optimization Business Case, FEI, 2016*
Free Rider Rate	*Review of Continuous Optimization Program Data provided by BC Hydro as contained in Continuous Optimization Business Case, FEI, 2016*
Spillover Rate	*n/a*

Recommissioning - O&M	
Gas Savings per Participant	*Review of Continuous Optimization Program Data provided by BC Hydro as contained in Continuous Optimization Business Case, FEI, 2016*
Electricity Savings per Participant	*Review of Continuous Optimization Program Data provided by BC Hydro as contained in Continuous Optimization Business Case, FEI, 2016*
Incremental Cost	*Review of Continuous Optimization Program Data provided by BC Hydro as contained in Continuous Optimization Business Case, FEI, 2016*
Measure Life	*Review of Continuous Optimization Program Data provided by BC Hydro as contained in Continuous Optimization Business Case, FEI, 2016*
Free Rider Rate	*Review of Continuous Optimization Program Data provided by BC Hydro as contained in Continuous Optimization Business Case, FEI, 2016*
Spillover Rate	*n/a*

Commercial Energy Assessments	
Gas Savings per Participant	*Energy Assessment Program Evaluations, 2008 and 2010 Friuch Consulting adjusted for current conditions by Program Manager, September2017*
Electricity Savings per Participant	*Review of Actual Program Data for 2014 – 2017, FEI, September 2017*
Incremental Cost	*Review of Actual Program Data for 2014 – 2017, FEI, September 2017*
Measure Life	*Review of Actual Program Data for 2014 – 2017, FEI, September 2017*
Free Rider Rate	*Energy Assessment Program Evaluations, 2008 and 2010 Friuch Consulting*
Spillover Rate	*n/a*

BC Energy Step Code - Whole Building	
Gas Savings per Participant	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Electricity Savings per Participant	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Incremental Cost	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Measure Life	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Free Rider Rate	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Spillover Rate	*n/a*

Non-BC Energy Step Code - Whole Building	
Gas Savings per Participant	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Electricity Savings per Participant	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Incremental Cost	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Measure Life	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Free Rider Rate	*Review of Technical Reference Manuals from other jurisdictions and other relevant publications, FEI, January 2010.*
Spillover Rate	*n/a*

Early Engagement	
Gas Savings per Participant	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Electricity Savings per Participant	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Incremental Cost	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Measure Life	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Free Rider Rate	*Review of Technical Reference Manuals from other jurisdictions and other relevant publications, FEI, January 2010*
Spillover Rate	*n/a*

Non-BC Energy Step Code - Engineered	
Gas Savings per Participant	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Electricity Savings per Participant	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Incremental Cost	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Measure Life	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Free Rider Rate	*Review of Technical Reference Manuals from other jurisdictions and other relevant publications, FEI, January 2010*
Spillover Rate	*n/a*

BC Energy Step Code Capacity Building - Charrettes	
Gas Savings per Participant	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Electricity Savings per Participant	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Incremental Cost	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Measure Life	*Preliminary program design work, Dunsky Energy Consulting, February 2018*
Free Rider Rate	*Program Manager market knowledge, FEI, and advice from Dunsky Energy Consulting, February 2018*
Spillover Rate	*n/a*

Existing Program Participants	
Gas Savings per Participant	*Review of existing New Construction actual program data 2011 - 2018, FEI, February 2018*
Electricity Savings per Participant	*Review of existing New Construction actual program data 2011 - 2018, FEI, February 2018*
Incremental Cost	*Review of existing New Construction actual program data 2011 - 2018, FEI, February 2018*
Measure Life	*Review of existing New Construction actual program data 2011 - 2018, FEI, February 2018*
Free Rider Rate	*Review of existing New Construction actual program data 2011 - 2018, FEI, February 2018*
Spillover Rate	*n/a*

Industrial Energy Efficiency Program Area

Technology Implementation	
Gas Savings per Participant	*FEI (2017), Analysis of 2015-2017 program participants.*
Electricity Savings per Participant	*FEI (2017), Analysis of 2015-2017 program participants.*
Incremental Cost	*FEI (2017), Analysis of 2015-2017 program participants.*
Measure Life	*FEI (2017), Analysis of 2015-2017 program participants.*
Free Rider Rate	*Preliminary determination based on Commercial Performance Program: FEI (2010), Review of Technical Reference Manuals from Other Jurisdictions (Updated on a Project by Project Basis).*
Spillover Rate	*n/a*

Feasibility Study	
Gas Savings per Participant	*n/a*
Electricity Savings per Participant	*n/a*
Incremental Cost	*FEI (2017), Analysis of 2016-2017 study participants*
Measure Life	*n/a*
Free Rider Rate	*n/a*
Spillover Rate	*n/a*

Plant Wide Audit	
Gas Savings per Participant	*n/a*
Electricity Savings per Participant	*n/a*
Incremental Cost	*FEI (2017), Analysis of 2016-2017 audit participants*
Measure Life	*n/a*
Free Rider Rate	*n/a*
Spillover Rate	*n/a*

Process Boiler (Hot Water and Steam)	
Gas Savings per Participant	*FEI (2018), Analysis of Prism Engineering (2013), Update of Energy Savings Analysis from FortisBC Efficient Boiler Program.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*FEI (2017), Analysis of 2016 Efficient Boiler Program participants; FEI (2017), Vendor Costing Survey.*
Measure Life	*FEI (2017), Review of Technical Reference Manuals from other jurisdictions.*
Free Rider Rate	*Efficient Boiler Program Impact Evaluation (2003).*
Spillover Rate	*n/a*

Air Curtains - Small Door	
Gas Savings per Participant	*Posterity Group (2017), Analysis of: Enbridge Gas Distribution (2016), Updated DSM Measures and the Technical Resource Manual (TRM), EB-2016-0246, Exhibit B.*
Electricity Savings per Participant	*Posterity Group (2017), Analysis of: Enbridge Gas Distribution (2016), Updated DSM Measures and the Technical Resource Manual (TRM), EB-2016-0246, Exhibit B; Environment and Climate Change Canada (2017), Canadian Weather Year for Energy Calculation [online datasets]; Illinois Energy Efficiency Stakeholder Advisory Group (2017), Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 6.0, Volume 2.*
Incremental Cost	*Posterity Group (2017), Analysis of: Enbridge Gas Distribution (2016), Updated DSM Measures and the Technical Resource Manual (TRM), EB-2016-0246, Exhibit B; Illinois Energy Efficiency Stakeholder Advisory Group (2017), Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 6.0, Volume 2.*
Measure Life	*Enbridge Gas Distribution (2016), Updated DSM Measures and the Technical Resource Manual (TRM), EB-2016-0246, Exhibit B.*
Free Rider Rate	*Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018).*
Spillover Rate	*n/a*

Air Curtains - Medium Door	
Gas Savings per Participant	*Posterity Group (2017), Analysis of: Enbridge Gas Distribution (2016), Updated DSM Measures and the Technical Resource Manual (TRM), EB-2016-0246, Exhibit B.*
Electricity Savings per Participant	*Posterity Group (2017), Analysis of: Enbridge Gas Distribution (2016), Updated DSM Measures and the Technical Resource Manual (TRM), EB-2016-0246, Exhibit B; Environment and Climate Change Canada (2017), Canadian Weather Year for Energy Calculation [online datasets]; Illinois Energy Efficiency Stakeholder Advisory Group (2017), Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 6.0, Volume 2.*
Incremental Cost	*Posterity Group (2017), Analysis of: Enbridge Gas Distribution (2016), Updated DSM Measures and the Technical Resource Manual (TRM), EB-2016-0246, Exhibit B; Illinois Energy Efficiency Stakeholder Advisory Group (2017), Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 6.0, Volume 2.*
Measure Life	*Enbridge Gas Distribution (2016), Updated DSM Measures and the Technical Resource Manual (TRM), EB-2016-0246, Exhibit B.*
Free Rider Rate	*Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018).*
Spillover Rate	*n/a*

Air Curtains - Large Door	
Gas Savings per Participant	*Posterity Group (2017), Analysis of: Enbridge Gas Distribution (2016), Updated DSM Measures and the Technical Resource Manual (TRM), EB-2016-0246, Exhibit B.*
Electricity Savings per Participant	*Posterity Group (2017), Analysis of: Enbridge Gas Distribution (2016), Updated DSM Measures and the Technical Resource Manual (TRM), EB-2016-0246, Exhibit B; Environment and Climate Change Canada (2017), Canadian Weather Year for Energy Calculation [online datasets]; Illinois Energy Efficiency Stakeholder Advisory Group (2017), Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 6.0, Volume 2.*
Incremental Cost	*Posterity Group (2017), Analysis of: Enbridge Gas Distribution (2016), Updated DSM Measures and the Technical Resource Manual (TRM), EB-2016-0246, Exhibit B; Illinois Energy Efficiency Stakeholder Advisory Group (2017), Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 6.0, Volume 2.*
Measure Life	*Enbridge Gas Distribution (2016), Updated DSM Measures and the Technical Resource Manual (TRM), EB-2016-0246, Exhibit B.*
Free Rider Rate	*Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018).*
Spillover Rate	*n/a*

Direct Contact Water Heater	
Gas Savings per Participant	*Posterity Group (2017), Analysis of: Pacific Gas &Electric Company (2016), Work Paper PGECORPRO106 Direct Contact Water Heater, Revision 4.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Posterity Group (2017), Analysis of: Pacific Gas &Electric Company (2016), Work Paper PGECORPRO106 Direct Contact Water Heater, Revision 4.*
Measure Life	*Michigan Public Service Commission (2017), 2017 Michigan Energy Measures Database.*
Free Rider Rate	*Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018).*
Spillover Rate	*n/a*

Steam Traps Survey	
Gas Savings per Participant	*n/a*
Electricity Savings per Participant	*n/a*
Incremental Cost	*CLEAResult (2016), Market Characterization of Stream Trap Maintenance Practices.*
Measure Life	*n/a*
Free Rider Rate	*Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018).*
Spillover Rate	*n/a*

Steam Traps Replacement	
Gas Savings per Participant	*CLEAResult (2016), Market Characterization of Stream Trap Maintenance Practices.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*CLEAResult (2016), Market Characterization of Stream Trap Maintenance Practices.*
Measure Life	*CLEAResult (2016), Market Characterization of Stream Trap Maintenance Practices.*
Free Rider Rate	*Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018).*
Spillover Rate	*n/a*

1" Insulation 0.5-1" HW Pipe	
Gas Savings per Participant	*Posterity Group (2017), Analysis of: Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110912A, Revision 3.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Posterity Group (2017), Analysis of: Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110912A, Revision 3.*
Measure Life	*Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110912A, Revision 3.*
Free Rider Rate	*Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018).*
Spillover Rate	*n/a*

1" Insulation ≥ 1" HW Pipe	
Gas Savings per Participant	*Posterity Group (2017), Analysis of: Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110912A, Revision 3.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Posterity Group (2017), Analysis of: Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110912A, Revision 3.*
Measure Life	*Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110912A, Revision 3.*
Free Rider Rate	*Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018).*
Spillover Rate	*n/a*

1" Insulation 0.5-1" LPS Pipe	
Gas Savings per Participant	*Posterity Group (2017), Analysis of: Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110912A, Revision 3.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Posterity Group (2017), Analysis of: Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110912A, Revision 3.*
Measure Life	*Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110912A, Revision 3.*
Free Rider Rate	*Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018).*
Spillover Rate	*n/a*

1" Insulation ≥ 1" LPS Pipe	
Gas Savings per Participant	*Posterity Group (2017), Analysis of: Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110912A, Revision 3.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Posterity Group (2017), Analysis of: Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110912A, Revision 3.*
Measure Life	*Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110912A, Revision 3.*
Free Rider Rate	*Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018).*
Spillover Rate	*n/a*

1" Insulation 0.5-1" HPS Pipe	
Gas Savings per Participant	*Posterity Group (2017), Analysis of: Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110912A, Revision 3.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Posterity Group (2017), Analysis of: Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110912A, Revision 3.*
Measure Life	*Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110912A, Revision 3.*
Free Rider Rate	*Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018).*
Spillover Rate	*n/a*

1" Insulation ≥ 1" HPS Pipe	
Gas Savings per Participant	*Posterity Group (2017), Analysis of: Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110912A, Revision 3.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Posterity Group (2017), Analysis of: Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110912A, Revision 3.*
Measure Life	*Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110912A, Revision 3.*
Free Rider Rate	*Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018).*
Spillover Rate	*n/a*

Tank Insulation 1" Low Temp	
Gas Savings per Participant	*Posterity Group (2017), Analysis of: Pacific Gas &Electric Company (2014), Work Paper PGECORPRO103 Tank Insulation, Revision 5.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Posterity Group (2017), Analysis of: Pacific Gas &Electric Company (2014), Work Paper PGECORPRO103 Tank Insulation, Revision 5; McMaster-Carr Website (2018), https://www.mcmaster.com/.*
Measure Life	*Pacific Gas &Electric Company (2014), Work Paper PGECORPRO103 Tank Insulation, Revision 5.*
Free Rider Rate	*Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018).*
Spillover Rate	*n/a*

Tank Insulation 1" High Temp	
Gas Savings per Participant	*Posterity Group (2017), Analysis of: Pacific Gas &Electric Company (2014), Work Paper PGECORPRO103 Tank Insulation, Revision 5.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Posterity Group (2017), Analysis of: Pacific Gas &Electric Company (2014), Work Paper PGECORPRO103 Tank Insulation, Revision 5; McMaster-Carr Website (2018), https://www.mcmaster.com/.*
Measure Life	*Pacific Gas &Electric Company (2014), Work Paper PGECORPRO103 Tank Insulation, Revision 5.*
Free Rider Rate	*Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018).*
Spillover Rate	*n/a*

Tank Insulation 2" High Temp	
Gas Savings per Participant	*Posterity Group (2017), Analysis of: Pacific Gas &Electric Company (2014), Work Paper PGECORPRO103 Tank Insulation, Revision 5.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Posterity Group (2017), Analysis of: Pacific Gas &Electric Company (2014), Work Paper PGECORPRO103 Tank Insulation, Revision 5; McMaster-Carr Website (2018), https://www.mcmaster.com/.*
Measure Life	*Pacific Gas &Electric Company (2014), Work Paper PGECORPRO103 Tank Insulation, Revision 5.*
Free Rider Rate	*Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018).*
Spillover Rate	*n/a*

Other Prescriptive Measures	
Gas Savings per Participant	*Preliminary engineering estimate, FEI, (to be studied further in 2018)*
Electricity Savings per Participant	*Preliminary engineering estimate, FEI, (to be studied further in 2018)*
Incremental Cost	*Preliminary engineering estimate, FEI, (to be studied further in 2018)*
Measure Life	*Preliminary engineering estimate, FEI, (to be studied further in 2018)*
Free Rider Rate	*Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018).*
Spillover Rate	*n/a*

Strategic Energy Management - Individual Large Customer	
Gas Savings per Participant	*Preliminary engineering estimate (to be formalized in 2018)*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Estimate based on BC Hydro program planning (to be formalized in 2018)*
Measure Life	*Estimate based on BC Hydro program planning (to be formalized in 2018)*
Free Rider Rate	*Preliminary determination based on Commercial Performance Program (to be formalized during program design and evaluation): FEI (2010), Review of Technical Reference Manuals from other jurisdictions.*
Spillover Rate	*n/a*

Strategic Energy Management - Cohort Medium Customers	
Gas Savings per Participant	*Preliminary engineering estimate (to be formalized in 2018)*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Estimate based on BC Hydro program planning (to be formalized in 2018)*
Measure Life	*Estimate based on BC Hydro program planning (to be formalized in 2018)*
Free Rider Rate	*Preliminary determination based on Commercial Performance Program (to be formalized during program design and evaluation): FEI (2010), Review of Technical Reference Manuals from other jurisdictions.*
Spillover Rate	*n/a*

Low Income Energy Efficiency Program Area

Energy Savings Kit	
Gas Savings per Participant	*GJ Savings per participant average is based upon 2017 actual participation.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Average based on the full cost of the gas measures included in the ESK.*
Measure Life	*Average based on the individual gas measures included in the Energy Saving Kit*
Free Rider Rate	*E Source Review of Low Income Net to Gross in other Jurisdictions : Low-income, Income Assisted Customers or Charitable Programs Oct. 30, 2017; BC Hydro, October 2017*
Spillover Rate	*n/a*

Energy Conservation Assistance	
Gas Savings per Participant	*GJ Savings per participant average is based upon 2017 actual participation.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Based on average cost of the customized bundle of measures installed. Includes the full cost of the gas measures installed in gas heated homes.*
Measure Life	*Average based on the individual gas measures installed.*
Free Rider Rate	*E Source Review of Low Income Net to Gross in other Jurisdictions : Low-income, Income Assisted Customers or Charitable Programs October 2017; BC Hydro, October 2017*
Spillover Rate	*n/a*

Space Heat Top Up	
Gas Savings per Participant	*EBP Deemed Savings Analysis by FEI applying results from Update of Energy Savings Analysis From FortisBC Efficient Boiler Program – Final Report, August 2013, Prism Engineering.*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Analysis of 2016 Program Participant Data, FEI, November, 2017 for Efficient Boiler, and Vendor Costing Survey, FEI, 2015 for Base Efficiency Boiler*
Measure Life	*Review of Technical Reference Manuals from other jurisdictions, FEI, 2017 including* *KEMA: Boilers & Burners 1.2796.040 High Efficiency Modulating Hot Water Boiler* *ASHRAE Equipment Life Tables*
Free Rider Rate	*E Source Review of Low Income Net to Gross in other Jurisdictions : Low-income, Income Assisted Customers or Charitable Programs October 2017; BC Hydro, October 2017*
Spillover Rate	*n/a*

Water Heating Top Up	
Gas Savings per Participant	*Efficient Commercial Water Heater Evaluation – Final Report, Prism Engineering, February 2017*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Analysis of 2016 Program Participant Data, FEI, November, 2017 for Efficient Boiler, and Vendor Costing Survey, FEI, 2016 for Base Efficiency Boiler*
Measure Life	*Review of Technical Reference Manuals from other jurisdictions, FEI, 2017 including* *MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING, Appendix C: Substantiation Sheets by Navigant Consulting* *KEMA Measure Life Study*
Free Rider Rate	*E Source Review of Low Income Net to Gross in other Jurisdictions : Low-income, Income Assisted Customers or Charitable Programs October 2017; BC Hydro, October 2017*
Spillover Rate	*n/a*

Furnace Replacement Top Up (Baseline: Mid Eff.)	
Gas Savings per Participant	*Residential Furnace Early replacement methodology applied using commercial sector GJ savings estimation from Ontario Energy Board: EB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge, adjusted to BC climate conditions by FEI, February 2018*
Electricity Savings per Participant	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018* *Based on evaluation report* *Furnace Early Replacement Program – Preliminary Evaluation Year 1 Pilot, Habart & Associates Inc. May 2013*
Incremental Cost	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018 based on Program Participant data 2017*
Measure Life	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018* *based on reviews of Measure Life studies* *MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING, Appendix C: Substantiation Sheets by Navigant Consulting, High Efficiency (Condensing) Furnace – Residential"* *KEMA Measure Life Study: HVAC, 4.1697.190 Furnace (90% AFUE or greater)*
Free Rider Rate	*E Source Review of Low Income Net to Gross in other Jurisdictions : Low-income, Income Assisted Customers or Charitable Programs October 2017; BC Hydro, October 2017*
Spillover Rate	*n/a*

Furnace Replacement Top Up (Baseline: Std. Eff.)	
Gas Savings per Participant	*Residential Furnace Early replacement methodology applied using commercial sector GJ savings estimation from Ontario Energy Board: OEB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge, adjusted to BC climate conditions by FEI, February 2018*
Electricity Savings per Participant	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018* *Based on evaluation report* *Furnace Early Replacement Program – Preliminary Evaluation Year 1 Pilot, Habart & Associates Inc. May 2013*
Incremental Cost	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018 based on Program Participant data 2017*
Measure Life	*Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018* *based on reviews of Measure Life studies* *MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING, Appendix C: Substantiation Sheets by Navigant Consulting, High Efficiency (Condensing) Furnace –* Residential*”* *KEMA Measure Life Study: HVAC, 4.1697.190 Furnace (90% AFUE or greater)*
Free Rider Rate	*E Source Review of Low Income Net to Gross in other Jurisdictions : Low-income, Income Assisted Customers or Charitable Programs October 2017; BC Hydro, October 2017*
Spillover Rate	*n/a*

0.67 EF Storage Tank Water Heater Top Up	
Gas Savings per Participant	*Energy Savings Assumptions Review (of multiple energy savings data sources), FEI, November 2014, revisited February 2018 including* *Final Report 0.67 Energy Star Water Heater Pilot Project, June 12, 2014* *Deemed savings review of other jurisdictions*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Review of program participant data from 2017, FEI, February 2018*
Measure Life	*Review of Technical Reference Manuals from other jurisdictions applied to actual program measure installation data from 2017. FEI, February 2018 including BC Hydro Powersmart F13 Effective Measure Life and Persistence*
Free Rider Rate	*E Source Review of Low Income Net to Gross in other Jurisdictions : Low-income, Income Assisted Customers or Charitable Programs October 2017; BC Hydro, October 2017*
Spillover Rate	*n/a*

Tankless Water Heater Top Up	
Gas Savings per Participant	*Energy Savings Assumptions Review (of multiple energy savings data sources), FEI, November 2014, revisited February 2018 including* *Deemed savings review of other jurisdictions* *A Canadian High-Efficiency Natural Gas Water Heater Pilot Project, Natural Gas Technologies Centre, July 2014*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Review of actual program measure installations from 2017, FEI, February 2018 based on Program Participant data 2017*
Measure Life	*Review of Technical Reference Manuals from other jurisdictions applied to actual program measure installation data from 2017. FEI, February 2018 including* *MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING, Appendix C: Substantiation Sheets by Navigant Consulting, page C-85*
Free Rider Rate	*E Source Review of Low Income Net to Gross in other Jurisdictions : Low-income, Income Assisted Customers or Charitable Programs October 2017; BC Hydro, October 2017* *02.16.2018*
Spillover Rate	*n/a*

Condensing Storage Tank Water Heater Top Up	
Gas Savings per Participant	*Energy Savings Assumptions Review (of multiple energy savings data sources), FEI, November 2014, revisited February 2018 including* *Deemed savings review of other jurisdictions* *A Canadian High-Efficiency Natural Gas Water Heater Pilot Project, Natural Gas Technologies Centre, July 2014*
Electricity Savings per Participant	*n/a*
Incremental Cost	*Review of program measure installations from 2017, FEI, February 2018 based on Program Participant data 2017*
Measure Life	*Review of Technical Reference Manuals from other jurisdictions applied to actual program measure installation data from 2017. FEI, February 2018 including BC Hydro Powersmart F13 Effective Measure Life and Persistence*
Free Rider Rate	*E Source Review of Low Income Net to Gross in other Jurisdictions : Low-income, Income Assisted Customers or Charitable Programs October 2017; BC Hydro, October 2017*
Spillover Rate	*n/a*

Non-Profit (Bundled) Rebates	
Gas Savings per Participant	*FortisBC Multi Unit Residential Buildings – Energy Conservation Measures Review – v2, Prism Engineering, January 2017* *FortisBC Enclosure Program Report_v2, RDH Building Science, January 2017*
Electricity Savings per Participant	*FortisBC Multi Unit Residential Buildings – Energy Conservation Measures Review – v2, Prism Engineering, Jan 2017* *FortisBC Enclosure Program Report_v2, RDH Building Science, January 2017*
Incremental Cost	*FortisBC Multi Unit Residential Buildings – Energy Conservation Measures Review – v2, Prism Engineering, Jan 2017* *FortisBC Enclosure Program Report_v2, RDH Building Science, January 2017*
Measure Life	*Review of Technical Reference Manuals from other jurisdictions*
Free Rider Rate	*E Source Review of Low Income Net to Gross in other Jurisdictions : Low-income, Income Assisted Customers or Charitable Programs October 2017; BC Hydro, October 2017*
Spillover Rate	*n/a*

Appendix B

FEI 2017 ANNUAL DSM REPORT

Diane Roy
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March 29, 2018

British Columbia Utilities Commission
Suite 410, 900 Howe Street
Vancouver, BC
V6Z 2N3

Attention: Mr. Patrick Wruck, Commission Secretary and Manager, Regulatory Support

Dear Mr. Wruck:

Re: FortisBC Energy Inc. (FEI)

Natural Gas Demand-Side Management (DSM) – 2017 Annual Report

Attached please find the Natural Gas DSM Program 2017 Annual Report for FEI.

If further information is required, please contact Ken Ross, Manager, Integrated Resource Planning and DSM Reporting at 604-576-7343 or ken.ross@fortisbc.com.

Sincerely,

FORTISBC ENERGY INC.

Original signed:

Diane Roy

Attachment

FortisBC Energy Inc.

Natural Gas
Demand-Side Management Programs
2017 Annual Report

March 29, 2018

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Appendix A 2017 Internal Audit Report

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1. REPORT OVERVIEW

FortisBC Energy Inc. (FEI or the Company), is committed to delivering a broad portfolio of cost-effective natural gas Demand-side Management[1] (DSM) measures that address the expectations of customers while meeting the requirements for public utilities to pursue cost-effective DSM. In 2017, total expenditures, including $1.104 million attributable to third party co-funding such as received from the British Columbia Ministry of Energy, Mines and Petroleum Resources (MEM), were $35.143 million. Based solely on FEI's DSM expenditures, the Company achieved a combined portfolio Modified Total Resource Cost (MTRC)[2] of 1.2 on expenditures of $34.039 million, meeting FEI's goal of cost-effective program delivery.

This DSM Annual Report (the Report) outlines the Company's actual results and expenditures for 2017. The Report follows a similar format to the 2016 and previous Annual Reports, relying on detailed tables to demonstrate Program results and expenditures. The Report compares 2017 actual activity and results to the Company's 2014-2018 DSM Plan, filed as part of FEI's 2014-2018 Performance Based Ratemaking (PBR) Application (2014-2018 PBR Plan) and accepted by the Commission in its Decision and Order G-138-14 (the Decision). Where the details of individual programs vary substantially from the 2014-2018 DSM Plan, explanations are provided in the applicable Program Area sections of the Report.

1.1 Purpose of Report: Transparency, Accountability and Update on Progress

The Report details the Company's activities for the overall DSM Portfolio and in each Program Area. Incentive and non-incentive expenditures are reported at the level of each program or measure, as well as at the program area and Portfolio levels. Results for the following cost effectiveness tests are provided for the overall Portfolio and each Program Area in Section 2, and for each program as appropriate in the respective Program Area sections: Total Resource Cost (TRC), Ratepayer Impact Measure (RIM), Participant Cost Test (PCT), and Utility Cost Test (UCT). In accordance with British Columbia's Demand-Side Measures Regulation (DSM Regulation), results of the MTRC calculations are also provided where appropriate (see Section 2.1).

The Report also demonstrates that the Company is meeting the accountability mechanisms directed by the Commission in Order No. G-36-09. One such mechanism was the requirement to file DSM Annual Reports, which states:

> A requirement that Terasen [now FEI] submit annually to the Commission, by the end of the first quarter following year-end, for each year of the funding period, a

[1] Throughout this Annual Report the use of the term Demand-Side Management or "DSM" is intended to refer to demand-side measures in BC as defined in the BC Demand-Side Measures Regulation.

[2] Pursuant to the BC Demand-side Measures Regulation, the Portfolio level MTRC is calculated based on costs and benefits of all programs in the Portfolio as well as any Program Area and Portfolio level administration costs, and including the benefit adders for those programs for which the MTRC is relied upon to determine cost effectiveness on an individual program basis (i.e. those programs that have been designated as being under the MTRC Cap as presented in Section 2.1 of this report).

report on all [DSM] initiatives and activities, expenditures and results for TGI and TGVI.

It should be noted that the DSM Regulation was amended by the Province in March, 2017. These amendments impact some of the cost-effectiveness calculations, increase spending limits under the MTRC Cap (see Section 2.1) and expand the adequacy requirements of a DSM Portfolio (see Section 2.3). At the time of filing and acceptance, the 2014-2018 DSM Plan was in compliance with the DSM Regulation. Due to the timing of the DSM Regulation amendments, certain aspects of the DSM Regulation amendments, particularly the adequacy requirements, could not be feasibly implemented in 2017, however FEI considers its 2014-2018 DSM Plan to be in compliance with the DSM Regulation at the time of acceptance by the Commission. As such, FEI is reporting its activity as related to adequacy requirements against the DSM Regulation in place at the time of acceptance. FEI will address the expanded adequacy requirements of the DSM Regulation noted above in its next DSM expenditure plan application for the period 2019 – 2022 to be submitted to the Commission in 2018.

1.2 Organization of the DSM Annual Report

The following describes how each section of the Report presents the results of 2017 DSM activities:

Section 1: Report Overview

- Provides a high-level background for the Report.

Section 2: Portfolio Overview

- Provides a summary and detail regarding the overall actual 2017 expenditures for DSM activities, along with an explanation of expenditures held in both the DSM deferral account and another deferral account set up for DSM incentive amounts provided to Alternative Energy Services (AES) projects in which FEI is a participant.
- Section 2.5 discusses any new requirements from the Commission concerning information to be included in the 2017 DSM Annual Report.

Section 3: Funding Transfers

- Provides a discussion on funding transfers.

Section 4: Advisory Group Activities

- Provides information regarding Energy Efficiency and Conservation Advisory Group (EECAG) activities in 2017, including a summary of meetings and accountability considerations.

Sections 5 - 9 provide information on:

- Residential, Low Income, Commercial, Innovative Technologies, and Industrial Energy Efficiency Program Areas, respectively;

- Each section contains a table summarizing the planned and actual expenditures for the respective Program Area in 2017, including incentive and non-incentive spending, annual and NPV gas savings, as well as TRC and other cost-effectiveness test results. Additional tables outline the individual 2017 programs, including program and measure descriptions, program assumptions and sources for these assumptions, and a breakdown of incentive and non-incentive spending. Where applicable, details on program closures or planned programs that were not launched in 2017 are also included in these program detail sections.

Section 10: Conservation Education and Outreach Initiatives

- Provides both a summary and details regarding actual 2017 expenditures for the Conservation Education and Outreach (CEO) Program Area.

Section 11: Enabling Activities

- Provides both summary and detail regarding actual 2017 expenditures for the Enabling Activities that support the work of the DSM Portfolio as a whole.

Section 12: Evaluation

- Provides both summary and detail regarding pending and actual expenditures for 2017 program evaluation activities, as well as summary results from evaluations and studies completed in 2017.

Section 13: Data Gathering, Reporting and Internal Control Processes

- Provides a summary of the Company's data tracking, process control, and reporting for 2017 DSM activities, and a high-level description of the Company's internal approval process for programs.

Section 14: 2017 DSM Annual Report Summary

- Provides a summary of the Report and FEI's 2017 DSM activity.

2. PORTFOLIO OVERVIEW

In this Section, FEI provides its DSM energy savings, expenditures and cost-effectiveness test results at an overall Portfolio level for 2017. A summary of the overall Portfolio results is provided in Table 2-1, demonstrating that the Company achieved a combined Portfolio MTRC of 1.2. FEI achieved DSM expenditures of $34.039 million and recorded annual natural gas savings of 533,538 GJ in 2017.

Table 2-1: Overall DSM Portfolio Results for 2017

Indicator - 2017 Results		Total
Annual Gas Savings (GJ/yr.)		533,538
NPV of Gas Savings (GJ)		4,769,193
Utility Expenditures, Incentives ($000s)		21,836
Utility Expenditures, Non-Incentives ($000s)		12,203
Utility Expenditures, Total ($000s)		34,039
Benefit/Cost Ratios	TRC	0.7
	MTRC	1.2
	Utility	1.2
	Participant	1.2
	RIM	0.7

Table 2-2 provides the expenditures and cost-effectiveness test results by Program Area for the overall DSM Portfolio.

Table 2-2: Overall DSM Portfolio Level Results by Program Area 2017

Portfolio	Annual Gas Savings (GJ/yr.)		NPV Gas Savings (GJ)	Utility Expenditures ($000s)						Benefit/Cost Ratios				
				Incentives		Non-Incentives		All Spending						
	2014-2018 DSM Plan	2017 Actual		2014-2018 DSM Plan	2017 Actual	2014-2018 DSM Plan	2017 Actual	2014-2018 DSM Plan	2017 Actual	TRC	MTRC	Utility	Participant	RIM
Portfolio Level Activities														
Total	No Direct Savings			n/a	n/a	n/a	1,559	n/a	1,559	No Direct Savings				
Residential Sector														
Total	136,672	137,161	1,446,618	7,486	9,688	3,214	2,515	10,700	12,203	0.5	1.7	1.0	1.1	0.5
Commercial Sector														
Total	237,665	238,688	1,906,805	8,424	8,847	1,992	1,987	10,416	10,834	0.8	n/a	1.4	1.4	0.6
Industrial Sector														
Total	190,300	105,516	1,007,011	2,193	1,614	789	485	2,983	2,099	1.3	n/a	4.5	0.7	2.0
Low Income														
Total	27,768	47,263	343,071	1,778	1,592	1,469	1,052	3,247	2,644	1.2	2.1	1.4	2.9	0.7
Conservation Education and Outreach														
Total	No Direct Savings			0	0	2,400	2,590	2,400	2,590	No Direct Savings				
Innovative Technologies														
Total	5,343	4,910	65,687	574	95	644	833	1,218	928	0.5	n/a	0.6	7.1	0.4
Enabling Activities														
Total	No Direct Savings			n/a	n/a	4,425	1,181	4,425	1,181	No Direct Savings				
TOTAL PORTFOLIOS														
Total	**597,748**	**533,538**	**4,769,193**	**20,455**	**21,836**	**14,933**	**12,203**	**35,388**	**34,039**	**0.7**	**1.2**	**1.2**	**1.2**	**0.7**

Notes:

- Portfolio Level Activities are those activities for which the costs cannot be assigned to individual DSM programs. It should be noted that these activities are distinct from the Enabling Activities specifically listed in Section 9 of the 2014-2018 DSM Plan. These distinct Portfolio Level Activities include expenditures such as EECAG activities, Portfolio level staff labour, staff training and conferences, research and association memberships, Portfolio level research studies, and regulatory work including consulting fees.

Throughout this Report, the following general notes also apply to all the Program Areas:

- In the above table, and in tables throughout the Report, any difference in the totals between the Portfolio Overview, Program Area, and individual program tables is due to rounding. Some "zero" values are a reflection of rounding to the $000 expenditure level when expenditures were under $500.
- A "Non-Program Specific Expense" line item has been included for each Program Area in Sections 5 through 10. These expenditures support multiple programs within that Program Area and, therefore, are not specific to only one program. Generally, these expenditures represent items such as training, travel, marketing collateral and consulting services that support the overall Program Area.

It is FEI's view that, as with prior annual reports, the savings reported herein continue to be conservative and lower than the savings experienced in the marketplace as a result of the Company's DSM activities, causing the cost-effectiveness test results reported to be lower than they would be otherwise, for the following reasons:

- <u>Net to Gross Ratio</u> - The Net-to-Gross ratio that FEI is using to report energy savings from DSM activity is highly conservative in that it includes the free ridership impact, which serves to reduce reported energy savings, but in most cases does not include the energy savings benefits of spillover effect.[3] FEI intends to continue identifying and incorporating spillover effects into reporting of energy savings impacts from DSM activity on a program-by-program basis, wherever spillover can be supported.

- <u>Attribution from Government Regulation</u> – The introduction of many municipal, provincial and federal minimum equipment and system performance standards is supported by the Company's DSM activity. Attribution savings for the implementation of a new standard on minimum fireplace efficiency have been identified and estimated as part of the Residential EnerChoice Fireplace Program (see Section 5.3). As the Province has shifted the implementation of the new standard to January of 2019, FEI expects to claim those attributed savings in its 2018 Annual Report. The Company continues to believe the claimed savings are conservative and do not represent all of the savings attributable to FEI's codes and standards work. FEI will continue to look for opportunities to claim energy savings from the implementation of new standards.

- <u>Conservation Education and Outreach</u> – CEO activities had expenditures of $2.5 million in 2017. These activities do result in energy savings; however, since these savings remain difficult to quantify, FEI does not currently attribute energy savings to them and these benefits are not reflected in the TRC.

[3] Free ridership refers to individuals who participate in a program who would have participated in the absence of an incentive. Spillover refers to individuals that adopt efficiency measures because they are influenced by program-related information and marketing efforts, though they do not actually participate in the program. These can be included in the Net-to-Gross ratio employed in the cost-effectiveness analysis to capture the additive effects of spillover to balance the reductive effects of free ridership.

- Enabling Activities – Enabling Activities similarly had expenditures of $1.1 million in 2017 for work that contributes to energy savings but that cannot currently be quantified. Since these savings are not included in the Portfolio TRC calculation, the Company believes the Portfolio energy savings benefits are higher than reported.

FEI's DSM activities include a number of specified demand side measures as defined the DSM Regulation. Specified demand-side measures within FEI's Portfolio include the Innovative Technologies programs (see Section 8), education and community engagement programs (see Section 10), and Codes and Standards related DSM activity (see Section 11). The DSM Regulation defines how the Commission must consider these specified measures. Section 4(4) of the DSM Regulation stipulates that the cost effectiveness of specified measures must be determined by the cost effectiveness of the Portfolio as a whole. These measures are therefore not subject to the 40 percent 'MTRC Cap' (see Section 2.1). Additionally, these measures cannot be determined to be not cost-effective under the Utility Cost Test.

In summary, FEI's 2017 DSM expenditures, including specified DSM, are cost-effective as defined under the DSM Regulation.

2.1 Portfolio Level MTRC Calculation and Results

In 2017, FEI met the conditions of the DSM Regulation, achieving a Portfolio MTRC value of 1.2 with 24 percent of the Portfolio enabled by the MTRC cost-effectiveness test (see Table 2-2). While FEI strives for TRC test results that approach or exceed 1.0 within each program and across all programs, there are benefits to implementing programs that do not meet this threshold. Some of these benefits include making programs available to those customers that would otherwise be underserved (such as low income and residential customers), water savings, increased human health and comfort, and economic benefits such as job creation. These benefits were recognized in the 2011, 2014 and 2017 amendments to the DSM Regulation, which enable the use of an MTRC in determining program and Portfolio cost effectiveness. The MTRC uses the long-run marginal cost of acquiring electricity generated from clean or renewable resources in British Columbia as a proxy for the avoided cost of natural gas and allows for the inclusion of non-energy benefits (NEBs).[3]

Utilities can implement DSM with TRC values less than 1.0 but that meet an MTRC threshold of 1.0[4] as long as expenditures on these activities do not exceed 40 percent of the total Portfolio

[3] The DSM Regulation was amended in July 2014 to allow for the whole cost of the long-run marginal cost of acquiring electricity generated from clean or renewable resources in British Columbia to be used as a proxy for the avoided cost of natural gas in the MTRC cost-effectiveness test. As the DSM Regulation stipulates, the updated value that FEI has used in 2017 for the avoided cost of gas in the MTRC calculation is $102/MWh, or $28.34/GJ, as indicated in BC Hydro's F2017 to F2019 Revenue Requirements Application, Appendix X, Table X-1, Exhibit B-1-2: Avoided Cost of Electric Energy. Further, the MTRC Cap was increased from 33% to 40% in the March 24, 2017 amendments to the DSM Regulation.

[4] The Commission approved the assessment of the cost effectiveness using an MTRC of 1 or greater on an overall portfolio basis as part of its Decision and Order G-44-12 on FEI's 2012-2013 Revenue Requirements Application (2012-13 RRA), page 174. While this approval was not explicitly stated in the most recent 2014-2018 PBR Plan Decision and Order G-138-14, FEI interprets this approval to be implicit in the acceptance of the 2014-2018 DSM Plan.

expenditure. FEI refers to this 40 percent as the “MTRC Cap”. Table 2-3 shows both the TRC and MTRC of those programs to which the MTRC cost effectiveness test is applied and confirms that these programs make up 24.4 percent of FEI’s 2017 DSM Portfolio spending.

Table 2-3: Programs Subject to MTRC and the Relative Proportion of 2017 Portfolio Spending

Program	Program TRC	Program MTRC	Expenditure ($000s) subject to cap	% of Portfolio Spending
Energy Star Domestic Hot Water	0.3	1.6	2,834	8.3%
Furnace Replacement	0.4	1.4	3,325	9.8%
New Home	0.3	1.7	220	0.6%
Energy Efficiency Home Performance (Home Renovation Rebate Program)	0.5	2.4	1,925	5.7%
Total			**$8,303**	**24.4%**

2.2 Meeting Approved Spending Levels

FEI’s 2017 DSM expenditure limit of $35.4 million was accepted on September 12, 2014, pursuant to the Decision on FEI’s 2014-2018 PBR Plan.[5] The Company’s 2017 DSM expenditures were within accepted levels for 2017 and have increased from 2016 spending of just over $32 million.

As part of the Commission’s decision, FEI was granted approval to add $15 million of the requested annual DSM budget to rate base each year of the PBR period, with any additional DSM spend being captured in a DSM non-rate base deferral account attracting AFUDC. Any new amounts accumulated in the non-rate base DSM deferral account are then transferred to the FEI rate base DSM deferral account in the following year. The Commission also approved the amortization of these amounts over 10 years. In accordance with the Commission’s decision, $19.039 million was placed in the non-rate based DSM deferral account in early 2018.

FEI has managed its 2017 DSM activity within the funding limits approved by the Commission. Section 3 discusses funding transfers between program areas in 2017 within the overall DSM funding envelope and within rules for transferring funds between program areas as set out by the Commission.

2.3 Meeting Adequacy Requirements of the DSM Regulation

The adequacy requirements set out in the DSM Regulation at the time the 2014 – 2018 DSM Plan was accepted are as follows:

[5] BCUC Order G-138-14, page 277 of the Decision.

> A public utility's plan portfolio is adequate for the purposes of Section 44.1 (8) c of the Act only if the plan portfolio includes all the following:
>
> a) A demand-side measure intended specifically to assist residents of low-income households to reduce their energy consumption;
> b) If the plan portfolio is introduced on or after June 1, 2009, a demand-side measure intended specifically to improve the energy efficiency of rental accommodations;
> c) An education program for students enrolled in schools in the public utility's service area;
> d) If the plan portfolio is submitted on or after June 1, 2009, an education program for students enrolled in post-secondary institutions in the public utility's service area.

Section 6 provides details regarding FEI's DSM programs for low income customers. FEI also continues to deliver the Rental Apartment Efficiency Program (RAP) through its Residential, Low Income and Commercial programs as discussed in each of the respective Program Area sections (Sections 5, 6 and 7) and a full program overview for RAP is presented in Section 7.3.1. Section 7 of the Report provides details on a number of other Commercial and Low Income energy efficiency programs intended for use by owners of rental buildings, including the Energy Specialist Programs. In terms of education programs, FEI's School Education Program, Commercial and Residential customer education programs, and other energy efficiency and conservation outreach initiatives are presented in Section 10.

2.4 Addressing BCUC Directives from the FEI 2014-2018 PBR Plan Application Decision

FEI filed for acceptance of its 2014-2018 DSM Plan and associated funding request as part of the 2014-2018 PBR Plan. The Decision on the 2014-2018 PBR Plan set out a number of Directives for the 2014-2018 DSM Plan. The following section addresses the Directives relevant to the overall 2017 DSM Portfolio. Program specific Directives are addressed in the applicable Program Area sections of the Report.

2.4.1 LABOUR COSTS

Pursuant to Directive 145[6] of the Decision, labour costs are included in the "Administration" expenditures for each program in the specific Program tables included in the applicable Program Area sections (Sections 5-11). FEI notes that the 2014-2018 DSM Plan as accepted by the Commission was not re-cast with labour included at the program level. This change therefore impacts the direct comparison of actual program and Program Area spending to plan spending. The inclusion of labour costs at the program level can cause program area expenditures to appear higher than the accepted amounts even though non-

[6] Decision, page 273.

labour costs are within accepted amounts. Actual spending in the “Enabling Activities” program area will also be lower than planned since a substantial amount of labour costs planned for this program area are being reported within other program areas. This issue is also discussed in Section 3 on funding transfers.

2.5 Collaboration & Integration

The Company continues to collaborate and integrate DSM programming among BC’s largest energy utilities, as well as with other entities such as governments and industry associations. The Company recognizes that doing so will maximize program efficiency and effectiveness. Collaborative activity is captured in the individual Program Area sections and program descriptions found in Sections 5 through 11.

FEI, FortisBC Inc. (FBC) and BC Hydro and Power Authority (BC Hydro) (the BC Utilities) continued to collaborate on various programs and projects through their voluntary Memorandum of Understanding (MOU), the purpose of which is to develop enhanced utility integration in support of government legislation, policy and direction. The MOU currently covers 2016 through to August 2018. The BC Utilities also continue to experience cost efficiencies from their collaboration efforts, including streamlined application processes for customers, extended program reach and consistent and unified messaging resulting in improved energy literacy.

2.6 Summary

The Company’s DSM Portfolio met the goal of cost effectiveness with a Portfolio MTRC value of 1.2 in 2017. The Company is of the view that both energy savings accounted for in the Portfolio and the resulting TRC remain conservative. Benefits from additional activities, such as CEO, play a very important role in supporting the development and delivery of programs, while creating a culture of conservation in British Columbia.

3. FUNDING TRANSFERS

Three Program Areas – Residential, Commercial and CEO – incurred actual program expenditures that appeared to be greater than their respective accepted Program Area funding amounts.[8] In the case of CEO and Commercial, however, exceedance of the accepted Program Area funding level was the result of reporting labour expenditures at the program level as directed by the Commission.[7] The accepted 2014-2018 DSM Plan was based on labour being reported at the Portfolio level, and planned Program Area expenditure levels were not re-stated subsequent to the Commission's decision regarding the reporting of labour costs at the program level. Therefore, the "accepted" or "plan" Program Area funding limits do not include labour. The expenditures for Commercial and CEO, as shown in Table 2.2, do not exceed planned values if labour costs are removed, therefore no funding transfer is required.

For the Residential Program Area, expenditures other than labour costs exceeded the accepted funding level by close to $1.0 million as a result of the success of the residential programs. To accommodate these additional expenditures in the Residential Program Area, $800,000 from the Industrial Program Area and $200,000 from the Innovative Technologies Program Area were moved into the Residential Program Area without exceeding 25% of approved expenditures within the respective Program Areas.[8]

[8] Order G-138-14.
[7] Directive 145, Order No. G-138-14
[8] As part of Order G-138-14, the Commission directed FEI to continue following the rules for funding transfers that were set by the Commission for the 2012-2013 test period. In Order G-44-12 the Commission determined that funding transfers greater than 25% from one approved Program Area to another required prior approval by the Commission. That limit has not been exceeded in 2017.

4. ADVISORY GROUP ACTIVITIES

4.1 Overview

The Energy Efficiency and Conservation Advisory Group (EECAG) provides insight and feedback on FEI's Portfolio of DSM activities and related issues. This includes DSM program and Portfolio performance, development and design, funding transfers, policy and regulations that may impact DSM activities, and other issues and activities as they arise.

EECAG members may be appointed based on their relevant subject matter expertise, representation of a common interest shared by stakeholders, or representation of a particular organization/group and/or interest. This includes, but is not limited to, governments, regions, First Nations organizations, customers, suppliers, industries, non-governmental organizations, research institutes and other groups that have historically intervened in FEI's regulatory proceedings.

Since the formation of the EECAG in 2009, FEI has gained valuable insight on DSM program design and implementation and developed positive working relationships with stakeholders. EECAG input continues to be instrumental as FEI moves forward with DSM activities, helping to ensure that efforts are aligned with the interests and suggestions of stakeholders.

In recent years, including 2017, FEI's DSM Portfolio has been stable in terms of overall funding and program activities, and therefore meetings with EECAG members have been less frequent than during the early years of program development and ramp-up. A single EECAG workshop late in the year was sufficient to inform EECAG members of the latest developments in DSM activities and to gain their feedback on Portfolio results and planning. EECAG members are also invited to take part in any of FEI's planning design workshops that bring together stakeholders who have an interest in a particular Program or Program Area. In 2017, a number of EECAG members took part in consultations, other than the EECAG workshop, that were designed to gather input into overall Portfolio planning.

4.2 Summary of the 2017 Workshop

The 2017 EECAG workshop was held on November 28 in Vancouver and was well attended by EEGAG members or their alternate delegates. The primary objective of the 2017 workshop was to engage EECAG members on development of the next DSM Plan for the 2019-2022 period. The EECAG Independent Facilitator was engaged in workshop design and facilitation of the workshop. Copies of materials and minutes for these meetings were distributed to EECAG members and other workshop attendees.

The November 2017 EECAG Workshop used a group breakout format to:

- Provide an update on the current (2014-2018) DSM Plan;
- Set the context and seek input for the next DSM Plan and expenditure application for the 2019-2022 time period; and

- Explain the next steps and timing for the DSM expenditure plan for 2019-2022, including additional opportunities for review and input by stakeholders.

Participants were provided with a draft version of the 2019-2022 DSM Plan in advance of the meeting and the group sessions were designed and facilitated to gather feedback on the Plan for each of the Program Areas. The FEI and FBC Conservation & Energy Management (C&EM) department presented both the gas and electric DSM Plans, however this section focuses on the feedback and input provided with respect to the natural gas DSM Plan.

EECAG members provided substantial feedback on the overall draft DSM Plan as well as each of the Program Areas. Overall impressions of the draft DSM Plan were that it is "going in the right direction". General feedback was positive with some areas identified as needing additional information. EECAG member ideas for strengthening the draft DSM Plan were noted for further investigation and consideration in finalizing the plan. A number of positive aspects of the draft DSM Plan were also noted, and additional opportunities for EECAG engagement on the development of the plan were outlined.

FEI continues to value the input from EECAG members. The 2017 workshop and additional consultation efforts with EECAG members that followed have been effective in improving the delivery of DSM activities and in improving the preparation of the 2019-2022 DSM Plan.

5. RESIDENTIAL ENERGY EFFICIENCY PROGRAM AREA

5.1 Overview

The Residential Energy Efficiency Program Area reduced annual natural gas consumption by 137,161 GJ, achieving an overall combined TRC/MTRC of 1.7. Over $12.2 million was invested in Residential Energy Efficiency programs in 2017, and 79 percent of this investment was customer incentive spending. Table 5-1 summarizes the expenditures for the Residential Energy Efficiency Program Area in 2017, including incentive and non-incentive spending, annual and NPV gas savings, as well as TRC/MTRC and other cost-effectiveness test results.

Residential programs serve over 912,000 customers in the FEI service territories. For DSM purposes, these customers predominantly include those living in single-family homes, row houses, townhomes or mobile homes.[9] Some in-suite measures, such as low flow fixtures and a small number of fireplaces and water heaters in multi-unit residential buildings are also included in this funding envelope. Residential programs serve retrofit and new home applications. In combination with the Company's education and outreach activities, these programs play an important role in driving a culture of conservation in British Columbia.

Table 5-1: Residential Energy Efficiency Program Area Results Summary

Program	Annual Gas Savings (GJ/yr.)		Actual NPV Gas Savings (GJ)	Utility Expenditures ($000s)						Benefit/Cost Ratios				
				Incentives		Non-Incentives		All Spending						
	2014-2018 DSM Plan	2017 Actual		2014-2018 DSM Plan	2017 Actual	2014-2018 DSM Plan	2017 Actual	2014-2018 DSM Plan	2017 Actual	TRC	MTRC	Utility	Participant	RIM
Non Program Specific Expenses														
Total		No Direct Savings		0	0	540	768	540	768			No Direct Savings		
Energy Efficiency Home Performance (Home Renovation Rebate Program)														
Total	47,131	15,846	208,584	1,228	1,391	423	534	1,651	1,925	0.5	2.4	0.9	1.1	0.5
Furnace Replacement Program														
Total	31,104	37,821	424,456	2,984	3,035	356	290	3,340	3,325	0.4	1.4	1.1	0.8	0.5
EnerChoice Fireplace Program														
Total	9,779	30,039	300,977	657	1,730	244	256	901	1,986	2.5	n/a	1.3	6.8	0.5
Appliance Service Program														
Total		No Direct Savings		356	385	100	62	456	447			No Direct Savings		
ENERGY STAR® Domestic Hot Water "DHW" Technologies														
Total	12,464	28,331	311,164	1,025	2,549	95	285	1,120	2,834	0.3	1.6	0.9	0.7	0.5
Domestic Hot Water Conservation Program /Low Flow Fixtures														
Total	12,825	3,157	30,151	190	269	100	-1	290	269	1.8	n/a	0.7	3.4	0.4
New Home Program														
Total	7,320	1,012	13,542	666	109	118	111	784	220	0.3	1.7	0.5	1.3	0.3
New Technologies Program														
Total	1,798	No Direct Savings		237	0	99	0	335	0			n/a		
Rental Apt Efficiency (RAP) *Residential Portion*														
Total	0	20,955	157,745	0	221	0	156	0	377			n/a		
Customer Engagement Tool for Conservation Behaviours														
Total		No Direct Savings		0	0	1,006	54	1,006	54			n/a		
On-Bill Financing														
Total	14250	No Direct Savings		143	0	133	0	276	0			n/a		
ALL PROGRAMS														
Total	**136,672**	**137,161**	**1,446,618**	**7,486**	**9,688**	**3,214**	**2,515**	**10,700**	**12,203**	**0.5**	**1.7**	**1.0**	**1.1**	**0.5**

Notes:

- ∗ RAP includes a combination of residential and commercial measures for both low income qualified and the able-to-pay rental apartment market, each funded from their respective Program

[9] Programs for Multifamily Dwellings served under Rate Schedule 2 or 3 are included in the Commercial Energy Efficiency Program Area (please refer to Section 7) with a few exceptions as noted.

Areas. RAP expenditures shown here are related only to the residential portion of RAP. Full RAP details are provided in Section 7.3.1, Table 7-10;

- Cost effectiveness values for the *Residential Portion* of RAP are not provided as they do not represent a complete program view. Please refer to Table 7-10 for RAP's cost effectiveness results.

5.2 Residential TRC and MTRC Results

FEI's DSM Program Principles state that programs should be universal, offering access to programs for all residential and commercial customers. Although many Residential programs are challenged in meeting a conventional TRC test where gas costs are relatively low, these programs, with their broad reach, are cost-effective when considering broader societal benefits such as water savings, increased human health and comfort, economic benefits such as job creation and greenhouse gas emissions reductions. This is recognized in the DSM Regulation which enables the inclusion of lower TRC programs through the application of the MTRC as discussed in Section 2.1. The overall 2017 Residential Program Area TRC was 0.5 with a combined TRC/MTRC result of 1.7.

5.3 2017 Residential Energy Efficiency Programs

Tables 5-2 through 5-8 outline the specific Residential Energy Efficiency programs undertaken in 2017, including program and measure descriptions and a breakdown of non-incentive spending.

Table 5-2: Energy Efficient Home Performance Program - Home Renovation Rebate

Program Description	This collaborative program, administered by the Utility Partners, promotes energy-efficiency home upgrades, while educating homeowners on the value of whole home performance. Federal, provincial and local governments co-promote this program and other related initiatives, including consumer education, capacity building for the trades, home labeling, and NRCan's Home Energy Rating System.						
Target Market	Residential customers						
New vs Retrofit	Retrofit						
Partners	BC Hydro, FortisBC (Electric), BC Ministry of Energy, Mines and Petroleum Resources, Natural Resources Canada, and local governments.						
Eligible Measures	Draftproofing	Attic Insulation	Basement Insulation	Wall Insulation	$750 Bonus Offer		
Incremental Measure Cost	$989	$1,147	$1,463	$1,953	N/A		
Incentive Amount	Up to $500	Up to $600	Up to $1,000	Up to $1,200	$750		
Savings Per Participant	6.6 GJ	8.9 GJ	6.1 GJ	5.6 GJ	N/A		
Measure Life	6 years for draftproofing; 25 years for insulation						
Free Rider Rate	20%						
Sources of Assumptions	Dunsky Energy Consulting Analysis, 2013, 2015 - 2016 Analysis of installation costs from participant data, FEI, November 2016 Consultations with BC Hydro, 2010 Conservation Potential Review, ICF Marbek, 2010 and Dunsky Energy Consulting. Review of 2017 participant data and Analysis of Net-to-gross Survey Results for the ecoENERGY Retrofit for Homes program, Bronson Consulting Group, August 2010						
Participants	2017	Projected	Actual				
	Total	3,780	2,505				
Expenditures ($,000s)			Non-Incentives				
	2017	Incentives	Industry Support	Admin	Communication	Research & Evaluation	Total
	Total	1,391	78	277	15	164	1,925

Notes:

- This program is a collaboration between FEI, FBC, and BC Hydro, with support from MEM, and Natural Resources Canada.
- The "$750 Bonus Offer" also includes the Municipal Partner Offer (MPO), where eligible participants from participating municipalities received a $500 top-up. In 2017, there were 15 eligible MPO participants.
- Industry support includes FEI's application support fees to Energy Advisors and contribution to the Home Performance Stakeholder Council (HPSC). The HPSC is an industry led group comprised of key industry players tasked with addressing the fragmented interests, opportunities and challenges that exist in BC's continuously evolving home performance industry. Funding for the HPSC is supported by FEI, FBC, BC Hydro, and MEM.
- Administration expenditures include FEI's contribution to the development of an online application form with BC Hydro to enable an enhanced customer experience and faster rebate processing times.
- Research & Evaluation includes the development of a Program Registered Contractor framework for insulators, training for contractors, and site visits to assess program compliance.

Table 5-3: Furnace and Boiler Replacement Program

Program Description	The Furnace and Boiler Replacement program targets customers with functioning furnaces (standard or mid-efficiency) or boilers. Through a combination of marketing, incentives and industry outreach, the program encourages customers to replace the equipment immediately, rather than waiting for it to fail at some point in the future.						
Target Market	Residential customers						
New vs Retrofit	Retrofit						
Partners	N/A						
Eligible Measures	Standard efficiency	Mid - efficiency	Boilers				
Incremental Measure Cost	$1,840	$1,840	$3,540				
Incentive Amount	$500	$500	$500				
Contractor Incentive	$50	$50	$50				
Savings Per Participant	6.9 GJs	5.0GJs	8.7GJs				
Measure Life	Furnace & boilers - 18 years						
Free Rider Rate	Early Replacement Methodology						
Sources of Assumptions	Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018 Furnace Replacement Pilot Program – Preliminary Evaluation Results, Sampson Research, May 2014 Furnace Early Replacement Program – Preliminary Evaluation Year 1 Pilot, Habart & Associates Inc. May 2013 MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING, Appendix C: Substantiation Sheets by Navigant Consulting, High Efficiency (Condensing) Furnace – Residential" KEMA Measure Life Study: HVAC, 4.1697.190 Furnace (90% AFUE or greater)						
Participants	2017	Projected	Actual				
	Total	3,730	5,951				
Expenditures ($,000s)			Non-Incentive Expenditures				
	2017	Incentives	Dealer Incentives	Admin	Communication	Research & Evaluation	Total
	Total	3,035	91	94	20	85	3,325

Notes:

- Based on industry feedback, the 2017 Furnace and Boiler Replacement program involved reducing the incentive from $800 to $500 in order to leave the program in market for a longer duration, which drove higher quality installations and allowed a greater number of customers to participate in the program.
- A greater emphasis was placed on Quality Installation. To be eligible for the rebate, the program required the installation of a two-pipe direct vent system. Contractors were required to sign a set of terms and conditions, pass site verification and agree to complete installations according to the best practices outlined in the *High-efficiency furnace installation guide for existing houses.* This guide was developed in collaboration with industry associations including the Thermal Environmental Comfort Association (TECA) and the Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI), and was co-funded by FEI and MEM.
- Contractor incentives of $50 per participant are allocated to the administration portion of non-incentive spend.

Table 5-4: EnerChoice Fireplace Program

Program Description	This program promotes the purchase and installation of energy-efficient EnerChoice fireplaces for zone heating. The program educates consumers and dealers about the EnerChoice label and the benefits of selecting natural gas fireplaces based on energy-efficiency and heating attributes, rather than just decorative features. Program awareness and participation was promoted through a combination of customer and dealer incentives, and promotional activities.
Target Market	Residential customers
New vs Retrofit	Both
Partners	N/A
Eligible Measures	EnerChoice Fireplace
Incremental Measure Cost	$132
Customer Incentive	$300
Contractor Incentive	$50 (Retrofit only)
Savings Per Participant	EnerChoice Fireplace (Retrofit): 7.8GJ EnerChoice Fireplace (New Construction): 5.0GJ
Measure Life	15 years
Free Rider Rate	37%
Spillover	14% (Retrofit only)
Sources of Assumptions	2010 Conservation Potential Review, ICF Marbek, 2010 Fireplace Impact Evaluation, Sampson Research, 2015 AFER Study, Apartment Fireplace Efficiency Retrofit (AFER) Project, Building Energy Solutions, April, 2017 Regulatory Proposal (Sept 2016), Prepared by: Energy Efficiency Branch, BC Ministry of Energy and Mines Pre-Feasibility Study: Upgrades for Decorative Fireplaces-Ref: P132144JGW Analysis of 2017 Participant Data John Sampson Analysis, February 2017

Participants	2017	Projected Total	Actual: Retrofit	Actual: New Construction	Actual: Total
	Total	2,190	4,214	1,553	5,767

Expenditures ($,000s)	2017	Incentives	Non-Incentives: Dealer Incentives	Non-Incentives: Admin	Non-Incentives: Communication	Non-Incentives: Research & Evaluation	Total
	Total	1,730	197	52	7	0	1,986

Notes:

- The FortisBC eligible EnerChoice fireplace directory must be direct-vented, temperature modulating and not have a standing pilot. These requirements support the BC Building Code and provincial policy.
- Contractor incentives of $50 per participant are allocated to the administration portion of non-incentive spend.
- In 2016, the Energy Efficiency Branch of the B.C. Government introduced a regulatory proposal to increase the standard of efficiency for fireplaces sold in B.C., which is currently expected to take effect on January 1, 2019. The regulatory change in increasing the fireplace minimum efficiency standards presents an opportunity for FEI to claim attribution savings, pursuant to the DSM Regulation, as a result of FEI's efforts towards advancing fireplace standards. FEI has estimated the current attributed savings is 133,000 GJ/yr as of 2017. Once the fireplace regulation is in effect, FEI will claim the attributed savings, make appropriate adjustments to program design, and note changes to the cost effectiveness inputs. The approach to reporting code and standards attribution savings, similar to reporting DSM program savings, will be done through the annual DSM report for each respective measure.

Table 5-5: Appliance Service Program

Program Description	This program provides customer education related to the importance of regular appliance maintenance to ensure efficient operation of natural gas appliances. This program also creates opportunities for contractors to dialogue with customers about upgrading appliances to more efficient models.
Target Market	Residential customers
New vs Retrofit	Retrofit
Partners	N/A
Eligible Measures	Furnace Service (61%), Fireplace Service (33%), Boiler (6%)
Incremental Measure Cost	N/A
Incentive Amount	$25 incentive per service; Average of $31 per participant
Savings Per Participant	N/A
Measure Life	N/A
Free Rider Rate	N/A

Participants (no. of services)

2017	Projected	Actual
Total	14,250	15,394

Expenditures ($,000s)

2017	Incentives	Non-Incentives: Admin	Non-Incentives: Communication	Non-Incentives: Research & Evaluation	Total
Total	385	25	21	15	447

Table 5-6: ENERGY STAR® Water Heater Program

Program Description	This program promotes the replacement of standard efficiency water heaters with efficient ENERGY STAR® models. As part of a longer term market transformation strategy, the program introduced 0.67 EF storage tank water heaters and new technologies with energy factors (EF) greater than 0.80. Additional technologies include condensing and non-condensing tankless water heaters, and condensing storage tanks. The program is available to both retrofit and new construction markets. The program supports upcoming federal and provincial Minimum Efficiency Act Standards for natural gas- and propane-fired water heaters.
Target Market	Residential customers
New vs Retrofit	Both
Partners	N/A

Eligible Measures	**ESTAR 0.67 EF Storage Tank**	**Non-Condensing Tankless**	**Condensing Tankless**	**Condensing Storage Tank**
Incremental Measure Cost				
Retrofit	$416	$1,877	$2,837	$2,666
New Construction	$250	$1,130	$1,700	$1,600
Incentive Amount	$200	$400	$500	$1,000
Savings Per Participant	3.0 GJ	6.9 GJ	9.5 GJ	6.9 GJ

Measure Life	17.2 years
Free Rider Rate	27%
Sources of Assumptions	Energy Savings Assumptions Review (of multiple energy savings data sources), FEI, November 2014, revisited February 2018 including Final Report 0.67 Energy Star Water Heater Pilot Project, June 12, 2014 Deemed savings review of other jurisdictions Review of program participant data from 2017, FEI, February 2018 Review of Technical Reference Manuals from other jurisdictions applied to actual program measure installation data from 2017. FEI, February 2018 including BC Hydro Powersmart F13 Effective Measure Life and Persistence

Participants

2017	Projected Total	Actual: ESTAR 0.67 EF Storage Tank – Retrofit	ESTAR 0.67 EF Storage Tank – New	Non-Condensing Tankless – Retrofit	Non-Condensing Tankless – New	Condensing Tankless – Retrofit	Condensing Tankless – New	Condensing Storage Tank – Retrofit	Condensing Storage Tank – New
Total	1,950	2,613	173	95	253	1,643	1,000	275	256

Expenditures ($,000s)

2017	Incentives	Non-Incentives: Dealer Incentives	Non-Incentives: Admin	Non-Incentives: Comm.	Non-Incentives: Research & Evaluation	Total
Total	2,549	225	60	0	0	2,834

Table 5-7: Domestic Hot Water Conservation - Low Flow Fixtures and Washer Promotions

<table>
<tr><td>Program Description</td><td colspan="6">The objective of this program is to reduce hot water consumption in houses, row houses and MURBS through partnerships with utilities or government. Initiatives include the installation of low-flow fixtures and ENERGY STAR® washers and dryers.</td></tr>
<tr><td>Target Market</td><td colspan="6">Residential customers</td></tr>
<tr><td>New vs Retrofit</td><td colspan="6">Retrofit</td></tr>
<tr><td>Partners</td><td colspan="6">BC Hydro, FBC, and Municipalities</td></tr>
<tr><td>Eligible Measures</td><td colspan="6">Low-Flow Fixtures; ENERGY STAR® Washers and Dryers</td></tr>
<tr><td colspan="7">ENERGY STAR Washers:</td></tr>
<tr><td>Incremental Measure Cost</td><td colspan="6">$77</td></tr>
<tr><td>Incentive Amount</td><td colspan="6">Partnership with BC Hydro:
• $50 rebate (FEI contributes $25) on qualifying ENERGY STAR® clothes washers - IMEF of 2.82 to 2.91, and WF of 3.50 or less
• $100 rebate (FEI contributes $75) on qualifying ENERGY STAR® clothes washers - IMEF of 2.92 or higher, WF of 3.20 or less
Partnership with FBC:
• $50 rebate (FEI contributes $25) on qualifying ENERGY STAR® clothes washers - IMEF of 2.74 to 2.91, and IWF of 3.50 or less
• $100 rebate (FEI contributes $75) on qualifying ENERGY STAR clothes washers - IMEF of 2.92 or higher, IWF of 3.20 or less</td></tr>
<tr><td>Savings Per Participant</td><td colspan="6">1.0 GJ Natural Gas plus 0.25 GJ electric - BC Hydro</td></tr>
<tr><td>Measure Life</td><td colspan="6">14 years</td></tr>
<tr><td>Free Rider Rate</td><td colspan="6">20%</td></tr>
<tr><td colspan="7">ENERGY STAR Dryers:</td></tr>
<tr><td>Incremental Measure Cost</td><td colspan="6">$50</td></tr>
<tr><td>Incentive Amount</td><td colspan="6">Partnership with BC Hydro:
• $100 rebate (FEI contributes $100) on qualifying ENERGY STAR® gas dryers - CEF of 3.93 or higher
Partnership with FBC:
• $100 rebate (FEI contributes $100) on qualifying ENERGY STAR Natural gas dryers</td></tr>
<tr><td>Savings Per Participant</td><td colspan="6">0.7 GJs</td></tr>
<tr><td>Measure Life</td><td colspan="6">12 years</td></tr>
<tr><td>Free Rider Rate</td><td colspan="6">20%</td></tr>
<tr><td colspan="7">Low Flow Fixtures:</td></tr>
<tr><td>Incremental Measure Cost</td><td colspan="6" rowspan="5">100 showerheads were provided to the City of Vancouver for piloting their water conservation initiative.</td></tr>
<tr><td>Incentive Amount</td></tr>
<tr><td>Savings Per Participant</td></tr>
<tr><td>Measure Life</td></tr>
<tr><td>Free Rider Rate</td></tr>
<tr><td>Sources of Assumptions</td><td colspan="6">Review of Clothes Washer Technology Analysis, BC Hydro, 2010, 2010 Conservation Potential Review, ICF Marbek, 2010 and Technical Reference Manuals from other jurisdictions.
Market Review, ESource, December 2014 and High Efficiency Natural Gas Laundry Dryers, Posterity Group and Sampson Research, December 2014
Consultation with program partners
Ontario Power Authority "2010 Prescriptive Measures and Assumptions: Release 1"
BC Hydro and FortisBC based on market share of eligible washers</td></tr>
<tr><td rowspan="2">Participants</td><td>2017</td><td>Projected</td><td>Actual</td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td>N/A</td><td>3,959</td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">Expenditures ($,000s)</td><td>2017</td><td>Incentives</td><td colspan="3">Non-Incentives</td><td>Total</td></tr>
<tr><td></td><td></td><td>Admin</td><td>Communication</td><td>Research & Evaluation</td><td></td></tr>
<tr><td>Total</td><td>269</td><td>6</td><td>1</td><td>-7</td><td>269</td></tr>
</table>

Notes:

- The Washer promotion was a collaboration with BC Hydro for a spring promotion in May-June and fall promotion in October-November. In addition, FEI collaborated with FBC from January to December.

Table 5-8: New Home Program

Program Description	This program provides education and financial incentives to support energy-efficient building practices for the Residential sector. This program supports efficiency updates to the BC Building Code (effective Dec. 2014). In June 2015, the utilities launched ENERGY STAR® for New Homes as the new whole home performance standard.					
Target Market	Builders of residential properties – single family homes and townhomes and homeowner builders					
New vs Retrofit	New Construction					
Partners	BC Hydro and FBC					
Eligible Measures	**ENERGY STAR® Single Family Dwellings**			**ENERGY STAR® TH/RH/Duplex**		
Incremental Measure Cost	$3,238			$1,873		
Incentive Amount	$2,000			$700		
Savings Per Participant	20.7 GJs			10.4 GJs		
Measure Life	25 years					
Free Rider Rate	15% for ENERGY STAR					
Sources of Assumptions	New Construction Costs and Savings and Life Cycle Costs, First published in 2011 and updated in 2014, Cooper and Habart, and Dunsky Energy Consulting ISE Consulting Group Analysis, March 2014 Analysis of program participants and data					
Participants	2017	Projected	Actual			
			SFD	Row/Townhome	Duplex	Total
	Total	1,338	52	9	2	63
Expenditures ($,000s)	2017		Non-Incentives			
		Incentives	Program Administration	Communication	Research & Evaluation	Total
	Total	109	90	3	18	220

Notes:

- FEI collaborates with BC Hydro and FBC on this program. As of January 2016, BC Hydro no longer offers incentives, although they continue to provide education to builders and energy advisors, and support policy regarding High Performance Homes in BC.
- The participant counts in this table are for the ENERGY STAR component of the program. Incentives for natural gas water heaters and fireplaces installed in new home construction are noted under their respective program tables.
- In 2017, FEI initiated plans to provide support for the adoption of the BC Energy Step Code within the New Home Program, as directed in the 2017 Amendment to the DSM Regulation, which supports utilities' ability to provide incentives for builders who adopt and comply with the Energy Step Code in municipalities across BC.

5.4 2017 Residential Energy Efficiency Programs Planned But Not Launched

5.4.1 CUSTOMER ENGAGEMENT TOOL

In Q4 of 2017, FEI and FBC conducted a Request for Information process for the Customer Engagement Tool (CET), in preparation for a 2018 Request for Proposal process to begin CET development.

5.4.2 ON-BILL FINANCING

On-bill financing initiatives have been found to be expensive and administratively burdensome, with low uptake rates. Partnerships with third party financial organizations supporting this initiative ended in 2017.

5.4.3 NEW TECHNOLOGIES

FEI continues to explore new technologies through the Innovative Technologies Program. There were no new technologies deployed in 2017.

5.5 Summary

Residential Energy Efficiency Program Area activity in 2017 resulted in over 137,000 GJ/year of natural gas savings. These programs enabled customers to upgrade appliances and capture energy savings, and continued to build on relationships with the trades for education and program awareness. The combination of financial incentives, policy support, contractor outreach, and effective marketing in these programs is instrumental to the ongoing success of these programs in generating natural gas savings and fostering market transformation in the residential sector.

6. LOW INCOME ENERGY EFFICIENCY PROGRAM AREA

6.1 Overview

During 2017, DSM investments in the Low Income Program Area grew by over 10% relative to 2016. This equates to 47,263 GJ in annual gas savings which is considerably higher than the 27,768 GJ in the 2014-18 DSM Plan.

Table 6-1 summarizes the planned and actual expenditures for the Low Income Program Area in 2017, including incentive and non-incentive spending, annual and NPV gas savings, as well as the cost-effectiveness test results. The TRC and MTRC for Low Income programs use a value of 140% of the benefits in accordance with the DSM Regulation.

Table 6-1: 2017 Low Income Program Results Summary

Program	Annual Gas Savings (GJ/yr.)		Actual NPV Gas Savings (GJ)	Utility Expenditures ($000s)						Benefit/Cost Ratios				
				Incentives		Non-Incentives		All Spending						
	2014-2018 DSM Plan	2017 Actual		2014-2018 DSM Plan	2017 Actual	2014-2018 DSM Plan	2017 Actual	2014-2018 DSM Plan	2017 Actual	TRC	MTRC	Utility	Participant	RIM
Non Program Specific Expenses														
Total	No Direct Savings			0	0	305	255	305	255	No Direct Savings				
Energy Saving Kit (ESK)														
Total	7,554	29,019	218,451	70	234	46	134	116	368	5.5	n/a	6.4	9.4	1.0
Energy Conservation Assistance Program (ECAP)														
Total	9,161	8,251	71,004	1,333	1,193	901	427	2,234	1,620	0.4	1.8	0.5	1.5	0.3
Residential Energy Efficiency Works (REnEW)														
Total	No Direct Savings			0	0	81	184	81	184			n/a		
Low Income Space-Heat Top Up														
Total	2,261	1,883	22,454	63	80	13	0	76	80	2.8	n/a	3.2	3.5	0.9
Low Income Water-Heating Top Up														
Total	661	353	3,036	10	9	5	0	15	9	3.2	n/a	3.7	4.1	0.9
Non-Profit Custom Program														
Total	8,131	0	0	302	0	119	34	421	34			n/a		
Rental Apt Efficiency (RAP) *Low Income Portion*														
Total	0	7,757	28,127	0	76	0	18	0	94			n/a		
ALL PROGRAMS														
Total	**27,768**	**47,263**	**343,071**	**1,778**	**1,592**	**1,469**	**1,052**	**3,247**	**2,644**	**1.2**	**2.1**	**1.4**	**2.9**	**0.7**

Notes:

- RAP includes a combination of residential and commercial measures for both low income-qualified and the able-to-pay rental apartment market, each funded from their respective Program Areas. RAP expenditures shown here are related only to the Low Income portion of RAP. Full RAP details are provided in Section 7.3.1, Table 7-10
- Cost effectiveness values for the *Low Income Portion* of RAP are not provided as they do not represent a complete program view. Please refer to Table 7-10 for the program's cost effectiveness results.

6.2 2017 Low Income Programs

Tables 6-2 through 6-7 outline the specific Low Income programs undertaken in 2017, including program and measure descriptions and a breakdown of non-incentive spending.

Table 6-2: Energy Saving Kit (ESK) Program

Program Description	The goal of this program is to reach a broad audience of Low Income customers and enable them to take some simple steps towards saving energy by installing a bundle of easy-to-install items that are delivered to their door. Promotional activities include bill inserts, event promotions such as food banks, targeted digital campaigns and partnerships with government ministries and non-profits that serve the low income population.				
Target Market	Low Income Residential Customers				
New vs Retrofit	Retrofit				
Partners	BC Hydro and FortisBC Inc. (FBC)				
Eligible Measures	Bundle of measures including high efficiency water fixtures, draft proofing tape, outlet gaskets, window film, etc.				
Incremental Measure Cost	$ 21.61 Average based on the full cost of the gas measures included in the ESK.				
Incentive Amount	$ 21.61 Since the program is free to participants, the incentive equals the incremental cost.				
Savings Per Participant	2.7 GJ per year				
Measure Life & Source	10 years - Average based on the individual gas measures included in the Energy Saving Kit				
Free Rider Rate & Source	0% - E Source Review of Low Income Net to Gross in other Jurisdictions : Low-income, Income Assisted Customers or Charitable Programs Oct. 30, 2017; BC Hydro, Oct. 30, 2017				
Participants	2017	Projected	Actual		
	Total	5,174	10,828		
Expenditures ($,000s)	2017	Incentives	Admin	Communication	Research & Evaluation	Total
	Total	234	38	96	0	368

Notes:

- Participation in the ESK Program is above the 2014-2018 DSM Plan and is aligned with recent years' participation although not quite as high as 2016.

Table 6-3: Energy Conservation Assistance Program (ECAP)

Partners	BC Hydro and FortisBC Inc. (FBC)					
Eligible Measures	Bundle of customized measures, which may include low-flow fixtures, water heater pipe wrap, professional draft proofing, outlet gaskets, window film, insulation, improved ventilation, CO detectors, and furnaces.					
Incremental Measure Cost	$627 Based on average cost of the customized bundle of measures installed. Includes the full cost of the gas measures installed in gas heated homes.					
Incentive Amount	$627 Since the program is free to participants, the incentive equals the incremental cost.					
Savings Per Participant	3.72 GJ per year					
Measure Life & Source	12 years - Average based on the individual gas measures installed.					
Free Rider Rate & Source	0% - E Source Review of Low Income Net to Gross in other Jurisdictions : Low-income, Income Assisted Customers or Charitable Programs Oct. 30, 2017; BC Hydro, Oct. 30, 2017					
Participants	2017	Projected	Actual			
	Total	1,645	2,218			
Expenditures ($,000s)	2017	Incentives	Admin	Communication	Research & Evaluation	Total
	Total	1,193	158	142	127	1,620

Notes:

- Participation in ECAP is above the 2014-2018 DSM Plan and saw the strongest participation in the Program since launch.
- In 2017 ECAP piloted furnace installations and duct sealing for the first time in manufactured homes.

Table 6-4: Residential Energy Efficiency Works (REnEW) Program

Program Description	The goal of this program is to enhance the energy efficiency trade sector in BC in a manner that also enhances communities. This program targets individuals facing barriers to employment and provides training in energy efficiency retrofitting. The training is delivered by industry experts at no cost to participants.
Target Market	Low income individuals facing barriers to employment
New vs Retrofit	N/A
Partners	Ministry of Energy and Mines, FortisBC Inc. (FBC)
Eligible Measures	N/A
Incremental Measure Cost	N/A
Incentive Amount	N/A
Savings Per Participant	N/A
Measure Life & Source	N/A
Free Rider Rate & Source	N/A
Participants	2017: Projected / Actual Total: 20 / 12
Expenditures ($,000s)	2017: Incentives / Admin / Communication / Research & Evaluation / Total Total: 0 / 148 / 4 / 32 / 184

Table 6-5: Low Income Space Heat Top Up

Program Description	The existing Commercial Space Heat Program offers rebates to commercial customers for the installation of high efficiency space heating equipment in commercial applications. The Low Income Space Heat Top Up Program is an add-on to the existing Commercial Space Heat Program and offers an additional rebate over and above the commercial rebate if the customer meets the eligibility criteria. Promotional activities include partnerships with BC Housing, BC Non-Profit Housing Association (BCNPHA), and the provincial and regional BCNPHA conferences, trade shows and educational seminars.
Target Market	The Low Income Space Heat Top Up Program is primarily focused on apartment buildings that are owned or operated by a First Nations band, a non-profit housing provider, or a housing co-operative.
New vs Retrofit	Both
Partners	N/A
Eligible Measures	Condensing boilers and mid-efficiency boilers.
Incremental Measure Cost	$7,683 per appliance - Analysis of 2016 Program Participant Data, FEI, November, 2017 for Efficient Boiler, and Vendor Costing Survey, FEI, 2015 for Base Efficiency Boiler
Incentive Amount	Condensing: $6/MBH Mid-efficiency: $3/MBH
Savings Per Participant	129 GJ/yr - EBP Deemed Savings Analysis by FEI applying results from Update of Energy Savings Analysis From FortisBC Efficient Boiler Program – Final Report, August 2013, Prism Engineering.
Measure Life & Source	20 years - Review of Technical Reference Manuals from other jurisdictions, FEI, 2017 including KEMA: Boilers & Burners 1.2796.040 High Efficiency Modulating Hot Water Boiler ASHRAE Equipment Life Tables
Free Rider Rate & Source	0% -E Source Review of Low Income Net to Gross in other Jurisdictions : Low-income, Income Assisted Customers or Charitable Programs Oct. 30, 2017; BC Hydro, Oct. 30, 2017
Participants	2017: Projected / Actual Total: 22 / 15
Expenditures ($,000s)	2017: Incentives / Admin / Communication / Research & Evaluation / Total Total: 80 / 0 / 0 / 0 / 80

Note:

- 2017 was the first full year with this program in market.

Table 6-6: Low Income Water Heating Top Up

<table>
<tr><td>Program Description</td><td colspan="6">The existing Commercial Water Heater Program was launched in 2010 and it offers rebates to commercial customers for the installation of high efficiency water heating equipment in commercial applications. The Low Income Water Heater Top Up Program will piggyback on the existing Commercial Water Heater Program and offer an additional incentive over and above the commercial rebate if the customer meets the eligibility criteria.

Promotional activities will include partnerships with BC Housing, BC Non-Profit Housing Association (BCNPHA), and the provincial and regional BCNPHA conferences, trade shows and educational seminars.</td></tr>
<tr><td>Target Market</td><td colspan="6">The existing Commercial Water Heating Program offers rebates to commercial customers for the installation of high efficiency water heating equipment in commercial applications. The Low Income Water Heating Top Up Program is an add-on to the existing Commercial Water Heating Program and offers an additional rebate over and above the commercial rebate if the customer meets the eligibility criteria.

Promotional activities include partnerships with BC Housing, BC Non-Profit Housing Association (BCNPHA), and the provincial and regional BCNPHA conferences, trade shows and educational seminars.</td></tr>
<tr><td>New vs Retrofit</td><td colspan="6">Both</td></tr>
<tr><td>Partners</td><td colspan="6">N/A</td></tr>
<tr><td>Eligible Measures</td><td colspan="6">High Efficiency Storage Tanks, High Efficiency Domestic Hot Water Boilers, High Efficiency Tankless Domestic Hot Water</td></tr>
<tr><td>Incremental Measure Cost</td><td colspan="6">$4890 per appliance - Analysis of 2016 Program Participant Data, FEI, November, 2017 for Efficient Boiler, and Vendor Costing Survey, FEI, 2016 for Base Efficiency Boiler</td></tr>
<tr><td>Incentive Amount</td><td colspan="6">Storage tank water heater: $2/MBH
Hot water supply boiler (84%-89.9% thermal efficiency): $1/MBH
Hot water supply boiler (90%+ thermal efficiency): $2/MBH
High-efficiency tankless water heater: $1/MBH</td></tr>
<tr><td>Savings Per Participant</td><td colspan="6">34 GJ/year per appliance - Energy Savings Assumptions Review (of multiple energy savings data sources), FEI, November 2014, revisited February 2018 including
Final Report 0.67 Energy Star Water Heater Pilot Project, June 12, 2014
Deemed savings review of other jurisdictions
A Canadian High-Efficiency Natural Gas Water Heater Pilot Project, Natural Gas Technologies Centre, July 2014</td></tr>
<tr><td>Measure Life & Source</td><td colspan="6">12 years -Review of Technical Reference Manuals from other jurisdictions applied to actual program measure installation data from 2017. FEI, February 2018, including BC Hydro Powersmart F13 Effective Measure Life and Persistence and MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING, Appendix C: Substantiation Sheets by Navigant Consulting</td></tr>
<tr><td>Free Rider Rate & Source</td><td colspan="6">0% - E Source Review of Low Income Net to Gross in other Jurisdictions : Low-income, Income Assisted Customers or Charitable Programs Oct. 30, 2017; BC Hydro, Oct. 30, 2017</td></tr>
<tr><td rowspan="2">Participants</td><td>2017</td><td>Projected</td><td>Actual</td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td>18</td><td>11</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Expenditures ($,000s)</td><td>2017</td><td>Incentives</td><td>Admin</td><td>Communication</td><td>Research & Evaluation</td><td>Total</td></tr>
<tr><td>Total</td><td>9</td><td>0</td><td>0</td><td>0</td><td>9</td></tr>
</table>

Note:

- 2017 was the first full year with this program in market.

Table 6-7: Non-Profit Custom Program

Program Description	This program is designed to encourage social housing apartment buildings to replace inefficient equipment and systems with high-efficiency solutions. The program is built around three components: 1) An energy study: Currently there are two avenues available to non-profit housing providers to receive a free energy audit and study. Most participants are having their energy study performed by BC Non-Profit Housing Association (BCNPHA). Some participants are opting to go through the RAP Low Income program for these services. 2) Implementation support: Currently the implementation support is available through the RAP Low Income program. There is additional work still under development for this component of the program. Future implementation support could be offered to housing providers that have used BCNPHA for their energy study. 3) Incentives for Measures: At this point, it is only the Space Heat Top Up and the Water Heater Top Up measures that are available. Analysis is currently being performed on additional measures to offer additional incentives for.					
Target Market	The Non-Profit Custom Program is primarily focused on apartment buildings that are owned or operated by First Nations bands, non-profit housing providers, or housing co-operatives.					
New vs Retrofit	Both					
Partners	N/A					
Eligible Measures	Eligible measures include boilers and water heaters. Additional measures may in the future include items such as heating controls (i.e. zone controls, temperature set back controls, etc.) and potentially building envelope measures.					
Incremental Measure Cost	N/A					
Incentive Amount	N/A					
Savings Per Participant	N/A					
Measure Life & Source	N/A					
Free Rider Rate & Source	N/A					
Participants	2017	Projected	Actual			
	Total	12	2,347			
Expenditures ($,000s)	2017	Incentives	Admin	Communication	Research & Evaluation	Total
	Total	76	44	0	7	127

Note:

- In 2017 the Low Income Rental Efficiency Program (RAP Low Income) continued to address several of the objectives of the Non-Profit Custom Program. As well, additional development was completed including multiple meetings with key stakeholders to identify gaps, gaining clarity on the needs of the non-profit housing sector, and expanding the scope of the Non-Profit Custom Program to include more electrical measures by partnering with BC Hydro and FBC.

6.3 Summary

The Low Income Program Area has been an important priority for the Company since the initial creation of the DSM Program Principles. In 2017 all historical Low Income programs were operating at some of their highest participation levels to date and programs continue to evolve to include more energy efficiency opportunities for low income customers.

7. COMMERCIAL ENERGY EFFICIENCY PROGRAM AREA

7.1 Overview

In 2017, Commercial Energy Efficiency programs continued to encourage commercial customers to reduce their overall consumption of natural gas and associated energy costs. The Commercial Energy Efficiency Program Area reduced annual natural gas consumption by approximately 238,688 GJs and achieved an overall TRC of 0.8. $10.834 million was invested in Commercial Energy Efficiency, of which 82% was incentive spending. Table 7-1 summarizes expenditures for the Commercial Energy Efficiency Program Area in 2017, including incentive and non-incentive spending, annual and NPV gas savings, as well as TRC and other cost-effectiveness test results.

Table 7-1: 2017 Commercial Energy Efficiency Program Results Summary

Program	Annual Gas Savings (GJ/yr.)		Actual NPV Gas Savings (GJ)	Utility Expenditures ($000s)						Benefit/Cost Ratios				
				Incentives		Non-Incentives		All Spending						
	2014-2018 DSM Plan	2017 Actual		2014-2018 DSM Plan	2017 Actual	2014-2018 DSM Plan	2017 Actual	2014-2018 DSM Plan	2017 Actual	TRC	MTRC	Utility	Participant	RIM
Non Program Specific Expenses														
Total	No Direct Savings			0	0	1,100	554	1,100	554	No Direct Savings				
Space Heating Program														
Total	61,825	73,264	873,565	2,053	3,041	75	289	2,128	3,330	1.6	n/a	2.3	2.4	0.8
Water Heating Program														
Total	16,946	11,703	126,897	269	301	38	127	307	428	0.9	n/a	2.5	1.3	0.8
Commercial Food Service Program														
Total	17,802	10,078	86,723	392	287	108	147	500	434	1.0	n/a	1.7	2.1	0.7
Customized Equipment Upgrade Program														
Total	51,817	51,383	512,567	2,226	2,242	272	435	2,498	2,677	0.6	n/a	1.2	1.0	0.5
EnerTracker Program														
Total	0	0	0	0	0	0	0	0	0	n/a	n/a	n/a	n/a	n/a
Continuous Optimization Program														
Total	88,276	47,472	202,568	1,215	781	173	6	1,389	788	1.0	n/a	2.0	1.8	0.7
Commercial Energy Assessment Program														
Total	0	14,671	14,671	379	61	81	38	460	99	0.9	n/a	1.0	3.0	0.5
Energy Specialist Program														
Total	0	7,549	7,549	1,890	1,567	144	129	2,034	1,696	n/a	n/a	n/a	n/a	n/a
Commercial EDX/Portfolio Manager														
Total	0	0	0	0	0	0	79	0	79	n/a	n/a	n/a	n/a	n/a
Rental Apt Efficiency (RAP) *Commercial Portion*														
Total	0	22,569	82,264	0	568	0	183	0	751	n/a				
ALL PROGRAMS														
Total	**237,665**	**238,688**	**1,906,805**	**8,424**	**8,847**	**1,992**	**1,987**	**10,416**	**10,834**	**0.8**	**n/a**	**1.4**	**1.4**	**0.6**

Notes:

- FEI has not used the MTRC for Commercial programs as the low TRC value observed in the Customized Equipment Program is due in large part to timing between energy study payments and recording of implemented measures and thus recording of savings. Also see notes to Table 7-5.
- RAP includes a combination of residential and commercial measures for both low income-qualified and the able-to-pay rental apartment market, each funded from their respective Program Areas. RAP expenditures shown here are related only to the commercial portion of RAP. Full RAP details are provided in Section 7, Table 7-10.

- Cost effectiveness values for the Commercial portion of RAP are not provided as they do not represent a complete program view. Please refer to Section 7.3.1, Table 7-10 for the program's cost effectiveness results.

7.2 2017 Commercial Energy Efficiency Programs

The following tables outline the specific Commercial Energy Efficiency programs undertaken in 2017, including program and measure descriptions and a breakdown of non-incentive spending.

Table 7-2: Space Heat Program

Program Description	This program provides rebates for the installation of high efficiency space heating equipment in commercial applications. Currently only rebates for high efficiency boilers are offered. Rebates for condensing rooftop units may also be offered via the program in 2018.					
Target Market	Commercial					
New vs Retrofit	Both					
Partners	N/A					
	Retrofit	New Construction				
Incremental Measure Cost	$24,227	$21,541				
Incentive Amount	$13,641	$23,429				
Savings Per Participant	407 GJ	639 GJ				
Measure Life	20 years					
Free Rider Rate	18%					
Source of Inputs	EBP Deemed Savings Analysis by FEI applying results from Update of Energy Savings Analysis From FortisBC Efficient Boiler Program – Final Report, August 2013, Prism Engineering Analysis of 2016 Program Participant Data, FEI, November, 2017 for Efficient Boiler, and Vendor Costing Survey, FEI, 2015 for Base Efficiency Boiler Review of Technical Reference Manuals from other jurisdictions, FEI, 2017 including KEMA: Boilers & Burners 1.2796.040 High Efficiency Modulating Hot Water Boiler ASHRAE Equipment Life Tables Efficient Boiler Program Impact Evaluation, June 12, 2003					
Participants	2017	Projected	Actual			
	Total	204	203			
Expenditures ($,000)	2017	Incentives	Admin	Communication	Research & Evaluation	Total
	Total	3,041	289	0	0	3,330

Table 7-3: Water Heating Program

Program Description	This program provides rebates for the installation of high-efficiency commercial water heaters with thermal efficiencies greater than or equal to 84%.				
Target Market	Commercial				
New vs Retrofit	Both				
Partners	N/A				
	Retrofit	New Construction			
Incremental Measure Cost	$7,582	$15,065			
Incentive Amount	$1,824	$3,813			
Savings Per Participant	140 GJ	167 GJ			
Measure Life & Source	17 years				
Free Rider Rate & Source	38%				
Input Sources	Efficient Commercial Water Heater Evaluation – Final Report, Prism Engineering, February 2017. Analysis of 2016 Program Participant Data, FEI, November, 2017 for Efficient Boiler, and Vendor Costing Survey, FEI, 2016 for Base Efficiency Boiler. Review of Technical Reference Manuals from other jurisdictions, FEI, 2017 including MEASURES AND ASSUMPTIONS FOR DEMAND SIDE MANAGEMENT (DSM) PLANNING, Appendix C: Substantiation Sheets by Navigant Consulting. KEMA Measure Life Study. Efficient Commercial Water Heater Evaluation – Final Report, Prism Engineering, February 2017				
Participants	2017	Projected	Actual		
	Total	141	128		
Expenditures ($,000)	2017	Incentives	Admin	Communication	Research & Evaluation	Total
	Total	301	127	0	0	428

Table 7-4: Commercial Food Service Program

Program Description	This program offers a suite of rebates for the installation of high-efficiency cooking appliances and it may also provide other incentives relevant to commercial food service participants such as low-flow pre-rinse spray valve or faucet aerator installations.					
Target Market	Commercial					
New vs Retrofit	Both					
Partners	N/A					
	Retrofit	New Construction				
Incremental Measure Cost	$4,831	$5,461				
Incentive Amount	$2,695	$3,175				
Savings Per Participant	52 GJ	135 GJ				
Measure Life & Source	**Food Service** - 12 Years; **Pre-Rinse Spray Valve** - 5 Years; **Aerator** - 10 Years					
Free Rider Rate & Source	20%					
Input Sources	Commercial Food Service Incentive Program Evaluation, Final Report, Fish and River Consultants, February 2018. Food Service Incentive Program Study, Fisher_Nickel, Inc. (FNi), November 2011. Review of actual program data 2010 - 2016, FEI, February 2018. Program Cost Data Review, FEI, 2017 and Vendor costing survey 2017-2018. Review of TRMs from other jurisdictions, FEI, 2017 including KEMA Measure Life Study. Ontario Energy Board: OEB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge.					
Participants	2017	Projected	Actual			
	Total	490	103			
Expenditures ($,000)	2017	Incentives	Admin	Communication	Research & Evaluation	Total
	Total	287	101	1	45	434

Notes:

- In 2017 as part of the Commercial Food Service Program, FEI, in partnership with The City of Vancouver, offered a program to install low-flow pre-rinse spray valves (PRSV) and faucet aerators in food service establishments. Installation of 163 pre-rinse spray valves and 291 faucet aerators in the City of Vancouver occurred in 2017, however FEI has not paid any of the incentives and therefore is only claiming the associated GJs.
- The GJ savings from the PRSV and Food Service Program are blended and included in the average values for the retrofit market. The Incentive Amount and Incremental Measure Cost include the Food Service Program only as FEI was not billed for any PRSV installations in 2017.

Table 7-5: Customized Equipment Upgrade Program

Program Description	This program provides eligible customers with funding towards the completion of a detailed Energy Study, to identify energy saving opportunities specific and customized to their facilities, and subsequent capital incentive funding to encourage the implementation of any cost effective measures identified therein. The program seeks to capture energy savings associated with measures that are otherwise difficult to incent as part of a prescriptive program because they are complex, and one project may include multiple measures with interactive effects. The expected energy savings, measures, capital cost, incentives etc., will necessarily vary depending on the customer, though each project is submitted to a TRC test and must be approved by the utility.					
Target Market	Commercial customers					
New vs Retrofit	Both					
Partners	BC Hydro (New Construction) FortisBC (New Construction and Retrofit programs - Program development/testing stage)					
Eligible Measures	Utility funded energy study, and utility incented Energy Saving Measures as identified in the energy study and approved by the utility. Energy Saving Measures are variable.					
Incremental Measure Cost	Variable. Dependent upon participant's proposed Energy Saving Measures.					
Incentive Amount	If TRC ≥ 1.0 then $5 / discounted GJ saved over 50% of the Energy Measure Life (EML), up to 10 yrs.					
Savings Per Participant	Variable. Dependent upon participant's proposed Energy Saving Measures.					
Measure Life & Source	Variable. Dependent upon participant's proposed Energy Saving Measures.					
Free Rider Rate & Source	Variable. Dependent upon participant's proposed Energy Saving Measures.					
Participants	2017	Projected	Actual			
	Total	78	69			
Expenditures ($,000s)	2017	Incentives	Admin	Communication	Research & Evaluation	Total
	Total	2,242	430	0	6	2,677
Expenditures ($,000s)	2017	Incentives	Admin	Communication	Research & Evaluation	Total
New Construction	Total	340	54	0	6	400
Expenditures ($,000s)	2017	Incentives	Admin	Communication	Research & Evaluation	Total
Retrofit	Total	1,902	375	0	0	2,277

Notes:

- The Customized Equipment Upgrade Program is complex in nature and has variable measure savings, costs, incentives and/or cash flows that, unlike in prescriptive programs, occur over a period of years. Consequently, providing results for this program within an annual report format is challenging. In general, the savings in this program occur in later years after the participants have had the time to implement customized Energy Conservation Measures, while some program incentives and costs are payable at the outset. As a result, the TRC in 2017 appears low when considering only costs and savings in a single year. Please refer to the notes provided below for additional details.

- New Construction Program:
  - Participation in this program can last for approximately five years. This is broken down into approximately 24 months to prepare the required whole building energy simulation, followed by up to 36 months to build the proposed building. The program incurs incentive expenditures upon the successful completion of the energy simulation, as well as upon completion of the building, while natural gas savings are only obtained upon completion of the proposed building.
  - This program is in partnership with BC Hydro. Participants are recorded when the energy simulations or the new buildings are complete, and the incentive becomes payable.
  - The '2017 Actual' participants include 12 completed energy simulations, and two completed buildings with implemented measures. The associated natural gas savings from these two projects is approximately 9,912 GJ/year.
- Retrofit Program:
  - Participation in this program can last for approximately two years. This is broken down into approximately 6 months to prepare the required energy study, followed by 18 months to implement the proposed Energy Conservation Measures. The program incurs incentive expenditures upon the successful completion of the energy study, as well as upon installation of the approved Energy Conservation Measures, while natural gas savings are only obtained upon installation of the approved Energy Conservation Measures.
  - The '2017 Actual' participants includes 23 completed energy studies, and 21 projects where Energy Conservation Measures were installed. The associated natural gas savings from these 21 projects is approximately 65,652 GJ/year.

Table 7-6: Continuous Optimization Program

Program Description	The Continuous Optimization Program (C.Op) is designed to help commercial building owners identify and correct energy wasting operation faults, and continuously monitor building performance to help maintain and improve energy efficiency, resulting in reduced operating costs. C.Op is offered in partnership with BC Hydro. In the FortisBC electric service territory, C.Op is offered in partnership with FortisBC Inc. as the Building Optimization Program (B.Op). The program funds re-commissioning services to study the participant's building and recommend energy efficiency improvements, as well as access to an energy management information system (EMIS) to assist in tracking the building's performance after the re-commissioning work is complete. In return, participants must implement, at their costs, measures identified by the re-commissioning study that when combined have a payback period of two years or less.					
Target Market	Commercial customers with buildings >50,000 ft^2 who consume an average of 7,500 GJ of natural gas per year or natural gas is 40% of their building's total energy consumption.					
New vs Retrofit	Retrofit					
Partners	BC Hydro FortisBC					
Eligible Measures	RE/Retro-commissioning study, employee training, and "near time" energy consumption monitoring.					
Incremental Measure Cost	Average nominal program duration incremental cost (7 years): $41,275 2016 observed average implemented incremental cost: $31,303					
Incentive Amount	Average nominal program duration incentive amount (7 years): $15,915 2016 observed average implemented incentive amount: $19,527					
Savings Per Participant	Average expected annual natural gas savings: 1,465 GJ/year 2016 observed average implemented natural gas savings: 1,187 GJ/year					
Measure Life & Source	5 years - the duration of utility support for the energy management information system, plus one year.					
Free Rider Rate & Source	0% - BC Hydro					
Participants	2017	Projected	Participants Implementing in 2017	Cumulative Program Participants		
	Total	567	40	373		
Expenditures ($,000s)	2017	Incentives	Admin	Communication	Research & Evaluation	Total
	Total	781	6	0	0	788

Notes:

- The Continuous Optimization Program is conducted in partnership with BC Hydro. BC Hydro acts as the primary administrator of program activities, with FEI providing financial and process support for gas customer participants.
- Participation in this program lasts for approximately seven years for a typical participant. The seven years are composed of approximately 12 months of baseline data collection, 24 months of re-commissioning study work plus the implementation of a recommended bundle of energy conservation measures, and 48 months of monitoring and continuous improvement.
- Participants are recorded as soon as they are accepted into the program, however natural gas savings do not occur until they have completed the implementation of a recommended bundle of energy conservation measures, approximately 36 months later. As such, the program incurs incentive expenses (for the upgrading of meter equipment, re-commissioning costs and EMIS costs) before natural gas savings are obtained.

- The average nominal program duration incremental cost represents the total incremental cost expected to be incurred when an average participant completes the full 7 year run in the program. The 2017 observed average implemented incremental cost represents the incremental costs incurred specifically in 2017 divided by the total number of participants who implemented in 2017.
- The average nominal program duration incentive amount represents the total incentive expected to be paid when an average participant completes the full seven year run in the program. The 2017 observed average implementation incentive amount represents the incentive paid specifically in 2017 divided by the total number of participants who implemented in 2017. Due to the nature of the program, the incentive amount paid is not solely attributable to those who implemented in 2017.
- The average expected annual natural gas savings represent the expected annual natural gas savings per participant after they have completed the implementation of a recommended bundle of energy conservation measures. The 2017 observed average implemented natural gas savings represent natural gas savings attributed to customers who have completed the implementation of a recommended bundle of energy conservation measures specifically in 2017 divided by the total number of participants who implemented in 2017.

Participant count clarification:

- "2017 Actual" represents the number of new participants who were approved in 2017. There were no new participants because the current program is fully subscribed and closed to new participants.
- "Participants implementing in 2017" represents the number of participants who have successfully completed implementing the bundle of energy conservation measures in 2016.
- "Cumulative Program Participants" represent the total number of approved program participants from the entire multi-year duration. Program participants have the option to discontinue participation in the program during the multi-year duration. A number of program participants chose to discontinue participation in 2017 which, combined with the program being closed to new participants, resulted in a lower cumulative participation number than the previous year.

Table 7-7: Commercial Energy Assessment Program

<table>
<tr><td>Program Description</td><td colspan="6">This program identifies inefficiencies at the participant's facilities via an on-site walkthrough assessment by an energy-efficiency consultant. The consultant then produces a report that describes the observed inefficiencies, outlines proposed solutions, and identifies any applicable incentive programs. FortisBC then forwards the report to the participant. Simple measures, such as low-flow faucet aerators and pre-rinse spray valves, are provided to the participant at no charge.</td></tr>
<tr><td>Target Market</td><td colspan="6">Medium commercial and small industrial customers with an average annual consumption between 1,500 and 10,000 GJ.</td></tr>
<tr><td>New vs Retrofit</td><td colspan="6">Retrofit</td></tr>
<tr><td>Partners</td><td colspan="6">FortisBC Inc.</td></tr>
<tr><td>Incremental Measure Cost</td><td colspan="6">$1,529</td></tr>
<tr><td>Incentive Amount</td><td colspan="6">$1,328</td></tr>
<tr><td>Savings Per Participant</td><td colspan="6">491.0 GJ</td></tr>
<tr><td>Measure Life & Source</td><td colspan="6">**Energy Assessment** - 1.17 Years - Conservative estimate based on the implementation of low-cost, simple recommendations (such as operational adjustments) from the energy assessment report, past spray valve program data and database for Energy Efficiency Resources (DEER). San Francisco, CA, California Public Utilities Commission, 2011. **Pre-Rinse Spray Valve** - 5 Years - KEMA – State of Wisconsin Public Service Commission of Wisconsin, Focus on Energy Evaluation, Ontario Energy Board, Measures and Assumptions for DSM Planning, February 6, 2009
Aerator - 10 Years - Terasen Gas TRC Model RES (3/4/2013) & Navigant Consulting, Measures and Assumptions For Demand Side Management Planning (April 16, 2009; Page C-102)</td></tr>
<tr><td>Free Rider Rate & Source</td><td colspan="6">35% - 2010 Friuch Energy Assessment Evaluation, past spray valve program data</td></tr>
<tr><td rowspan="2">Participants</td><td>2017</td><td>Projected</td><td>Actual</td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td>524</td><td>46</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Expenditures ($,000s)</td><td>2017</td><td>Incentives</td><td>Admin</td><td>Communication</td><td>Research & Evaluation</td><td>Total</td></tr>
<tr><td>Total</td><td>61</td><td>38</td><td>0</td><td>0</td><td>99</td></tr>
</table>

Notes:

- At the time of writing the 2014-2018 DSM Plan, FEI was unsure whether the Provincial Government's Business Energy Advisor (BEA) program would continue or not. A contingency measure was planned for this program to ensure small businesses had access to energy analysis if the BEA program was discontinued. Participation from small business customers was foreseen in the 2014-2018 DSM Plan. As the BEA program was continued, the scope of the Commercial Energy Assessment Program was not expanded to include small businesses and the number of participants in 2017 is significantly less than was estimated in the 2014-2018 DSM Plan. In addition, a significant number of multi-family apartment customers now receive their energy assessments through the RAP Program.

Table 7-8: Energy Specialist Program

<table>
<tr><td>Program Description</td><td colspan="6">This program funds Energy Specialist positions within customers' organizations, up to $60,000 based on an annual contract. Funded Energy Specialists' key priority is to identify and implement opportunities for their organization to participate in FortisBC's DSM programs, while also identifying and implementing non-program specific opportunities to use natural gas more efficiently. This program is funded as an enabling program.</td></tr>
<tr><td>Target Market</td><td colspan="6">Large Commercial and Institutional Customers</td></tr>
<tr><td>New vs Retrofit</td><td colspan="6">Retrofit</td></tr>
<tr><td>Partners</td><td colspan="6">BC Hydro, FortisBC Inc.</td></tr>
<tr><td>Eligible Measures</td><td colspan="6">Energy Specialist position</td></tr>
<tr><td>Incremental Measure Cost</td><td colspan="6">$60,000</td></tr>
<tr><td>Incentive Amount</td><td colspan="6">$60,000</td></tr>
<tr><td>Savings Per Participant</td><td colspan="6">Total 2017 (non-C&M program) annual natural gas savings = 7,549 GJ/ year</td></tr>
<tr><td>Measure Life & Source</td><td colspan="6">N/A</td></tr>
<tr><td>Free Rider Rate</td><td colspan="6">29% - Based on an evaulation study conduted in 2015 by Prism on projects that were outside of the incentive funding.</td></tr>
<tr><td rowspan="2">Participants</td><td>2017</td><td>Projected</td><td>Actual</td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td>32</td><td>31</td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Expenditures ($,000s)</td><td>2017</td><td>Incentives</td><td>Admin</td><td>Communication</td><td>Research & Evaluation</td><td>Total</td></tr>
<tr><td>Total</td><td>1,567</td><td>114</td><td>0</td><td>15</td><td>1,696</td></tr>
</table>

Notes:

- The Energy Specialist Program continues to experience success as an enabling program. In 2017, organizations with Energy Specialists were responsible for 45% of the natural gas savings and 48% of the incentives paid out by Commercial C&EM programs. This is in addition to the Conservation Education and Outreach, Innovative Technologies, Low Income, and Residential programs and incentives that Energy Specialists promoted and used in 2017.
- Some organizations had Energy Specialists for part of the year only as their funding agreements concluded and were not renewed.
- The energy savings listed only apply to natural gas projects completed by Energy Specialists in 2017 that did not directly receive incentive funding from another C&EM program. These energy savings are only reported and have not been included in the calculations for the benefit/cost tests, as the required inputs are not available.
- The energy savings of 7,549 GJs / year is an estimation submitted by Energy Specialists for savings that are not captured by C&EM programs. A third party review was undertaken on projects that claimed over 100 GJs saved. At the time of filing, only a portion of the evaluation study had been completed. Therefore, the savings that are claimed are partially verified by a third party, and projects that had not been fully reviewed yet were vetted for accuracy by FEI's internal engineering team at a high level.

7.3 2017 Programs with Joint Program Area Budgets

7.3.1 RENTAL APARTMENT EFFICIENCY PROGRAM (RAP)

RAP includes a combination of residential and commercial measures for both the low income and the able to pay rental apartment market, each funded from their respective Program Areas. This program is specifically designed to overcome barriers to adopting energy efficiency measures otherwise experienced by rental building owners and their tenants, and includes expenditures from each of the Residential, Low Income and Commercial Program Areas. The expenditures and related savings for this program attributable to each program area are provided in Table 7-9 and correspond to the RAP expenditures shown in the Program Area Summary Tables for each of the three program areas.

Table 7-9: Rental Apartment Efficiency (RAP) – Full Program Summary

Program	Annual Gas Savings (GJ/yr.)		Actual NPV Gas Savings (GJ)	Utility Expenditures ($000s)						Benefit/Cost Ratios				
				Incentives		Non-Incentives		All Spending						
	2014-2018 DSM Plan	2017 Actual		2014-2018 DSM Plan	2017 Actual	2014-2018 DSM Plan	2017 Actual	2014-2018 DSM Plan	2017 Actual	TRC	MTRC	Utility	Participant	RIM
Rental Apt Efficiency (RAP) - Commercial Portion														
Total	0	22,569	82,264	0	568	0	183	0	751	0.9	n/a	0.9	2.9	0.8
Rental Apt Efficiency (RAP) - Low Income Portion														
Total	0	7,757	28,127	0	76	0	18	0	94	0.8	2.1	3.2	1.1	0.7
Rental Apt Efficiency (RAP) - Residential Portion														
Total	0	20,955	157,745	0	221	0	156	0	377	2.7	n/a	3.4	7.3	0.7
Overall Program														
Total	**0**	**51,281**	**268,136**	**0**	**864**	**0**	**357**	**0**	**1,221**	**1.4**	**n/a**	**1.9**	**3.4**	**0.8**

Table 7-10: Rental Apartment Efficiency (RAP)

Program Description	There are three components to the RAP program. The first component is to provide direct install in-suite energy efficiency upgrades. These devices will be installed by an agent of FortisBC into each individual rental suite. The second component is to provide those participants with energy assessments recommending building-level energy efficiency upgrades such as condensing boilers, high efficiency water heaters and control upgrades. The last component is to provide participants with support in implementing those energy efficiency recommendations and applying for rebates. Expenditures for RAP are budgeted within 3 program areas based on the in-suite versus the common area expenses. All the in-suite related expenses are budgeted in the Residential Program Area, while the common area related expenses are budgeted in the Commercial Program Area. This includes expenditures associated with the energy assessment, implementation support common area upgrades. For the low income rental customer all expenditures related to both the in-suite and common area expenses are budgeted in the Low Income Program Area.					
Target Market	Purpose-Built Rental Apartment Buildings					
New vs Retrofit	Retrofit					
Partners	FortisBC Inc.					
Eligible Measures	1.5 GPM Showerheads, 1.5 GPM Handheld Showerheads, 0.8 GPM Bathroom Aerators, 0.8 GPM Kitchen Aerators Walkthrough Energy Audits, Implementation Support, Condensing Boilers, Energy Efficiency Water Heaters					
Incremental Measure Cost	Varies					
Incentive Amount	Varies					
Savings Per Participant	Varies					
Measure Life & Source	Varies					
Free Rider Rate & Source	Varies					
Participants	2017	Total	Commercial	Low Income	Residential	
	Projected	0				
	Actual	24206	183	2347	21676	
Participants by Measure Type			Commercial	Low Income	Residential	
	Non-SST 1.5 Showerhead			645	6056	
	Non-SST 1.5 GPM Handheld			86	1172	
	Non-SST 1.5 GPM Bathroom Aerator			818	7329	
	Non-SST 1.5 GPM Kitchen Aerator			769	7119	
	Energy Assessment Reports		130	25		
	Implementation Support Partial		3			
	Implementation Support Full		24	2		
	Boiler Top Ups (40% of the rebate)			2		
	Water Heaters		4			
	Condensing Boilers		22			
		Total	183	2,347	21,676	
Expenditures ($,000s)			Non-Incentives			
	2017	Incentives	Admin	Communication	Research & Evaluation	Total
	Commercial	568	121	51	11	751
	Low Income	76	18	0	0	94
	Residential	221	97	45	14	377
	Total	864	235	96	25	1,221

7.4 Summary

Commercial Energy Efficiency Program Area activity in 2017 achieved approximately 238,688 GJ of annual natural gas savings and a TRC of 0.8. All programs continue to maintain steady performance in terms of participation, incentive expenditures and natural gas savings. Of particular note are the Space Heat Program and Commercial Custom Design Program, which remain cornerstone programs for the Commercial Program Area. These programs invested over $3 million and $2.2 million respectively in customers' natural gas efficiency projects in 2017. The programs continue to focus on generating natural gas savings and fostering market transformation in the commercial sector.

8. INNOVATIVE TECHNOLOGIES PROGRAM AREA

8.1 Overview

A primary objective of the Innovative Technologies Program Area is to identify market-ready technologies that are not yet widely adopted in British Columbia, and which are suitable for the development of or inclusion in the Portfolio of ongoing DSM programs in other Program Areas. This is accomplished through pilot and demonstration projects, pre-feasibility studies and the use of Industry Standard Evaluation, Measurement and Verification (EM&V) protocols to validate manufacturers' claims related to equipment and system performance. Results from Innovative Technologies activities are used in making future DSM programming decisions and technology inclusions.

Just as important as identifying new technologies that should be incorporated into the DSM Portfolio are findings that indicate which technologies should not. Section 8.3 summarizes how the activities and processes for the Innovative Technologies Program Area were successful in identifying proposed projects that should not proceed to full pilot phase or further.

All 2017 activities undertaken in this Program Area meet the definition of technology innovation programs as set out in the DSM Regulation. It should be noted that Innovative Technologies are considered a "specified demand-side measure"[10], meaning that the Program Area or the measures therein are not subject individually to a cost-effectiveness test. Instead the cost-effectiveness of these expenditures will be evaluated as part of the DSM portfolio as a whole.[11] Innovative Technologies expenditures are also not subject to the 40 percent cap on programs for which the MTRC is utilized as a cost-effectiveness measure according to Section 4 (4) of the DSM Regulation .[12]

Table 8.1 summarizes expenditures for the Innovative Technologies Program Area in 2017, including incentive and non-incentive spending, annual and NPV gas savings, as well as TRC and other cost-effectiveness test results where applicable.

[10] BCUC Log No. 36730, Request for Clarification of Order G-44-12 and Decision on the 2012 – 2013 Revenue Requirements Application and Natural Gas Rates Application

[11] Subsection 4(4) of the Demand-Side Measures Regulation, and the Decision on the 2012 – 2013 Revenue Requirements Application and Natural Gas Rates Application, page 175.

[12] BCUC Log No. 36730, Request for Further Clarification of Order G-44-12 and Decision on the 2012 – 2013 Revenue Requirements Application and Natural Gas Rates Application and the Commission's May 11, 2012 letter.

Table 8-1: 2017 Innovative Technologies Program Area Results Summary

Program	Annual Gas Savings (GJ/yr.)		Actual NPV Gas Savings (GJ)	Utility Expenditures ($000s)						Benefit/Cost Ratios				
				Incentives		Non-Incentives		All Spending						
	2014-2018 DSM Plan	2017 Actual		2014-2018 DSM Plan	2017 Actual	2014-2018 DSM Plan	2017 Actual	2014-2018 DSM Plan	2017 Actual	TRC	MTRC	Utility	Participant	RIM
Non Program Specific Expenses														
Total	No Direct Savings			n/a	0	n/a	375	n/a	375	No Direct Savings				
Pilot/Demonstration Projects														
Total	5,343	4,910	65,687	574	95	644	342	1,218	437	1.1	n/a	1.3	7.1	0.6
Studies														
Total	No Direct Savings			n/a	0	n/a	117	0	117	No Direct Savings				
ALL PROGRAMS														
Total	**5,343**	**4,910**	**65,687**	**574**	**95**	**644**	**833**	**1,218**	**928**	**0.5**	**n/a**	**0.6**	**7.1**	**0.4**

8.2 2017 Innovative Technologies Activities

Tables 8-2 outlines the specific Innovative Technologies Pilot activities undertaken in 2017, including program and measure descriptions and a breakdown of non-incentive spending.[13]

[13] As Innovative Technologies activities are considered pilots rather than DSM programs, they were not presented in individual program tables as in other Program Area sections in the Report.

Table 8-2: Pilots

Program Description	The Pilot Program focused on evaluating market-ready technologies and conducting small scale pilots to gather data to validate manufacturers' claims about measure system performance and energy savings. The data from pilots can also be used to help improve the quality and installation of future systems, and to understand and reduce market barriers. Technologies that successfully emerge from the Innovative Technologies Program will be considered for inclusion in the various program areas within the larger C&EM portfolio.
Target Market	Variable
New vs Retrofit	Retrofit
Heat Reflector (HRP) Pilot	To assess energy savings, costing and customer acceptance data related to the installation of a Reflector Panel behind a perimeter heating system in rental MURBs. Energy saving details will be achieved through analysis of billing consumption data on a building level, costing data from the completion of 30 installations and customer acceptance from surveying all building managers at the end of the heating season. Results handed off to program area team Q2 2017. 2017 Participants Total 30
Smart Learning Thermostat Pilot	This joint pilot between FortisBC Energy Inc. and FortisBC Inc. is designed to gauge the customer acceptance and energy savings associated with smart learning thermostats where the results will inform future Demand Side Management (DSM) and Demand Response (DR) program offerings. Smart Learning Thermostat ("SLT") pilot focuses on the Nest, Ecobee3 and Honeywell Lyric products. The objectives of the pilot are to fill the information gaps identified with customer acceptance, costing and savings for SLTs for both natural gas and electric residential customers. The overall end goal is to provide usable results to the appropriate program teams for them to make a decision for next steps. Results are expected Q3 2019. 2017 Participants Total 0
Combination Space and Water Heating System (CURP) Pilot	Objectives of the pilot are to identify field-validated energy performance of each combination system type, technical issues, field-validated incremental costs, customer acceptance and the effective marketing channels for promoting a combination system retrofit rebate. The results will provide insight into a cost-effective rebate program for residential customers to upgrade their existing space and water heating equipment to combination systems. Results handed off to program area team Q2 2017. 2017 Participants Total 0
Participants	2017 Projected Actual Total n/a 30

Expenditures ($,000s)

2017	Incentives	Non-Incentive Expenditures: Admin	Non-Incentive Expenditures: Communication	Non-Incentive Expenditures: Research & Evaluation	Total
Total	95	64	98	181	437

Notes:

- HRP Pilot participants were enrolled and reported in 2016, therefore no (new) participants reported in 2017.
- Participants and savings in the Smart Learning Thermostat Pilot will be attributed when final incentive payments are provided. No final incentive payments made in 2017, therefore no participants reported.
- CURP pilot wrapped up in 2017, therefore no (new) participants reported in 2017.

Tables 8-3 outlines the specific Innovative Technologies Study activities undertaken in 2017, including program and measure descriptions and a breakdown of non-incentive spending.

Table 8-3: Studies

<table>
<tr><td>Description</td><td colspan="6">Studies are used to assess the market opportunity, technical characteristics and projected energy savings of commercially available DSM technologies. The results can be used to determine the feasibility of launching a pilot or to make future program area inclusion decisions.</td></tr>
<tr><td>Target Market</td><td colspan="6">Variable</td></tr>
<tr><td>New vs Retrofit</td><td colspan="6">N/A</td></tr>
<tr><td>Direct Vent Wall Furnace Study Prefeasibility Study</td><td colspan="6">Direct Vent Wall Furnaces are compact self-contained combustion units that are installed on exterior walls so that combustion by-products are discharged outside through a vent. Direct Vent Wall Furnaces can be a good alternative to central heating systems, especially if a home does not have existing ducting or is built on a concrete slab. The objective of the study was to investigate Direct Vent Wall Furnaces that can be installed to replace lower efficiency space heating systems and lower efficiency fireplaces in both new construction and retrofit applications for all suitable residential building types. The study was completed in Q3 2017.</td></tr>
<tr><td>Web Enabled Thermostats Prefeasibility Study</td><td colspan="6">Web-enabled programmable thermostats allow users to control temperature setbacks as well as HVAC controls remotely using the internet. A large number of thermostats can be controlled and programmed through a central portal. This allows commercial building owners to optimize the heating and cooling energy usage of their buildings without having to physically be at the property and/or without having to physically interact with each thermostats in their facility. The objective of the study was to assess the market opportunity, technical characteristics and projected energy savings for web-enabled programmable thermostats that can be installed in both new construction and existing commercial buildings for all suitable commercial building types across FortisBC's service territory. The study was completed in Q3 2017.</td></tr>
<tr><td>Commercial Boiler Controls Prefeasibility Study</td><td colspan="6">Boiler load controls can reduce the energy consumption of existing boiler systems, and are generally applied to hydronic building heating systems, although they can also be used for DHW systems and combination boilers. The control systems fall broadly into two categories, Boiler cycling controls which reduce the energy consumption of the boiler through a reduction in boiler cycling and Building zoning controls which is an automation systems that controls the quantity of heat provided to different zones within the building to reduce the overall heating energy provided. The objective of this study was to investigate combination of space heating boiler operation or set point adjustment controls, hot water distribution controls and occupied space heating controls for central gas fired boiler systems in commercial building. The study was completed in Q2 2017.</td></tr>
<tr><td rowspan="3">Expenditures ($,000s)</td><td rowspan="2">2017</td><td rowspan="2">Incentives</td><td colspan="3">Non-Incentive Expenditures</td><td rowspan="2">Total</td></tr>
<tr><td>Admin</td><td>Communication</td><td>Research & Evaluation</td></tr>
<tr><td>Total</td><td>0</td><td>117</td><td>0</td><td>0</td><td>117</td></tr>
</table>

8.3 Summary

Innovative Technologies represent a key component of FEI's overall commitment to DSM activities by identifying viable technologies and projects that have the potential to support the development of new programs within the larger DSM Portfolio.

Overall, the Innovative Technologies initiatives successfully achieved results in evaluating the feasibility of new technologies and providing insights used towards the design of future DSM programs. The Innovative Technologies Program Area continues to use consistent criteria to ensure the greatest potential for screening technologies for further development as full programs in other areas of the DSM Portfolio.

9. INDUSTRIAL ENERGY EFFICIENCY PROGRAM AREA

9.1 Overview

In 2017, the Industrial Energy Efficiency Program Area continued to encourage industrial customers to consume natural gas more efficiently and achieved an overall TRC of 1.3, with a combined net natural gas savings of 105,516 GJ/yr. Table 9-1 summarizes expenditures for the Industrial Energy Efficiency Program Area in 2017, including incentive and non-incentive spending, annual and NPV gas savings, as well as TRC and other cost-effectiveness test results.

Table 9-1: 2017 Industrial Energy Efficiency Program Results Summary

Program	Annual Gas Savings (GJ/yr.)		Actual NPV Gas Savings (GJ)	Utility Expenditures ($000s)						Benefit/Cost Ratios				
				Incentives		Non-Incentives		All Spending						
	2014-2018 DSM Plan	2017 Actual		2014-2018 DSM Plan	2017 Actual	2014-2018 DSM Plan	2017 Actual	2014-2018 DSM Plan	2017 Actual	TRC	MTRC	Utility	Participant	RIM
Non Program Specific Expenses														
Total	No Direct Savings			n/a	n/a	262	150	262	150	No Direct Savings				
Industrial Optimization Program														
Total	122,474	103,429	982,135	1,609	1,558	447	330	2,056	1,888	1.3	n/a	4.9	0.7	2.2
Specialized Industrial Process Technology Program														
Total	67,826	2,086	24,875	584	56	81	5	665	61	1.1	n/a	3.9	1.3	0.9
ALL PROGRAMS														
Total	**190,300**	**105,516**	**1,007,011**	**2,193**	**1,614**	**789**	**485**	**2,983**	**2,099**	**1.3**	**n/a**	**4.5**	**0.7**	**2.0**

Note:

- For the purpose of cost-effectiveness tests, 105,516 GJ in savings has been claimed for 2017. As a project's total incentive can be made across multiple years, the annual natural gas savings are pro-rated based on the proportion of the project's incremental cost that is reported in that year. Please refer to the Industrial Optimization Program description below for further details on this methodology.

9.2 2017 Industrial Energy Efficiency Programs

Tables 9-2 and 9-3 show the Industrial Energy Efficiency Program Area activity undertaken in 2017, including program and measure descriptions and a breakdown of non-incentive spending.

Table 9-2: Industrial Optimization Program

Program Description	The program includes measures that allow customers to identify, assess, and implement customized cost-effective energy efficiency projects for industrial processes using natural gas as process heat or an energy source.				
Target Market	Medium and large industrial facilities				
New vs Retrofit	Both				
Eligible Measures	Variable. Natural gas measures with a TRC ≥ 1.0				
Incremental Measure Cost	Dependent upon participant's proposed energy conservation measures.				
Incentive Amount	Variable. Dependent on project characteristics.				
Savings Per Participant	Variable. Dependent on project characteristics.				
Measure Life & Source	Variable. Dependent upon participant's proposed energy conservation measures				
Free Rider Rate & Source	10% Technology Implementation; 20% Industrial Energy Audit, Plant Wide Audit, Feasibility Study. Source: Preliminary determination based on Commercial Performance Program: FEI (2010), Review of Technical Reference Manuals from Other Jurisdictions (Updated on a Project by Project Basis) and best jusdgement.				
Participants	2017	Projected	Actual		
	Total	31	24		
Expenditures ($,000s)	2017	Incentives	Admin	Communication	Research & Evaluation	Total
	Total	1,558	276	0	53	1,888

Notes:

- Participation in the program can span multiple years due to the timescales associated with completing an energy study, procuring and installing an energy conservation measure, and multi-year measurement and verification analysis.
- Measures include Industrial Energy Audit, Plant Wide Audit, Feasibility Study, and Technology Implementation. FEI is no longer accepting applications for the Energy Audit measure as this was replaced by the Plant Wide Audit and Feasibility Study measures in 2015. Energy Audit participants that completed energy studies and received incentives in 2017 are reported herein.
- The net natural gas savings reported in 2017 under the Industrial Optimization Program are solely attributable to projects implemented through the Technology Implementation measure. Natural gas savings from energy conservation measures identified, installed, but not receiving incentives through the Technology Implementation measure of the Industrial Optimization Program are not claimed at this time.
- In 2017, two Plant Wide Audits and thirteen Feasibility Studies were completed. Eleven projects progressed to Technology Implementation measure and are expected to save 290,792 GJ/yr. of natural gas once installed.
- Depending on the size of the incentive, Technology Implementation project incentive payments are either paid fully on project commissioning or are paid across several years after commissioning and based on the natural gas saving performance. Hence, for larger incentives, only a portion of the incentive is paid on project commissioning. For consistency in performing cost benefit analyses, only a prorated portion of the natural gas savings and project costs are included in the determination of the cost benefit ratios. In 2016, FEI reviewed and revised the proration methodology adopted in 2013. The revised methodology results in a more accurate reflection of program cost effectiveness by mitigating the risk of not fully reporting a project’s incremental cost and more accurately presenting natural gas savings in a given year. The revised approach is used for the 2017 reporting period.

- In 2017, FEI worked to align the incentive and M&V approach for Technology Implementation projects signed between 2013 and 2016 with the approach adopted in 2016. This alignment was done to simplify the payment structure and condense the program participation period.

Table 9-3: Specialized Industrial Process Technology Program

Program Description	This program provides prescriptive incentives to Industrial customers to encourage the implementation of specific technologies and best practices targeted at particular industrial processes using natural gas as process heat or an energy source.					
Target Market	Small, Medium and Large Industrial Facilities					
New vs Retrofit	Both					
Incremental Measure Cost	Variable. Dependent on measure.					
Incentive Amount	Variable. Dependent on measure.					
Savings Per Participant	Variable. Dependent on measure.					
Measure Life & Source	Variable. Dependent on measure.					
Free Rider Rate & Source	20% - steam trap audit and replacement; 18% - hot water process boilers; 20% - steam boiler upgrades; 20% pipe insulation; 20% other measures. Sources: Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018). Efficient Boiler Program Impact Evaluation (2003). Specialized Industrial Process Technology Program business case					
Participants	2017	Projected	Actual			
	Total	18	3			
Expenditures ($,000s)	2017	Incentives	Admin	Communication	Research & Evaluation	Total
	Total	56	5	0	0	61

Notes:

- Applications for this measure are administered through the Commercial Program Area's Space Heating Program for efficiency, however participation counts, incremental costs, and natural gas savings are reported under the Specialized Industrial Process Technology Program.
- Incentive structure, natural gas savings methodology, and free ridership rates used for the hot water process boiler measure are sourced from the Commercial Program Area's Space Heating Program.
- FEI launched the steam trap audit and replacement, pipe and tank insulation, air curtains and direct contact water heater prescriptive measures in Q4 2017. Applications for these measures are administered under the Industrial Program Area. Due to the timing of the program release to market no applications were received in 2017.

9.3 Summary

The Industrial Energy Efficiency Program Area activity in 2017 resulted in 105,516 GJ/yr. of net natural gas savings and a TRC of 1.3. Enhancements to the Industrial Optimization Program have resulted in increased participation and greater natural gas savings in 2017 relative to 2016. Launching the Specialized Industrial Process Technology Program into market was a significant milestone as it represents the first time FEI has been able to support a customer consuming less than 10,000 GJ/yr. to implement high efficiency equipment for their industrial processes.

10. CONSERVATION EDUCATION AND OUTREACH INITIATIVES

10.1 Overview

The CEO Program Area continues to support the DSM Portfolio goals of energy conservation in a variety of ways. In order to foster a culture of conservation, several programs and campaigns were undertaken in 2017, providing new information about behaviour change and customer attitudes on efficiency. Educating all types of customers including residential, commercial and students – remains a strong priority and FEI is continuing to ensure steps are taken to make the information relevant and timely for these customers.

Continued collaboration with FBC was ongoing in 2017 to maximize efficiencies across both teams. Costs continue to be shared on school, residential and commercial outreach as applicable. The fourth annual Efficiency in Action awards were held recognizing natural gas commercial organizations that have most effectively utilized C&EM programs and achieved natural gas savings. FEI's partnership with BC Hydro continued in 2017. This included collaboration on the Energy Wise Network Program for commercial customers that led to over 80 natural gas behavior change projects being submitted in 2017 with a completion date of March 31, 2018. The multi-lingual outreach program, Empower Me, continued to reach new Canadians in nine languages through a community based social marketing approach. Empower Me received City of Surrey's Clean Energy City Award: Innovation in Energy Conservation & Efficiency, Community Category. A pilot initiative was also undertaken in 2017 using the Empower Me approach to reach multi-lingual small businesses.

CEO continued to provide information to customers and the general public on natural gas conservation and energy literacy and sought out new opportunities to reach customers face-to-face. In collaboration with FBC a new initiative was successfully piloted with small businesses in the shared service territory focused on face-to-face efficiency education. The development and testing phase for the curriculum-connected on-line resource initiative "Energy Leaders" for BC elementary and secondary school teachers was completed and the initiative moved to a full offering for teachers. Discovery for Grade 10-12 curriculum was completed. FEI also continues to support various training seminars and educational workshops in collaboration with such organizations as the Greater Vancouver Home Builders Association and other industry associations.

As these are not incentive-based programs, FEI has not attributed direct savings to them in 2017. The following tables do not contain information about eligible measures, incentive amounts, savings levels, free-ridership, spillover or participation levels. CEO costs are included at the Portfolio level and incorporated into the overall DSM Portfolio cost-effectiveness results. Although there were no energy savings attributed to the CEO Program Area in 2017, FEI continues to focus on behavioural change opportunities that lead to potential energy savings.

Table 10-1 summarizes expenditures for the CEO Program Area in 2017. The approved spending for 2017 was $2.400 million and actual spending in 2017 was $2,590 million.

Table 10-1: 2017 CEO Initiative Results Summary

Program	Annual Gas Savings (GJ/yr.)		Actual NPV Gas Savings (GJ)	Utility Expenditures ($000s)						Benefit/Cost Ratios				
				Incentives		Non-Incentives		All Spending						
	2014-2018 DSM Plan	2017 Actual		2014-2018 DSM Plan	2017 Actual	2014-2018 DSM Plan	2017 Actual	2014-2018 DSM Plan	2017 Actual	TRC	MTRC	Utility	Participant	RIM
Non-Program Specific Expenses														
Total	No Direct Savings			0	0	240	99	240	99	No Direct Savings				
Residential Education Program														
Total	No Direct Savings			0	0	990	1,480	990	1,480	No Direct Savings				
Commercial Education Program														
Total	No Direct Savings			0	0	450	449	450	449	No Direct Savings				
School Education Program														
Total	No Direct Savings			0	0	720	562	720	562	No Direct Savings				
ALL PROGRAMS														
Total	No Direct Savings			**0**	**0**	**2,400**	**2,590**	**2,400**	**2,590**	**No Direct Savings**				

10.2 2017 CEO Programs

Tables 10-2 through 10-4 outline the CEO initiatives undertaken in 2017. This includes program descriptions as well as a breakdown of spending, all of which is classified as “non-incentive spending”.

Table 10-2: Residential Education Program

<table>
<tr><td>Program Description</td><td colspan="6">This program provides information to Residential customers and the general public on natural gas conservation and energy literacy by seeking opportunities to engage with customers broadly and directly. This audience also included low income and multi-lingual customers.

Promotional activities in 2017 included a multimedia general rebates awareness campaign, engagement campaigns as well as educational seminars and participation in home shows and community events. The Program also included the cost of production of materials for events and prizing for audience engagement that are utilized at events targeting Residential customers and children.

In addition, continuing partnerships with the regional Canadian Home Builders' Associations and local sports organizations expanded outreach opportunities to engage with Residential customers.

Furthermore, FEI continues to focus on behavioural change opportunities that lead to energy savings however we currently do not verify and report on those savings.

Collaborations between internal departments and with other utilities and partners were sought to achieve cost efficiencies in the budget, particularly for advertising and for outreach events.</td></tr>
<tr><td>Target Market</td><td colspan="6">Residential customers and general public</td></tr>
<tr><td>New vs Retrofit</td><td colspan="6">Both</td></tr>
<tr><td rowspan="3">Expenditures ($,000s)</td><td></td><td></td><td colspan="3">Non-Incentive Expenditures</td><td></td></tr>
<tr><td>2017</td><td>Incentives</td><td>Admin</td><td>Communication</td><td>Research & Evaluation</td><td>Total</td></tr>
<tr><td>Total</td><td>0</td><td>876</td><td>604</td><td>0</td><td>1,480</td></tr>
</table>

Table 10-3: Commercial Education Program

Program Description	This program provides ongoing communication and education about energy conservation initiatives as well as encourages behavioural changes that help Commercial customers reduce their organization's energy consumption. The Commercial sector is made up of small and large businesses in a variety of sub sectors such as retail, offices, multi-family residences, schools, hospitals, hospitality services and municipal/institutions. Promotional activities for 2017 included print and online communications, industry association meetings and tradeshows, award and development of face-to-face engagement opportunities specific to small businesses. Our fourth annual Efficiency in Action Awards, which recognizes Commurecial customers for their innovation in energy efficiency also took place. In addition, continuing partnerships with the Business Improvement Associations of BC (BIABC) and Climate Smart expanded outreach to small to medium-sized businesses. This program area continued to guide and support behaviour education campaigns delivered by energy specialists (or an energy manager) in their respective organizations. Collaborations between internal departments, FortisBC Inc. as well as with other utilities, were pursued to achieve cost efficiencies such as the Energy Wise Network joint initiative with BC Hydro.					
Target Market	Commercial customers, multi-family, energy specialists, energy management staff					
New vs Retrofit	Retrofit					
Expenditures ($,000s)			Non-Incentive Expenditures			
	2017	Incentives	Admin	Communication	Research & Evaluation	Total
	Total	0	190	250	9	449

Table 10-4: School Education Program

Program Description	This is an education program for students enrolled in [K-12] schools and post secondary schools in the Company's service area. This program now has an online resource for teachers directly linking to the K-9 curriculum. Other activities include assembly style presentations related to conserving energy for K-7 students, delivered internally through our Energy is Awesome presentations and externally through our BC Lions Energy Champions initiative. These activities also include distribution of energy efficient fixtures and colouring books. Partnerships and funding support for post-secondary activities included on-campus education campaigns.					
Target Market	Students and teachers					
New vs Retrofit	Retrofit					
Expenditures ($,000s)			Non-Incentive Expenditures			
	2017	Incentives	Admin	Communication	Research & Evaluation	Total
	Total	0	328	111	123	562

10.3 Summary

All of the initiatives described in CEO are designed to foster a culture of energy conservation in BC. This Program Area is important to deliver overall conservation messaging, support energy efficiency literacy and assist with increasing program awareness. By changing attitudes and behaviours, the Company will help communities reach their goals, help customers save energy and money, increase participation in DSM programs and ultimately support the shared goals of FEI and the Provincial Government. This Program Area continues to explore new ways and seek out new opportunities and channels to connect with customers to ultimately grow the culture of energy conservation.

11. ENABLING ACTIVITIES

11.1 Overview

In 2017, Enabling Activities continued to support and supplement FEI's DSM program development and delivery, advancing energy efficiency in British Columbia. This included:

- the ongoing Trade Ally Network Program;
- work completed in advancing national and provincial building codes, appliance/equipment standards, and regulations;
- maintenance of the Company's DSM program tracking system;
- completion of the Conservation Potential Review; and
- continued funding to support post-secondary energy management programs.

While these activities play a very important role in FEI's Portfolio of DSM activities by advancing the delivery of all Program Areas, the Company has not claimed any energy savings in 2017 for work completed in this area.

While no energy savings will be claimed for Enabling Activities in 2017, FEI identified energy efficiency savings from Codes and Standards advancement as part of the EnerChoice Fireplace Program. As discussed in Section 5.2, the BC government will implement the new standard for ensuring minimum fireplace efficiency in January of 2019. As such, FEI expects to claim these energy savings in 2018 when the new standard implementation is confirmed. No other opportunities to identify attribution savings were identified in 2017. FEI will continue to examine and, where appropriate, adopt methodologies for claiming energy savings from Codes and Standards for future programs. Table 11-1 summarizes the projected and actual expenditures for the Enabling Activities in 2017.

Table 11-1: 2017 Enabling Activities Results

Program	Annual Gas Savings (GJ/yr.)		Actual NPV Gas Savings (GJ)	Utility Expenditures ($000s)						Benefit/Cost Ratios				
				Incentives		Non-Incentives		All Spending						
	2014-2018 DSM Plan	2017 Actual		2014-2018 DSM Plan	2017 Actual	2014-2018 DSM Plan	2017 Actual	2014-2018 DSM Plan	2017 Actual	TRC	MTRC	Utility	Participant	RIM
Trade Ally Network														
Total	No Direct Savings			n/a	n/a	500	723	500	723	No Direct Savings				
Codes and Standards														
Total	No Direct Savings			n/a	n/a	35	184	35	184	No Direct Savings				
TrakSmart Maintenance														
Total	No Direct Savings			n/a	n/a	80	107	80	107	No Direct Savings				
Conservation Potential Review														
Total	No Direct Savings			n/a	n/a	0	54	0	54	No Direct Savings				
Commercial End-Use Study														
Total	No Direct Savings			n/a	n/a	30	0	30	0	No Direct Savings				
New Homes Study														
Total	No Direct Savings			n/a	n/a	30	0	30	0	No Direct Savings				
Home Energy Efficiency Web Portal														
Total	No Direct Savings			n/a	n/a	100	0	100	0	No Direct Savings				
Energy Management Education Funding														
Total	No Direct Savings			n/a	n/a	150	114	150	114	No Direct Savings				
ALL PROGRAMS														
Total	No Direct Savings			**n/a**	**n/a**	**925**	**1,181**	**925**	**1,181**	No Direct Savings				

11.2 2017 Enabling Activities by Program

The following tables outline the specific Enabling Activities undertaken in 2017 by activity, including activity descriptions and a breakdown of spending. Note that all expenditures under Enabling Activities are considered non-incentive spending.

Table 11-2: Trade Ally Network

<table>
<tr><td>Program Description</td><td colspan="5">This program develops and manages a contractor network to promote DSM programs and energy-efficiency messaging. FEI identifies trade allies as equipment manufacturers, service contractors, and distributors, and recognizes the influence these industry groups have with the end-use Residential and Commercial customers who make energy-efficiency decisions. This program also supports funding energy efficiency training as outlined in the DSM Regulation.</td></tr>
<tr><td rowspan="2">Expenditures ($,000s)</td><td>2017</td><td>Admin</td><td>Communication</td><td>Research & Evaluation</td><td>Total</td></tr>
<tr><td>Total</td><td>178</td><td>523</td><td>22</td><td>723</td></tr>
</table>

Table 11-3: Codes and Standards

<table>
<tr><td>Program Description</td><td>Utilities have a unique understanding of energy supply and customer demand cycles, which can be of assistance in the development of codes and standards. The content and timing of code implementation directly affects market transformation in all program areas. FEI's level of regulatory involvement typically includes one of three involvement classifications: monitoring, stakeholder engagement and developing regulations. The Codes & Standards area "supports the development of or compliance with specified standard or a measure respecting energy conservation or the efficient use of energy" as referred to in the definition of "specified demand-side measures" in the DSM Regulation.</td></tr>
<tr><td>Policy Initiatives consultation process</td><td>Evaluation, analysis and review of national, provincial and municipal initiatives for energy efficiency.</td></tr>
<tr><td>Industry consultation process</td><td>Collaboration with entities like BC Hydro and the Home Owner Protection Office (HPO) for the development of industry training and guidelines on implementation of new energy efficiency measures. Participation with the BC Safety Authority Gas Technology Committee industry stakeholder group.</td></tr>
<tr><td>Involvement with supporting projects</td><td>Active participation for supporting projects like: the Natural Resources Canada new EnerGuide rating system and Leadership in Energy Efficiency Partnerships (LEEP).</td></tr>
<tr><td>Codes and Standards Strategy</td><td>Active participation on the Canadian Standards Association (CSA) Strategic Steering Committee on Fuel Burning Equipment. This committee is the highest level committee in the fuel sector at CSA and oversees all committees and sub-committees in the fuel burning sector. Consultation with the Canadian Gas Association (CGA), Canadian Institute of Plumbing and Heating (CIPH), Heating Refrigeration and Air-conditioning Institute (HRAI) and the Canadian Home Builders Association (CHBA) on codes and regulations that are common to our industries. Research on the new provincial performance path for residential and commercial buildings i.e. the BC Energy Step Code was conducted. The research study focused on understanding technical changes to traditional building approaches, along with the economic impacts of building to the step code tiers including choices of mechanical and HVAC systems.</td></tr>
<tr><td>Codes and Standards Maintenance</td><td>Active participation on the CSA Technical Committee on Energy Efficiency and Related Performance of Fuel-Burning Appliances and Equipment. This committee oversees all of the eleven existing performance standards for gas-fired equipment and is looking to develop new needed standards for equipment. Participation in the Standards Council of Canada, committee on Domestic gas cooking appliances ISO/TC 291.</td></tr>
<tr><td>Internal awareness of Code and Regulatory changes</td><td>Development of internal documents and updates for relevant program areas and personnel.</td></tr>
<tr><td>Standards library</td><td>Purchase of up to date testing standards and up to date building codes for reference.</td></tr>
<tr><td>Expenditures ($,000s)</td><td><table><tr><td>2017</td><td>Admin</td><td>Communication</td><td>Research & Evaluation</td><td>Total</td></tr><tr><td>Total</td><td>78</td><td>2</td><td>104</td><td>184</td></tr></table></td></tr>
</table>

Table 11-4: TrakSmart Maintenance

Program Description	Ongoing IT license and maintenance costs related to the portfolio DSM tracking system.				
Expenditures ($,000s)	2017	Admin	Communication	Research & Evaluation	Total
	Total	107	0	0	107

Table 11-5: Conservation Potential Review

Program Description	FEI considers the CPR to be an important tool for use in developing, supporting, and assessing current and future DSM expenditure applications, as well as for directional input into program development. The purpose of a CPR study is to examine available technologies and determine their conservation potential, which includes the amount of energy savings that can be achieved through energy-efficiency and conservation programs over the study period. This project was worked on in collaboration with BC Hydro, Pacific Northern Gas and FortisBC Electric. Core work on the CPR began in 2015 and continued through 2016. The CPR econonmic potential and market potential reports were completed in 2017.				
Expenditures ($,000s)	2017	Admin	Communication	Research & Evaluation	Total
	Total	54	0	0	54

Table 11-6: Energy Management Education Funding

Program Description	Funding to support post-secondary energy management programs such as the UBC Master of Engineering Leadership Program in Clean Energy Engineering and the BCIT Sustainable Energy Management Advanced Certificate.				
Expenditures ($,000s)	2017	Admin	Communication	Research & Evaluation	Total
	Total	114	0	0	114

11.3 2017 Enabling Activities Planned But Not Launched

11.3.1 HOME ENERGY EFFICIENCY WEB PORTAL

FEI's vision for the Home Energy Efficiency Web Portal has changed over time. In 2017, through Innovative Clean Energy (ICE) funds provided by the BC government, the BC Home Energy Coach service was established. BC residents can phone or email this free service to receive information on how to improve energy efficiency in their home. A database of province-wide incentives are included as part of this initiative, which fulfils the original objectives of the

Home Energy Efficiency Web Portal project.[14] Given the Province's implementation of the Home Energy Coach service, FEI will no longer be pursuing the Home Energy Efficiency Web Portal.

11.3.2 RESIDENTIAL END USE STUDY (REUS)

The REUS provides a snapshot of the FEI Residential customer base. It provides information about the building characteristics, the fuel choice for heating, cooling and cooking, the types and ages of installed appliances, energy-use behaviours, and customer attitudes towards energy issues. The REUS also includes a billing analysis to determine natural gas consumption by appliance type. The study was originally forecast to take place in 2016. Initial scoping for the study was started in 2016. The questionnaire was drafted and the study was fielded in 2017. The report will be delivered in 2018. C&EM's portion of the costs will be incurred upon the report being delivered in 2018.

11.3.3 COMMERCIAL END USE STUDY (CEUS)

The CEUS provides a snapshot of the FEI Commercial customer base including multi-family residential buildings. The survey collects information about the building, the business(es) occupying the building, the fuel choice for heating, cooling and cooking, the types and ages of appliances installed, energy-use behaviours, and customer attitudes towards energy issues. The CEUS was originally forecast to take place in 2017 but that timing was changed and the study was conducted in 2014. Reporting of the CEUS expenditures were included in the FortisBC Energy Utilities 2014 Energy Efficiency and Conservation Annual Report. The next CEUS is expected to be conducted in 2019.

11.3.4 NEW HOMES STUDY

The New Homes study was not completed in 2017 as the objectives for New Homes research changed over time. In 2017, significant resources supported the introduction and adoption of the BC Energy Step Codes, which remove the need for the New Homes Study as originally intended.

11.4 Summary

Enabling Activities are critical initiatives that support and supplement DSM program development and delivery. The success of the Residential Furnace Replacement Program (see Section 5.3, Table 5-3), which was promoted through the contractor network, demonstrates the value of the Trade Ally Network Program. Communications were immediate and responsive through the network and at the end of the program, 72 percent of the program's participants used contractors who were members of the Trade Ally Network.

FEI's involvement in codes and standards work in 2017 continued to encompass varying degrees of activities including monitoring, reviewing and responding to existing and proposed

[14] More information can be found at www.BCEnergyCoach.ca.

regulatory changes and direct participation in various working groups that explore the development of future targets, codes and standards. The Conservation Potential Review Economic and Market Potential reports were finalized in the first half of 2017. This project involved a collaboration between BC Hydro, Pacific Northern Gas, FEI and FBC.

12. EVALUATION

In alignment with the Company's EM&V Framework and industry standard practice, program evaluation activities are assessed at different stages of each program's lifecycle.[15] Based on this ongoing assessment, all programs are evaluated when appropriate. The 2017 evaluation activities presented here reflect the number of programs in market, the different stages of their lifecycle, and the type of evaluation activities required to provide program feedback.

12.1 2017 Program Evaluation and Evaluation Research Activities

In 2017, FEI's various evaluation activities included quantifying energy savings, assessing participant awareness and satisfaction, identifying barriers to participation, assessing customer usability and engagement with various FEI DSM outreach activities, and conducting industry research. Measurement and Verification (M&V) activities focused on identifying and verifying project and measure level savings assumptions and understanding any issues associated with equipment installation in the field.

Table 12-1 provides a summary of all program evaluation and evaluation research related activities undertaken in 2017. Expenditures for these activities have been accounted for within the applicable program or Program Area non-incentive costs included in previous sections, but are also reported here in order to provide a concise, easy-to-view summary of evaluation activities. Included in the table are: a list of all the 2017 evaluation activities; the Program Area each activity occurred in; the general type of evaluation activity undertaken; the Company's actual 2017 evaluation expenditures; and a status update on each activity. The total expenditure for program evaluation and research activities in 2017 is approximately $703,000.

[15] Types of evaluation activities include: Communications evaluations, which focus on advertising and media outreach; Evaluation studies, where quality assurance or inspection is conducted to gain more insight on the incented measure; Market studies, research and interviews with industry stakeholder to assess market penetration; Process evaluations, where surveys and interviews are used to assess customer satisfaction and program success; Impact evaluations, to measure the achieved energy savings attributable from the program; Market Analysis, to characterized the industry and the program's effect on market penetration and, Measurement & Verification, to monitor real time energy savings associated with energy conservation measures.

Table 12-1: Inventory of DSM Program Evaluation and Evaluation Research Activities Conducted in 2017[18]

Evaluation Name	Program Area	Type of Evaluation	Years the program has been running [19]	Evaluation Partnership	Actual Evaluation Expenditure (000's)	Evaluation Status [20]
FortisBC Communication Tracking: Energy Efficiency Conservation	C&EM Portfolio	Communication	ongoing	none	$3	Customer engagement and awareness of C&EM activities. **Completed October 2017 by Sentis Research**
C&EM Rebates UX Testing	C&EM Portfolio	Communication	ongoing	none	$7	Usability testing of the rebates section of FortisBC.com website. **Completed July 2017 by FortisBC**
Review of Net-to-Gross Assumptions (FEI & FBC Energy Efficiency Programs)	C&EM Portfolio	Evaluation Study	none	FortisBC Energy Inc. & FortisBC Inc.	$13	Review of net-to-gross (NTG) methods, data sources, and assumption used by FortisBC to ensure alignment with the industry best practices. **Completed December 2017 by Sampson Research**
Contractor Research Survey	Residential	Process	Ongoing	FortisBC Energy Inc. & FortisBC Inc.	$37	Survey with program participants and non-participants within the Contractor community. **Completed May 2017 by Participant Research and Sentis Research Inc.**
Appliance Maintenance Rebate Program -Evaluation 2017	Residential	Process	8	none	$15	Quantitative research study among 2017 program participants to assess the program and gather feedback for future program design. **Expected completion by Q2 2018**
Evaluation & Contractor Outreach	Residential	Evaluation Study	1	none	$1	Educating contractors on best practices based on learnings from the Home Energy Rebate Offer (HERO) Quality Study of Insulation evaluation study completed May 2016 and reported in the 2016 Annual Report.
Home Renovation Rebate Program - Insulation & Program Compliance Site Visits	Residential	Evaluation Study	3	none	$56	Ongoing site visit of homes with insulation and draft proofing measures with a focus on quality assurance and program compliance.
Program Registered Contractor Training	Residential	Evaluation Study	Ongoing	none	$17	Ongoing contractor training to provide installation best practices and ensure quality workmanship.
Furnace Replacement Program - Participant Survey	Residential	Process	5	none	$28	Quantitative research study among 2016 program participants to assess customer satisfaction and gather feedback for future program design. **Completed July 2017 by Sentis Research Inc.**
Furnace Replacement Program - Market Evaluation for Quality Installation	Residential	Market Study	5	none	$8	Market assessment to gather feedback and recommendations for furthering quality installation of furnaces. **Expected completion by Q2 2018**

18 Table 12.1 does not include Prefeasibility Studies. Please refer to the Innovative Technologies section (Section 8) for details.

19 Measurement & Verification studies require time to conduct activities which include, but are not limited to, project commissioning, installing and removal of monitoring equipment, data collection and, data analysis and reporting. The column 'Years the program has been running' will refer to the time required to conduct the M&V activities. M&V activities align with the International Performance Measurement and Verification Protocol (IPMVP). Concepts and Options for Determining Energy and Water Savings. Prepared by the Efficiency Valuation Organization: www.evo-world.org. January 2012.

20 M&V completion refers to the time period where the actual monitoring and data collection ends. Analysis and reporting will require additional time

Table 12-1: Inventory of DSM Program Evaluation and Evaluation Research Activities Conducted in 2017 (continued)

Evaluation Name	Program Area	Type of Evaluation	Years the program has been running [19]	Evaluation Partnership	Actual Evaluation Expenditure (000's)	Evaluation Status [20]
Furnace Replacement Program - Quality Assurance & Program Compliance Site Visits	Residential	Evaluation Study	5	none	$48	Ongoing site visit of homes with furnace/boiler upgrades with a focus of quality assurance and program compliance.
Rental Apartment Efficiency Program (RAP) - Evaluation 2016	Residential / Commercial	Process	2	FortisBC Energy Inc. & FortisBC Inc.	$3	Building owner and Tenant survey for program evaluation with 2015 and 2016 program participants. **Completed December 2016 by Cohesium Research. Results reported in 2016 Annual Report**
Rental Apartment Efficiency Program (RAP) - Evaluation 2017	Residential / Commercial	Evaluation Study	2	none	$3	Ongoing performance testing for RAP participants.
Rental Apartment Efficiency Program (RAP) - Evaluation 2017	Residential / Commercial	Process	2	FortisBC Energy Inc. & FortisBC Inc.	$19	Building owner and Tenant survey for program evaluation with 2017 program participants. **Expected completion by Q1 2018**
Low Income General Survey	Low Income	Process	ongoing	none	$60	Survey and interviews were conducted to gather feedback for low income program design and marketing strategies. **Completed February 2017 by Participant Research and Sentis Research Inc.**
Energy Conservation Assistance Program (ECAP)	Low Income	Evaluation Study	6	FortisBC Energy Inc. and BC Hydro	$60	Ongoing Quality Assurance to ensure products are installed according to program policies and procedures.
Energy Conservation Assistance Program (ECAP) - Overall Program Evaluation 2017	Low Income	Process & Impact	6	FortisBC Energy Inc. and FortisBC Inc.	$28	Participant survey and monthly consumption usage conducted for the program. **Expected completion by Q2 2018**
Energy Conservation Assistance Program (ECAP) - Ongoing Feedback Survey	Low Income	Process	6	FortisBC Energy Inc. and BC Hydro	$3	Ongoing survey with program participants to gather frequent and ongoing feedback on customer experience, satisfaction with the program and its program evaluators.
Energy Specialist Program - Evaluation 2017	Commercial	Process & Impact	8	FortisBC Energy Inc. & FortisBC Inc.	$15	The evaluation study includes program and industry stakeholder surveys and an energy savings audit on a subset of completed 2017 projects. **Expected completion by Q2 2018.**
Commercial Food Service Incentive Program - Evaluation 2017	Commercial	Process & Impact	6	none	$45	The evaluation consisted of a participant survey and energy impact analyses of the program from 2012 to 2016 **Completed December 2017 by Fish+River Consultants**

1 **Table 12-1: Inventory of DSM Program Evaluation and Evaluation Research Activities Conducted in 2017 (continued)**

2

Evaluation Name	Program Area	Type of Evaluation	Years the program has been running [19]	Evaluation Partnership	Actual Evaluation Expenditure (000's)	Evaluation Status [20]
Combination Space/Water Heating Units Pilot	Innovative Technologies	Process & Impact	3	none	$51	Combination of surveys with program participants and contractors, and analysis of the monthly consumption usage pre and post installation. **Completed July 2017 by Sampson Research**
Smart Learning Thermostat Pilot	Innovative Technologies	Measurement & Verification	1	FortisBC Energy Inc. & FortisBC Inc.	$54	Gauging customer acceptance and energy savings associated with smart learning thermostats. **Expected completion Q3 2019**
Heat Reflector Pilot (HRP)	Innovative Technologies	Evaluation Study & Measurement & Verification	2	none	$76	Customer survey, thermal imaging, equipment recording, and analysis of the consumption usage pre and post installation. **Completed November 2017 by RDH Building Science**
Industrial Optimization Program	Industrial	Measurement & Verification	6	none	$53	M&V was conducted on 14 projects in 2017 of which 2 completed its M&V requirements. The M&V activities include the completion of an M&V plan, commissioning validation site visits, and M&V reports.

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Table 12-2 contains a summary of all program evaluation studies and pilot program reports completed in 2017 and includes a brief description of the methodologies and key findings.

Table 12.2: Summary of Key Findings and Methodology for 2017 Completed DSM Program Evaluation Studies and Pilot Program Reports

Evaluation Name	Program Area	Type of Evaluation	Methodology	Outcome from Key Findings
FortisBC Communication Tracking: Energy Efficiency Conservation	C&EM Portfolio	Communications	Online interviews conducted with 800 British Columbia adults living within the FortisBC service territory.	**Results:** The percentage of participants had aided awareness of at least one of the three main energy efficiency activities undertaken by FortisBC trended upward from 66% in 2016 to 78% in 2017. The engagement index was redefined to provide greater differentiation between levels of engagement. Overall, nearly three-quarters of participants were at least moderately engaged, four-in-ten were extremely or highly engaged. **Outcome of Key Findings:** Continue to emphasize the overarching energy efficiency activities rather than individual programs to build awareness.
C&EM Rebates UX Testing	C&EM Portfolio	Communications	One-on-one user testing sessions with both Commercial and Residential customers.	**Results:** Improvements identified for the web page particularly in regard to search functionality and the use of imagery to guide customers. **Outcome of Key Findings:** As a results of the study, improvements were made to the rebates section of the corporate website.
Review of Net-to-Gross Assumptions (FEI & FBC Energy Efficiency Programs)	C&EM Portfolio	Evaluation Study	Interviews with FortisBC program managers and evaluation specialists, review of program evaluations, market research, and other FortisBC internal documents and industry literature review.	**Results:** Net-to-Gross methods were identified and best practice methods were recommended. **Outcome of Key Findings:** The results of the study will help inform future program evaluations.

Table 12-2: Summary of Key Findings and Methodology for 2017 Completed DSM Program Evaluation Studies and Pilot Program Reports (continued)

Evaluation Name	Program Area	Type of Evaluation	Methodology	Outcome from Key Findings
Contractor Research Survey	Residential	Process	Telephone surveys were conducted with 119 program participants and 100 non-participant contractors between March 16 to April 7, 2017. Six focus groups sessions were held in Coquitlam, Kelowna and Prince George. 13 program participants and 13 non-participants attended the sessions between April 12 to April 20, 2017. The research assisted in gathering feedback regarding; FortisBC, its various DSM initiatives, the Trade Ally Network and the Electrical Contractor Program.	**Results**: Overall, contractors are highly satisfied with the DSM program rebate application process. 71% of contractors rated the current program rebate amount as "Good deal/saves money" and "Good selling tool/incentive". Two-thirds (67%) of contractors who considered the timing of the furnace/boiler replacement rebate offer important would like the rebate to be offered all year round. 88% of TAN Members and 61% of non-participant gas contractors helped the customer complete the rebate application form. **Outcome of Key Findings:** Results were taken under consideration for 2018 program design and 2019-2022 DSM Plan development.
Furnace Replacement Program - Participant Survey	Residential	Process	3,554 program participants were contacted by telephone to participant in an online survey and to take photos of their installed furnace. A total of 422 participants completed the survey between June 1 to June 23, 2017.	**Results:** The survey results showed an overall program satisfaction rating of 88%. Over half the participants who completed the survey (57%) were satisfied with the rebate amount. 77% of the participants survey indicated "excellent" or "very good" with the overall satisfaction with the contractors who installed their furnace. **Outcome of Key Findings:** Feedback from the survey was taken into account for the new program design and offer.

Table 12-2: Summary of Key Findings and Methodology for 2017 Completed DSM Program Evaluation Studies and Pilot Program Reports (continued)

Evaluation Name	Program Area	Type of Evaluation	Methodology	Outcome from Key Findings
Rental Apartment Efficiency Program (RAP) - Evaluation 2017	Residential/Commercial	Process	This study is an ongoing evaluation conducted annually for the program. Two separate surveys were conducted; a building owner survey and tenant survey. A telephone survey was completed for 45 property owners/managers and an online survey was completed for 166 tenants.	**Results**: The survey results continue to show positive feedback with 93% of the building owners and 70% of the tenants surveyed indicating "very" or "somewhat satisfied" with the overall program. Owners/managers continue to view the program's communications positively with approximately 9 in 10 owners/managers "very" or "somewhat satisfied" with the accessibility of the program information, the ease of understanding the information, knowing how/who to contact regarding the program, and the level of communications throughout the entire program process. **Outcome of Key Findings**: Continue to conduct ongoing tenant and building owner surveys to provide feedback to program design.
Low Income General Survey	Low Income	Process	The evaluation study consisted of; an online survey with 1,483 BC residents (842 low income and 641 non-low income households), and follow-up interviews with 16 low income households. The evaluation objectives were to understand the low income population as a function of their demographics, impression of FortisBC, concerns regarding finances, and their attitudes and actions toward energy savings.	**Results:** Four key segment groups were identified within the low income participants group. Insights were garnered on considerations for marketing communications geared to each of the segments. **Outcome of Key Findings:** The study will inform future program communications and marketing strategies.

Table 12-2: Summary of Key Findings and Methodology for 2017 Completed DSM Program Evaluation Studies and Pilot Program Reports (continued)

Evaluation Name	Program Area	Type of Evaluation	Methodology	Outcome from Key Findings
Commercial Food Service Incentive Program - Evaluation 2017	Commercial	Process & Impact	The evaluation consisted of a participant survey and energy impact analyses of the program from 2012 to 2016. A combination of an online survey and telephone survey approach was used to gather feedback from a total of 328 participants. Program deemed savings analysis was conducted using data from the program application forms and from the participant survey.	**Results:** 197 out of the 328 program participants responded to the survey (60% response rate) with an average program satisfaction rating of 70%. A review of the 328 program participants which included 548 appliances that had been installed through the program resulted in a deemed savings of approximately 33,840 GJ per year. **Outcome of Key Findings:** Results from the study will inform future program design.
Combination Space/Water Heating Units Pilot	Innovative Technologies	Process & Impact	The study was conducted over a one year period and consisted of surveys (online and telephone) with program participants and contractors, and a billing consumption analysis at the building level. The pilot was comprised of 97 participants that installed either a boiler and tankless water heater, boiler and an indirect tank or a hydronic fan coil and tankless water heating system.	**Results:** Approximately 68% of participants installed a Type 1 combined system. Contractors believed the driver is due to higher customer demand for Type 1 and suitability for homes with boilers. The customer survey results indicated a 94% of participants were satisfied with the installed combined space and water heating system and over 75% reported that their homes were more comfortable than their previous system. Energy savings were derived from conducting a billing consumption analysis and varied across different combination types ranging between 18 to 20 GJ/yr. **Outcome of Key Findings:** Results from the study will inform future program design.

1 2 **Table 12-2: Summary of Key Findings and Methodology for 2017 Completed DSM Program Evaluation Studies and Pilot Program Reports (continued)**

Evaluation Name	Program Area	Type of Evaluation	Methodology	Outcome from Key Findings
Heat Reflector Pilot (HRP)	Innovative Technologies	Evaluation Study & Measurement & Verification	**M&V Plan:** Complies with the International Performance Measurement & Verification Protocol. The selected IPMVP option and measurement boundary was Option B[21]. **M&V**: The M&V study was conducted over a one year period. 20 participant buildings (19 in Lower Mainland, 1 in Kamloops) with heat reflectors installed, boiler set point adjustments made, and baseboard convectors cleaned were monitored and reviewed using; thermal imaging, equipment recording, customer survey, and analysis of billing consumption data on a building level.	**Results:** Surveys conducted with building managers showed tenants felt value in the cleaning of the baseboard convectors but reported higher incidents of tenant complaints after the HRP installation, though this may have been due to the uncharacteristically cold winter. The results showed that there is a difference in energy savings compared to buildings with non-condensing boilers and ones with condensing boilers. Buildings with non-condensing boilers saved 79 GJ/yr while buildings with condensing boilers increase their consumption by 23 GJ/yr. **Outcome of Key Findings:** Results from the study will inform future program design.
Industrial Optimization Program	Industrial	Measurement & Verification	**M&V Plan:** Complies with the International Performance Measurement & Verification Protocol. The selected IPMVP option and measurement boundary was Option B[21] **M&V:** M&V was conducted on ITRP006 Agropur (Victoria Plant) for steam boiler upgrade in a dairy processing plant.	**Results:** Three year M&V completed with a total verified natural gas savings of 9,544 GJ. The plant reduced their natural gas consumption by 9,544 GJ by upgrading their main steam boiler along with upgrades of their steam and condensate distribution system. The achieved savings were well aligned with the expected target savings and exceed the minimum savings to achieve cost effectiveness of the project. **Outcome of Key Findings:** M&V project completed with the full incentive payment issued to the participant as the natural gas savings met target savings.

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[21] IPMVP Option B - Measurement of all parameters governing energy use to assess consumption. www.evo-world.org

Table 12-2: Summary of Key Findings and Methodology for 2017 Completed DSM Program Evaluation Studies and Pilot Program Reports (continued)

Evaluation Name	Program Area	Type of Evaluation	Methodology	Outcome from Key Findings
Industrial Optimization Program	Industrial	Measurement & Verification	**M&V Plan:** Complies with the International Performance Measurement & Verification Protocol. The selected IPMVP option and measurement boundary was Option A[22] **M&V:** M&V was conducted on ITRP008 BA Blacktop for installation of stock feed covers	**Results:** Three year M&V completed with a total verified natural gas savings of 14,165 GJ. The plant reduced their natural gas consumption by 14,165 GJ by installing covers over their stock feed to reduce the moisture content of the feed going into the processing plant. The achieved savings were well aligned with the expected target savings and exceed the minimum savings to achieve cost effectiveness of the project. **Outcome of Key Findings**: M&V project completed with the full incentive payment issued to the participant as the natural gas savings met target savings.

[22] IPMVP Option A - Measurement of key parameters governing energy use to assess consumption. www.evo-world.org

12.2 Evaluation Collaboration

In 2017, FEI continued to seek opportunities to increase collaboration activities with FBC, BC Hydro, and other entities to conduct program evaluation for DSM programs. The number of collaboration activities depends on the timing of the activity, program participants, legal and privacy concerns, and available budget to conduct the study. Table 12-1 provides information on program evaluation activities conducted in partnership with other organizations. In keeping with the MOU on collaboration discussed in Section 2.5, FEI and BC Hydro held update meetings to review the evaluation plans and discuss future evaluation activities. FEI, FBC and BC Hydro continue to hold update meetings and explore opportunities for future collaboration on program evaluations.

13. DATA GATHERING, REPORTING AND INTERNAL CONTROLS PROCESSES

13.1 Overview

The following section outlines FEI's business practices to ensure DSM activities and associated spending are in compliance with the Company's internal control processes and Commission Decision and Order G-36-09, which directed the Company to include a discussion in the DSM Annual Report of the Company's internal data gathering, monitoring and reporting control practices.

13.2 Program Tracking, Evaluation and Reporting Functions

FEI staff responsible for tracking, evaluation and reporting of DSM activities continue to report to a different Director than staff responsible for program development and implementation in order to:

- conduct independent evaluation activities;
- maintain an independent library of inputs into cost effectiveness calculations; and
- centralize tracking and reporting processes.

13.3 Robust Business Case Process Applied to All Programs

Before a new DSM pilot or program can be implemented, a business case must first be developed. FEI is committed to putting each pilot or program through the appropriate level of internal scrutiny before moving ahead, and believes doing so ensures an increased chance of pilot or program effectiveness.

Business cases include information about program rationale and purpose, as well as a description of the target audience, assumptions, cost-benefit tests and proposed evaluation methods. Cost effectiveness analysis is performed using the California Standard Tests (CST) as outlined in the California Standard Practice Manual. FEI uses an in-house cost-benefit modeling tool developed in partnership with expert industry consultants[23] to apply the program costs and benefits in each of the four standard cost-effectiveness tests based on the California Standard Practice Manual (Rate Impact Measure ["RIM"], Utility, Participant, and TRC) and the MTRC in accordance with DSM Regulation. The results from this modelling are used as inputs for the business cases, which are approved in accordance with FEI's policy on financial authorization levels.

[23] Willis Energy Services Ltd. and The Cadmus Group Inc. provided input into this in-house cost-benefit modelling.

In addition to the internal business case process, the Decision directed FEI to submit a detailed plan for new programs for approval prior to the expenditure of any funds.[24] No new programs were submitted for approval to the Commission in 2017.

13.4 Incentive Applications Vetted for Compliance with Program Requirements

Ensuring that all customer applications are compliant with program eligibility requirements as laid out in program terms and conditions is also part of the internal control process. The Company has a number of mechanisms in place to ensure DSM incentive funding applications are in compliance with program requirements. The verification process is specific to each program and is dependent on the type of program, its complexity, the financial value of the incentive and other parameters. The general principles applied are as follows:

- Each application is reviewed for completeness and accuracy;
- Applications must meet the criteria outlined in the terms and conditions of the program put forward through the approval process;
- Once approved, incentives are distributed to participants; and
- Copies of application and supporting documents are filed and stored for seven years in case of an audit.

13.5 Internal Audit Services

FEI regularly engages its own Internal Audit Services (IAS) group to review the internal controls associated with the DSM activities. The IAS utilize the most recently completed year of operation on which to conduct their audit. The 2017 Internal Audit Report, thus covers 2016 DSM operations. The 2017 Internal Audit Report, included in Appendix A, concludes that key controls are in place and operating effectively to mitigate risk around program development, program administration including rebate payments, and program reporting and evaluation to an appropriately low level).

13.6 Summary

FEI is committed to strong internal controls in all aspects of the DSM programs. As demonstrated in this section, the Company's business practices related to program development, application processing and ongoing monitoring are all sound and subject to continuous improvement.

[24] Decision, page 278

14. 2017 DSM PROGRAMS ANNUAL REPORT SUMMARY

In 2017, FEI's DSM Portfolio expenditures reached 96 percent of Plan with 64 percent of actual DSM program spending going toward customer incentives. With almost 534,000 GJ of annual savings, DSM programming continued to contribute valuable options for customers to reduce their energy use. FEI cost effectively delivered these programs within the spending limits accepted by the Commission, and in accordance with the DSM Regulation. FEI works to ensure DSM programs are operating in compliance with the Company's DSM Guiding Principles and are meeting Provincial requirements for adequacy. FEI also continues to implement good internal data gathering, monitoring and reporting control practices.

Appendix A

2017 INTERNAL AUDIT REPORT

FortisBC Energy Inc.
Internal Audit Report

Date: October 10, 2017

To: **Roger Dall'Antonia**, EVP, Customer Service and Technology

CC: **Danielle Wensink**, Director, Conservation and Energy Management

From: **Katrina Craig**, Director, Internal Audit

Re: Conservation and Energy Management – Internal Control and Process Review

---

INTRODUCTION

The Conservation and Energy Management Program ("the Program" or "CEM") is designed to provide customers with tools and incentives to manage their natural gas consumption, reduce their energy costs, and lower their greenhouse gas emissions.

In September 2014, the British Columbia Utilities Commission ("BCUC") granted approval for the Program expenditure of $35.8 million for 2016 in order G-138-14. The Program includes rebates and incentives on a number of energy efficient appliances, equipment and systems as well as education and outreach initiatives to increase awareness of the energy efficiency and environmental benefits that can be achieved by using clean burning natural gas in high efficiency appliances.

SCOPE AND OBJECTIVES

The objective of the review was to evaluate the design and operating effectiveness of the key internal controls over the 2016 programs, namely those around program development, program administration including rebate payments, and program reporting and evaluation. This was accomplished by:

- Verifying program tracking, evaluation and reporting functions are separate from program development and implementation functions;
- Inspecting that a cost/benefit analysis is developed for each business case by Integrated Resource Planning (IRP);
- Understanding, documenting and obtaining evidence that controls are in place that help ensure program criteria are met for each application;
- Verifying the effectiveness of system-based application controls;
- Ensuring that program metrics and reports are produced and reviewed, on a regular basis, by Management for program monitoring and evaluation purposes; and
- Developing recommendations to address any control deficiencies or opportunities for improvement as identified.

OBSERVATIONS & CONCLUSION

Based on procedures performed, Internal Audit found that key controls are in place and operating effectively to mitigate risk around program development, program administration including rebate payments, and program reporting and evaluation to an appropriately low level.

Appendix C

DRAFT ORDER

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British Columbia
Utilities Commission

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Vancouver, BC Canada V6Z 2N3
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ORDER NUMBER
G-xx-xx

IN THE MATTER OF
the *Utilities Commission Act*, RSBC 1996, Chapter 473

and

FortisBC Energy Inc.
Application for Approval of 2019-2022 Demand Side Management Expenditures Plan

BEFORE:
[Panel Chair]
Commissioner
Commissioner

on Date

ORDER

WHEREAS:

A. On September 15, 2014, the British Columbia Utilities Commission (Commission) issued its Decision and Order G-138-14 on the FortisBC Energy Inc. (FEI) 2014-2019 Performance Based Ratemaking Plan (PBR Plan). In the decision accompanying Order G-138-14 (PBR Decision), the Commission accepted FEI's Utilities Commission Act (UCA) section 44.2 expenditure request for energy efficiency and conservation (EEC) programs for 2014 through 2019.;

B. In accordance with Directive 148 of the PBR Decision, FEI and FortisBC Inc. filed for approval of a new Rental Apartment Efficiency Program (RAP), and on September 24, 2015, the Commission issued order G-152-15A, approving the RAP;

C. In accordance with Directives 140 and 142 of the PBR Decision, FEI filed for approval of the detailed plans for four new EEC Programs, and on January 28, 2016, the Commission issued Order G-11-16 approving the four new EEC Programs;

D. On March 31, 2017, FEI filed its 2016 Demand Side Management (DSM) Annual Report (2016 Annual Report). In the 2016 Annual Report, FEI identified potential barriers and opportunities for future DSM programming, to be considered as FEI prepares its next DSM Plan for 2019 and beyond;

E. On June 22, 2018, FEI filed its Application for Approval of 2019-2022 Demand Side Management Expenditures Plan (DSM Plan);

F. FEI seeks acceptance, pursuant to section 44.2 of the UCA of Conservation and Energy Management (C&EM) (previously referred to as Energy Efficiency and Conservation (EEC)) total expenditures of $324.6 million for 2019 through 2022;

G. FEI seeks the following additional approvals:

1. approval for funding transfers as set out in Section 9.1 of the Application;

2. approval of the forecast rate base additions accounting treatment as set out in Section 9.2 of the Application; and

3. approval to move to a 16-year amortization period for DSM expenditures as set out in Section 9.3 of the Application;

H. The Commission has reviewed FEI's DSM Plan and requested approvals for C&EM expenditures for 2019 to 2022 and concludes that the requested expenditure schedules should be accepted.

NOW THEREFORE the Commission orders as follows:

1. Pursuant to section 44.2(a) of the UCA, the Commission accepts the FEI C&EM expenditure schedule of total DSM expenditures of $324.6 million for 2019 through 2022 on the C&EM program areas described in the DSM Plan.

2. The funding transfer rules as set out in Section 9.1 of the Application are approved;

3. Forecast rate base additions to the EEC deferral account of $30 million, on a net-of-tax basis, for each of the years 2019 through 2022 as set out in Section 9.2 of the Application are approved.

DATED at the City of Vancouver, in the Province of British Columbia, this (XX) day of (Month Year).

BY ORDER

(X. X. last name)
Commissioner

Appendix D

CPR TECHNICAL AND ECONOMIC POTENTIAL

NAVIGANT

British Columbia Conservation Potential Review

Prepared for:

FortisBC Energy Inc.

FORTIS BC

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Reference No.: 180336
January 23, 2017

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DISCLAIMER

This report was prepared by Navigant Consulting, Inc. (Navigant) for FortisBC Energy Inc. The work presented in this report represents Navigant's professional judgment based on the information available at the time this report was prepared. Navigant is not responsible for the reader's use of, or reliance upon, the report, nor any decisions based on the report. NAVIGANT MAKES NO REPRESENTATIONS OR WARRANTIES, EXPRESSED OR IMPLIED. Readers of the report are advised that they assume all liabilities incurred by them, or third parties, as a result of their reliance on the report, or the data, information, findings and opinions contained in the report.

EXECUTIVE SUMMARY

FortisBC Energy Inc. (FortisBC Gas) and the other BC Utilities engaged Navigant Consulting, Inc. (Navigant or the team) to prepare a conservation potential review (CPR) for electricity and natural gas across all of British Columbia over a 20-year forecast horizon from 2016 to 2035. The CPR's objective is to assess the energy efficiency potential in the residential, commercial, and industrial sectors by analyzing energy efficiency and peak-load-reduction measures, defining operational and maintenance activities to keep existing devices or equipment in good working order, and improving end-user behaviors to reduce energy consumption. These analysis efforts provide input data to Navigant's Demand Side Management Simulator (DSMSim™) model, which calculates technical and economic savings potential across FortisBC Gas's service territory. FortisBC Gas may use these results as input to their own DSM planning and long term conservation goals, energy efficiency program design, integrated resource planning (IRP), and load forecasting models.

The first stage of this CPR is to estimate technical and economic conservation potential, which is presented in this report. Further analyses, which will be presented in ensuing reports as part of the CPR's Additional Scope Services, include estimation of the province-wide technical and economic potential for electricity and natural gas, achievable market potential for gas savings and potential from fuel switching.

Approach

This section provides an overview of the methods Navigant employed for conducting the 2016 CPR for British Columbia.

Base Year and Reference Case Forecast

Navigant developed the Base Year (2014) Calibration (base year) based on an assessment of energy consumption in each utility's service territory, by customer sector and segment, end-use, fuel, and types of equipment used. The objective of the base year is to establish a profile of energy consumption by utility, which is consistent with the total energy consumption (gas and electricity) reported by each utility. The team used the base year as the foundation to develop the Reference Case Forecast of energy demand through 2035.

The Reference Case Forecast estimates the expected level of energy demand over the CPR period from 2016-2035 absent incremental demand-side management (DSM) activities and absent rate impacts on consumption. The significance of the Reference Case in the context of this CPR study is that it acts as the point of comparison (i.e., the reference) for the calculation of the technical and economic potential scenarios.

The Reference Case Forecast uses the base year calibration as the foundation for analysis. Navigant used two key inputs to construct the Reference Case forecast for each customer sector: building stock growth rates, and end-use intensity (EUI) trends. Applying building stock growth rates to the base year stocks of each customer segment results in a forecast of stocks through 2035. Similarly, applying the EUI trends to the base year EUIs results in a forecast of EUIs through 2035. The final step of this process involves multiplying the stock forecast with the corresponding EUI forecast in order to obtain a consumption forecast.

To construct the Reference Case Forecast, Navigant developed growth projections of residential building stock, commercial floor area, and industrial energy consumption. The team then modeled the potential for energy efficiency based on the resulting stock projections of each sector, while accounting for the changing mix of newly constructed versus existing building stock. The team applied EUI trends to the Base Year EUIs for each customer segment, and used these trends to represent natural change (i.e., naturally occurring increases or reductions in consumption not attributable to DSM programs) in end-use consumption over time.

Navigant compared the forecasts developed as part of the Reference Case for the residential, commercial, and industrial sectors with the long-term load forecast developed by each utility. The team performed this comparison to ensure that the Reference Case forecast is consistent with each utility's current expectations for load growth over the 2015 to 2035 period.

Measure Characterization

Navigant fully characterized over 200 measures across the BC Utility's residential, commercial, and industrial sectors, covering electric and natural gas fuel types. The team prioritized measures with high impact, data availability, and likelihood to be cost-effective as criteria for inclusion into DSMSim™.

The team reviewed current BC program offerings, previous CPR and other Canadian programs, and potential model measure lists from other jurisdictions to identify which energy efficient measures to include in the study. The team supplemented the measure list using the Pennsylvania, Illinois, Mid-Atlantic, and Massachusetts technical resource manuals (TRMs), and partnered with CLEAResult to inform the list of industrial measures. Navigant worked with the BC Utilities to finalize the measure list and ensure it contained technologies viable for future BC program planning activities. Appendix A.2 provides the references to the final measure list and assumptions.

Estimation of Potential

Navigant employed its proprietary DSMSim™ potential model to estimate the technical and economic savings potential for gas energy in FortisBC Gas's service territory.[1] DSMSim™ is a bottom-up technology diffusion and stock-tracking model implemented using a System Dynamics[2] framework. The DSMSim™ model explicitly accounts for different types of efficient measures such as retrofit (RET), replace-on-burnout (ROB), and new construction (NEW) and the impacts these measures have on savings potential. The model then reports the technical and economic potential savings in aggregate by service territory, sector, customer segment, end-use category, and highest-impact measures.

Technical potential is defined as the energy savings that can be achieved assuming that all installed measures can immediately be replaced with the efficient measure, wherever technically feasible, regardless of the cost, market acceptance, or whether a measure has failed (or "burned out") and is in need of being replaced. Technically feasible measures are commercially available measures that are compatible with and may replace the existing baseline technology. Economic potential is a subset of technical potential, using the same assumptions regarding immediate replacement as in technical potential, but limiting the calculation only to those measures that have passed the benefit-cost test chosen for measure screening, in this case the TRC test. Similar to technical potential, economic potential does not represent an achievable level of savings potential because it does not account for market adoption and acceptance, desired customer payback period, etc. The estimation of achievable market potential will be completed as part of this CPR's Additional Scope Services.

Savings reported in this study are "gross", rather than "net," meaning they do not include the effects of natural change (as described in Section 2.3.2). The technical potential results section concludes with a comparison of aggregate potential before consideration of natural change and after including natural change. Providing gross potential is advantageous because it permits a reviewer to more easily calculate net potential when new information about net-to-gross ratios or changing end-use intensities become available.

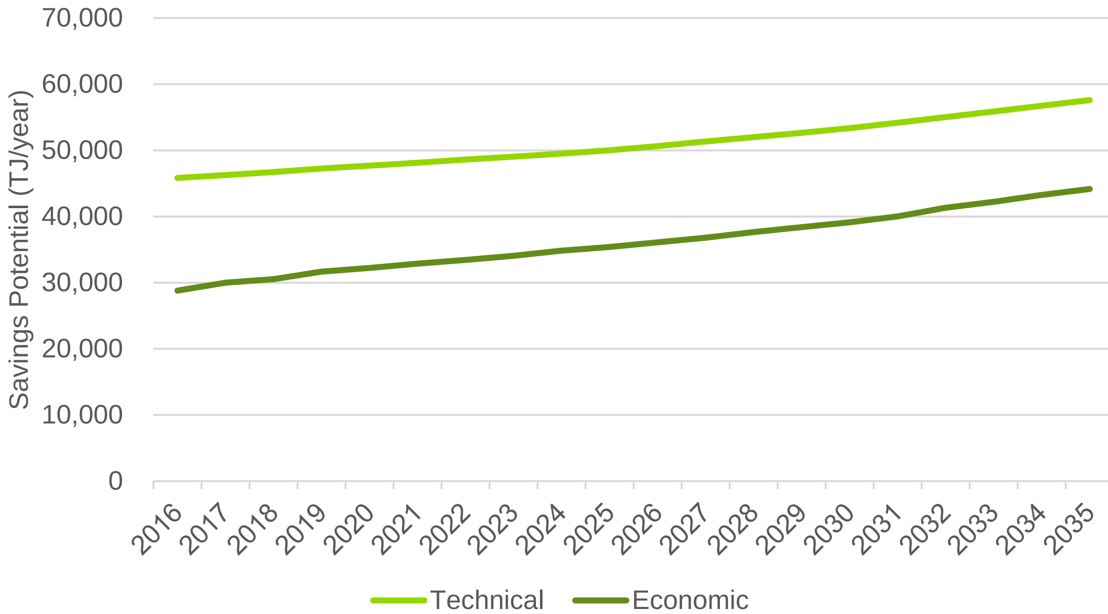
Findings

Figure ES-1 compares the total technical and economic gas energy savings potential in FortisBC Gas's service territories, and Table D-1 of Appendix D provides the associated data. Technical gas savings potential begins at approximately 46,000 TJ/year in 2016 and increases by 26% to 58,000 TJ/year by 2035. Economic gas savings potential grows by 53% from a 2016 value of 29,000 TJ/year to a 2035 value of 44,000 TJ/year. On average across the study period, 71% of technical potential is cost-effective, as reflected by the economic potential.

[1] The study also identified the impacts on electric consumption caused by gas measures with either dual-fuel savings or cross-fuel interactive effects. Since the electric impacts are negligible, they are included in Appendix A.1, but not within the body of the report.
[2] See Sterman, John D. *Business Dynamics: Systems Thinking and Modeling for a Complex World*. Irwin McGraw-Hill. 2000 for detail on System Dynamics modelling. Also see http://en.wikipedia.org/wiki/System_dynamics for a high-level overview.

The residential and commercial sectors' contributions to the growth of technical potential are nearly equal, whereas technical potential from the industrial sector declines slightly over the forecast period. The commercial sector drives the majority of the growth in economic potential.

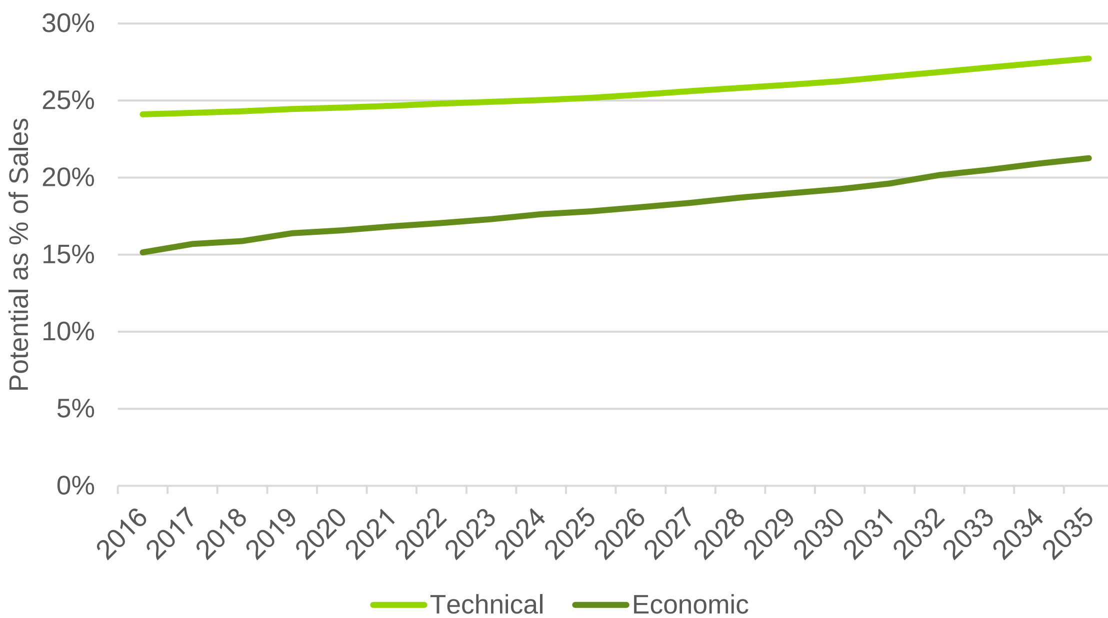
Figure ES-1. Total Gas Energy Savings Potential (TJ/year)



Source: Navigant

Figure ES-2 provides the technical and economic gas savings potential as a percentage of total gas consumption within the FortisBC Gas's service territories, and Table D-2 of Appendix D provides the associated data. The technical savings potential grows faster than the gas consumption forecast, such that the technical potential as a percentage of total gas consumption increases from 24% in 2016 to 28% by 2035. Economic savings potential increases from 15% in 2016 to 21%.

Figure ES-2. Total Gas Energy Savings Potential as a Percent of Total Consumption (%)



Source: Navigant

1. INTRODUCTION

1.1 Conservation Potential Review Background and Goals

The BC Utilities—defined in this report as BC Hydro, FortisBC Inc. (FortisBC Electric), FortisBC Energy Inc. (FortisBC Gas), and Pacific Northern Gas Ltd.—engaged Navigant Consulting, Inc. (Navigant or the team) to prepare a conservation potential review (CPR) for electricity and natural gas across all of British Columbia over a 20-year forecast horizon from 2016 to 2035. The CPR's objective is to assess the energy efficiency potential in the residential, commercial, and industrial sectors by analyzing energy efficiency and peak-load-reduction measures, defining operational and maintenance activities to keep existing devices or equipment in good working order, and improving end-user behaviors to reduce energy consumption. These analysis efforts provide input data to Navigant's Demand Side Management Simulator (DSMSim™) model, which calculates technical and economic savings potential across the BC Utilities' service territories. The BC Utilities may use these results as input to their own DSM planning and long-term conservation goals, energy efficiency program design, integrated resource planning (IRP), and load forecasting models.

1.2 Organization of Report

This report is organized as follows:

Section 2 describes the methodologies and approaches Navigant used for estimating energy efficiency and demand reduction potential, including discussion of base year calibration, Reference Case forecast, the frozen end-use intensity case, and measure characterization.

Section 3 offers the technical potential savings forecast for FortisBC Gas, including the methods for estimating technical potential and the modeling results by customer segment and end-use.

Section 4 offers the economic potential savings forecast for FortisBC Gas, including the methods for estimating economic potential and the modeling results by customer segment and end-use.

Accompanying Appendices provide detailed model results and additional context around modeling assumptions.

1.3 Caveats and Limitations

There are several caveats and limitations associated with the results of this study, as detailed below.

1.3.1 Forecasting Limitations

Navigant obtained future energy sales forecasts from each BC Utility. Each of these forecasts contain assumptions, methodologies, and exclusions which could differ by utility. Navigant has leveraged the assumptions underlying these forecasts, as much as possible, as inputs into the development of the Reference Case stock and energy demand projections. Where sufficient and detailed information could not be extracted, as a result of the granularity of the information available or customer data protection requirements, Navigant developed independent projections of stock for each utility. The team developed these independent projections based on secondary data resources and in collaboration with the utilities. These secondary resources and any underlying assumptions are referenced throughout this report.

1.3.2 Program Design

The results of this study provide a big picture view of the unmet savings potential in each of the BC Utilities' service territories. However, this study is not considered to be a detailed program design tool, as it does not consider incentive, marketing, advertising and budget levels, nor customers' willingness to adopt efficient measures. As such, the magnitude of the results should not be interpreted as the savings potential that could be realistically achieved by utility-sponsored energy conservation programs.

1.3.3 Measure Characterization

Efficiency potential studies may employ a variety of primary data collection techniques (e.g., customer surveys, on-site equipment saturation studies, and telephone interviews), which can enhance the accuracy of the results, though not without associated cost and time requirements. The scope of this study did not include primary data collection, but rather relied on data from the BC Utilities, other regional efficiency programs, Natural Resources Canada (NRCan), and technical reference manuals (TRMs) from Pennsylvania, Illinois, Mid-Atlantic, and Massachusetts to inform inputs to DSMSim™.

Furthermore, the team considers the measure list used in this study to appropriately focus on those technologies likely to have the highest impact on savings potential over the potential study horizon. However, there is always the possibility that emerging technologies may arise that could increase savings opportunities over the forecast horizon, and broader societal changes may impact levels of energy use in ways not anticipated in the study.

1.3.4 Measure Interactions

This study models energy efficiency measures independently .[3] As a result, the total aggregated energy efficiency potential estimates may be different from the actual potential available if a customer installs multiple measures in their home or business. Multiple measure installations at a single site generate two types of interactions: within-end-use interactions, and cross-end-use interactions. An example of a within-end-use interaction is when a customer implements an operational program to review and maintain steam traps, but also installs a more efficient boiler. To the extent that the steam trap program reduces heating requirements at the boiler, the savings from the efficient boiler would be reduced. An example of a cross-end-use interaction would be when a homeowner replaces a number of heat producing incandescent light bulbs with efficient LEDs. This impacts the cooling and heating load of the space—however slightly—by increasing the amount of heat required from the HVAC system, and decreasing the amount of cooling required.

[3] A small number of measures accounted for interactions among multiple efficient measures. For measures whose characterization was based on building energy model simulations evaluating bundled measures, interactive effects among those measures were included in the savings estimates (e.g., ENERGY STAR New Homes, Net-Zero New Homes, etc.).

Navigant employed the following methods to account for interactive effects:

- Where measures clearly compete for the same application (e.g., CFL and LED), the team created competition groups to eliminate the potential for double counting savings
- For measures with significant interactions (e.g., industrial process and boilers), the team adjusted applicability percentages to reflect varying degrees of interaction
- Wherever cross-end-use interactions were appreciable (e.g., lighting and HVAC), the team characterized those interactions for both same-fuel (e.g., lighting and electric heating) and cross-fuel (e.g., lighting and gas heating) applications

B.1 provides further discussion on the challenges involved with accurately determining interactive effects.

1.3.5 Measure-Level Results

This report includes a high-level account of savings potential results across the FortisBC Gas's service territories and focuses largely on aggregated forms of savings potential. However, Appendix A.1 provides results at the finest level of granularity, which is at the measure-level within each customer segment. The measure-level data is mapped to the various regions, customer segments and end-use categories to permit a reviewer to easily create custom aggregations

1.3.6 Gross Savings Study

Navigant and BC Utilities agreed to show savings from this study at the gross level, whereby natural change and free ridership, as it relates to program implementation, are not included in the savings estimates but rather are estimated separately. Providing gross potential is advantageous because it permits a reviewer to more easily calculate net potential when new information about changing end-use intensities or net-to-gross ratios become available. However, the team calculated natural change at end-use level, which is available in Appendix A.1. Additionally, each results section concludes with a comparison of aggregate potential before consideration of natural change and after including natural change.

2. APPROACH TO ESTIMATING ENERGY AND DEMAND SAVINGS

This section describes the methodologies Navigant employed for estimating energy and demand savings across the BC Utility's service territories including base year calibration, reference case forecast, the frozen end-use intensity case, and measure characterization.

2.1 Base Year Calibration

Navigant developed a Base Year Calibration (base year) based on an assessment of energy consumption in each utility's service territory, by customer sector and segment, end-use, fuel, and types of equipment used. The objective of the base year is to define a detailed profile of energy consumption by utility which matches the total energy consumption (gas and electricity) reported by each utility. The team used the base year as the foundation to develop the Reference Case Forecast of energy consumption through 2035. Section 2.2 discusses the development of the Reference Case.

Navigant developed the Base Year analysis for the province as a whole relying on data provided by the BC Utilities. This report presents data that is specific to FortisBC Gas. The resources provided by FortisBC Gas included the following data sources:

- Historical gas consumption;
- Residential accounts data;
- Residential and Commercial End-Use Surveys;
- Program evaluation reports, conditional demand analyses (CDA); and
- The 2010 and 2006 CPR reports.

Where utility- or FortisBC-specific information was not available, Navigant utilized data from publicly available sources such as BC Statistics (BC Stats), Statistics Canada (StatsCan), and Natural Resources Canada (NRCan) and the Office of Energy Efficiency (OEE) in addition to internal Navigant data sources. Navigant's review of these sources supported the data provided by FortisBC Gas and to ensure consistency among all data used in the study. In order to develop the final estimates of energy consumption, Navigant compared and calibrated preliminary estimates with actual sales data obtained from FortisBC Gas.

Navigant focused the calibration analysis on volumetric energy (e.g., MWh or GJ) consumed in each region by customer segment, end-use, and equipment type in order to develop the base year energy profile for each utility. Navigant chose not to perform calibration based on peak demand (e.g., MW or GJ/hr.) for several reasons. First, each utility reports sales and self-generation amounts at the level of aggregation required for this analysis (e.g., by residential, commercial, and industrial segments) exclusively by volumetric energy. Second, utilities rarely aggregate and report peak demand data (other than for billing purposes) at the level of aggregation required. Third, each utility had readily available (and granular) volumetric energy data.

2.1.1 Segmentation of Customer Sectors

Navigant disaggregated FortisBC Gas's base year gas consumption by region in the province, sector, and customer segment. Navigant worked with the BC utilities to determine an appropriate level of segmentation for each sector and an acceptable geographic representation resulting in four regions consistent with regional definitions used by FortisBC Gas.
Table 2-1 indicates the relationship between the four utilities' service territories and the regions considered in the CPR.

Table 2-1: Mapping of Utility Service Territories to CPR Regions

	Vancouver Island	Lower Mainland	Southern Interior	Northern BC
BC Hydro (Electric)	✓	✓	✓	✓
FortisBC (Electric)			✓	
FortisBC Energy (Gas)	✓	✓	✓	✓
PNG (Gas)				✓

Source: Navigant

The first major task to develop the base year gas calibration involved the disaggregation of the three main sectors—the residential, commercial, and industrial sectors—into specific customer segments. Each sector was segmented according to several factors including the availability and level of detail of the data provided by each utility, supporting information from secondary resources, level of consumption within segments, and consistency with previous CPRs.

The segmentation also reflects Navigant's modeling approach for representing efficiency measures within the DSMSim™ model. DSMSim™ models energy efficiency measures at the segment level, and tracks building and equipment stocks for each segment within each region and utility. Differences in fuel choices (i.e., space and water heating market shares), types of equipment used (i.e., use of a furnace or boiler for space heating), and equipment and system efficiency levels are all represented within the model for each segment, region, and utility, as required.

This modeling approach represents all measures separately within each customer segment, and does not require the duplication of segments using different space heating sources or different industrial processes. For example, the model represents space conditioning measures separately by heating type (e.g., characterizing thermal envelope measures for homes with electric or gas heat), eliminating the need to define a customer segment with electric heat versus a segment with gas heat.

Table 2-2 shows the segmentation used for the residential, commercial, and industrial sectors, with additional detail provided for each sector in the following sections. Although the streetlights/traffic signals segment is included in the commercial sector in Table 2-2, it has been analyzed and referenced separately throughout this report.

Table 2-2: Customer Segments by Sector

Residential	Commercial	Industrial
Single Family Detached	Accommodation	Agriculture
Single Family Attached/Row	Colleges/Universities	Cement
Apartments =< 4 stories	Food Service	Chemical
Apartments > 4 stories	Hospital	Food & Beverage
Other Residential	Logistics/Warehouses	Greenhouses
	Long Term Care	Mining - Coal
	Office	Mining - Metal
	Other Commercial	LNG Facilities
	Retail - Food	Oil and Gas
	Retail - Non Food	Manufacturing
	Schools	Pulp & Paper - Kraft
	Streetlights/Traffic Signals*	Pulp & Paper - TMP
		Wood Products
		Other Industrial
		Transportation

**Although the streetlights/traffic signals segment is included in the Commercial sector, it is only applicable to the electric utilities.*
Source: Navigant

2.1.1.1 FortisBC Gas Sales

FortisBC Gas supplies natural gas to residential, commercial and industrial customers across the four CPR regions. For internal purposes, FortisBC Gas distinguishes the location of its customers based on seven regions - different to the four CPR regions. As a result, to aggregate the FortisBC Gas sales data according to the four CPR regions, Navigant and FortisBC Gas developed a mapping to allocate sales and customer account data based on the seven FortisBC Gas regions and the four CPR regions.

The seven regions used by FortisBC Gas include Columbia, Fort Nelson, Inland, Lower Mainland, Revelstoke, Vancouver Island, and Whistler. Table 2-3 shows the mapping used to allocate sales to each of the CPR regions.

Table 2-3: Mapping of FortisBC Gas to CPR Regions

Code	Region	Vancouver Island	Lower Mainland	Southern Interior	Northern BC
COL	Columbia			✓	
FTN	Fort Nelson				✓
INL	Inland			✓	✓
LML	Lower Mainland		✓		
RSK	Revelstoke			✓	
VI	Vancouver Island	✓			
WH	Whistler		✓		

Source: Navigant analysis of FortisBC Gas data

A second step was also required in order to allocate FortisBC Gas sales and customers appropriately across customer sectors. This step deals specifically with apartment buildings. In this CPR, apartment buildings have been included in the residential sector. However, for billing purposes, FortisBC Gas includes apartment buildings in the commercial sector. As a result, a fraction of the commercial sector sales –attributed to apartment buildings- has been re-allocated to the residential sector. The fraction of sales attributed to apartment buildings was calculated as part of the analysis of Base Year sales, and is based on the stock of apartment units and the corresponding EUIs. Overall, relative to the initial allocation of sales the resulting residential sales are higher and the commercial sales are lower.

2.1.1.2 Residential Sector

Navigant divided residential customers into five segments based on the type of dwelling they occupied, as shown in Table 2-4.

Table 2-4: Description of Residential Segments

Segment	Description
Single Family Detached/Duplexes	Detached and duplex residential dwellings
Single Family Attached/Row	Attached, row and/or townhouses
Apartments < 4 stories	Apartment units located in low-rise apartment buildings made up of four stories or fewer
Apartments >= 4 stories	Apartment units located in high-rise apartment buildings made up of more than four stories
Other Residential	Manufactured, mobiles or other types of residential dwellings

Source: Navigant

This segmentation is largely consistent with the dwelling types employed in the FortisBC Gas 2010 CPR, with the following three exceptions:

» **Space heating system** - The 2010 CPR duplicated each residential dwelling type in order to model archetypes for different types of heating (e.g., electrically heated homes vs. gas heated homes). Based on Navigant's modelling approach, it is not necessary to duplicate residential segments to analyze dwelling types using different heating fuels.

» **Dwelling vintage** - The 2010 CPR divided the residential sector according to dwelling vintage (e.g., pre-1976 homes, and post-1976 homes). While Navigant recognizes that this approach is meant to reflect differences in gas consumption as a result of different types of equipment found in older and newer homes, Navigant's segmentation does not require this differentiation. These differences in gas consumption and the types of equipment used by different vintage homes can be, and are, captured in Navigant's *DSMSim* model.

» **Apartments -** The 2010 CPR included apartment buildings in the commercial sector, and divided them as large and medium apartment buildings to reflect differences in energy consumption that may appear in low and high rise buildings. For the base year and reference case analysis, this

CPR includes apartment buildings in the residential sector. This CPR also divides apartments based on buildings with less than or equal to 4 stories, and buildings with more than 4 stories. [4]

Navigant developed the breakdown of the residential sector into dwelling types based on FortisBC Gas billing data and supported by BC Hydro apartment unit counts. The team also used the same data sources to divide the total stock of each dwelling type by service region, provided in Table 2-5. While apartment buildings are reported in the residential sector for purposes of the base year analysis and the reference case forecast, they are moved to the commercial sector in the technical and economic potential results. Gas savings from apartment buildings are reported in the commercial sector because FortisBC Gas's conservation programs for apartment buildings are categorized as commercial programs.

Table 2-5: Base Year Housing Stocks (Residential units) – FortisBC Gas

Housing Type	Lower Mainland	Southern Interior	Vancouver Island	Northern BC	Total
Single Family Detached/Duplexes	475,475	170,298	89,448	45,448	780,669
Single Family Attached/Row	53,890	10,417	7,109	2,550	73,965
Apartments < 4 stories	216,678	52,875	59,179	10,195	338,927
Apartments >= 4 stories	158,724	6,853	17,195	1,007	183,779
Other Residential	10,348	8,940	2,198	2,405	23,891
Total	915,115	249,384	175,129	61,604	1,401,231
Apartments Excluded					
Apartments Total	375,402	59,729	76,374	11,202	522,707
Non-Apartments Total	539,713	189,655	98,755	50,402	878,525

The number of apartment units represents individual apartment suites and not single-meter apartment buildings which FortisBC Gas considers and bills as a single account.
Source: Navigant analysis based on data provided by FortisBC Gas and BC Hydro

2.1.1.3 Commercial Sector

Navigant divided the BC commercial sector into twelve (12) segments. The last segment listed below, streetlights and traffic signals, is only applicable to electric utilities.

[4] This CPR analyzes apartments units in the residential sector based on several factors. First, apartment buildings are generally characterized through Residential End Use Surveys (REUS) in parallel with non-apartment residential dwellings (e.g., detached and attached) – as is the case for BC Hydro's REUS studies but not FortisBC Gas. Second, end-use equipment – other than centralized systems for space heating, cooling and water heating – can be characterized in a consistent manner across apartments and non-apartment residential dwellings.

Table 2-6: Description of Commercial Segments

Segment	Description
Accommodation	Short-term lodging including related services such as restaurants and recreational facilities
Colleges/Universities	Post-secondary education facilities such as colleges, universities and related training centers
Food Service	Establishments engaged in preparation of meals, snacks and beverages for immediate consumption including restaurants, taverns, and bars.
Hospital	Diagnostic and medical treatment services such as hospitals and clinics
Logistics/Warehouses	Warehousing/storage facilities for general merchandise, refrigerated goods, and other wholesale distribution
Long Term Care	Residential care, nursing, or other types of long term care
Office	Administration, clerical services, consulting, professional, or bureaucratic work but not including retail sales.
Other Commercial	Establishments, not categorized under any other sector, including but not limited to recreational, entertainment and other miscellaneous activities
Retail - Food	Engaged in retailing general or specialized food and beverage products
Retail - Non Food	Engaged in retailing services and distribution of merchandise but not including food and beverage products
Schools	Primary and secondary schools (K to 12)
Streetlights/Traffic Signals	Roadway lighting and traffic signal loads

Source: Navigant

Navigant selected the commercial segments with the goal that the building types within those segments be reasonably similar in terms of gas and electricity use, operating and mechanical systems, and annual operating hours. This approach allowed for consistency in building characteristics within each segment as required by the measure characterization and modeling processes.

The selection of these commercial segments is similar to those for previous CPRs with the exception that Navigant does not distinguish commercial segments based on the size of facilities (e.g., large vs. medium facilities) as was done in the 2010 CPR. The analysis of gas consumption in the commercial sector is *scaled* based on the stock of commercial floor space in FortisBC Gas's territory. Using this approach, gas consumption is expressed in terms of GJ per square meter (GJ/m^2) of floor space. This approach assumes that the GJ/m^2 intensity within a commercial segment is constant, and independent of building size.[5] Another distinction, relative to the 2010 CPR, is that for the base year and reference case analysis, apartments units are included the residential sector. However, to report technical and economic savings potential results, apartments are moved to the commercial sector for consistency with the way FortisBC Gas delivers programs.

[5] While this CPR's modelling approach is different to the 2010 CPR, each modelling approaches has its own strengths and weaknesses. For example, the archetype-based approach provides increased visibility into the energy usage patterns of large vs. medium buildings. At the same time, the archetype based approach also introduces the risk of skewing energy consumption within a segment should the archetype analysis be based on a commercial building not representative of a segment-wide average. This potential shortcoming is addressed by Navigant's approach since developing a GJ/m2 intensity attempts to reflect segment-wide consumption patterns.

To determine the base year floor space stock for each commercial segment, Navigant applied the end-use intensities (EUIs) of each segment to the gas sales data provided by FortisBC Gas. Appendix B.3 describes in greater detail the methodology used to estimate the commercial EUIs. Table 2-7 summarizes the resulting floor space estimates developed for each commercial segment.

Table 2-7: Base Year Commercial Floor Area (million m^2) – FortisBC Gas

Segment	Lower Mainland	Southern Interior	Vancouver Island	Northern BC	Total
Accommodation	2.55	1.56	0.33	0.25	4.69
Colleges/Universities	4.10	0.39	0.74	0.07	5.30
Food Service	2.17	0.54	0.15	0.08	2.93
Hospital	1.56	0.64	0.05	0.10	2.35
Logistics/Warehouses	10.56	3.30	0.29	0.48	14.64
Long Term Care	2.05	0.87	0.36	0.04	3.33
Office	22.06	7.08	3.84	1.24	34.22
Other Commercial[6]	-	-	-	-	-
Retail - Food	2.10	0.99	0.27	0.11	3.47
Retail - Non Food	7.34	3.08	0.65	0.48	11.55
Schools	5.81	2.03	0.53	0.35	8.71
Total	**60.31**	**20.49**	**7.19**	**3.19**	**91.18**

Source: Navigant analysis of FortisBC Gas Sales and EUIs

[6] The Other Commercial segment was distributed across all other commercial segments proportionally. As a result, the Other Commercial segment does not include any floor area. FortisBC Gas directed Navigant to perform this distribution because of the wide variety of commercial building types reflected in the Other Commercial segment.

2.1.1.4 Industrial Sector

Navigant divided the BC industrial sector into 15 segments as shown in Table 2-8.

Table 2-8: Description of Industrial Segments

Segment	Description
Agriculture	Engaged in growing crops, raising animals, harvesting timber, fish and other animals, including farms, irrigation, ranches, or hatcheries.
Cement	Cement manufacturers and related operations including asphalt and concrete
Chemical	Industrial facilities that produce industrial and consumer chemicals including paints, synthetic materials, pesticides, and pharmaceuticals
Food & Beverage	Food and beverage industrial facilities including breweries, tobacco, meat/dairy and animal food manufacturers
Greenhouses	Engaged in growing nursery stock and flowers, including greenhouses, and nurseries.
Mining - Coal	Thermal and metallurgical coal mines
Mining - Metal	Copper, gold and other metal mines
LNG Facilities	Natural gas liquids processing facilities
Oil and Gas	Industries that explore, operate or develop oil and gas resources including the production of petroleum, mining and extraction of shale oil and oil sands.
Manufacturing	Industrial facilities that engage in light and heavy manufacturing processes including fabricated metal, metal manufacturing, machinery, and textiles.
Pulp & Paper - Kraft	Pulp and Paper industrial facilities dedicated specifically to the chemical kraft process
Pulp & Paper - TMP	Pulp and Paper industrial facilities dedicated to the thermo-mechanical pulp (TMP) process
Wood Products	Industrial facilities that manufacture wood products including lumber, plywood, veneer, boards, panel boards and pellets.
Other Industrial	Other industrial facilities and related production operations not categorized under any other industrial segment, including construction, contracting services, waste management and municipal water.
Transportation	Facilities providing transportation of passengers/cargo/resources and support activities related to common modes of transportation including air, rail, water, road, and pipeline.

Source: Navigant

Navigant selected these industrial segments to group industries with similar manufacturing processes, operations, outputs, and patterns of electricity and gas use. Some sectors such as and Pulp & Paper, which contribute significantly to FortisBC Gas energy sales, were further sub-divided into Pulp & Paper - Kraft and Pulp & Paper -TMP. This subdivision allowed differences in processes or patterns of energy use for each segment to be characterized more accurately than if they were combined into one segment. While this approach attempts to better characterize and analyze energy consumption in certain industrial segments, the proposed segmentation is not intended to accurately represent energy consumption at individual industrial facilities. The team also notes that, in general, the industrial sector exhibits much greater diversity regarding energy usage compared to the commercial or residential sectors.

2.1.2 End-Use Definitions

The next step in the base year calibration analysis involved the establishment of specific end-uses for each customer sector. This CPR defines end-uses as a specific activity or customer need that requires energy, such as space heating or domestic water heating, without specifying the particular type of equipment used to satisfy that need. There are two industrial end-uses, however, that do not align to this definition and represent specific types of industrial equipment; Boilers and Pumps. These two end-uses were defined as specific industrial equipment to better reflect the nature of energy consumption and to enable the model to capture and analyze savings potential arising from these sources.

Table 2-9 presents the list of end-uses by sector used in the CPR, with end-use definitions provided in Appendix B.1. These end-use categories have significant impact on the base year calibration since Navigant calculated the energy consumption for a given baseline measure based on the gas intensity of the end-use to which that measure is assigned. These end-uses also allow Navigant's model to incorporate changes in electric and gas end-use intensity over time.

Table 2-9: End-Uses by Sector

Residential	Commercial	Industrial
Appliances	Cooking	Boilers
Electronics	HVAC Fans/Pumps	Compressed Air
Hot Water	Hot Water	Fans & Blowers
Lighting	Lighting	Industrial Process
Other	Office Equipment	Lighting
Space Cooling	Other	Material Transport
Space Heating	Refrigeration	Process Compressors
Ventilation	Space Cooling	Process Heating
Whole Facility	Space Heating	Product Drying
	Whole Facility	Pumps
		Refrigeration
		Space Heating
		Whole Facility

Source: Navigant

2.1.3 Fuel Share and Equipment Data

Navigant developed fuel share and equipment data for each end-use based on the segmentations defined in the previous sections. The team followed two approaches, depending on sector, as described below:

- **Residential and Commercial Sectors**

  Navigant developed estimates of the distribution of fuel shares for each end-use and the types of equipment that contribute to energy consumption within each end-use based on available data from prior FortisBC Gas end-use surveys. Navigant analyzed FortisBC Gas's *2012 Residential End-Use Survey* (2012 REUS) and *2015 Commercial End-Use Survey* (2015 CEUS). Navigant's review of these resources was supported by data from BC Hydro's *2014 Residential End-Use Survey* (2014 REUS) and *2015 Commercial End-Use Survey* (2015 CEUS). The team also relied on program evaluation reports, conditional demand analysis (CDA) studies, and monitoring surveys provided by both utilities[7]. Appendix B.2 and Appendix B.3 summarize the fuel shares and equipment shares used for the residential and commercial sectors, respectively.

- **Industrial Sector**

  Navigant subcontracted CLEAResult, who has considerable expertise in the industrial sector in BC, to develop an estimate of the distribution of energy consumption by each end-use for each industrial customer segment. CLEAResult determined these estimates based on a detailed database of industrial equipment such as pumps, fans, blowers, motors, compressed air equipment, etc. This database contains information on equipment types, key equipment characteristics including system efficiency and/or equipment efficiency levels, and equipment market shares. CLEAResult developed this database based on *Power Smart* industrial reviews, industrial energy assessments, equipment inventories, and ongoing audit and market assessment work with BC Hydro and FortisBC.

Appendix B.2 and Appendix B.3 provide the information developed for each sector and the resulting estimates of energy intensity.

2.1.4 Calibration Process

This section describes the calibration process Navigant used for the residential, commercial, and industrial sectors.

2.1.4.1 Residential and Commercial Sectors

For the residential and commercial sectors, Navigant developed a base year calibration model to analyze gas consumption at an equipment level, at an end-use level, and at a segment level. The team developed this calibration model to accurately calibrate the estimated gas consumption of each sector to the Fortis Gas sales.

The calibration process began at an equipment level for each of the energy-intensive end-uses—the primary end-uses—and at an end-use level for the less energy-intensive end-uses—the secondary end-uses. Navigant determined the primary end-uses as those that make up more than 15% of gas consumption and for which the availability of equipment data enabled a detailed analysis of equipment data. The calibration model for primary end-uses involved a complete bottom-up buildup of detailed equipment information including various efficiency levels, unit energy consumption (UEC) for each efficiency level, equipment market shares, and fuel types for different equipment. The team extracted these inputs primarily from FortisBC Gas and BC Hydro's REUS and CEUS studies. For the secondary end-uses, calibration focused primarily on analyzing and establishing end-use intensities based on previous CPR studies, CDA reports, and other secondary resources. This process ensured that the segment-level EUIs approximated the sales targets with reasonable precision.

The calibration model used these inputs to aggregate gas consumption by end-uses and by customer segment, and compared the results to the FortisBC Gas sales at the lowest level of disaggregation available. The calibration of the base year was an iterative process to estimate energy consumption from

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[7] We note that the BC Utilities provided some data sources on a confidential basis and thus they are not publically available.

the lowest level of granularity (i.e., equipment types) to the sector level. Each calibrated iteration required refining of key variables and inputs such as the market share of equipment types, UECs by equipment, and fuel shares.

Table 2-10 shows an example of the calibration process followed for single family detached/duplexes in the Southern Interior region. The process used to calibrate the estimate of energy use builds on an estimate of the percentage of homes with a particular end-use and fuel type, using a particular type of equipment and efficiency within an end-use. The fuel shares (column B), equipment shares (column E), and an estimated level of energy use for each equipment type (column F) are multiplied to obtain an estimated UEC (column G). In the example below, column G sums the total consumption across all water heating equipment. The team summed the resulting EUCs across end-uses to obtain the segment-level intensity (GJ per year), and then calibrated to match the actual target intensity stemming from FortisBC Gas sales data. Navigant repeated this same process across all residential and commercial segments in each region.

Table 2-10: Example of Calibration Process (Single Family Detached/Duplexes – Southern Interior)

A	B	C	D	E	F	G	H	I
End Use	**Fuel Share (%)**	**Equipment**	**Efficiency**	**Equipment Share (%)**	**Annual Energy Use (GJ)**	**End-Use Weighted Avg. Use (GJ)**	**Total Uncalibrated Consumption (GJ)**	**Total Calibrated Consumption (GJ)**
Space Heating	*85%*	*…*	*…*	*…*	*…*	*…*	*51.7*	*57.7*
Water Heating	*72%*	*Gas Water Heater Conventnl*	*n/a*	*83%*	*17.7*	*12.2*	*12.2*	*13.6*
		Gas Water Heater Condensing	*n/a*	*13%*	*13.7*			
		Gas DHW Tankless	*n/a*	*4%*	*10.9*			
Cooling	*0%*	*…*	*…*	*…*	*…*	*…*	*0.0*	*0.0*
Appliances	*100%*	*…*					*1.3*	*1.4*
Lighting	*0%*	*…*	*…*	*…*	*…*	*…*	*0.0*	*0.0*
Electronics	*0%*	*…*	*…*	*…*	*…*	*…*	*0.0*	*0.0*
Other	*0%*	*…*	*…*	*…*	*…*	*…*	*2.5*	*2.8*
Ventilation	*0%*	*…*	*…*	*…*	*…*	*…*	*0.0*	*0.0*
Estimated Consumption (GJ per year)							*67.7*	***75.6***
Target Consumption (GJ per year)			*- calculated based on Fortis Gas 2014 sales data*				*75.6*	***75.6***
	Uncalibrated vs. Target						***90%***	***100%***

Appliances are assigned a fuel share of 100%. This implies that all gas appliances have a fuel share of 100% gas. Similarly, electric utilities have an appliances fuel share of 100%. The actual penetration of individual gas appliances (e.g., x% of homes have a gas clothes dryer) is represented by the equipment shares column.
Source: Navigant

Navigant developed the calibration process to operate across all of the dimensions of the model as listed below (e.g., energy types, sectors, regions, etc.). The following sections present the key estimates of energy use by end-use, sector, and region. Most inputs to the calibration process, including efficiency levels and shares, equipment types, equipment shares, fuel shares, and EUIs by end-use, segment, and region, are presented in Appendix B.2 for the residential sector and Appendix B.3 for the commercial sector.

Table 2-11: Base Year Calibration Dimensions (Residential and Commercial Sectors)

Element	No. of Dimensions	Dimensions	
Energy Types	2	**Electricity**	**Natural Gas**
Sectors	2	Residential, Commercial	
Regions	4	Lower Mainland Southern Interior Vancouver Island Northern BC	
Utilities	4	BC Hydro FortisBC Inc.	FortisBC Energy Inc. Pacific Northern Gas
Segments	17	Residential (5), Commercial (12)	
End-Uses	17	Residential (8), Commercial (9)	
Equipment Types	<5	Varies by end-use—generally less than five	
Efficiency Levels	>2	Generally two for each equipment type	

Source: Navigant

2.1.4.2 Industrial Sector

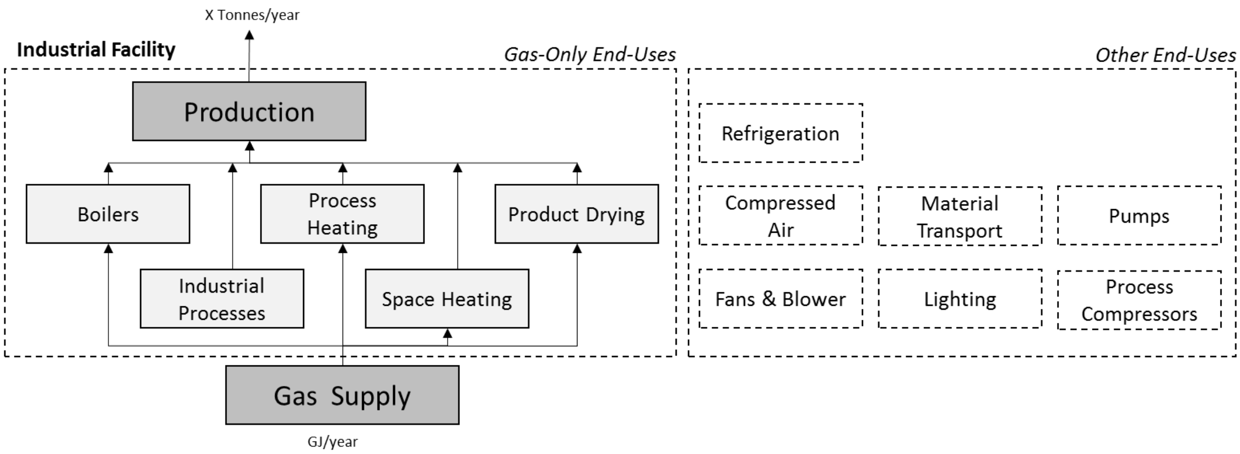
CLEAResult developed estimates of the distribution of energy consumption by end-use for each industrial segment. To calculate the energy consumption by end-use, CLEAResult utilized detailed data on industrial facilities for each of the industrial segments from numerous resources including:

- *BC Hydro* Industrial Electricity Analysis Reviews of industrial customers
- Prior industrial energy assessments performed for BC Hydro and FortisBC
- Detailed energy audits of large industrial facilities in BC
- Inventories of industrial equipment
- CLEAResult professional experience and literature review

Over many years of data collection, CLEAResult has used these resources to build a detailed database of industrial equipment such as pumps, fans, blowers, motors, compressed air equipment, etc. For each equipment type, CLEAResult determined key equipment characteristics including overall system efficiency and/or equipment efficiency levels and equipment market shares, and developed industrial models for BC Hydro and FortisBC. CLEAResult has used these models on a continuous basis to assist BC Hydro and FortisBC with market assessments and DSM program business-case developments. For this CPR, Navigant and CLEAResult aligned the industrial models with up-to-date billing account information broken down into the various industrial segments, and developed end-use allocation factors to estimate the proportion of energy use attributed to each end-use.

CLEAResult's industrial models are broken down into separate sub-models for the major industrial energy end-use categories. Figure 2-1 shows a schematic example of one of these industrial models. As illustrated, a subset of all industrial end-uses are served by natural gas.

Figure 2-1: Schematic of Industrial Model



Source: Navigant schematic of CLEAResult model

The production occurring in each particular segment drives the models for the major energy use industrial segments. A given amount of production requires a certain amount of electricity or natural gas consumption, and this energy can be broken down into each of the end-uses based on the installed equipment.

This detailed modeling approach is not appropriate for certain diverse segments such as food and beverage, manufacturing, and "other" industrial. These three segments involve such a large variety of processes and equipment types that it is not practical to setup an energy model for them. For these industrial segments, the team used end-use information from over 200 facility audits—sponsored by BC Hydro and FortisBC, and including industry groups such as the *BC Food Processors Association* and *Canadian Manufacturers & Exporters*—to estimate the end-use breakdown of each segment. For each of these audits, CLEAResult developed a breakdown of equipment and energy end-use, which Navigant used to develop the end-use breakdown of the food and beverage, manufacturing, and "other" industrial segments.

Table 2-12 shows the resulting end-use consumption percentages developed by CLEAResult, as a distribution of gas consumption by end-use for each industrial segment.

Table 2-12: Industrial End-use Allocation Factors (%)

Segment	Boilers	Compressed Air	Fans & Blowers	Industrial Process	Lighting	Material Transport	Process Compressors	Process Heating	Product Drying	Space Heating	Pumps	Refrigeration	**Total**
Agriculture	50%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	**100%**
Cement	4%	0%	0%	0%	0%	0%	0%	90%	4%	2%	0%	0%	**100%**
Chemical	48%	0%	0%	0%	0%	0%	0%	43%	0%	9%	0%	0%	**100%**
Coal Mining	8%	0%	0%	0%	0%	0%	0%	0%	89%	2%	0%	0%	**100%**
Food & Beverage	73%	0%	0%	0%	0%	0%	0%	20%	0%	7%	0%	0%	**100%**
Greenhouses	75%	0%	0%	0%	0%	0%	0%	22%	0%	3%	0%	0%	**100%**
LNG Facilities	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	**0%**
Manufacturing	5%	0%	0%	0%	0%	0%	0%	43%	21%	31%	0%	0%	**100%**
Metal Mining	8%	0%	0%	0%	0%	0%	0%	0%	89%	2%	0%	0%	**100%**
Oil and Gas	5%	0%	0%	75%	0%	0%	0%	10%	0%	10%	0%	0%	**100%**
Pulp & Paper - Kraft	48%	0%	0%	0%	0%	0%	0%	38%	12%	2%	0%	0%	**100%**
Pulp & Paper - TMP	49%	0%	0%	0%	0%	0%	0%	0%	49%	2%	0%	0%	**100%**
Transportation	40%	0%	0%	0%	0%	0%	0%	0%	0%	60%	0%	0%	**100%**
Wood Products	11%	0%	0%	0%	0%	0%	0%	5%	81%	4%	0%	0%	**100%**
Other Industrial	30%	0%	0%	0%	0%	0%	0%	7%	13%	50%	0%	0%	**100%**

Source: CLEAResult

The next step of the industrial sector analysis was to determine the total gas consumption by each segment. Navigant worked with FortisBC Gas to determine the total sales in each industrial segment during the base year. Table 2-13 shows the total gas consumption of each industrial segment region in the base year (2014).

Table 2-13: Base Year Industrial Gas Consumption by Segment (TJ) – FortisBC Gas

Segment	All Regions
Agriculture	1,601
Cement	908
Chemical	1,284
Coal Mining	2,517
Food & Beverage	4,000
Greenhouses	5,473
LNG Facilities	-
Manufacturing	5,710
Metal Mining	10
Oil and Gas	8,761
Pulp & Paper - Kraft	14,585
Pulp & Paper - TMP	3,450
Transportation	921
Wood Products	7,567
Other Industrial	789
Totals	**57,577**

Source: Navigant analysis of FortisBC Gas data

The final step of this analysis was the application of the end-use consumption percentages to the gas consumption corresponding to each industrial segment. Table 2-14 shows the resulting distribution of gas consumption by end-use and by industrial segment.

Table 2-14: Base Year Industrial Gas Consumption by End-use (TJ) – FortisBC Gas

Segment	Boilers	Compressed Air	Fans & Blowers	Industrial Process	Lighting	Material Transport	Process Compressors	Process Heating	Product Drying	Space Heating	Pumps	Refrigeration	Total
Agriculture	800	-	-	-	-	-	-	-	-	800	-	-	**1,601**
Cement	36	-	-	-	-	-	-	817	36	18	-	-	**908**
Chemical	611	-	-	-	-	-	-	557	-	116	-	-	**1,284**
Coal Mining	200	-	-	-	-	-	-	11	2,250	56	-	-	**2,517**
Food & Beverage	2,929	-	-	-	-	-	-	794	-	278	-	-	**4,000**
Greenhouses	4,105	-	-	-	-	-	-	1,204	-	164	-	-	**5,473**
LNG Facilities	-	-	-	-	-	-	-	-	-	-	-	-	**-**
Manufacturing	267	-	-	-	-	-	-	2,471	1,209	1,762	-	-	**5,710**
Metal Mining	1	-	-	-	-	-	-	0	9	0	-	-	**10**
Oil and Gas	438	-	-	6,571	-	-	-	876	-	876	-	-	**8,761**
Pulp & Paper - Kraft	7,001	-	-	-	-	-	-	5,542	1,750	292	-	-	**14,585**
Pulp & Paper - TMP	1,690	-	-	-	-	-	-	-	1,690	69	-	-	**3,450**
Transportation	368	-	-	-	-	-	-	-	-	552	-	-	**921**
Wood Products	799	-	-	-	-	-	-	363	6,097	308	-	-	**7,567**
Other Industrial	234	-	-	-	-	-	-	58	104	393	-	-	**789**
Totals -	**19,480**	**-**	**-**	**6,571**	**-**	**-**	**-**	**12,694**	**13,147**	**5,686**	**-**	**-**	**57,577**

Source: Navigant analysis of FortisBC Gas sales data and CLEAResult data

2.1.5 FortisBC Gas Base Year Consumption

Each of the BC utilities provided Navigant with information on actual sales and customer numbers for the base year (2014). Table 2-15 shows FortisBC Gas's total gas consumption by customer sector in 2014 (the "actual consumption").

Note that for the base year and reference case analysis, Navigant included apartment units in the residential sector. However, to report technical and economic savings potential in Section 3 and 4, apartments are included in the commercial sector. For reference, the second half of Table 2-15 shows the breakdown of the residential segment excluding apartment units.

Table 2-15: Actual Consumption in 2014 (TJ) – FortisBC Gas

Segment	Lower Mainland	Southern Interior	Vancouver Island	Northern BC	Total
Residential	65,227	16,103	6,789	4,949	**93,069**
Commercial	25,595	9,859	2,969	2,211	**40,634**
Industrial	22,019	12,281	8,587	14,690	**57,577**
Total	**112,841**	**38,243**	**18,346**	**21,850**	**191,280**
Apartments Excluded					
Residential (excl. Apts.)	49,192	13,917	5,539	4,469	**73,117**
Apartments	16,035	2,186	1,251	480	**19,952**
Commercial	25,595	9,859	2,969	2,211	**40,634**
Industrial	22,019	12,281	8,587	14,690	**57,577**
Total	**112,841**	**38,243**	**18,346**	**21,850**	**191,280**

Source: Navigant analysis of FortisBC Gas data

2.1.6 Comparison between Base Year and Actual Consumption

Navigant used the calibration process—described in previous sections—along with the actual consumption targets to develop calibrated estimates of gas consumption (the "base year consumption").

Table 2-16 shows the result of the base year calibration by sector and region. This table compares the actual consumption targets (based on FortisBC Gas sales) with the base year consumption (determined through the calibration process). As illustrated by the last column, the base year consumption values developed for the CPR study matches the 2014 actual consumption of each sector and region.

Table 2-16: 2014 Actual Consumption vs. Base Year Consumption (TJ) – FortisBC Gas

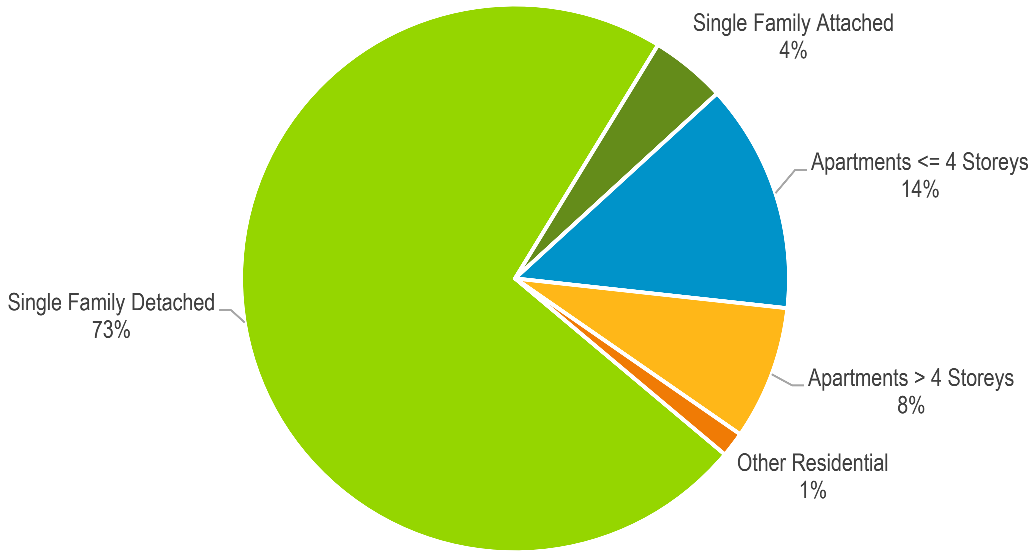
Region	Sect or	Actual Consumption (TJ)	Base Year (TJ)	Difference (%)
Lower Mainland	Residential	65,227	65,227	0.0%
	Commercial	25,595	25,595	0.0%
	Industrial	22,019	22,019	0.0%
Southern Interior	Residential	16,103	16,103	0.0%
	Commercial	9,859	9,859	0.0%
	Industrial	12,281	12,281	0.0%
Vancouver Island	Residential	6,789	6,789	0.0%
	Commercial	2,969	2,969	0.0%
	Industrial	8,587	8,587	0.0%
Northern BC	Residential	4,949	4,949	0.0%
	Commercial	2,211	2,211	0.0%
	Industrial	14,690	14,690	0.0%
Total	**Residential** *(includes apartments)*	**93,069**	**93,069**	**0.0%**
	Commercial	**40,634**	**40,634**	**0.0%**
	Industrial	**57,577**	**57,577**	**0.0%**

Source: Navigant analysis

As part of the development of the base year, Navigant determined the gas consumption for each segment within the residential, commercial, and industrial sectors. The distribution of gas consumption by segment and end-use for each sector is shown by Figure 2-2 through Figure 2-7, and the tabulated results are shown by Table 2-17 (residential) and Table 2-18 (commercial). The industrial results were shown by Table 2-14 in Section 2.1.4.2.

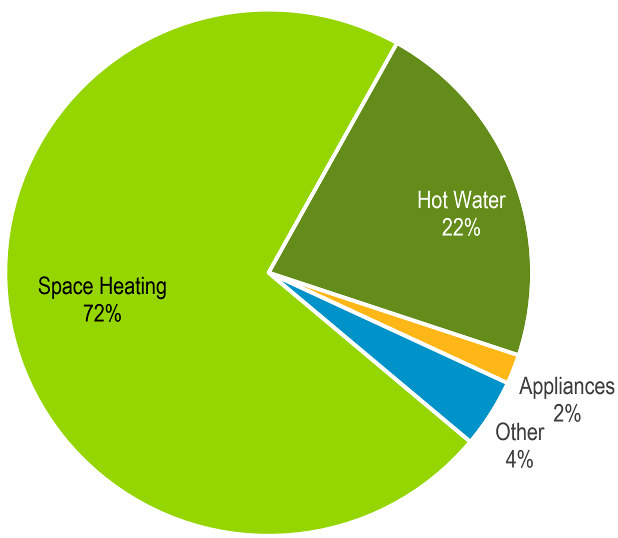
Additional information relating to each segment can be found in Appendix B.2 (for the residential sector), Appendix B.3 (for the commercial sector), and Appendix B.4 (for the industrial sector).

Figure 2-2: Base Year Residential Consumption by Segment (%)



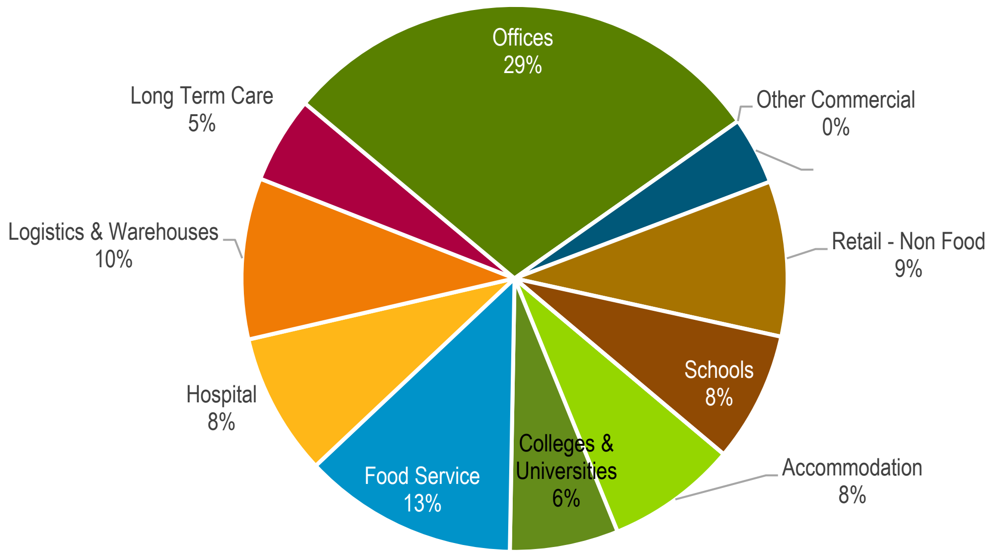
Source: Navigant analysis

Figure 2-3: Base Year Residential Consumption by End-Use (%)



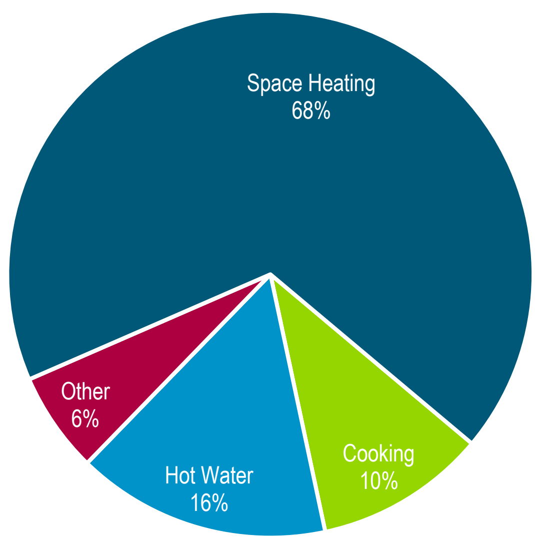
Source: Navigant analysis

Figure 2-4: Base Year Commercial by Segment Consumption (%)



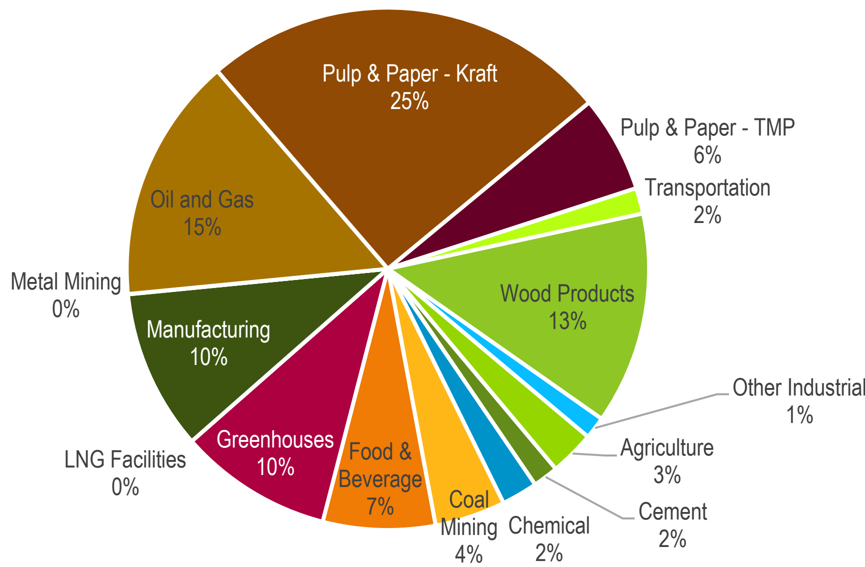
Source: Navigant analysis

Figure 2-5: Base Year Commercial by Segment End-Use (%)



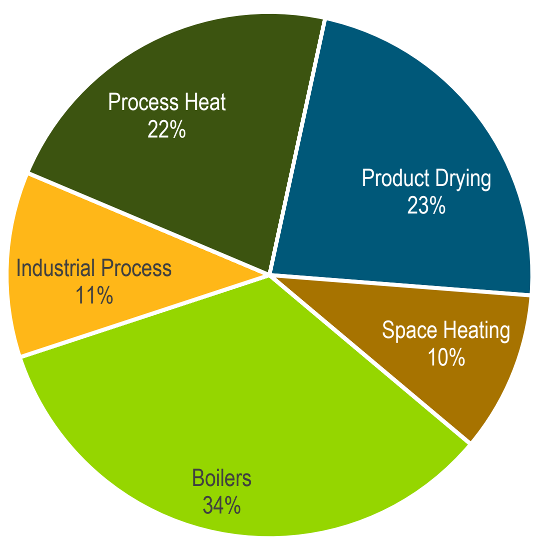
Source: Navigant analysis

Figure 2-6: Base Year Industrial Consumption by Segment (%)



Source: Navigant analysis

Figure 2-7: Base Year Industrial Consumption by End-Use (%)



Source: Navigant analysis

Table 2-17: Base Year Residential Consumption by Segment and End-use (TJ) – FortisBC Gas

Segment	Space Heating	Hot Water	Space Cooling	Appliances	Lighting	Electronics	Other	Ventilation	Total
Single Family Detached/Duplexes	53,132	11,235	-	1,103	-	-	2,129	-	**67,598**
Single Family Attached/Row	3,219	770	-	63	-	-	96	-	**4,148**
Apartments <= 4 stories	6,026	5,214	-	314	-	-	1,043	-	**12,597**
Apartments > 4 stories	3,596	2,944	-	188	-	-	628	-	**7,355**
Other Residential	1,036	287	-	21	-	-	27	-	**1,370**
Totals -	**67,009**	**20,449**	**-**	**1,688**	**-**	**-**	**3,923**	**-**	**93,069**

Source: Navigant analysis

Table 2-18: Base Year Commercial Consumption by Segment and End-use (TJ) – FortisBC Gas[8]

Segment	Cooking	NVAC Fans/Pumps	Hot Water	Lighting	Office Equipment	Other	Refrigeration	Space Cooling	Space Hating	Total
Accommodation	368	-	1,201	-	-	262	-	-	1,309	**3,141**
Colleges/Universities	198	-	367	-	-	346	-	-	1,715	**2,625**
Food Service	2,454	-	1,394	-	-	55	-	-	1,253	**5,155**
Hospital	153	-	644	-	-	548	-	-	2,083	**3,428**
Logistics/Warehouses	68	-	265	-	-	273	-	-	3,251	**3,857**
Long Term Care	186	-	517	-	-	217	-	-	1,170	**2,091**
Office	319	-	1,126	-	-	638	-	-	9,800	**11,882**
Other Commercial	-	-	-	-	-	-	-	-	-	**-**
Retail - Food	259	-	225	-	-	65	-	-	1,076	**1,624**
Retail - Non Food	150	-	269	-	-	75	-	-	3,204	**3,698**
Schools	131	-	340	-	-	41	-	-	2,628	**3,140**
Totals -	**4,285**	**-**	**6,348**	**-**	**-**	**2,518**	**-**	**-**	**27,489**	**40,640**

Source: Navigant analysis

[8] Gas sales initially attributed to the *Other Commercial* segment were distributed across all other commercial segments proportionally.

2.2 Reference Case Forecast

This section presents the Reference Case for the CPR study period from 2015 to 2035. The Reference Case estimates the expected level of gas consumption over the CPR period, absent incremental demand-side management (DSM) activities or load impacts from conservation rates. Gas consumption levels in the Reference Case are also based on codes and standards previously included in regulation and reflected in each utility's load forecast.[9] The Reference Case is significant in the context of this CPR study because it acts as the point of comparison (i.e., the reference) for the calculation of the technical and economic potential scenarios.

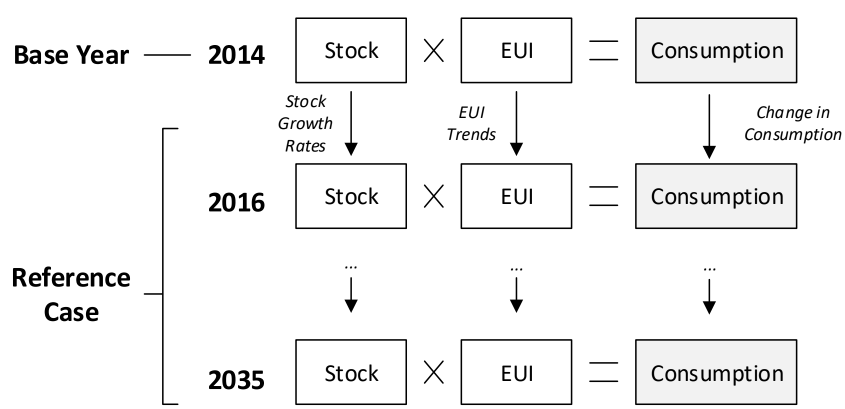
The Reference Case Forecast uses the base year calibration—presented in the previous section—as the foundation for analysis.

Navigant constructed the Reference Case forecast using two different approaches based on sector.

- **Residential and commercial sectors:** For the residential and commercial sectors, Navigant used two key inputs: stock growth rates and EUI trends. Navigant developed stock growth projections of residential accounts and commercial floor area. The team then modeled the potential for energy efficiency based on the resulting stock projections of each customer segment. The team applied EUI trends to the base year EUIs for each customer segment, and used these trends to represent natural change in end-use consumption over time.

  Figure 2-8 illustrates the process used to develop the Reference Case for the residential and commercial sectors. This figure illustrates that applying stock growth rates to the base year stocks of each customer segment results in a forecast of stocks through 2035. Similarly, applying the EUI trends to the base year EUIs results in a forecast of EUIs through 2035. The final step of this process involves multiplying the stock forecast with the corresponding EUI forecast in order to obtain a load forecast.

Figure 2-8: Schematic of Reference Case Development



Source: Navigant

[9] Each utility's load forecast reflects specific effectiveness dates and performance thresholds for codes and standards previously enshrined in regulation. By extension, recently announced performance targets or codes and standards that are not yet enshrined in regulation –such as the target for net zero new construction included in the BC Climate Leadership Plan– are excluded from the analysis.

- **Industrial sector:** The Reference Case for the Industrial sector assumed frozen EUIs over the Reference Case forecast (e.g., frozen EUIs assume that EUIs do not change and are static over time). A more detailed discussion supporting this assumption is presented in Section 2.2.3.3. Based on the frozen-EUI approach, the Industrial Reference Case was established solely by developing energy demand growth assumptions for each industrial segment.

Navigant compared the forecasts developed for the Reference Case for the residential, commercial, and industrial sectors with the long-term load forecast developed by each utility. This comparison ensured that the Reference Case forecast is consistent with each utility's current expectations for load growth over the 2015 to 2035 period.

2.2.1 Approach

This section introduces the overall process for developing the residential and commercial Reference Case. As noted earlier, the Reference Case approach for the industrial sector differed from the residential and commercial sectors.

Navigant's Reference Case started with the base year estimate of stocks and gas consumption for 2014. Two key inputs were the basis for projected change in gas consumption through the CPR study period:

- Stock growth rates
- Gas EUI trends

To develop the Reference Case for each sector, Navigant first developed the stock growth rates based on the CPR segmentation for each sector and region. The second step established appropriate EUI trends that the team applied to each segment and region. Finally, the team applied these two inputs to the base year estimates of stock and EUIs, and projected the results through 2035 to construct the Reference Case.

Navigant developed the growth rates for stock and the EUI trends based primarily on information provided by FortisBC Gas. Secondary sources supported any gaps in these data.

The following two sections provide detailed descriptions of the approach followed to establish stock growth rates and gas EUI trends for each sector.[10] As noted in previous sections, for the base year and reference case analysis apartment units have been included in the residential sector. As such, the following sections will present stock growth rates and EUI trends for apartment units within the residential sector.

[10] For the industrial sector, the stock growth rate section (Section 2.2.2.3) presents the demand forecast established for each industrial customer segment, and the EUI trends section (Section 2.2.3.3) describes the reasoning for a frozen EUI approach.

2.2.2 Stock Growth Rates

This section describes the approach followed to develop stock growth rates for the residential, commercial and industrial sectors.[11]

2.2.2.1 Residential Sector

To develop the residential Reference Case, Navigant first developed and applied growth rates for each residential segment and region over the CPR study period. Navigant established the stock growth rates from household forecasts derived from FortisBC's 2014 Long Term Resource Planning (LTRP) Demand Forecast (as updated)[12]. Based on the residential stock forecasts, average annual growth rates were established for each five-year period in the forecast (e.g., 2015 to 2020, 2021 to 2025, etc.). The team applied these five-year growth rates over the same periods through the end of the CPR study period for each residential segment. A detailed description of the approach used to develop the residential household projections is included in Appendix B.2.

[11] In relation to the natural turnover of commercial floor stock, Navigant's model assumes a stock demolition rate of 0.5% per year for commercial and residential segments and 0% for industrial segments. These demolition rates apply to the existing stock in each year of the analysis. A demolition rate of 0.5% is a conservative assumption used to avoid over-estimation of growth in building stock by recognizing that some new construction is replacing demolished stock and does not add to the total count of building stock. Industrial demolition rates are 0% because industrial facilities are less homogenous than commercial and residential buildings, and the closure of a single plant can represent a significant percentage of a given industrial segment. Given the lack of information about planned closures of industrial facilities, the 0% industrial demolition rate is a more reasonable assumption than representing industrial demolition as a continuous decay of building stock, as is modelled for commercial and residential buildings.

[12] The customer and demand forecast presented in FortisBC Gas's 2014 LTRP was developed from the 2011 year-end actual customer count. A subsequent update was prepared with the only change being the use of the more recent 2012 year-end actual customer count. This update is the most recent long term forecast available and thus has been used in the preparation of the 2016 CPR.

Table 2-19 shows the growth rates employed in the CPR study.

Table 2-19: Annual Growth Rates by Residential Segment and Region (%) – FortisBC Gas

Region	Segment	CPR Period			
		2014-2020	2021-2025	2026-2030	2031-2035
Lower Mainland	Single Family Detached/Duplexes	0.4%	0.2%	0.3%	0.3%
	Single Family Attached/Row	0.8%	0.5%	0.5%	0.5%
	Apartments =< 4 stories	0.6%	0.4%	0.4%	0.5%
	Apartments > 4 stories	0.6%	0.4%	0.4%	0.5%
	Other Residential	0.5%	0.3%	0.4%	0.4%
Southern Interior	Single Family Detached/Duplexes	0.9%	0.6%	0.6%	0.7%
	Single Family Attached/Row	1.3%	1.1%	0.9%	0.7%
	Apartments =< 4 stories	0.7%	0.6%	0.5%	0.5%
	Apartments > 4 stories	0.7%	0.6%	0.5%	0.5%
	Other Residential	1.6%	0.9%	0.9%	0.8%
Vancouver Island	Single Family Detached/Duplexes	0.5%	0.4%	0.4%	0.5%
	Single Family Attached/Row	0.9%	0.6%	0.6%	0.5%
	Apartments =< 4 stories	0.4%	0.2%	0.3%	0.3%
	Apartments > 4 stories	0.4%	0.2%	0.3%	0.3%
	Other Residential	1.0%	0.5%	0.6%	0.8%
Northern Region	Single Family Detached/Duplexes	0.5%	0.3%	0.3%	0.4%
	Single Family Attached/Row	0.7%	0.5%	0.5%	0.5%
	Apartments =< 4 stories	0.4%	0.3%	0.3%	0.3%
	Apartments > 4 stories	0.4%	0.3%	0.3%	0.3%
	Other Residential	1.2%	0.8%	1.1%	0.8%

Source: Navigant analysis of FortisBC Gas's 2014 LTRP

Table 2-20 presents the Reference Case forecast of households by segment and region over time. The team initially based the number of residential dwellings presented in Table 2-20 on the base year residential stock determined for 2014, but adjusted these numbers by applying the growth rates presented above in Table 2-19.

Table 2-20: Number of Residential Dwellings by Segment by Region – FortisBC Gas

Region	Segment	CPR Period				
		2014	2020	2025	2030	2035
Lower Mainland	Single Family Detached/Duplexes	475,475	486,379	492,271	499,539	507,855
	Single Family Attached/Row	53,890	56,388	57,682	59,107	60,645
	Apartments <= 4 stories	216,678	224,205	228,772	233,693	239,023
	Apartments > 4 stories	158,724	164,237	167,583	171,188	175,092
	Other Residential	10,348	10,653	10,806	10,998	11,203
Southern Interior	Single Family Detached/Duplexes	170,298	179,429	185,320	191,223	198,147
	Single Family Attached/Row	10,417	11,282	11,916	12,474	12,933
	Apartments <= 4 stories	52,875	54,993	56,591	58,010	59,346
	Apartments > 4 stories	6,853	7,128	7,335	7,519	7,692
	Other Residential	8,940	9,849	10,318	10,791	11,225
Vancouver Island	Single Family Detached/Duplexes	89,448	92,186	93,847	95,823	98,015
	Single Family Attached/Row	7,109	7,483	7,700	7,916	8,118
	Apartments <= 4 stories	59,179	60,627	61,388	62,210	63,136
	Apartments > 4 stories	17,195	17,616	17,837	18,076	18,345
	Other Residential	2,198	2,336	2,395	2,473	2,577
Northern Region	Single Family Detached/Duplexes	45,448	46,703	47,400	48,200	49,120
	Single Family Attached/Row	2,550	2,652	2,713	2,779	2,853
	Apartments <= 4 stories	10,195	10,436	10,584	10,724	10,896
	Apartments > 4 stories	1,007	1,031	1,045	1,059	1,076
	Other Residential	2,405	2,582	2,689	2,842	2,957
Segment Totals	Single Family Detached/Duplexes	780,669	804,697	818,838	834,784	853,136
	Single Family Attached/Row	73,965	77,804	80,011	82,276	84,549
	Apartments <= 4 stories	338,927	350,261	357,334	364,637	372,401
	Apartments > 4 stories	183,779	190,012	193,800	197,841	202,205
	Other Residential	23,891	25,419	26,208	27,104	27,961
Total		**1,401,231**	**1,448,194**	**1,476,192**	**1,506,641**	**1,540,253**

Source: Navigant analysis of Base Year residential stock and FortisBC Gas's 2014 LTRP

2.2.2.2 Commercial Sector

To develop the commercial Reference Case, the team first selected floor area as the most appropriate driver for gas consumption in the commercial sector. This section describes the development and application of floor space growth rates for each commercial segment and region over the CPR study period. To develop projections of commercial floor area growth by segment, the team relied on three key resources:

- StatsCan's Labour Force Statistics for British Columbia (*BC Labour Force Statistics*)[13]
- NRCan-Office of Energy Efficiency (OEE) Comprehensive Energy Consumption Database
- FortisBC Gas's 2014 LTRP

The primary resource employed to develop stock growth rates was the BC Labour Force Statistics, which tracks labour force levels for 11 commercial segments and 36 commercial sub-segments across seven economic regions in British Columbia. BC Stats uses these statistics for employment forecasting, which represent the most granular publicly available resource reporting commercial sector trends since 2000. The team relied on these data because both employment levels and floor space can serve as the basis for predicting energy demand.[14]

Navigant calculated the statistical relationship between labour force levels and commercial floor space to determine the appropriateness of using labour as a proxy for floor space. The OEE database tracks commercial floor space in BC disaggregated across 10 commercial segments. Since the OEE reports data at a provincial level and not disaggregated across regions, the team summed employment levels across all regions. The team analyzed floor space and labour force levels for the period between 2000 and 2012 for each OEE commercial segment. Table 2-21 below shows the correlation coefficient corresponding to each segment. Most segments show a strong positive correlation with coefficient values ranging between 0.80 and 0.97.

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[13] *CANSIM Labor Force Survey Estimates (LFS) (March 2001 to December 2015)* – Table 282-026

[14] For example, vacant floor space can misrepresent the actual stock of floor space in use. As a result, projections of floor space, which account for vacant floor space, can skew energy demand upwards. In Ontario, the Independent Electricity System Operator (IESO) employs a forecasting approach based on employment levels. The IESO utilizes employment figures as an indicator to forecast electricity demand in the near term (i.e., 18-Month Outlook forecasts) and in the long term (i.e., Long Term Energy Plan). The IESO employs non-manufacturing employment levels to forecast demand in the commercial sector, and manufacturing employment for the industrial sector.

Table 2-21: Correlation Coefficient (Floor Space vs. Labor Force) – Commercial Sector

OEE Commercial Segment	Correlation Coefficient (2000 – 2012)
Wholesale Trade	0.80
Retail Trade	0.90
Transportation and Warehousing	(0.27)
Information and Cultural Industries	(0.62)
Offices	0.80
Educational Services	0.87
Health Care and Social Assistance	0.95
Arts, Entertainment and Recreation	0.83
Accommodation and Food Services	0.89
Other Services	0.13

Source: Navigant analysis of OEE and StatsCan data

Three of the commercial OEE segments - Transportation and Warehousing, Information and Cultural Industries, and Other Services - are exceptions with a negative correlation or close to no correlation at all. Two of the commercial segments in this CPR - Logistics and Warehousing and Other Commercial - use employment levels derived from these three OEE segments to establish stock growth rates. To avoid the use of poorly correlated variables, the team adjusted the growth rates for these two segments to follow the growth in commercial gas consumption in each region, determined from Fortis Gas's 2014 LTRP.

Navigant mapped the employment levels of the BC Labour Force Statistics to each of the CPR commercial segments and regions in the Reference Case. The team then analyzed employment growth rates over the 15-year period from 2000 to 2014 to use as a proxy to establish commercial floor space growth rates.

Finally, Navigant analyzed the FortisBC Gas 2014 LTRP to ensure that the stock growth rates applied in the Reference Case aligned with the overall trends in commercial demand projected by FortisBC Gas. The team applied the growth rates derived from the BC Labour Force Statistics to the first five years of the CPR forecast through 2020. For each subsequent five-year period in the forecast, the team applied an adjustment multiplier to the stock growth rates in each region of BC to align with the 2014 LTRP.

For example, the 2014 LTRP projects commercial consumption in the Lower Mainland to grow slightly from 2015 through 2035, with very little incremental demand over time. The team adjusted the Reference Case growth rates established for the Lower Mainland every five-year period to align with these trends in consumption.

Table 2-22 presents the growth rates employed in the CPR study for each segment and across time. The Lower Mainland has the most modest stock growth rates – aligned with the gas sales projections of the load forecast. In general, commercial floor space growth expectations are higher in the Southern Interior, Northern BC, and particularly in Vancouver Island where more aggressive sales projections are forecasted. At a segment level, expectations of commercial floor space growth in the long term care, hospitals, and food service segments are to be at levels significantly higher than the regional average. The following paragraphs provide additional information related to these three segments:

- **Colleges/Universities:** Historical post-secondary enrollment data from StatsCan shows an average annual growth rate of 3.3% across the province.[15] Enrolment in 2000/2001 was reported at 183,000, growing to approximately 278,000 by 2013/2014. BC Labour Force Statistics show that employment growth rates are highest in the Lower Mainland, and slower paced in the Southern Interior, Vancouver Island, and Northern BC.
- **Long Term Care:** BC is experiencing the fastest growth rate of senior citizens across Canada.[16] In absolute numbers, much of this expected growth is in the Lower Mainland and Vancouver Island where retirement homes clusters are most predominant. However, in relative terms, growth rates in the Southern Interior and Northern BC will be higher.[17] BC's Ministry of Health forecasts that demand for long-term care facilities will more than double by 2036 as a result projected growth in the senior population over the next 20 years.[18] Based on BC Labour Force Statistics, employment in nursing and residential care facilities more than doubled in the Southern Interior from 3,700 in 2000 to 9,200 in 2014, at an average annual growth rate of 4.8%.
- **Hospitals:** The Ministry of Health has identified the province's aging hospital infrastructure and current hospital capacity as critical challenges to meet projected provincial demand over the next two decades.[19] Following hospital closures across the province between 2002 and 2004, employment in healthcare has grown from 69,000 in 2005 to 91,700 in 2014, at an annual growth rate of 3.2%.[20] The Ministry of Health forecasts significant increases in demand in all health services through 2036. Projections show hospital floor space growing at rates much higher than each regional average, with highest growth rates in Vancouver Island and Northern BC.

Table 2-23 shows the estimated stock of commercial floor space over time. The base year commercial stock determined for 2014 is the initial basis for the stock of commercial floor space presented in Table 2-23, then the team adjusted future years by applying the growth rates identified in Table 2-22.

Note that as described in Section 2.1.1.3, gas consumption from the Other Commercial segment was distributed across all other commercial segments in proportion to their consumption. Since the base year gas consumption for the Other Commercial segment is zero, growth rates are also zero.

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[15] Statistic Canada. Table 477-0019. Post-secondary enrollments from 2000/2001 to 2013/2014.

[16] British Columbia. Ministry of Health. (2014). Setting priorities for the B.C. health system. Retrieved from http://www.health.gov.bc.ca/library/publications/year/2014/Setting-priorities-BC-Health-Feb14.pdf

[17] Office of the Senior's Advocate. May 2015. *"Senior's Housing in BC"*. Available: https://www.seniorsadvocatebc.ca/wp-content/uploads/sites/4/2015/05/Seniors-Housing-in-B.C.-Affordable-Appropriate-Available.pdf

[18] Marowitz, Ross. June 2015. The Canadian Press. *"Canada's Next Boom Industry? Retirement Homes, Developer Says"*. Available: http://www.huffingtonpost.ca/2015/06/17/quebec-developer-forecast_n_7603704.html

[19] Ministry of Health (2014)

[20] Cohen, March. July 2012. BC Health Coalition. *"Caring for BC's Aging Population".* Available: https://www.policyalternatives.ca/sites/default/files/uploads/publications/BC%20Office/2012/07/CCPABC-Caring-BC-Aging-Pop.pdf

Table 2-22: Annual Growth Rates by Commercial Segment and Region (%) – FortisBC Gas

Region	Segment	CPR Period			
		2014-2020	2021-2025	2026-2030	2031-2035
Lower Mainland	Accommodation	1.4%	1.2%	1.0%	0.8%
	Colleges/Universities	1.8%	1.5%	1.3%	1.1%
	Food Service	1.2%	1.0%	0.9%	0.7%
	Hospital	1.5%	1.3%	1.1%	0.9%
	Logistics/Warehouses	1.6%	1.4%	1.2%	1.0%
	Long Term Care	1.5%	1.3%	1.1%	0.9%
	Office	1.6%	1.3%	1.2%	0.9%
	Other Commercial	-	-	-	-
	Retail - Food	1.0%	0.8%	0.7%	0.6%
	Retail - Non Food	1.0%	0.8%	0.7%	0.6%
	Schools	1.1%	0.9%	0.8%	0.6%
Southern Interior	Accommodation	2.2%	1.9%	1.8%	1.6%
	Colleges/Universities	1.8%	1.5%	1.4%	1.3%
	Food Service	1.6%	1.4%	1.3%	1.2%
	Hospital	2.5%	2.2%	2.0%	1.9%
	Logistics/Warehouses	1.7%	1.5%	1.4%	1.3%
	Long Term Care	4.3%	3.6%	3.4%	3.1%
	Office	1.8%	1.5%	1.4%	1.3%
	Other Commercial	-	-	-	-
	Retail - Food	1.3%	1.1%	1.0%	0.9%
	Retail - Non Food	0.6%	0.5%	0.5%	0.5%
	Schools	0.8%	0.7%	0.6%	0.6%
Vancouver Island	Accommodation	0.3%	0.3%	0.3%	0.3%
	Colleges/Universities	3.1%	3.7%	3.4%	3.0%
	Food Service	0.1%	0.2%	0.2%	0.1%
	Hospital	4.7%	5.6%	5.2%	4.5%
	Logistics/Warehouses	1.2%	1.4%	1.3%	1.1%
	Long Term Care	4.9%	5.9%	5.4%	4.7%
	Office	1.7%	2.1%	1.9%	1.7%
	Other Commercial	-	-	-	-
	Retail - Food	0.2%	0.2%	0.2%	0.2%
	Retail - Non Food	1.8%	2.1%	2.0%	1.7%
	Schools	3.0%	3.6%	3.3%	2.9%
Northern BC	Accommodation	1.6%	1.9%	1.7%	1.5%
	Colleges/Universities	2.6%	3.2%	2.9%	2.6%
	Food Service	0.6%	0.7%	0.6%	0.6%
	Hospital	3.9%	4.7%	4.3%	3.8%
	Logistics/Warehouses	0.5%	0.6%	0.6%	0.5%
	Long Term Care	5.1%	6.1%	5.6%	4.9%
	Office	1.1%	1.3%	1.2%	1.0%
	Other Commercial	-	-	-	-
	Retail - Food	0.9%	1.1%	1.0%	0.9%
	Retail - Non Food	0.7%	0.8%	0.8%	0.7%
	Schools	1.3%	1.6%	1.4%	1.2%

Source: Navigant analysis of StatsCan Labour Market Statistics (CANSIM Table 282-026)

Table 2-23: Commercial Floor Space by Segment by Region (million m^2) – FortisBC Gas

Region	Segment	CPR Period				
		2014	2020	2025	2030	2035
Lower Mainland	Accommodation	2.55	2.78	2.94	3.10	3.23
	Colleges/Universities	4.10	4.55	4.90	5.24	5.52
	Food Service	2.17	2.34	2.46	2.57	2.66
	Hospital	1.56	1.71	1.82	1.93	2.02
	Logistics/Warehouses	10.56	11.61	12.43	13.20	13.84
	Long Term Care	2.05	2.24	2.39	2.52	2.64
	Office	22.06	24.21	25.88	27.45	28.77
	Other Commercial	-	-	-	-	-
	Retail - Food	2.10	2.24	2.33	2.41	2.48
	Retail - Non Food	7.34	7.83	8.16	8.47	8.72
	Schools	5.81	6.21	6.50	6.76	6.98
Southern Interior	Accommodation	1.56	1.77	1.95	2.13	2.31
	Colleges/Universities	0.39	0.43	0.47	0.50	0.54
	Food Service	0.54	0.59	0.63	0.67	0.71
	Hospital	0.64	0.74	0.82	0.91	1.00
	Logistics/Warehouses	3.30	3.67	3.95	4.23	4.50
	Long Term Care	0.87	1.10	1.31	1.55	1.81
	Office	7.08	7.88	8.49	9.10	9.70
	Other Commercial	-	-	-	-	-
	Retail - Food	0.99	1.08	1.14	1.20	1.25
	Retail - Non Food	3.08	3.24	3.33	3.41	3.49
	Schools	2.03	2.15	2.22	2.30	2.36
Vancouver Island	Accommodation	0.33	0.34	0.35	0.35	0.36
	Colleges/Universities	0.74	0.89	1.06	1.26	1.46
	Food Service	0.15	0.15	0.15	0.15	0.16
	Hospital	0.05	0.07	0.09	0.11	0.14
	Logistics/Warehouses	0.29	0.32	0.34	0.36	0.39
	Long Term Care	0.36	0.47	0.62	0.81	1.02
	Office	3.84	4.30	4.77	5.24	5.69
	Other Commercial	-	-	-	-	-
	Retail - Food	0.27	0.28	0.29	0.29	0.29
	Retail - Non Food	0.65	0.73	0.81	0.89	0.97
	Schools	0.53	0.63	0.75	0.89	1.03
Northern BC	Accommodation	0.25	0.28	0.31	0.33	0.36
	Colleges/Universities	0.07	0.08	0.10	0.11	0.13
	Food Service	0.08	0.08	0.08	0.08	0.09
	Hospital	0.10	0.12	0.15	0.18	0.22
	Logistics/Warehouses	0.48	0.50	0.52	0.53	0.55
	Long Term Care	0.04	0.06	0.08	0.10	0.13
	Office	1.24	1.33	1.42	1.51	1.59
	Other Commercial	-	-	-	-	-
	Retail - Food	0.11	0.11	0.12	0.13	0.13
	Retail - Non Food	0.48	0.51	0.53	0.55	0.57
	Schools	0.35	0.38	0.41	0.44	0.46
Segment Totals	Accommodation	4.69	5.17	5.54	5.91	6.25
	Colleges/Universities	5.30	5.95	6.53	7.11	7.64
	Food Service	2.93	3.16	3.32	3.48	3.62
	Hospital	2.35	2.64	2.89	3.14	3.38

Region	Segment	CPR Period				
		2014	2020	2025	2030	2035
	Logistics/Warehouses	14.64	16.11	17.24	18.33	19.28
	Long Term Care	3.33	3.86	4.40	4.98	5.59
	Office	34.22	37.73	40.56	43.30	45.74
	Other Commercial	-	-	-	-	-
	Retail - Food	3.47	3.71	3.87	4.03	4.16
	Retail - Non Food	11.55	12.31	12.83	13.32	13.75
	Schools	8.71	9.37	9.88	10.38	10.83
Totals	**Schools**	**91.18**	**100.01**	**107.06**	**113.97**	**120.24**

Source: Navigant analysis of StatsCan Labour Market Statistics and FortisBC Gas's 2014 LTRP

2.2.2.3 Industrial Sector

To develop the industrial Reference Case, the team developed and applied growth rates of gas demand for each industrial segment and region over the CPR study period. The team derived the demand growth rates from the FortisBC Gas 2014 LTRP.

FortisBC Gas's 2014 LTRP reports industrial sector gas sales as a whole and not broken down into individual industrial segments. To disaggregate the sector-wide forecast into industrial segments, Navigant and FortisBC worked together to develop gas sales projections which aligned with the sector-level forecast established for each region. Appendix B.4 describes the approach used to develop the industrial forecast in more detail.

Using this industrial load forecast, the team calculated average annual growth rates for each segment for each five-year period (e.g., 2015 to 2020, 2021 to 2025). The team applied these five-year growth rates to the same periods through the end of the CPR study period. For industrial segments with no presence in any particular region, the team specified a demand growth rate of zero (0.0%).

Table 2-24 presents the demand growth rates employed in the CPR study. Broadly speaking, the demand growth rates for the industrial sector show a gradual decline in gas sales over time across most segments and across each region. The growth rates presented in Table 2-24 lead to the estimated industrial consumption shown in Table 2-25. The base year consumption is the initial basis for the industrial demand in Table 2-25, which is then adjusted in future years by applying the growth rates identified in Table 2-24.

Table 2-24: Annual Growth Rates by Industrial Segment and Region (%) – FortisBC Gas

Region	Segment	CPR Period			
		2015-2020	2021-2025	2026-2030	2031-2035
Lower Mainland	Agriculture	-0.4%	-0.5%	0.3%	0.6%
	Cement	-1.2%	-1.8%	-0.1%	-0.1%
	Chemical	-2.4%	-1.4%	-0.5%	-0.2%
	Mining - Coal	-1.9%	-2.0%	-1.1%	-0.9%
	Food & Beverage	-1.8%	-2.0%	-1.1%	-0.9%
	Greenhouses	-1.0%	-1.1%	-0.2%	0.0%
	LNG Facilities	0.0%	0.0%	0.0%	0.0%
	Manufacturing	0.6%	0.0%	1.0%	1.2%
	Mining - Metal	-1.9%	-2.0%	-1.1%	-0.9%
	Oil and Gas	-1.9%	-2.0%	-1.1%	-0.9%
	Pulp & Paper - Kraft	0.0%	0.0%	0.0%	0.0%
	Pulp & Paper - TMP	-1.9%	-2.0%	-1.1%	-0.9%
	Transportation	-1.3%	-1.2%	-1.2%	-1.0%
	Wood Products	-0.7%	-0.9%	-0.1%	0.2%
	Other Industrial	2.4%	2.4%	-0.7%	-1.7%
Southern Interior	Agriculture	-0.6%	-0.8%	-0.8%	-0.8%
	Cement	-1.0%	-0.1%	0.7%	0.5%
	Chemical	0.9%	0.7%	0.7%	0.7%
	Mining - Coal	-0.5%	0.2%	-0.3%	-0.3%
	Food & Beverage	1.9%	1.7%	1.7%	1.7%
	Greenhouses	1.8%	1.6%	1.6%	1.6%
	LNG Facilities	0.0%	0.0%	0.0%	0.0%
	Manufacturing	-0.3%	-0.4%	-0.3%	-0.3%
	Mining - Metal	0.3%	0.7%	-4.1%	4.0%
	Oil and Gas	-0.1%	-0.3%	-0.3%	-0.3%
	Pulp & Paper - Kraft	-0.1%	-0.3%	-0.3%	-0.3%
	Pulp & Paper - TMP	-0.1%	-0.3%	-0.3%	-0.3%
	Transportation	1.0%	0.8%	0.7%	0.7%
	Wood Products	-0.3%	-1.0%	-0.6%	-0.6%
	Other Industrial	-2.1%	3.9%	1.8%	1.1%
Vancouver Island	Agriculture	1.1%	0.9%	1.5%	1.5%
	Cement	0.3%	-0.4%	1.0%	0.9%
	Chemical	-1.0%	0.1%	0.7%	0.7%
	Mining - Coal	0.0%	0.0%	0.0%	0.0%
	Food & Beverage	-0.4%	-0.5%	0.0%	0.1%
	Greenhouses	0.5%	0.3%	0.9%	0.9%
	LNG Facilities	0.0%	0.0%	0.0%	0.0%
	Manufacturing	2.1%	1.5%	2.1%	2.1%
	Mining - Metal	-0.4%	-0.6%	0.0%	0.0%
	Oil and Gas	0.0%	0.0%	0.0%	0.0%
	Pulp & Paper - Kraft	0.0%	0.0%	0.0%	0.0%
	Pulp & Paper - TMP	-0.4%	-0.6%	0.0%	0.0%
	Transportation	0.2%	0.3%	0.0%	0.0%
	Wood Products	0.8%	0.5%	1.1%	1.1%
	Other Industrial	3.9%	3.9%	0.4%	-0.8%
Northern BC	Agriculture	1.1%	1.0%	1.0%	1.1%
	Cement	0.3%	-0.3%	0.6%	0.4%
	Chemical	-0.9%	0.1%	0.2%	0.3%
	Mining - Coal	-0.4%	-0.5%	-0.5%	-0.4%
	Food & Beverage	-0.4%	-0.5%	-0.4%	-0.4%
	Greenhouses	0.5%	0.4%	0.4%	0.5%
	LNG Facilities	0.0%	0.0%	0.0%	0.0%
	Manufacturing	2.1%	1.5%	1.7%	1.7%
	Mining - Metal	-0.4%	-0.5%	-0.5%	-0.4%
	Oil and Gas	-0.4%	-0.5%	-0.5%	-0.4%
	Pulp & Paper - Kraft	-0.4%	-0.5%	-0.5%	-0.4%
	Pulp & Paper - TMP	-0.4%	-0.5%	-0.5%	-0.4%
	Transportation	0.2%	0.3%	-0.5%	-0.5%
	Wood Products	0.8%	0.6%	0.6%	0.7%
	Other Industrial	3.9%	3.9%	0.0%	-1.3%

Source: Navigant analysis of FortisBC Gas 2014 LTRP

Table 2-25: Industrial Consumption by Segment by Region (TJ) – FortisBC Gas

Region	Segment	CPR Period				
		2014	2020	2025	2030	2035
All Regions	Agriculture	1,601	1,616	1,627	1,644	1,664
	Cement	908	874	837	837	831
	Chemical	1,284	1,196	1,188	1,188	1,191
	Mining - Coal	2,517	2,443	2,458	2,417	2,378
	Food & Beverage	4,000	3,807	3,658	3,538	3,435
	Greenhouses	5,473	5,384	5,309	5,260	5,219
	LNG Facilities	-	-	-	-	-
	Manufacturing	5,710	6,037	6,215	6,443	6,687
	Mining - Metal	10	10	9	9	9
	Oil and Gas	8,761	8,512	8,310	8,139	7,981
	Pulp & Paper - Kraft	14,585	14,318	13,991	13,702	13,427
	Pulp & Paper - TMP	3,450	3,414	3,384	3,361	3,341
	Transportation	921	897	885	844	805
	Wood Products	7,567	7,606	7,481	7,443	7,421
	Other Industrial	789	921	1,092	1,078	1,006
Total		**57,577**	**57,036**	**56,444**	**55,903**	**55,393**

Source: Navigant analysis of FortisBC Gas 2014 LTRP

2.2.3 EUI Trends

This section discusses the EUI trends across the residential, commercial, and industrial sectors.

2.2.3.1 Residential Sector

To develop EUI trends for the Residential sector Reference Case, Navigant reviewed several resources including the FortisBC Gas 2012 REUS study, the accompanying Residential CDA study, BC Hydro's 2014 REUS, and the NRCan-OEE database. The main resource used to estimate the change in EUIs over time was BC Hydro's 2014 REUS study. BC Hydro's REUS was preferred over FortisBC Gas's REUS because it provided more granularity across individual residential segments. BC Hydro's REUS also provides survey results for gas equipment penetration for various years including 2002, 2003, 2005, 2007, and 2014. The team used the REUS data for each of these years to calculate an average annual rate of change for each EUI. A limitation of this approach is that the REUS data reflects the impact of provincial and federal DSM programs while the objective of this analysis is to trend natural change in EUIs in the absence of DSM impacts.

In certain cases, extrapolating recent trends 20 years into the future is uncertain and can result in implausibly high changes in the EUI over the forecast horizon. Recognizing this, Navigant endeavored to temper short-term trends by assuming a reduction in EUI trends further into the future. To determine these reductions in EUI trends over time, the team analyzed the FortisBC Gas 2014 LTRP. The analysis of the load forecast ensured that the Reference Case residential consumption—determined based on the growing residential stock and the EUI trends—aligned with the forecast of residential consumption reported in FortisBC Gas's load forecast. Navigant made these adjustments to the EUI trends across every five-year period of the CPR analysis horizon.

Based on this analysis, the team applied the EUI trends from the REUS analysis to the first five years of the CPR period, and systematically decreased the magnitude of EUI trends over the subsequent five-year periods. Specifically, the EUI trends decrease by a factor of 20% every five-year period. This 20% reduction enables the Reference Case residential consumption to match the load forecast consumption.[21] These EUI trends implicitly reflect natural changes in residential end-use consumption caused by naturally occurring improvements in end-use equipment efficiency, fuel share changes, saturation levels of energy efficient equipment, existing building retrofit activities, and stock turnover.

Table 2-26 shows the EUI trends determined for each residential segment and end-use over time, and Table 2-27 provides the resulting EUIs for each five-year period in the Lower Mainland. Navigant based the EUIs presented in Table 2-27 on the base year EUIs (for 2014) and adjusted them with the EUI trends identified in Table 2-26. The Reference Case EUIs for the Southern Interior, Vancouver Island and Northern BC are presented in Appendix B.2.

Please note that minor year-to-year changes in EUIs may not be explicitly reflected in the tables due to rounding.

As Table 2-26 indicates, gas consumption by most end-uses is expected to decrease over the CPR period. Current trends show that gas consumption from space heating and water heating are expected to decline over time, while consumption from appliances will increase. In general, the magnitude of the expected annual change in EUIs is greater in the near term and will decrease over time.

- **Space heating** – The use of natural gas for space heating has continued a small downward trend over the past decade—primarily in single detached homes and apartment units—resulting in a decrease in the gas space heating EUI. This trend is driven primarily by the lower penetration of gas space heating in new homes.
- **Water Heating** – Electricity consumption from water heating increases across most segments because of increased penetration of electric water heaters. The trend is most prevalent in single detached and attached homes. As a result, gas consumption for water heating has seen a steady decline across these segments. Survey results also show that apartment buildings are increasingly opting for centralized systems, rather than in-suite water heating units. Although, gas penetration of in-suite units has decreased, overall gas consumption is projected to increase due to centralized systems.
- **Appliances** – Gas consumption for appliances is forecast to increase over time, and at higher rates than space heating and water heating. Although gas clothes dryers are becoming less common, the increased adoption of gas-fired stoves and ranges has offset the impact of dryers and is expected to continue increasing gas consumption for appliances.

As noted for some of these end-uses, changing fuel shares for individual residential segments cause change in gas consumption over time.

[21] For example, if the EUI trend determined from the 2014 REUS was a 1.0% decrease in EUI per year, the team applied 1.0% per year from 2015 through 2020, 0.8% per year from 2021 through 2025, 0.64% per year from 2026 through 2030, and 0.51% per year from 2031 through 2035.

Table 2-26: Residential Gas Intensity Trends (%) – Five-Year Trends

Residential Segment	End-Use	CPR Period			
		2015-2020	2020-2025	2025-2030	2030-2035
Single Family Detached	Space Heating	-1.8%	-1.4%	-1.1%	-0.9%
	Water Heating	-0.9%	-0.7%	-0.6%	-0.4%
	Cooling	-	-	-	-
	Appliances	1.3%	1.1%	0.9%	0.7%
	Lighting	-	-	-	-
	Electronics	-	-	-	-
	Other	-1.3%	-1.0%	-0.8%	-0.7%
	Ventilation	-	-	-	-
Single Family Attached/Row	Space Heating	-1.5%	-1.2%	-1.0%	-0.8%
	Water Heating	-0.7%	-0.6%	-0.5%	-0.4%
	Cooling	-	-	-	-
	Appliances	1.3%	1.0%	0.8%	0.7%
	Lighting	-	-	-	-
	Electronics	-	-	-	-
	Other	-1.1%	-0.9%	-0.7%	-0.6%
	Ventilation	-	-	-	-
Apartments =< 4 stories	Space Heating	-2.0%	-1.6%	-1.3%	-1.0%
	Water Heating	0.4%	0.3%	0.3%	0.2%
	Cooling	-	-	-	-
	Appliances	1.7%	1.4%	1.1%	0.9%
	Lighting	-	-	-	-
	Electronics	-	-	-	-
	Other	-0.8%	-0.6%	-0.5%	-0.4%
	Ventilation	-	-	-	-
Apartments > 4 stories	Space Heating	-2.0%	-1.6%	-1.3%	-1.0%
	Water Heating	0.4%	0.3%	0.3%	0.2%
	Cooling	-	-	-	-
	Appliances	1.7%	1.4%	1.1%	0.9%
	Lighting	-	-	-	-
	Electronics	-	-	-	-
	Other	-0.8%	-0.6%	-0.5%	-0.4%
	Ventilation	-	-	-	-
Other Residential	Space Heating	-1.7%	-1.4%	-1.1%	-0.9%
	Water Heating	-1.2%	-1.0%	-0.8%	-0.6%
	Cooling	-	-	-	-
	Appliances	1.0%	0.8%	0.6%	0.5%
	Lighting	-	-	-	-
	Electronics	-	-	-	-
	Other	-1.5%	-1.2%	-0.9%	-0.8%
	Ventilation	-	-	-	-

Source: Navigant analysis of BC Hydro's 2014 REUS

Table 2-27: Residential Gas Intensity (GJ/household) – Lower Mainland

Residential Segment	End-Use	CPR Period				
		2015	2020	2025	2030	2035
Single Family Detached	Space Heating	77	69	64	61	58
	Hot Water	15	14	14	13	13
	Cooling/Refrigeration	-	-	-	-	-
	Appliances	1	1	2	2	2
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	3	2	2	2	2
	Ventilation	-	-	-	-	-
	Total	95	87	82	78	75
Single Family Attached/Row	Space Heating	47	43	40	38	37
	Hot Water	10	10	10	9	9
	Cooling/Refrigeration	-	-	-	-	-
	Appliances	1	1	1	1	1
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	1	1	1	1	1
	Ventilation	-	-	-	-	-
	Total	59	55	52	50	48
Apartments =< 4 stories	Space Heating	21	19	17	16	15
	Hot Water	17	18	18	18	19
	Cooling/Refrigeration	-	-	-	-	-
	Appliances	1	1	1	1	1
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	3	3	3	3	3
	Ventilation	-	-	-	-	-
	Total	43	41	40	39	38
Apartments > 4 stories	Space Heating	21	19	17	16	15
	Hot Water	17	17	18	18	18
	Cooling/Refrigeration	-	-	-	-	-
	Appliances	1	1	1	1	1
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	4	3	3	3	3
	Ventilation	-	-	-	-	-
	Total	43	41	39	39	38
Other Residential	Space Heating	45	40	38	36	34
	Hot Water	13	12	12	11	11
	Cooling/Refrigeration	-	-	-	-	-
	Appliances	1	1	1	1	1
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	1	1	1	1	1
	Ventilation	-	-	-	-	-
	Total	60	55	51	49	47

Source: Navigant analysis of BC Hydro's 2014 REUS

2.2.3.2 Commercial Sector

The next step in building the commercial sector Reference Case involved the development and application of EUI trends over the CPR study period. Navigant reviewed several resources including FortisBC Gas's 2015 CEUS, the NRCan-OEE database for British Columbia, and BC Hydro's 2014 CEUS to develop these trends. The main resource for EUI trends in the commercial sector was BC Hydro's 2014 CEUS. The team preferred BC Hydro's 2014 CEUS to FortisBC's 2015 CEUS because it provides detailed survey results for each commercial segment in each region.

BC Hydro's 2014 CEUS surveyed commercial customers in relation to upgrades made to end-use equipment in the past 5 years.[22] Based on the incidence of equipment upgrades made to specific end-uses (e.g., space cooling vs. space heating), Navigant estimated the potential reduction in energy consumption from higher efficiency equipment. This approach is described in more detail in Appendix 0. A limitation of this approach is that the CEUS data reflects the impact of provincial and federal commercial DSM programs, while the objective of this analysis is to trend natural change in EUIs in the absence of DSM impacts. The impact of this limitation on the study is that the EUI trends established for these commercial end-uses may be overstated, which may affect the overall results of this study. Additionally, this EUI trending approach inherently reflects both new and existing buildings because the CEUS customer pool included both new and existing buildings.

This analysis resulted in EUI trends for all the end-uses for which equipment upgrade information was reported in 2014 CEUS. [23] This included the following end-uses:

- Lighting
- Water heating
- Space cooling
- HVAC fans/pumps
- Space heating

Two of these end-uses—water heating and space heating—are applicable to gas consumption. The 2014 CEUS did not report the necessary information to develop EUI trends for the *cooking* and *other* gas end-uses, so the team assumed they would remain flat.

Similar to the residential sector, Navigant analyzed FortisBC Gas's 2014 LTRP to establish changes in the magnitude of commercial EUI trends every five years over the entire CPR analysis period. This ensured that the Reference Case commercial consumption—determined based on the commercial floor space stock and the EUI trends—aligned with the forecast of commercial consumption reported in the 2014 LTRP.

Based on this analysis, the commercial EUI trends determined from the CEUS analysis are applied to the first five years of the analysis, decreasing slightly over the subsequent five-year periods. Specifically, the EUI trends decrease by a factor of 30% every five-year period. This 30% reduction in EUI trends enables the Reference Case commercial consumption to match the load forecast consumption.

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[22] For example, the incidence of water heating equipment upgrades within the past 5 years was 23% across the entire commercial sector. However, the incidence of water heating upgrades varied across commercial segments (e.g., 38% in Colleges & Universities, 12% in Offices).
[23] The 2014 CEUS did not report equipment upgrade information for the cooking, refrigeration, and office equipment end-uses.

Table 2-28 shows the EUI trends for each commercial segment and end-use, and Table 2-29 shows the resulting EUIs over five-year intervals for the Lower Mainland. The EUIs presented in Table 2-29 were initially derived from the base year EUIs (for 2014) and have been adjusted by applying the EUI trends identified in Table 2-28. The Reference Case EUIs for the Southern Interior, Vancouver Island and Northern BC are presented in Appendix B.3.

As seen in Table 2-28, gas consumption for water heating and space heating is expected to decrease over the CPR period.

These changes in EUIs over time implicitly reflect natural changes in gas end-use consumption caused by naturally occurring improvements in end-use equipment efficiency and saturation levels, fuel switching, and retrofit activities. For example, energy efficient improvements driven by initiatives like ENERGY STAR and the Leadership in Energy and Environmental Design (LEED) certification are expected to influence EUI trends. Although the impact of these two energy performance initiatives remains limited thus far, the initiatives are likely to increase adoption of commercial envelope measures and higher efficiency space heating, lighting and cooking equipment.

Table 2-28: Commercial Gas Intensity Trends (%) – Five-Year Trends

Commercial Segment	End-Use	CPR Period			
		2015-2020	2020-2025	2025-2030	2030-2035
Accommodation	Cooking	0.0%	0.0%	0.0%	0.0%
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	-0.8%	-0.6%	-0.4%	-0.3%
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	0.0%	0.0%	0.0%	0.0%
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	-1.7%	-1.2%	-0.8%	-0.6%
Colleges/ Universities	Cooking	0.0%	0.0%	0.0%	0.0%
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	-1.1%	-0.8%	-0.5%	-0.4%
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	0.0%	0.0%	0.0%	0.0%
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	-1.9%	-1.3%	-0.9%	-0.6%
Food Service	Cooking	0.0%	0.0%	0.0%	0.0%
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	-1.1%	-0.8%	-0.5%	-0.4%
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	0.0%	0.0%	0.0%	0.0%
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	-2.0%	-1.4%	-1.0%	-0.7%
Hospital	Cooking	0.0%	0.0%	0.0%	0.0%
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	-0.7%	-0.5%	-0.3%	-0.2%
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	0.0%	0.0%	0.0%	0.0%
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	-1.8%	-1.2%	-0.9%	-0.6%
Logistics/ Warehouses	Cooking	0.0%	0.0%	0.0%	0.0%
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	-0.7%	-0.5%	-0.4%	-0.3%
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	0.0%	0.0%	0.0%	0.0%
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	-1.3%	-0.9%	-0.7%	-0.5%
Long Term Care	Cooking	0.0%	0.0%	0.0%	0.0%
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	-1.0%	-0.7%	-0.5%	-0.3%
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	0.0%	0.0%	0.0%	0.0%
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	-1.8%	-1.3%	-0.9%	-0.6%
Office	Cooking	0.0%	0.0%	0.0%	0.0%

Commercial Segment	End-Use	CPR Period			
		2015-2020	2020-2025	2025-2030	2030-2035
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	-0.4%	-0.3%	-0.2%	-0.1%
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	0.0%	0.0%	0.0%	0.0%
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	-1.8%	-1.2%	-0.9%	-0.6%
Other Commercial	Cooking	0.0%	0.0%	0.0%	0.0%
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	-0.4%	-0.3%	-0.2%	-0.1%
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	0.0%	0.0%	0.0%	0.0%
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	-1.8%	-1.2%	-0.9%	-0.6%
Retail - Food	Cooking	0.0%	0.0%	0.0%	0.0%
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	-0.9%	-0.6%	-0.4%	-0.3%
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	0.0%	0.0%	0.0%	0.0%
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	-2.2%	-1.5%	-1.1%	-0.7%
Retail – Non Food	Cooking	0.0%	0.0%	0.0%	0.0%
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	-0.9%	-0.6%	-0.4%	-0.3%
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	0.0%	0.0%	0.0%	0.0%
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	-2.2%	-1.5%	-1.1%	-0.7%
Schools	Cooking	0.0%	0.0%	0.0%	0.0%
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	-0.6%	-0.4%	-0.3%	-0.2%
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	0.0%	0.0%	0.0%	0.0%
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	-1.8%	-1.2%	-0.9%	-0.6%

Source: Navigant analysis of BC Hydro 2014 CEUS

Table 2-29: Commercial Gas Intensity (MJ/m2) – Lower Mainland

Commercial Segment	End-Use	CPR Period				
		2015	2020	2025	2030	2035
Accommodation	Cooking	80	80	80	80	80
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	258	246	239	234	230
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	56	56	56	56	56
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	252	228	215	206	200
	Total	646	609	589	576	567
Colleges/ Universities	Cooking	37	37	37	37	37
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	69	65	62	61	60
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	65	65	65	65	65
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	310	276	259	247	239
	Total	481	444	424	410	401
Food Service	Cooking	839	839	839	839	839
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	476	446	430	418	411
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	19	19	19	19	19
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	425	376	351	334	323
	Total	1,759	1,680	1,638	1,610	1,591
Hospitals	Cooking	65	65	65	65	65
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	274	263	257	253	250
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	233	233	233	233	233
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	758	682	641	614	596
	Total	1,330	1,243	1,197	1,165	1,144
Logistics/ Warehouses	Cooking	5	5	5	5	5
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	18	17	17	17	16
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	19	19	19	19	19
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	201	185	177	171	167
	Total	242	226	217	211	207
Long Term Care	Cooking	56	56	56	56	56
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	156	147	142	138	136
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-

Commercial Segment	End-Use	CPR Period				
		2015	2020	2025	2030	2035
	Other	65	65	65	65	65
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	337	301	282	270	262
	Total	613	569	545	530	519
Office	Cooking	9	9	9	9	9
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	33	32	32	31	31
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	19	19	19	19	19
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	263	237	223	213	207
	Total	324	297	282	273	266
Other Commercial	Cooking	15	15	15	15	15
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	26	26	25	25	25
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	13	13	13	13	13
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	276	248	233	223	217
	Total	330	301	286	276	269
Retail - Food	Cooking	75	75	75	75	75
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	65	61	60	58	57
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	19	19	19	19	19
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	311	273	253	240	231
	Total	469	428	406	391	381
Retail – Non Food	Cooking	13	13	13	13	13
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	23	22	21	21	21
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	6	6	6	6	6
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	256	225	208	197	190
	Total	299	266	249	237	230
Schools	Cooking	15	15	15	15	15
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	39	38	37	36	36
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	5	5	5	5	5
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	277	249	234	224	218
	Total	336	307	291	280	273

Source: Navigant analysis of FortisBC Gas's 2014 LTRP, and BC Hydro 2014 CEUS

2.2.3.3 Industrial Sector

Discussions between Navigant and CLEAResult concluded "natural" change in industrial energy efficiency would be minimal over the study horizon. This assumption is consistent with past CPRs, which forecasted very small changes in industrial EUIs over a 20-year forecast horizon (typically only a few percent over 20 years)[24]. Given the expected small magnitude of natural change in industrial EUIs, inherent EUI forecasting uncertainty, and limited historical data availability for industrial EUIs, this study assumes that EUIs in the industrial sector will remain constant in the absence of conservation programs.

The study represents industrial production levels as an index that begins at 1.0 in 2014 and grows or declines in accordance with expected trends in production. These production levels are analogous to building stocks and are multiplied by EUIs to determine consumption in a given year.

The outline below details key considerations for the industrial consumption forecast.

- **Resource-extraction industries** are much more sensitive to primary cost drivers (timber prices, labor costs), suggesting their consumption is not strongly dependent on electricity and gas prices. The prime reason for upgrading equipment is for increasing production, market expansion, or new product lines, rather than to increase energy efficiency.
- **Non-resource-extraction industries** are unlikely to experience significant changes in EUIs. Many of these customers—particularly food & beverage and manufacturing customers—operate smaller facilities and the tendency is not to invest capital upgrading older facilities but rather in expanding or building new plants.
- The **pulp & paper and wood products** consumption has been declining steadily over the past decade, as is evident by mill shutdowns. By and large, these industrial segments are projected to continue declining through 2020, particularly in other regions where much of the industry is concentrated. Capital constraints in this segment limit the opportunities for energy efficiency. These industries—in addition to the chemical and cement sector—consist mainly of older plants where customers have shown reluctance to upgrade to more efficient equipment due to uncertain market conditions.

2.2.4 Reference Case Forecast and Comparison with Utility Forecast

This section provides the final Reference Case forecast and compares the sector-level results of the Reference Case forecast with FortisBC Gas's load forecast.

2.2.4.1 Reference Case Forecast

Table 2-30 summarizes the results of the Reference Case for each sector and customer segment. Navigant computed these results by applying the stock growth rates and the EUI trends established in previous sections for each customer segment to the base year results.

[24] The base year analysis did not characterize industrial consumption on a per-unit basis, as was done for the residential sector (i.e., kWh or GJ *per* household) and commercial sector (i.e., kWh or GJ *per* m2). Industrial EUIs are expressed directly in electric or gas units of consumption (i.e., kWh or GJ).

Table 2-30: Reference Case Forecast by Segment (TJ)

Sector	Segment	CPR Period				
		2015	2020	2025	2030	2035
Residential	Single Family Detached	67,598	63,730	61,177	59,574	58,711
	Single Family Attached/Row	4,148	4,212	4,249	4,318	4,406
	Apartments =< 4 stories	12,597	12,774	12,911	13,108	13,352
	Apartments > 4 stories	7,355	7,502	7,606	7,747	7,915
	Other Residential	1,370	1,366	1,353	1,358	1,369
	Total	**93,069**	**89,584**	**87,296**	**86,105**	**85,752**
Commercial	Accommodation	3,141	3,261	3,381	3,523	3,667
	Colleges/Universities	2,625	2,715	2,847	3,004	3,161
	Food Service	5,155	5,313	5,451	5,610	5,761
	Hospital	3,428	3,600	3,808	4,055	4,312
	Logistics/Warehouses	3,857	3,950	4,054	4,186	4,317
	Long Term Care	2,091	2,257	2,466	2,718	2,995
	Office	11,882	11,986	12,241	12,614	13,006
	Other Commercial	-	-	-	-	-
	Retail – Food	1,624	1,582	1,567	1,571	1,584
	Retail - Non Food	3,698	3,502	3,411	3,378	3,375
	Schools	3,140	3,081	3,083	3,122	3,176
	Street Lights	-	-	-	-	-
	Total	**40,640**	**41,248**	**42,308**	**43,781**	**45,351**
Industrial	Agriculture	1,601	1,616	1,627	1,644	1,664
	Cement	908	874	837	837	831
	Chemical	1,284	1,196	1,188	1,188	1,191
	Mining – Coal	2,517	2,443	2,458	2,417	2,378
	Food & Beverage	4,000	3,807	3,658	3,538	3,435
	Greenhouses	5,473	5,384	5,309	5,260	5,219
	LNG Facilities	-	-	-	-	-
	Manufacturing	5,710	6,037	6,215	6,443	6,687
	Mining – Metal	10	10	9	9	9
	Oil and Gas	8,761	8,512	8,310	8,139	7,981
	Pulp & Paper - Kraft	14,585	14,318	13,991	13,702	13,427
	Pulp & Paper - TMP	3,450	3,414	3,384	3,361	3,341
	Transportation	921	897	885	844	805
	Wood Products	7,567	7,606	7,481	7,443	7,421
	Other Industrial	789	921	1,092	1,078	1,006
	Total	**57,577**	**57,036**	**56,444**	**55,903**	**55,393**
Total		**191,286**	**187,867**	**186,048**	**185,789**	**186,497**

Source: Navigant analysis

2.2.4.2 Comparison between Reference Case and Utility Forecast

In this section, Navigant compares the Reference Case forecast with FortisBC Gas's 2014 LTRP. Since most of the demand growth assumptions underlying the load forecast were used as inputs to develop the stock growth rates in the Reference Case, the two forecasts are largely consistent.

Table 2-31 compares the projected gas sales in 2035 between the Reference Case and the Load Forecast.

Table 2-31: Reference Case Forecast

Class/Sector	Average Annual Growth Rate (%)		2035 Sales (TJ)		Difference (%)
	Reference Forecast	FortisBC Gas Forecast	Reference Forecast	FortisBC Gas Forecast	
Residential	-0.4%	-0.4%	85,752	85,752	0.0%
Commercial	0.5%	0.5%	45,351	45,351	0.0%
Industrial	-0.2%	-0.2%	55,393	55,393	0.0%
Total	**-0.1%**	**-0.1%**	**186,497**	**186,497**	**0.0%**

Source: Navigant analysis

2.3 Frozen End-use Intensity Case and Natural Change

Navigant's model uses the building stock projections from the Reference Case forecast to calculate technical and economic potential, but does not use the reference case's time-changing end-use intensities. Rather, it freezes the end-use intensities from the Reference Case forecast at 2016 levels and holds them fixed over time. This section describes the reasons for this approach and the method by which the team links the frozen EUI case back to the reference case using "natural change."

2.3.1 Frozen EUI Case

The Reference Case includes many embedded assumptions derived from observed trends in the market and forward-looking expectations. The Reference Case allows end-use intensities to change over time as a function of:

- Changing mix of efficient versus inefficient equipment
- Changing use of building space (e.g., open plan office spaces)
- Changing mix of commercial activities (e.g., decrease in manufacturing and increase in service industries)
- New trends in consumption (e.g., increase in use of home electronics)
- Fuel switching (e.g., switching from electric appliances to gas appliances, or vice versa)

Modelling these considerations at the *measure* level would require a detailed adoption forecast for every measure in each customer segment. Typically, potential studies forecast measure-level adoption when looking at achievable market potential in the context of utility-sponsored energy efficiency programs. The achievable market potential hinges on expected levels of incentives, program budgets, and marketing/advertising levels, and there is adequate industry experience to provide substance to these forecasts. Conversely, it is notoriously difficult to estimate retrospectively what would have happened with measure adoption in the absence of energy efficiency programs (typically estimated through "net-to-gross" ratio studies), and it is even more difficult and uncertain to *forecast* such "natural" behavior at the measure level. Since program design is outside the scope of this study, and considering the inherent uncertainty in forecasting natural adoption at the measure level, Navigant did not pursue and create detailed measure adoption forecasts for technical and economic potential. Rather, the study uses a "frozen EUI" approach to estimate technical and economic potential combined with an estimation of aggregate end-use intensity trends to calculate the natural change expected at the end-use level.

Navigant calculated technical and economic potential assuming that EUIs are frozen at 2016 levels, ensuring consistency between modelled energy sales and measure characterization. For example, measure characterization assumes a fixed mix of efficient and inefficient measures over time—absent any energy efficiency programs—implying that end-use intensities do not change over time when calculating technical and economic potential. However, building stock changes (e.g., growth in the residential customer count or commercial floor space) can increase overall energy sales and assumed total equipment counts, which would impact the estimates for technical and economic potential.

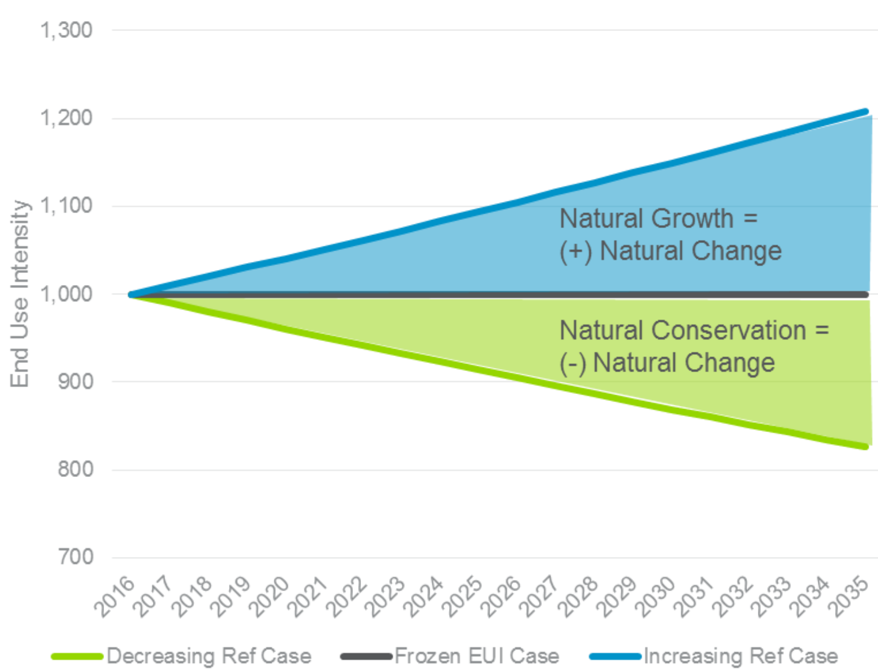
If end-use intensities are changing in the Reference Case, Navigant calculates what this study refers to as the "natural change"—defined in section 2.3.2—of EUIs over time. The team then applies this natural change to the technical and economic potential results using the frozen EUI to estimate the shift in potential savings.

2.3.2 Natural Change

Navigant's definition of "natural change" stems from two related concepts: natural conservation and natural growth. Natural *conservation* is a well-established concept in demand side management programs, and typically refers to actions taken by utility customers—in absence of utility-sponsored programs—to improve energy efficiency and reduce consumption. These actions are occurring naturally, with no influence from utilities or program administrators. Natural *growth* refers to actions taken by utility customers to *increase consumption* without the involvement of utility-guided programs. An example of natural growth is home electronics, where customers may be increasing their electric consumption (e.g., through addition of more televisions, computers, etc.) and causing an increase in the electronics end-use intensity.

This study captures the effects of natural conservation as well as natural growth within the end-use intensities, and defines these effects as "natural change." When natural change is positive for an end-use category, it reflects growth. When natural change is negative, it reflects conservation. Figure 2-9 illustrates this concept of natural change as it relates to the Reference Case end-use intensities as compared with the frozen EUI case.

Figure 2-9. Natural Change in Context of End-use Intensity



Source: Navigant

Navigant calculated natural change by subtracting the energy consumption in the frozen EUI case from the energy consumption in the Reference Case (see Table 2-32). Positive natural change results indicate a quantity of consumption missing from the frozen EUI case, whereas negative natural change indicates an overestimate of consumption in the frozen EUI case. Since Navigant estimates technical and economic potential based on the frozen EUI case, any missing consumption (i.e., positive natural change) is not included in the technical and economic results. Conversely, the model overestimates technical and economic potential when natural change is negative. Natural change helps provide a bound for the technical and economic potential forecasts, as it reflects one component of the uncertainty in energy savings from end-uses with expected changes to intensities over time.

Table 2-32. Illustrative Calculation of Natural Change

Year	Building Stock (homes)	Reference Case EUI (GJ/year-home)	Frozen Case EUI (GJ/year-home)	Reference Case Consumption (GJ/year)	Frozen EUI Case Consumption (GJ/year)	Natural Change (GJ/year)
	A	B	C	D = A x B	E = A x C	F = D - E
2016	1,000	70	70	70,000	70,000	0
2020	1,082	69	70	74,808	75,770	-962
2025	1,195	68	70	81,351	83,656	-2,305
2030	1,319	67	70	88,412	92,364	-3,952
2035	1,457	66	70	96,162	101,977	-5,815

Source: Navigant

Calculating technical and economic potential that includes natural change at the measure level would require measure-level adoption forecasts. As mentioned in section 2.3.1, Navigant's calculation of technical and economic potential does not involve forecasting adoption at the measure level. However, the team does estimate upper and lower bounds on the technical and economic potential inclusive of natural change at the end-use level.[25]

Navigant refined the frozen EUI technical potential by estimating savings potential percentages for natural change. The team calculated the technical potential as a percentage of consumption within a given end-use category, and applied that percentage to the natural change occurring within that end-use. For example, if the model concludes that technical potential for gas appliances is 30% of the total consumption from gas appliances, Navigant can apply that 30% to the natural change occurring within the appliance end-use to find a midway estimate between the technical potential and the upper or lower bound.

Table 2-33 builds off the example in Table 2-32 by estimating adjusted technical potential for the frozen EUI case by applying the example of 30% savings to the natural change estimates.

[25] Adding consumption from natural change directly to savings potential—instead of adding the expected savings from the natural change—typically exaggerates the upper or lower bound results.

Table 2-33. Illustrative Calculation of Bounds on Technical Potential (GJ/year)

Year	Frozen EUI Case Consumption	Natural Change	Tech Potent @ 30% Savings	Tech Potent + Nat Change	Tech Potent + 30% Nat Change
	A	B	C = A x 30%	D = B + C	E = B x 30% + C
2016	70,000	0	24,500	24,500	24,500
2020	75,770	-962	26,520	25,558	26,231
2025	83,656	-2,305	29,280	26,975	28,588
2030	92,364	-3,952	32,327	28,375	31,142
2035	101,977	-5,815	35,692	29,877	33,948

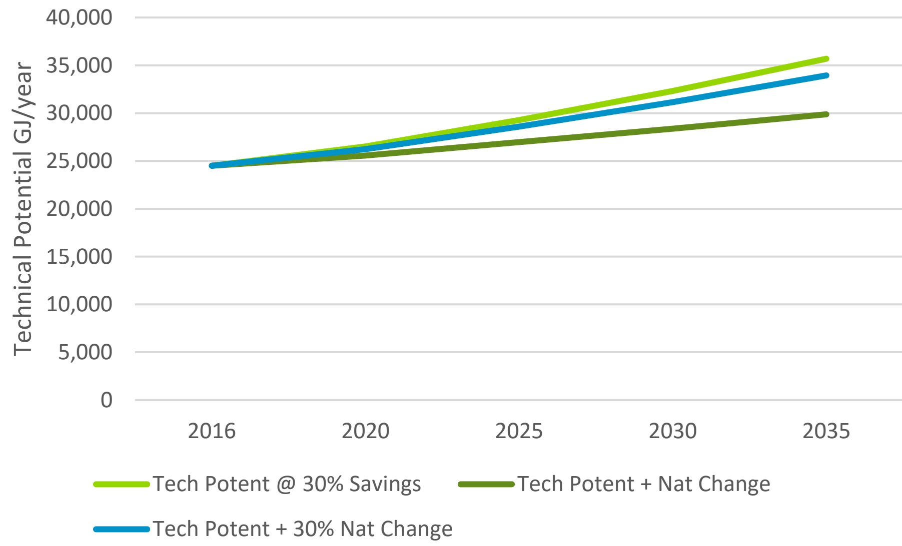
Source: Navigant

Where:

- **Frozen EUI Case Consumption** – the consumption forecast from the frozen EUI case
- **Natural Change** – the natural change between the frozen EUI case and the Reference Case
- **Tech Potent @ 30% Savings** – the technical potential assuming that efficient measures, in aggregate, lead to 30% savings as a percentage of the frozen EUI case's consumption
- **Tech Potent + Nat Change** – the sum of technical potential and natural change. Because natural change is negative, it reduces the total technical potential and indicates an extreme lower bound. This lower bound is overly conservative because it reduces the technical potential by the total natural change, rather than reducing potential by the overestimation of savings from natural change.
- **Tech Potent + 30% Nat Change** – the sum of technical potential and 30% of the natural change. Instead of reducing the technical potential by the total natural change, we reduce the potential by an estimate of the savings from natural change. The savings from natural change is a rough estimate based on the same 30% savings as a percentage of consumption used to estimate the technical potential. In reality, the percentage savings from natural change could be different from the 30% aggregate technical savings for the end-use.

Figure 2-10 plots the illustrative results from Table 2-33.

Figure 2-10. Illustrative Example of Technical Potential and Bounds Derived from Natural Change



Source: Navigant

At the end-use level, the technical potential plus the adjusted natural change (i.e., "Tech Potential + 30% Nat Change") will always fall between the technical potential and the bound created by adding natural change directly to the potential. At the sector level, however, this may not always be the case due to the aggregation of various end-use categories that may have positive or negative natural change. The natural change and estimated savings from natural change can be positive or negative and will cancel each other out, which leads to aggregate natural change and aggregate savings from natural change that can be in different proportions than was calculated at the end-use level. After aggregation, the technical potential plus the adjusted natural change may or may not fall between the technical potential and the bound.[26]

2.4 Measure Characterization

Navigant fully characterized over 200 measures across the BC Utilities' residential, commercial, and industrial sectors, covering electric and natural gas fuel types. The team prioritized measures with high impact, data availability, and most likely to be cost-effective as thresholds for inclusion into DSMSim™.

2.4.1 Measure List

Navigant developed a comprehensive measure list of energy efficiency measures likely to contribute to economic potential. The team reviewed current BC program offerings, previous CPR and other Canadian programs, and potential model measure lists from other jurisdictions to identify EE measures with the highest expected economic impact. The team supplemented the measure list using the Pennsylvania, Illinois, Mid-Atlantic, and Massachusetts technical resource manuals (TRMs), and partnered with CLEAResult to inform the list of industrial measures. Navigant worked with the BC Utilities to finalize the

[26] The effects of natural change by end-use category and customer segment are available in Appendix A.1.

measure list and ensure it contained technologies viable for future BC program planning activities. Appendix A.2 provides the final measure list and assumptions.

Working sessions with the BC Utilities revealed topics of note regarding the following measures:

- **Multi-Unit Residential Building (MURB) measures –** Navigant characterized both in-suite and common area measures for MURBs. In-suite measures are similar to other residential measures such as LED light bulbs, power strips, and televisions. Common area measures include space heating and hot water heating measures such as make-up air units, HVAC controls, central boilers, and roof deck insulation
- **Showerheads for MURBs –** The model currently uses material and labor costs for showerheads assuming the customer installs the measure themselves. However, BC Utilities offer a direct install program for showerheads in the MURB customer segment and may purchase showerheads at a wholesale price. Since the measure is already cost-effective without the direct install cost adjustments, this issue does not impact the technical and economic potential results. This issue would impact any further analysis of achievable potential, but that is outside of the scope of this study.

2.4.2 Measure Characterization Key Parameters

The measure characterization effort consisted of defining nearly 50 individual parameters for each of the 200 measures included in this study. This section defines the top 10 key parameters and how they impact technical and economic potential savings estimates.

1. **Measure Definition**: The team used the following variables to qualitatively define each characterized measure:
    - ***Replacement Type****:* Replacing the baseline technology with the efficient technology can occur in three variations:
        1. <u>Retrofit (RET)</u>: where the model considers the baseline to be the existing equipment, and uses the energy and demand savings between the existing equipment and the efficient technology during technical potential calculations. RET also applies the full installed cost of the efficient equipment during the economic screening.
        2. <u>Replace On Burnout (ROB):</u> where the model considers the baseline to be the code-compliant technology option, and uses the energy and demand savings between the current code option and the efficient technology during technical potential calculations. ROB also applies the incremental cost between the efficient and code-compliant equipment during the economic screening.
        3. <u>New Construction (NEW)</u>: where the model considers the baseline to be the least cost, code-compliant option, and uses the energy and demand savings between this specific current code option and the efficient technology during technical potential calculations. NEW also applies the incremental cost between the efficient and code-compliant equipment during the economic screening.
    - ***Baseline Definition***: Describes the baseline technology (e.g., the existing equipment).
    - ***EE Definition***: Describes the efficient technology set to replace the baseline technology.
    - ***Unit Basis***: The normalizing unit for energy, demand, cost, and density estimates.

2. **Regional, Sector, and End-use Mapping:** The team mapped each measure to the appropriate end-uses, customer segments, sectors, and climate regions across the BC Utility's service territory. Section 2.1 describes the breakdown of customer segments with each sector in greater detail. Navigant characterized weather dependent measures into four regions: Lower Mainland, Southern Interior, Vancouver Island, and Northern BC to account for changes in climate that impact energy savings.
3. **Annual Energy Consumption:** The annual energy consumption in kilowatt-hours (kWh) or mega joules (MJ) for each of the base and energy-efficient technologies
4. **Coincident Electric Demand**: The peak coincident demand in kilowatts (kW) for each of the base and energy-efficient technologies
5. **Fuel Type Applicability Multipliers**: Assigns the percentage of electric fuel type to measures with electric fuel type such as water heaters and space heating equipment
6. **Measure Lifetime:** The lifetime in years for the base and energy-efficient technologies. The Base and EE lifetime only differ in instances where the two cases represent inherently different technologies, such as light-emitting diodes (LEDs) or compact fluorescent lamp (CFL) bulbs compared to a baseline incandescent bulb.
7. **Incremental Costs:** The incremental cost between the assumed baseline and efficient technology, using the following variables:
    - ***Base Costs***: The cost of the base equipment, including both material and labor costs
    - ***EE Costs:*** The cost of the energy-efficient equipment
8. **Technology Densities**: This study defines "density" as the penetration or saturation of the baseline and efficient technologies across the BC Utility's territory. For residential measures, these saturations are on a per home basis, for commercial they are per 1,000 square meters of building space, and for industrial they are based on energy consumption.[27]
    - ***Base Initial Saturation***: The saturation of the baseline equipment in a territory for a given customer segment
    - ***EE Initial Saturation:*** The saturation of the efficient equipment in a territory for a given customer segment
    - ***Total Maximum Density***: The total number of both the baseline and efficient units in a territory for a given technology
9. **Technology Applicability:** The percentage of the base technology that can be reasonably and practically replaced with the specified efficient technology. For instance, occupancy sensors are only practical for certain interior lighting fixtures (an applicability less than 1.0), while all existing incandescent exit signs can be replaced with efficient LED signs (an applicability of 1.0).
10. **Competition Group**: The team combined efficient measures competing for the same baseline technology density into a single competition group to avoid the double-counting of savings. (Section 3.1.3 provides further explanation on competition groups.)

2.4.3 Measure Characterization Approaches and Sources

This section provides approaches and sources for the main measure characterization variables. The BC Utilities and Technical Advisory Committee reviewed Navigant's measure assumptions for each sector

[27] Navigant sourced density estimates from the residential end-use survey (REUS), commercial end-use survey (CEUS), BC Utility program data, and other related secondary resources.

and provided inputs to refine measure assumptions. Navigant also worked with CLEAResult to further customize industrial measures.

2.4.3.1 Energy and Demand Savings

Navigant took three general bottom-up approaches to analyzing residential and commercial measure energy and demand savings:

1. **TRM Standard Algorithms:** Navigant used TRM standard algorithms for unit energy savings and demand savings calculations for the majority of measures. FortisBC Gas provided coincidence factors for the residential sector.
2. **Program Evaluation Data:** Where available, Navigant used measure specific program evaluation data from the BC Utilities to inform energy savings.
3. **Engineering Analysis:** Navigant used appropriate engineering algorithms to calculate energy savings for any measures not included in BC Utility programs or available TRMs.

2.4.3.2 Incremental Costs

Navigant relied primarily on BC Utility provided program data and TRM data for incremental cost data. Navigant conducted secondary research and used other publicly available cost data sources such as the Database for Energy Efficient Resources (DEER), ENERGY STAR®, RSMeans, and the Michigan Energy Measures Database (MEMD) for all other cost data.[28]

2.4.3.3 Building Stock and Densities

The residential end-use survey (REUS) and commercial end-use survey (CEUS) provided building stock data for the BC Utility's service territory, enabling Navigant to characterize residential and commercial measures. The measure characterization workbooks include full documentation of assumptions applied to each measure. Navigant also used the REUS and CEUS reports to develop measure densities by customer segment. For measures not included in REUS and CEUS, Navigant reviewed other data sources such as NRCan for estimates.

2.4.3.4 Industrial Measures

The industrial sector measure characterization deploys a top-down approach, which differs from the residential and commercial sectors. Navigant characterized industrial measures as a percentage reduction of the customer segment and/or end-use consumption. CLEAResult evaluated past and recent project data from the BC Utilities to estimate the energy savings and incremental cost for all industrial measures.

[28] For example, measure costs for new construction whole-building measures were gathered from a variety of sources. For residential measures, Navigant received data from the BC Utilities, and performed secondary research for measures where data was not provided. For Commercial whole-building new construction measures, Navigant leveraged RSMeans new construction cost data for Vancouver, BC and supplemented those costs with data from LEED and green building reports that reported incremental costs associated with higher energy savings. Navigant determined energy savings and costs for the discrete new construction measures in their entirety without analyzing what bundles of other CPR measures would make up a new construction measure.

2.4.4 Codes and Standards Adjustments

Natural Resources Canada publishes all energy efficiency regulations. Amendment 14[29] states that the intent of the amendment is to "align with energy efficiency standards in force or soon to be in force in the U.S." The U.S. Department of Energy (DOE) Technical Support Documents (TSD)[30] contains information on energy and cost impact of each appliance standard. Engineering analysis is available in Chapter 5 of the TSD; energy use analysis is available in Chapter 7, and cost impact is available in Chapter 8.

As these codes and standards take effect, the energy savings from existing measures impacted by these codes and standards diminishes. Navigant accounts for the impact of codes and standards by baseline energy and cost multipliers—sourced from the DOE's analysis—which reduce the baseline equipment consumption starting from the year a particular code or standard takes effect.[31] The baseline cost of an efficient measure impacted by codes and standards will often increase upon implementation of the code. Technical and economic savings potential presented in the model results includes savings potential from codes and standards, and measure-level results show their contribution to overall potential. Savings potential results do not consider fuel switching.[32]

The City of Vancouver By-Law (VBBL) varies from the National Building Code for insulation measures and water heating equipment. Navigant did not estimate the impact of the VBBL as the model segmentation does not drill down to city level granularity. City specific stock and sales data are not available to estimate the impact of the VBBL. Navigant expects the impact of VBBL to be small compared to the EE potential of the entire province. The majority of energy efficient savings from Part 9 buildings come from existing buildings in the near future. The VBBL does not require a specific upgrade level if the retrofit project is less than $5,000, which represents most residential measures in the model. Part 3 Buildings from VBBL references the National Building Code and ASHRAE 90.1 standards. The model assumes the National Building Code as the baseline for Part 3 buildings, therefore, the discrepancy in impact is minimal for commercial buildings.

[29] Natural Resources Canada Amendment 14 to the Energy Efficiency Regulations. Access at: http://www.nrcan.gc.ca/energy/regulations-codes-standards/18437

[30] Appliance standards rulemaking notices and Technical Support Documents can be found at: http://energy.gov/eere/buildings/current-rulemakings-and-notices

[31] Navigant uses a similar method of applying multipliers for changes in measure economics over time if sufficient data exists for extrapolating such changes, e.g. reducing measure costs over time for Commercial High Efficiency Gas-Fired Condensing Rooftop Units (RTU).

[32] For example, if a natural gas heated new home is upgraded from the code-mandated performance level to an R-2000 home, the savings potential analysis assumes that this home remains natural gas heated.

3. TECHNICAL POTENTIAL FORECAST

This section describes Navigant's approach to calculating technical potential and presents the results for FortisBC Gas's service territory.

3.1 Approach to Estimating Technical Potential

This study defines technical potential as the total energy savings available assuming that all installed measures can *immediately* be replaced with the "efficient" measure/technology—wherever technically feasible—regardless of the cost, market acceptance, or whether a measure has failed and must be replaced.

Navigant used its DSMSim model to estimate the technical potential for demand side resources in the regions considered for this study. Navigant's modelling approach considers an energy-efficient measure to be any change made to a building, piece of equipment, process, or behaviour that could save energy. The savings can be defined in numerous ways, depending on which method is most appropriate for a given measure. Measures like condensing water heaters are best characterized as some fixed amount of savings per water heater; savings for measures like commercial automated building controls are typically characterized as a percentage of customer segment consumption; and measures like industrial ventilation heat recovery are characterized as a percentage of end-use consumption. The model can appropriately handle savings characterizations for all three methods.

The calculation of technical potential in this study differs depending on the assumed measure replacement type. Technical potential is calculated on a per-measure basis and includes estimates of savings per unit, measure density (e.g., quantity of measures per home) and total building stock in each service territory. The study accounts for three replacement types, where potential from retrofit and replace-on-burnout measures are calculated differently from potential for new measures. The formulae used to calculate technical potential by replacement type are shown below.

3.1.1 New Construction Measures

The cost of implementing new construction (NEW) measures is incremental to the cost of a baseline (and less efficient) measure. However, new construction technical potential is driven by equipment installations in new building stock rather than by equipment in existing building stock.[33] New building stock is added to keep up with forecast growth in total building stock and to replace existing stock that is demolished each year. Demolished (sometimes called replacement) stock is calculated as a percentage of existing stock in each year, and this study uses a demolition rate of 0.5% per year for residential and commercial stock and 0% for industrial stock. New building stock (the sum of growth in building stock and replacement of demolished stock) determines the incremental annual addition to technical potential, which is then added to totals from previous years to calculate the total potential in any given year. The equations used to calculate technical potential for new construction measures are provided below.

Equation 1. Annual Incremental NEW Technical Potential (AITP)

$AITP_{YEAR}$ = New $Buildings_{YEAR}$ (e.g., buildings/year[34]) X Measure Density (e.g., widgets/building) X $Savings_{YEAR}$ (e.g., GJ/widget) X Technical Suitability (dimensionless)

Equation 2. Total NEW Technical Potential (TTP)

$$TTP = \sum_{YEAR=2016}^{YEAR=2035} AITP_{YEAR}$$

3.1.2 Retrofit and Replace-on-Burnout Measures

Retrofit (RET) measures, commonly referred to as advancement or early-retirement measures, are replacements of existing equipment before the equipment fails. Retrofit measures can also be efficient processes that are not currently in place and that are not required for operational purposes. Retrofit measures incur the full cost of implementation less a deferred replacement credit, rather than incurring a cost incremental to some other baseline technology or process because the customer could choose not to replace the measure and would therefore incur no costs.[35] In contrast, replace-on-burnout (ROB) measures, sometimes referred to as lost-opportunity measures, are replacements of existing equipment that have failed and must be replaced, or they are existing processes that must be renewed. Because the failure of the existing measure requires a capital investment by the customer, the cost of implementing replace-on-burnout measures is always incremental to the cost of a baseline (and less efficient) measure.

[33] In some cases, customer-segment-level and end-use-level consumption are used as proxies for building stock. These consumption figures are treated like building stock in that they are subject to demolition rates and stock-tracking dynamics.
[34] Units for new building stock and measure densities may vary by measure and customer segment (e.g., 1,000 square meters of building space, number of residential homes, customer-segment consumption, etc.)
[35] This study's approach subtracts a deferred replacement credit from the full cost of implementation whenever the average remaining useful life of currently installed measures can be reasonably approximated. This methodology leads to a similar outcome as subtracting a salvage value from the full incremental cost. For more discussion of deferred replacement credits, see "Retrofit Economics 201: Correcting Commons Errors in Demand-Side Management Cost-Benefit Analysis" by Rachel Brailove, John Plunkett, and Jonathan Wallach.

Retrofit and replace-on-burnout measures have a different meaning for technical potential compared with new construction measures. In any given year, we use the entire building stock for the calculation of technical potential.[36] This method does not limit the calculated technical potential to any pre-assumed rate of adoption of retrofit measures. Existing building stock is reduced each year by the quantity of demolished building stock in that year and does not include new building stock that is added throughout the simulation. For retrofit and replace-on-burnout measures, annual potential is equal to total potential, thus offering an *instantaneous* view of technical potential. The equation used to calculate technical potential for retrofit and replace-on-burnout measures is provided below.

Equation 3. Annual/Total RET/ROB Technical Savings Potential

Total Potential = Existing Building Stock$_{YEAR}$ (e.g., buildings[37]) X Measure Density (e.g., widgets/building) X Savings$_{YEAR}$ (e.g., GJ/widget[38]) X Technical Suitability (dimensionless)

3.1.3 Competition Groups

Navigant's modelling approach recognizes that some efficient technologies will compete against each other in the calculation of potential. The study defines "competition" as an efficient measure competing for the same installation as another efficient measure. For instance, a consumer has the choice to install a condensing or a near-condensing water heater, but not both. These efficient technologies compete for the same installation.

General characteristics of competing technologies used to define competition groups in this study include the following:

- Competing efficient technologies share the same baseline technology characteristics, including baseline technology densities, costs, and consumption
- The total (baseline plus efficient) measure densities of competing efficient technologies are the same
- Installation of competing technologies is mutually exclusive (i.e., installing one precludes installation of the others for that application)
- Competing technologies share the same replacement type (RET, ROB, or NEW)

To address the overlapping nature of measures within a competition group, Navigant's analysis only selects one measure per competition group to include in the *summation* of technical potential across measures (e.g., at the end-use, customer segment, sector, service territory, or total level). The measure with the largest energy savings potential in a given competition group is used for calculating total technical potential of that competition group. This approach ensures that the aggregated technical potential does not double-count savings. However, the model still calculates the technical potential for

[36] In some cases, customer-segment-level and end-use-level consumption/sales are used as proxies for building stock. These consumption/sales figures are treated like building stock in that they are subject to demolition rates and stock-tracking dynamics.
[37] Units for building stock and measure densities may vary by measure and customer segment (e.g., 1,000 square meters of building space, number of residential homes, customer-segment consumption/sales, etc.).
[38] To determine energy savings, Navigant consistently applies one measure-specific baseline across the entire measure life of each respective measure.

each individual measure outside of the summations.

3.2 Technical Potential Results

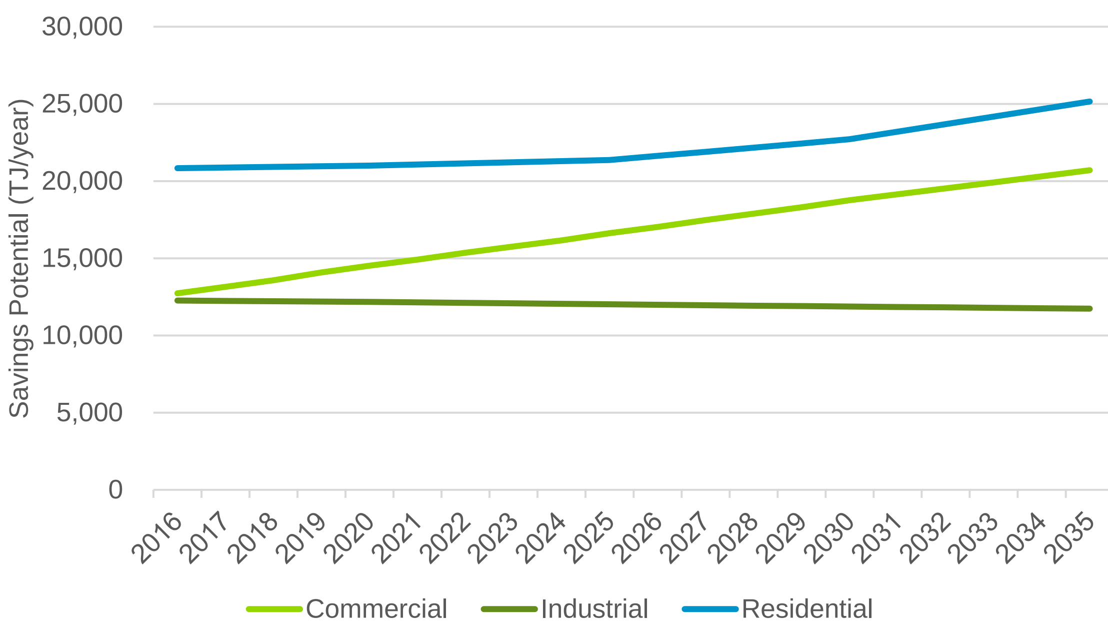
This section provides the technical savings potential calculated by the model at varying levels of aggregation. Results are shown by sector, customer segment, end-use category, and highest-impact measures. The section concludes with a review of natural change and its impacts on technical potential.

3.2.1 Results by Sector

Figure 3-1 shows the total gas energy technical savings potential split by sector, and Table D-3 in Appendix D provides the associated data. As noted in previous sections, although apartments were included in the residential sector for the Base Year and Reference Case analyses, technical and economic savings potential from apartments are reported with the commercial sector to align with FortisBC Gas's categorization for conservation programs.

The increased rate of growth in residential technical potential beginning around 2025 is due to improvements in whole-building energy efficiency practices for single-family detached homes. The upward trend in the commercial sector stems largely from high-impact whole-building new construction measures as well. Of the largest contributing industrial customer segments, reductions in potential from greenhouses and food and beverage outpace the increase in potential from manufacturing, leading to a slight decrease in industrial potential over the forecast period.

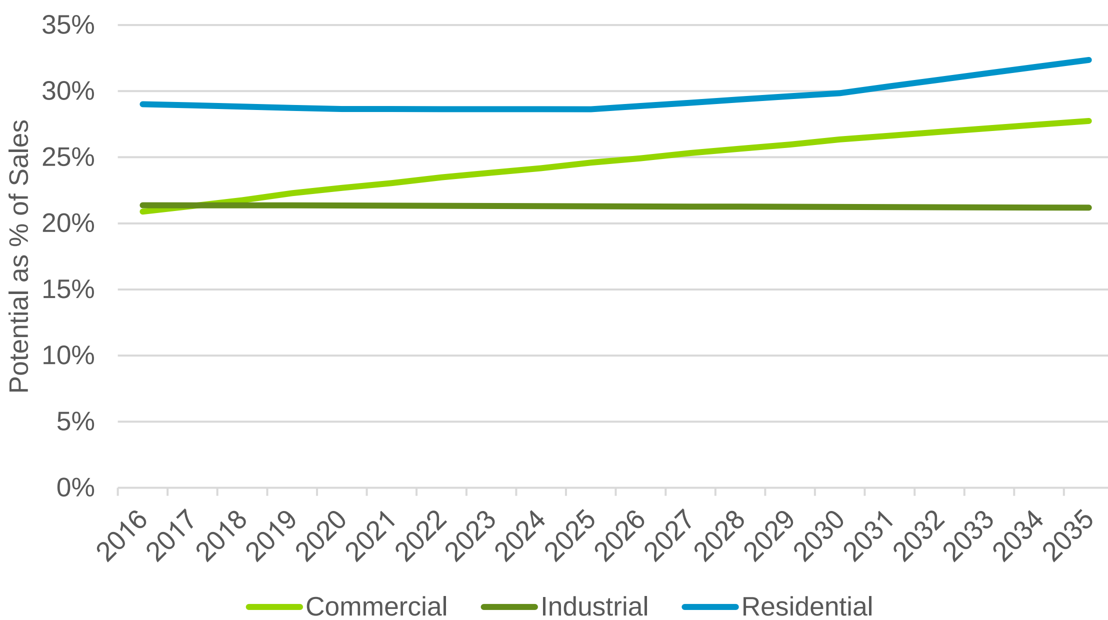
Figure 3-1. Gas Energy Technical Savings Potential by Sector (TJ/year)



Source: Navigant

Figure 3-2 shows the gas energy technical savings potential as a percentage of each sector's total forecasted consumption. Table D-4 in Appendix D provides the associated data. The percentages reflect a weighted average savings among measures applicable to existing building stock and new building stock constructed during the study period. As such, upward-sloping sectors indicate that savings opportunities—on a percentage of consumption basis—are larger in new construction than existing construction. Although growth in total residential consumption declines over time, the high impact new construction measures—several of which were not available until later years—help the residential percentages recover an upward trend by 2026. The commercial sector benefits from new construction measures with significant savings. New construction opportunities in the industrial sector are limited because many of the customer segments show no growth in the consumption forecasts. As such, the vast majority of savings from the industrial sector come from existing facilities rather than facilities constructed during the forecast period.

Figure 3-2. Gas Energy Technical Savings Potential by Sector as a Percent of Sector Consumption (%)

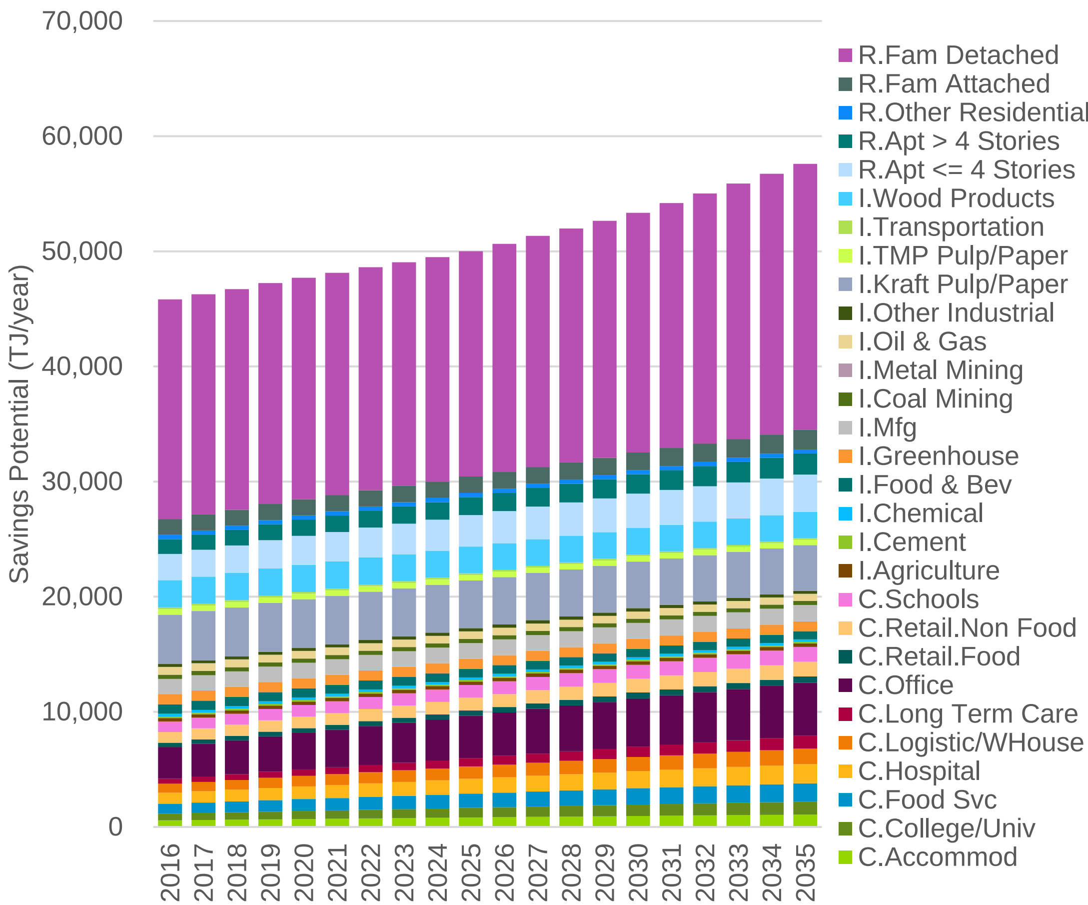


Source: Navigant

3.2.2 Results by Customer Segment

Figure 3-3 shows the gas energy technical savings potential across all customer segments, and Table D-5 in Appendix D provides the associated data.[39] This figure highlights the large savings potential of the residential detached single-family home customer segment relative to other customer segments. The growth in potential for the detached single-family home segment is the largest contributor to the increase in savings potential in the last ten years of the study. This coincides with the improvements to efficient home construction practices that reach maturity toward the end of the forecast. The savings opportunities from new construction buildings (45% above code) boost potential for most commercial segments. [40]

Figure 3-3. Gas Energy Technical Savings Potential by Customer Segment (TJ/year)



Source: Navigant

[39] The LNG segment does not appear in this figure because FortisBC Gas does not supply natural gas to LNG facilities. Gas sales to LNG facilities are zero across the Reference Case forecast, hence, the savings potential is also zero.

[40] Note that whole-building, new construction measures do not necessarily align with provincial energy *step* codes. For example, while the new construction 30% and 45% better than code measures were selected to broadly align with step codes, savings attributed to these measures are calculated based on overall energy consumption, and not based on a particular building code requirement stated in the step codes.

Figure 3-4, Figure 3-5, and Figure 3-6 break out the gas energy technical savings potential for each sector by customer segment. For the residential sector, detached single-family homes represents the largest savings potential of any customer segment by far, accounting for 91% of the total savings potential. Offices and apartments provide approximately half of the savings in the commercial sector. In general, the distribution of savings among customer segments aligns well with the distribution of gas consumption among segments. In the industrial sector, kraft pulp and paper accounts for the largest share of energy savings at 35%. Wood products and manufacturing also provide significant savings among industrial segments.

Figure 3-4. Residential Gas Energy Technical Potential Customer Segment Breakdown in 2025

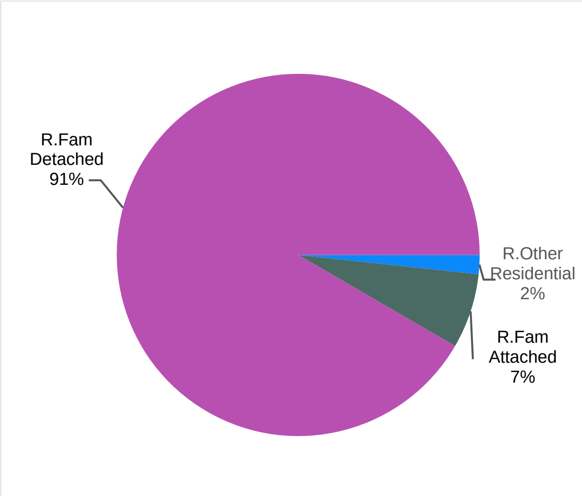


Figure 3-5. Commercial Gas Energy Technical Potential Customer Segment Breakdown in 2025

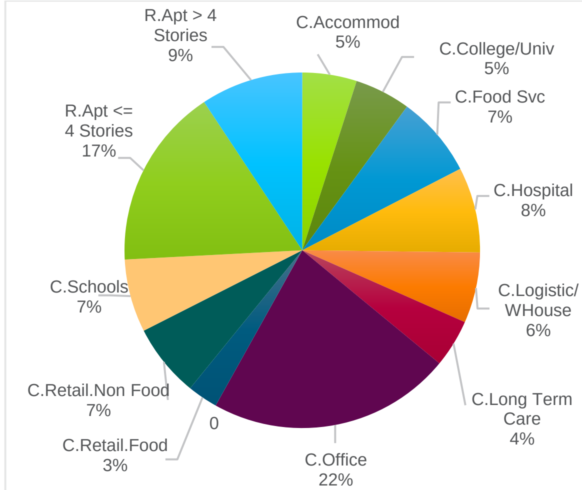
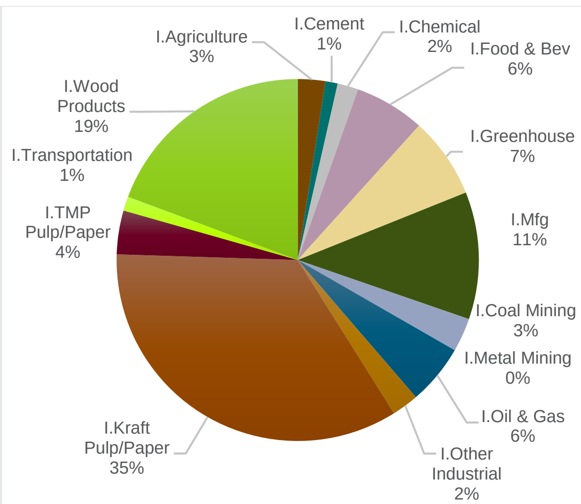


Figure 3-6. Industrial Gas Energy Technical Potential Customer Segment Breakdown in 2025

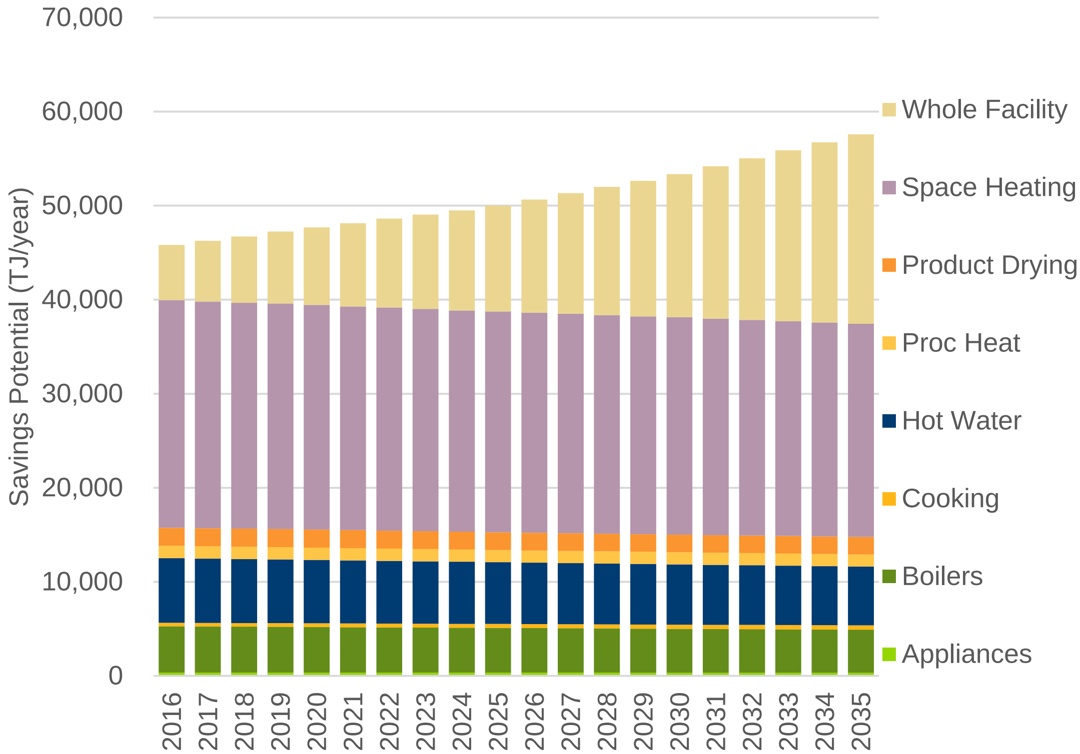


Source: Navigant

3.2.3 Results by End-use

Figure 3-7 shows the gas energy technical savings potential across end-uses. The data used to generate the figure are in Table D-6 in Appendix D. The dominant end-uses are space heating and whole facility. The bulk of savings potential in the space heating end-use come from smart thermostats. The whole facility end-use primarily consists of savings from comprehensive whole-facility new construction practices and energy management programs. As such, these whole-facility savings implicitly include savings from multiple end-uses.

Figure 3-7. Gas Energy Technical Savings Potential by End-Use across sectors (TJ/year)



Source: Navigant

Figure 3-8, Figure 3-9, and Figure 3-10 break out the gas energy technical savings potential for each sector. The space heating and hot water end-uses dominate the residential sector, together accounting for 87% of the total savings potential. In the residential sector, smart thermostats and efficient fireplaces are the two largest space heating measures, while condensing and non-condensing gas tankless water heaters contribute significantly to the hot water end-use's savings.[41] In the commercial sector, the space heating and whole facility end-uses account for roughly 89% of the total technical savings potential. Savings in commercial space heating come largely from wall insulation, HVAC control upgrades, and condensing make-up air units. Boilers measures, which are included in the hot water and space heating end-uses account for roughly 13% of the technical potential. The whole-facility end-use's savings are driven by new building construction practices that are at least 45% above code. While the appliances end-use is not inherent to the commercial sector, the inclusion of apartment buildings in the commercial sector means that savings from appliances are also reported in the commercial sector. In the industrial sector, the boiler end-use plays the largest role, consisting of high savings measures like process boiler load control and heat recovery systems.

[41] Note that efficient fireplaces and envelope upgrade measures are classified as space heating measures.

Figure 3-8. Residential Gas Energy Technical Potential End-Use Breakdown in 2025

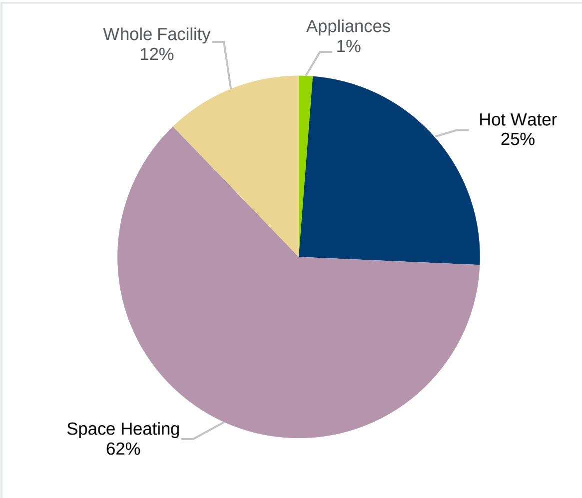


Figure 3-9. Commercial Gas Energy Technical Potential End-Use Breakdown in 2025

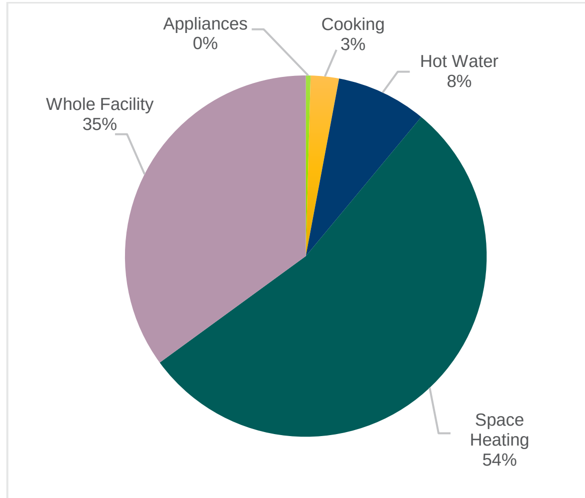
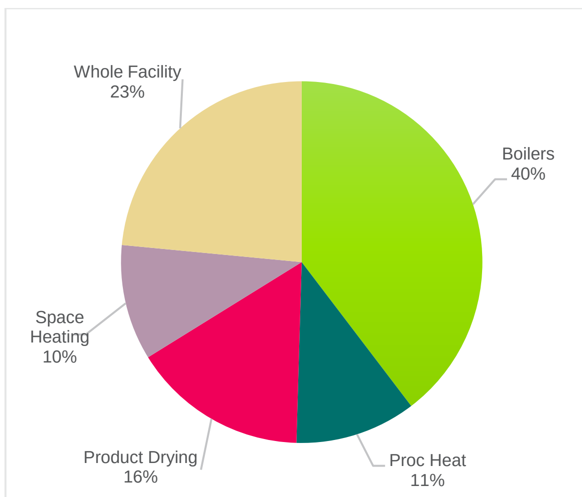


Figure 3-10. Industrial Gas Energy Technical Potential End-Use Breakdown in 2025[42]



Source: Navigant

3.2.4 Results by Measure

The measure-level savings potential shown in Figure 3-11 is prior to adjustments made to competition groups. Some of the measures shown here are not included in the customer segment, end-use, sector and portfolio totals because they are not the measures with the greatest savings potential for their respective competition group.

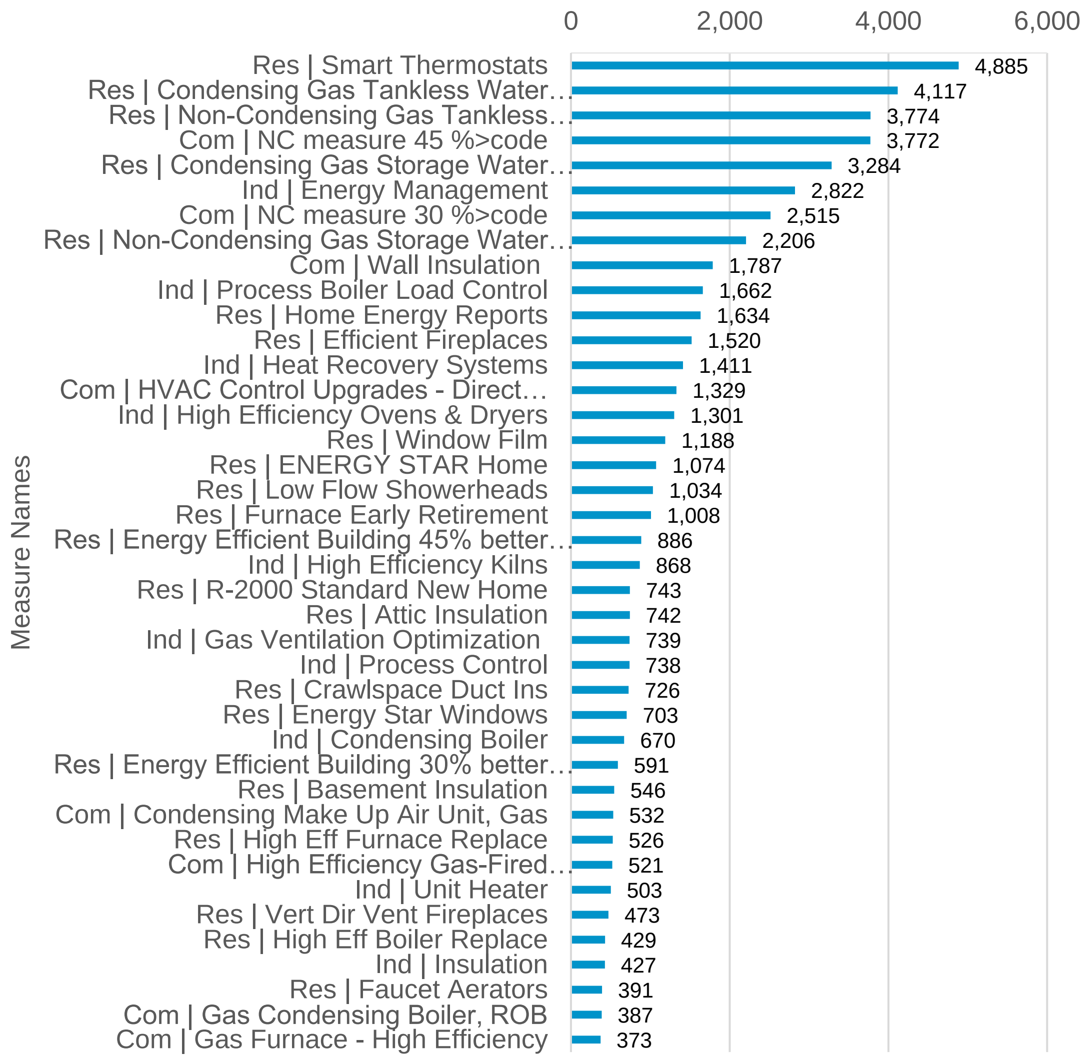
[42] Note that no natural gas energy savings measures are assigned to the *industrial process* end use. As a result, no energy savings potential is reported for this end use.

The figure presents the top forty measures ranked by their gas energy technical savings potential in 2025. Wherever a group of measures were similar in nature, Navigant consolidated their potential into a representative measure name to produce a more succinct view at the measure level. For example, the energy management potential in the figure represents the technical savings potential for industrial energy management and commercial energy management, which encompass energy savings opportunities unique to each sector.

When code-change measures become applicable, they “steal” savings potential from other related measures that may display significant savings in absence of the code. In this way, the sum of the total savings potential between the code and the related energy-efficient measure is the same before and after a code takes effect. This ensures there is no double counting of savings from codes and the energy efficient measures impacted by the code.

The top ten measures come from the space heating, whole-facility, and hot water end-uses. However, non-condensing gas tankless water heaters, new construction building practices at least 30% better than code, and condensing storage water heaters are in competition with other higher impact measures, so their savings do not contribute to aggregate potential results. Smart thermostats and energy management are two of the top ten measures that provide savings in multiple sectors. Thermostats contribute to residential and commercial savings.

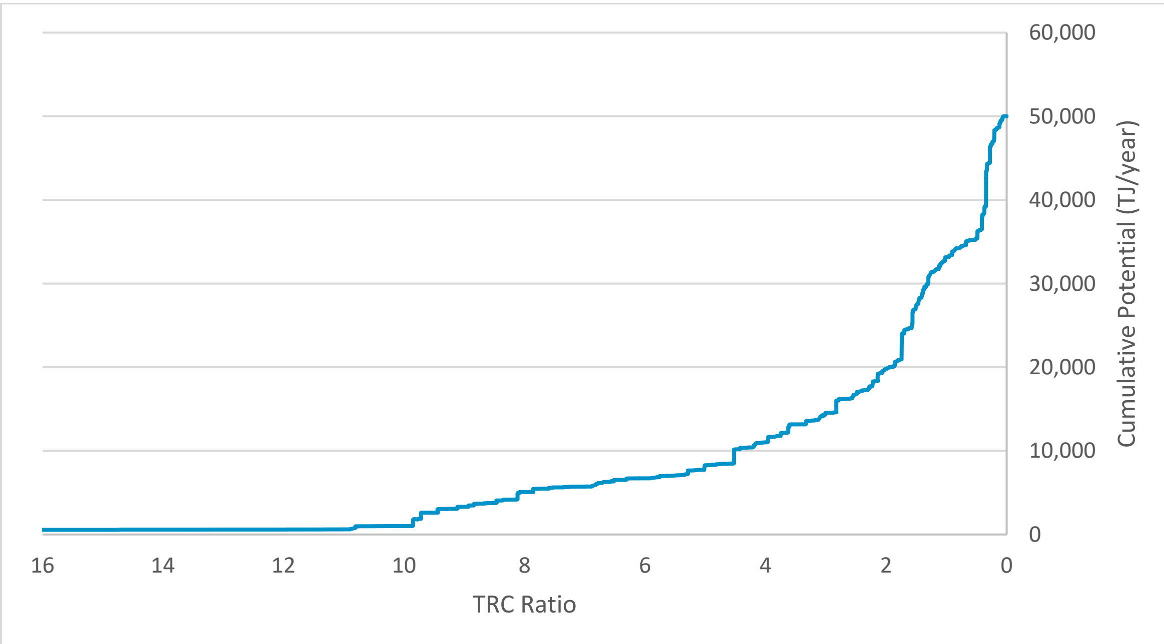
Figure 3-11. Top 40 Measures for Gas Energy Technical Savings Potential in 2025 (TJ/year)



Source: Navigant

Figure 3-12 provides a supply curve of technical savings potential versus the TRC ratio for all measures considered in the study. Navigant truncated this curve only to show TRC ratios below 16, although the full curve would extend well beyond this ratio. Much of the potential with TRC ratios larger than 16 come from new codes and standards measures, which the team modelled as having zero costs and infinite TRC ratios. There is a distinct "elbow" in the supply curve at a TRC ratio of about 4.0, indicating the majority of savings coming from measures with TRC ratios less than 4.0. For TRC ratios below 4.0, cumulative potential increases to about 33,000 TJ/year at a ratio of 1.0. Measures with TRC ratios less than 1.0 are non-cost-effective and do not appear in the economic potential.

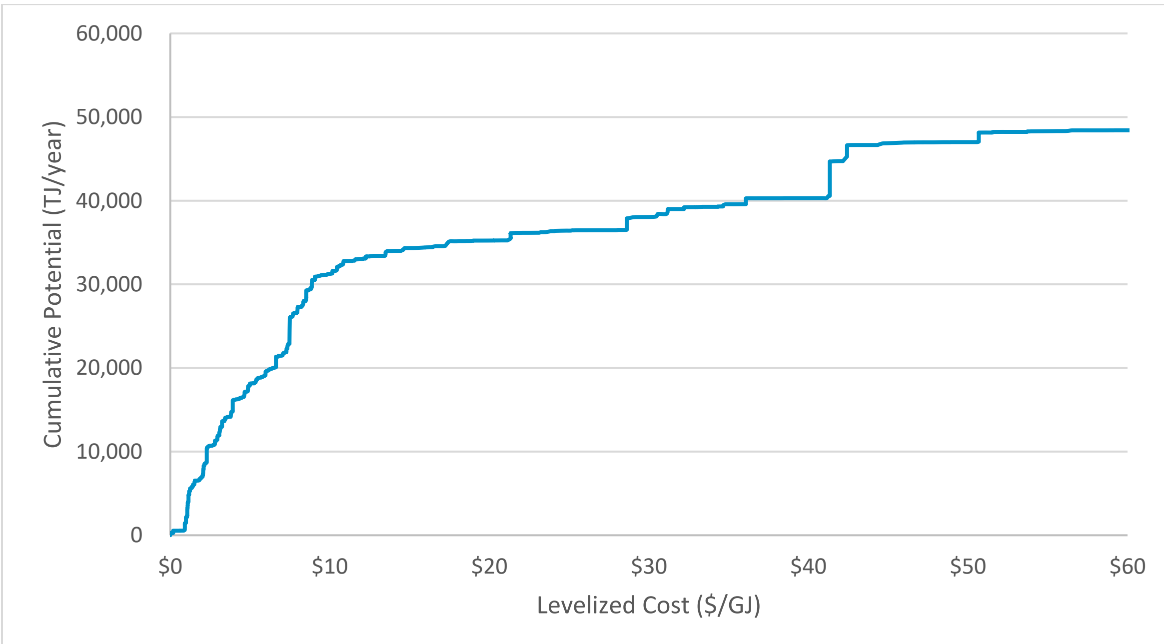
Figure 3-12. Supply Curve of Gas Energy Technical Potential (TJ/year) vs. TRC Ratio (ratio) in 2025



Source: Navigant

Figure 3-13 provides a supply curve of savings potential versus levelized cost of savings in $/GJ for all measures considered in the study. Navigant truncated this curve to show only those measures with a levelized cost less than $60/GJ, though the full curve would extend beyond this to measures with costlier savings. The savings potential having a cost of $0/GJ is due to code-change measures, which Navigant modelled as having zero costs. Total cumulative savings potential increase steadily to just over 48,000 TJ/year at a cost of $60/GJ, beyond which costlier modes of savings add minimal cumulative potential.

Figure 3-13. Supply Curve of Gas Energy Technical Potential (TJ/year) vs. Levelized Cost of Savings ($/GJ) in 2025



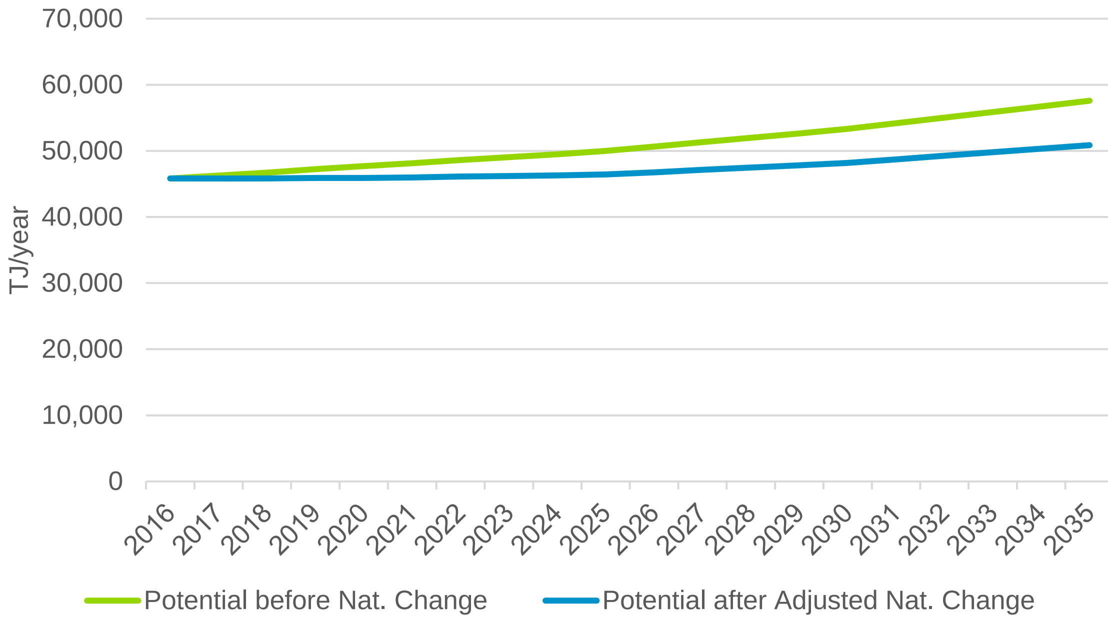
Source: Navigant

3.2.5 Adjustments for Natural Change

As discussed in section 2.3.2, Navigant estimated natural change to account for differences in end-use consumption in the Reference Case compared to the frozen EUI case. Natural change accounts for changes in consumption that are naturally occurring and are not the result of utility-sponsored programs or incentives. Adding natural change to the frozen EUI case required adjusting the technical potential forecasts accordingly.

Figure 3-14 shows the total technical potential across all sectors before and after adjusting for natural change. The total natural change across all sectors is negative in all years, indicating an overall natural tendency toward increased energy conservation rather than growth. The adjusted natural change is computed by accounting for the percentage of the gross natural change that could reasonably be attributed to energy savings for each end-use. On average across the study period, the technical potential after adjusted natural change is roughly 7% lower than the potential prior to natural change.

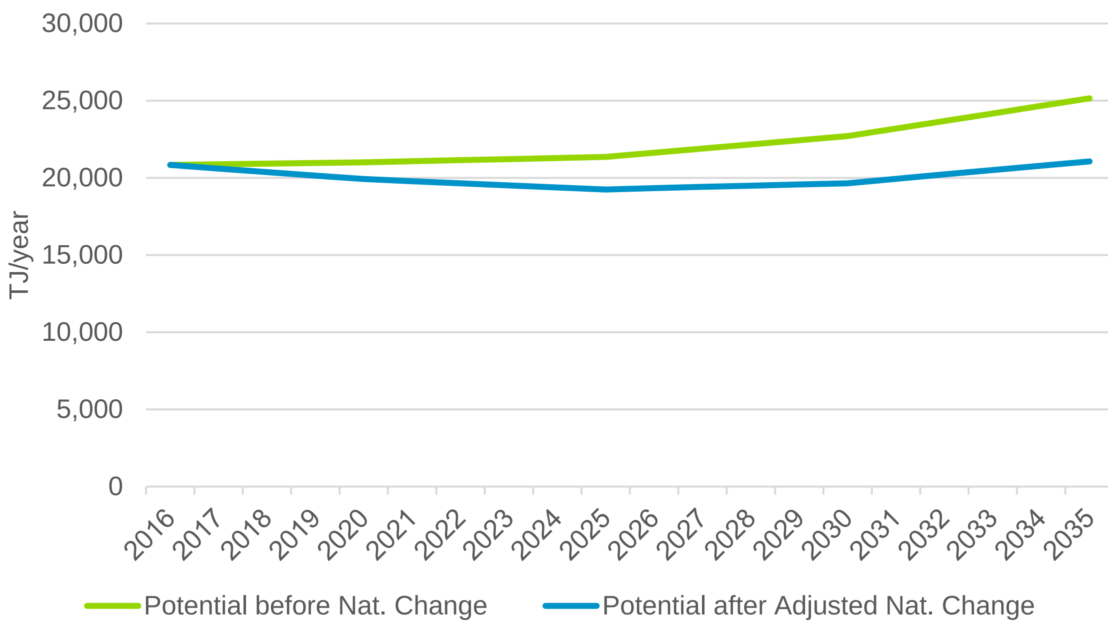
Figure 3-14. Gas Energy Technical Savings Potential with Natural Change – All Sectors (TJ/year)



Source: Navigant

Figure 3-15 shows the effect of adjustments for natural change in the residential sector. Space heating and hot water end-uses account for significant natural conservation. In contrast, appliances account for a minor amount of natural growth. When aggregated to the sector level, natural conservation has a much larger effect than natural growth. On average across the study period, the residential technical potential after adjusted natural change is roughly 10% lower than the potential prior to natural change.

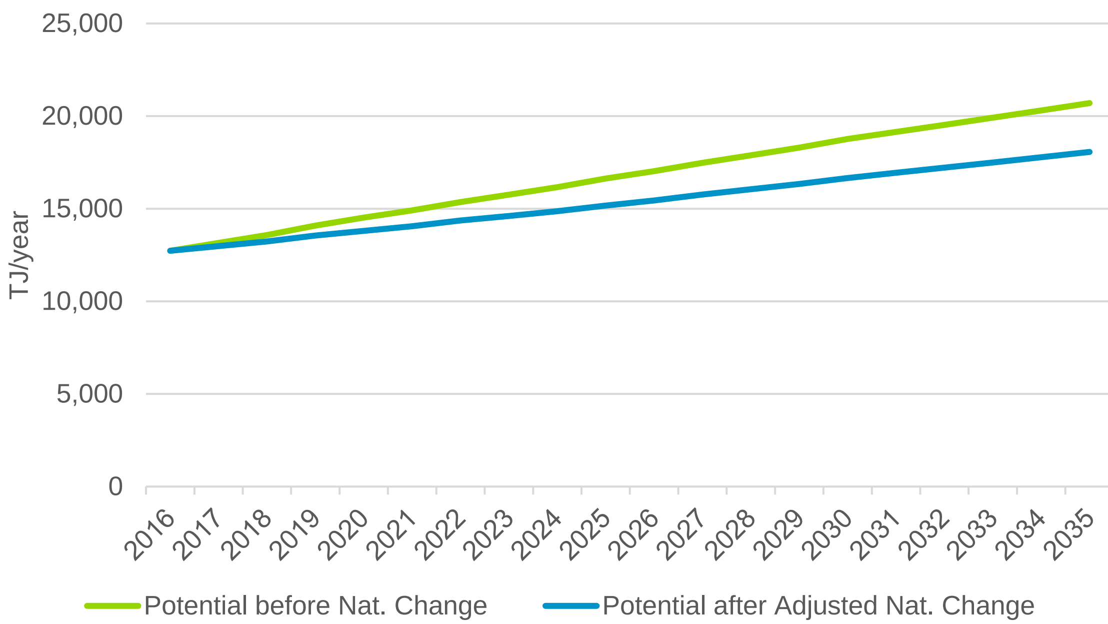
Figure 3-15. Residential Gas Energy Technical Savings Potential with Natural Change (TJ/year)



Source: Navigant

The effect of adjustments for natural change on the commercial sector's technical potential is slightly less than for the residential sector, as seen in Figure 3-16. Space heating and hot water are the commercial end-uses contributing to natural change, and both exhibit natural conservation. On average across the study period, the commercial technical potential after adjusted natural change is roughly 9% lower than the potential prior to natural change.

Figure 3-16. Commercial Gas Energy Technical Savings Potential with Natural Change (TJ/year)



Source: Navigant

For the industrial sector, there was no forecasted natural change, so adjustments to the technical potential results presented in previous sections were not necessary.

4. ECONOMIC POTENTIAL FORECAST

This section describes the economic savings potential, which is potential that meets a prescribed level of cost effectiveness, available in the BC Utilities' service territories. The section begins by explaining Navigant's approach to calculating economic potential. It then presents the results for economic potential.

4.1 Approach to Estimating Economic Potential

Economic potential is a subset of technical potential, using the same assumptions regarding immediate replacement as in technical potential, but including only those measures that have passed the benefit-cost test chosen for measure screening (in this case the Total Resource Cost (TRC) test, per the BC Utilities' guidance). The TRC ratio for each measure is calculated each year and compared against the measure-level TRC ratio screening threshold of 1.0. A measure with a TRC ratio greater than or equal to 1.0 is a measure that provides monetary benefits greater than or equal to its costs. If a measure's TRC meets or exceeds the threshold, it is included in the economic potential.

The TRC test is a cost-benefit metric that measures the net benefits of energy efficiency measures from combined stakeholder viewpoint of the utility (or program administrator) and the customers. The model calculates the TRC benefit-cost ratio using the following equation:

Equation 4. Benefit-Cost Ratio for Total Resource Cost Test

$$TRC = \frac{PV(Avoided\ Costs + O\&M\ Savings)}{PV(Technology\ Cost + Admin\ Costs)}$$

Where:

- *PV( )* is the present value calculation that discounts cost streams over time;
- *Avoided Costs* are the monetary benefits resulting from gas and electric savings (e.g., avoided costs of infrastructure investments, as well as avoided commodity costs due to gas and/or electric energy conserved by efficient measures);
- *O&M Savings* are the non-energy benefits such as operation and maintenance cost savings;
- *Technology Cost* is the incremental equipment cost to the customer;
- *Admin Costs* are the administrative costs incurred by the utility or program administrator.

Navigant calculated TRC ratios for each measure based on the present value of benefits and costs (as defined above) over each measure's life. Appendix A.3 presents the avoided costs, discount rates, and other key data inputs used in the TRC calculation, and Appendix A.2 provides measure-specific inputs. As agreed upon with the BC Utilities, effects of free ridership are not present in the results from this study, so no net-to-gross (NTG) factor was applied. Providing gross savings results will allow the BC Utilities to easily apply updated NTG assumptions in the future, as well as allow for variations in NTG assumptions by reviewers.

Although the TRC equation includes administrative costs, the study does not consider these costs during the economic screening process because an individual measure's cost effectiveness "on the margin" is the primary focus. Additionally, Navigant excluded administrative costs from this analysis because those costs are largely driven by program design, which is outside of the scope of this evaluation.

Similar to technical potential, only one "economic" measure (meaning that its TRC ratio meets the 1.0 threshold) from each competition group is included in the summation of economic potential across measures (e.g., at the end-use category, customer segment, sector, service territory or total level). If a competition group is composed of more than one measure that passes the TRC test, then the economic measure that provides the greatest gas savings potential is included in the summation of economic potential. This approach ensures that double counting is not present in the reported economic potential, though economic potential for each individual measure is still calculated and reported outside of the summation.

4.2 Economic Potential Results

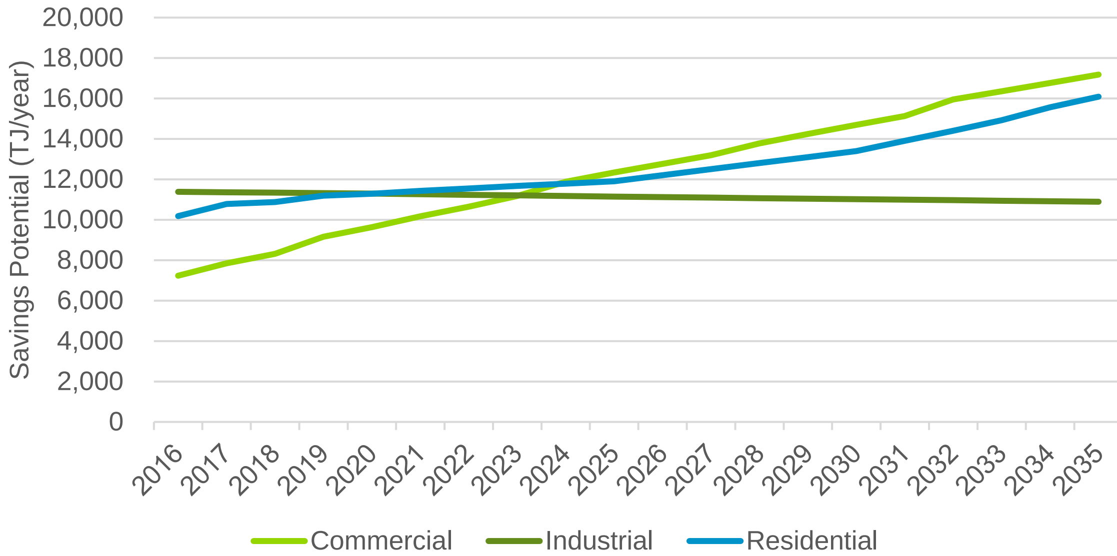
This section provides the results pertaining to economic savings potential at different forms of aggregation. Results are shown by sector, customer segment, end-use category and highest-impact measures.

4.2.1 Results by Sector

Figure 4-1 shows economic gas savings potential across all sectors. The data used to generate the figure are in Table D-7 in Appendix D. In contrast to technical potential, the residential economic potential shows a steady growth through 2035. The commercial economic potential grows nearly twice as fast as the technical potential. The industrial sector's economic potential exhibits similar decay trends as the technical potential. On average across the study period, 57% of residential, 74% of commercial and 93% of industrial technical potential pass the economic screening process.[43]

[43] The BC Utilities Commission (BCUC) allows for the use of a modified-TRC test (mTRC) for evaluating cost-effectiveness of energy efficiency measures. The mTRC test is based on higher avoided energy costs, and produces different results in comparison with the standard TRC test. The use of the mTRC test for economic potential is not in the scope of this portion of the BC CPR.

Figure 4-1. Gas Energy Economic Savings Potential by Sector (TJ/year)



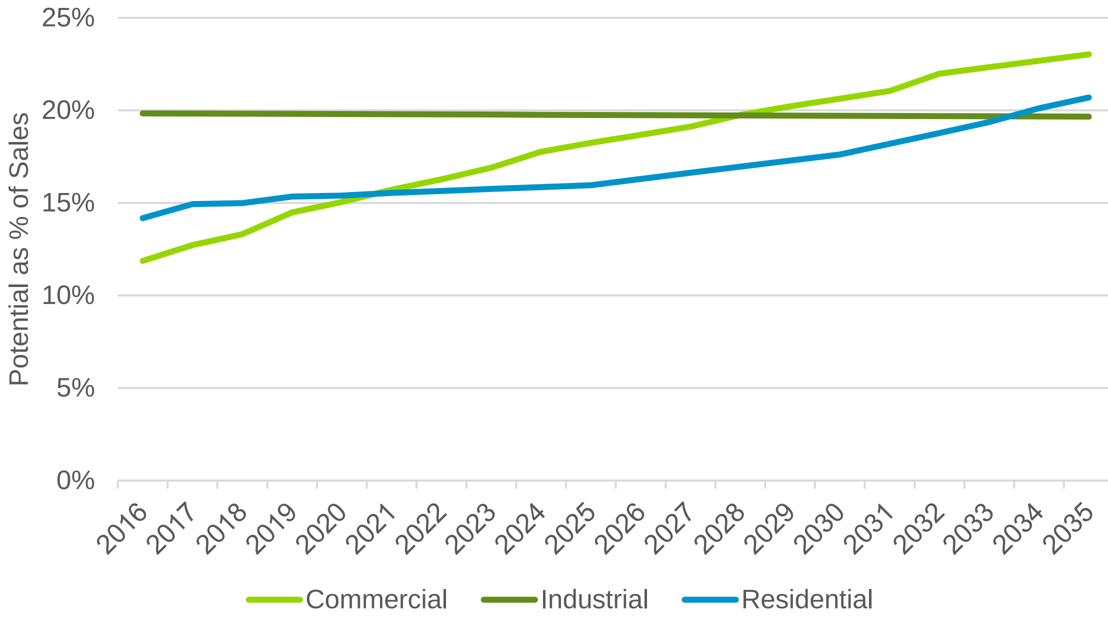
Source: Navigant

The bumps in select years of the residential and commercial economic potential occur whenever one or more measures cross the cost-effectiveness threshold in one or more customer segments. The slope of energy savings over time reflect changes in gas sales and the roll-out of high-efficiency, new construction measures. These measures having TRC ratios slightly less than 1.0 at the beginning of the study period become economically feasible as ***avoided gas costs—which escalate at a faster rate than equipment, operation and maintenance costs***—increase throughout the study the period. For example, smart thermostats become cost-effective in 2017 for the residential sector. The bumps in commercial economic potential prior to 2026 result from HVAC control upgrades using direct digital data control becoming cost-effective in various customer segments and years. When vertical direct-vent fireplaces become economically feasible in 2031, it induces the final visible jump in commercial potential.

Technical and economic energy potential are similar in the industrial sector because the measures included in the study are selected on the premise that they are currently or could become reasonably attractive to industrial customers and have some likelihood of adoption given a wide range of market environments. Considering many industrial customers purchase gas in bulk at rates lower than other customers, market experience has shown industrial customers require measures to be more economic than residential and commercial customers do. Thus, the measures deemed reasonably attractive to industrial customers tend to fair very well in a TRC ratio using the utility's avoided costs, which are often higher than industrial gas retail rates.

Figure 4-2 shows the economic gas savings potential as a percentage of gas consumption, with associated data presented in Table D-8 in Appendix D. Though it had the lowest technical potential as a percentage of consumption, the industrial sector had the highest percentages for economic potential. For the residential sector, the introduction of new whole-home new construction measures allowed the sector to increase economic savings despite the limited growth in residential consumption. Similarly, whole-building new construction practices in the commercial sector enable the increase in savings potential as a percent of commercial-sector consumption over time.

Figure 4-2. Gas Energy Economic Savings Potential by Sector as a Percent of Sector Consumption (%)

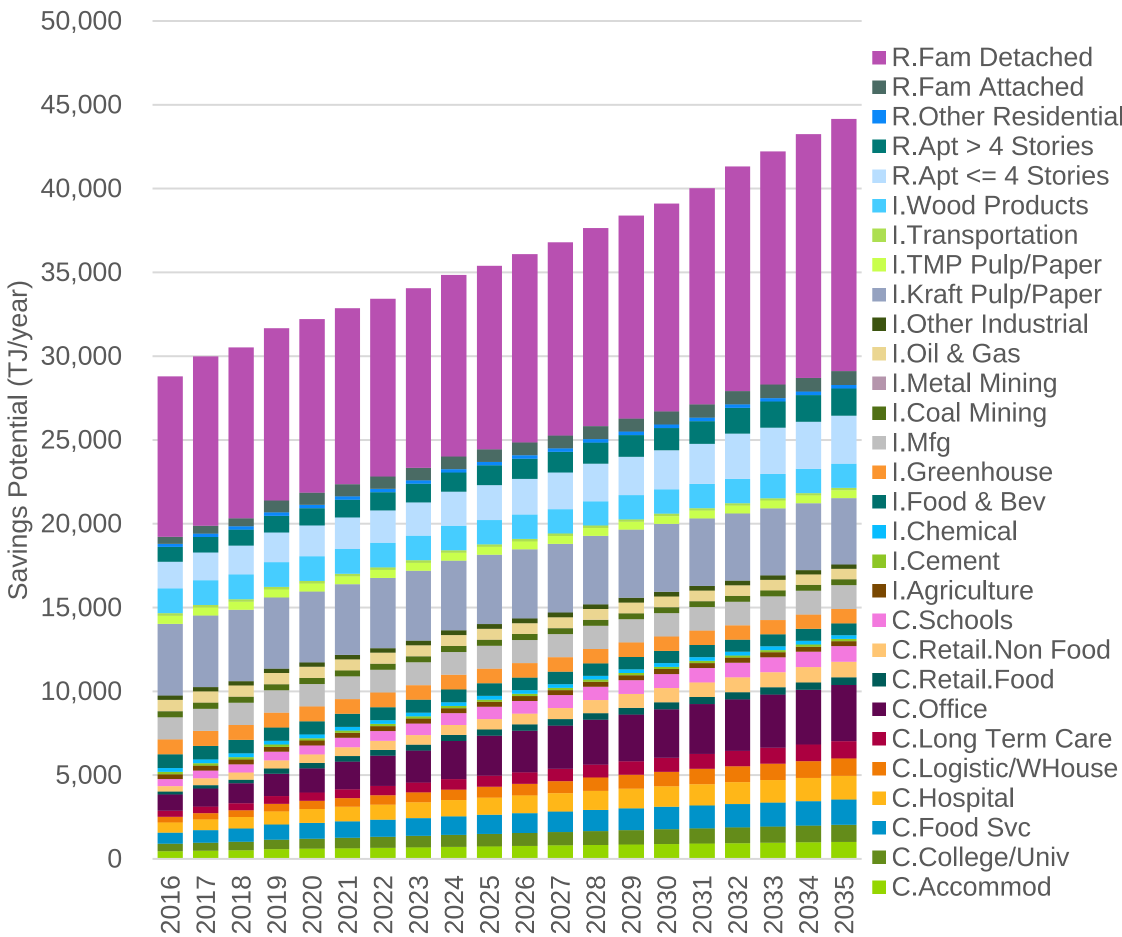


Source: Navigant

4.2.2 Results by Customer Segment

Figure 4-3 depicts the economic energy savings potential for all customer segments, and Table D-9 in Appendix D provides the corresponding data values. Depending on the customer segment, between 49% and 57% of the technical energy potential pass the economic screening threshold within the residential sector. The greatest reduction from technical potential to economic potential appeared in single-family attached homes, while the smallest reduction occurs in single-family detached homes. For the commercial customer segments, the reduction in economic potential relative to technical potential ranges from 59% to 92%. Non-food retail establishments see the greatest loss from non-economic potential, while long term care facilities are the most resilient. In the industrial sector, high-efficiency kilns do not pass the economic screen.

Figure 4-3. Gas Energy Economic Savings Potential by Customer Segment (TJ/year)



Source: Navigant

In general, the mix of economic energy savings from various customer segments within a given sector is similar between economic and technical potential. Detached single-family homes is the segment with the highest fraction of savings potential that are economic, and they provide the largest share of economic savings potential within the residential sector. Similarly, the mix of economic potential from the commercial segments do not change appreciably relative to the technical potential. The wood products segment falls from 19% of the industrial technical potential mix to 13% of the economic potential. Figure 4-4, Figure 4-5 and Figure 4-6 provide a breakdown of economic energy potential by customer segment and sector.

Figure 4-4. Residential Gas Energy Economic Potential Customer Segment Breakdown in 2025

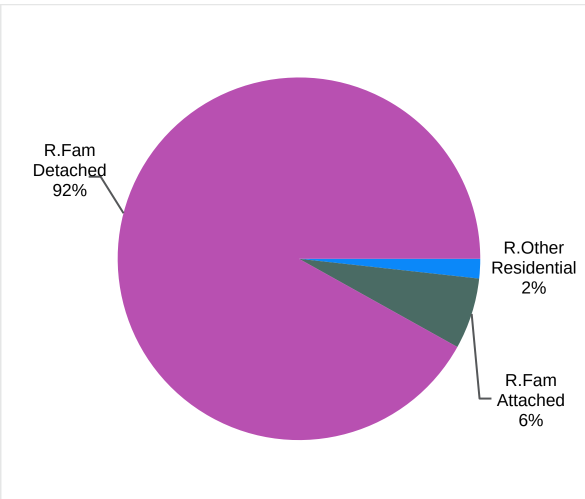


Figure 4-5. Commercial Gas Energy Economic Potential Customer Segment Breakdown in 2025

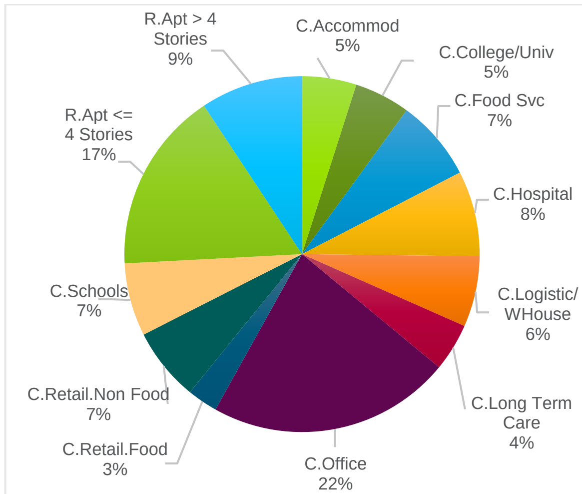
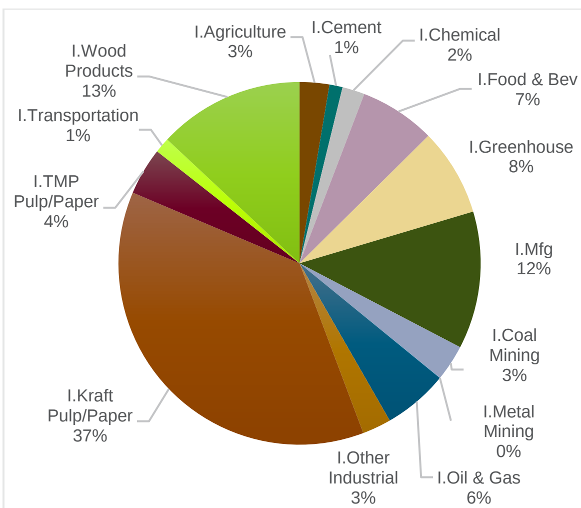


Figure 4-6. Industrial Gas Energy Economic Potential Customer Segment Breakdown in 2025

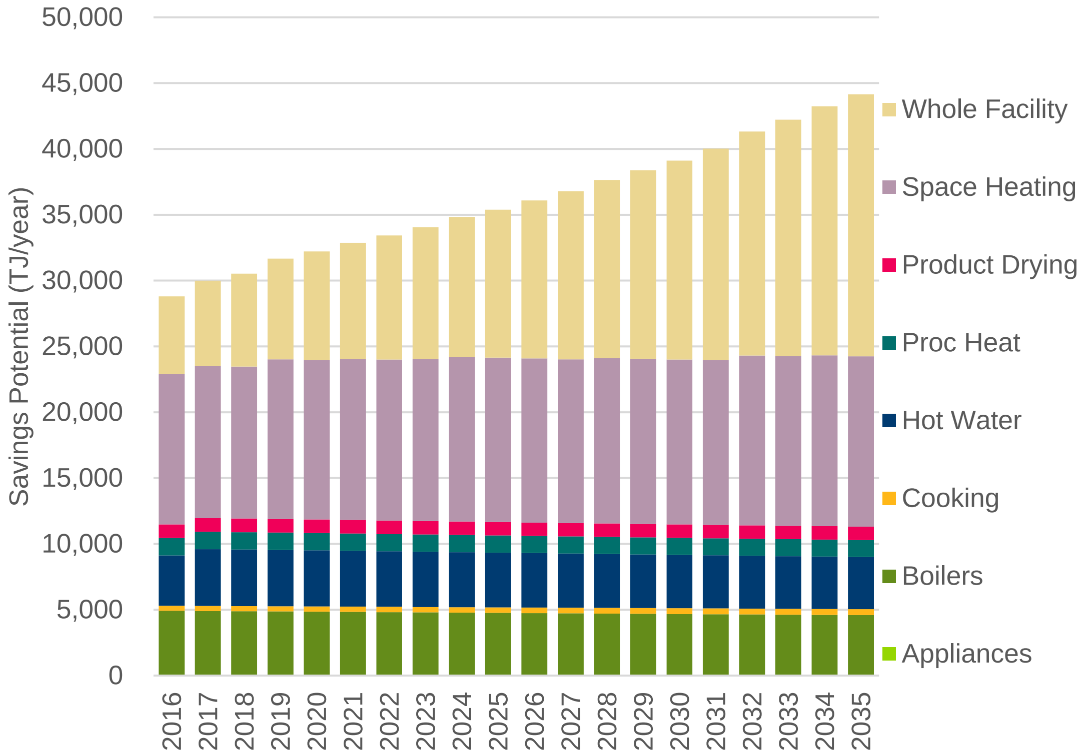


Source: Navigant

4.2.3 Results by End-use

Depending on the end-use category, between 0% and 100% of the technical energy potential is cost-effective. The least economic end-uses across all customer sectors are appliances (0% of technical potential), space heating (53% of technical potential), and product drying (54% of technical potential). Boilers, cooking, and process heat are end-use categories that have economic potential of 100% of technical potential. Figure 4-7, shows the economic gas potential by end-use, with associated data in Table D-10 in Appendix D.

Figure 4-7. Gas Energy Economic Savings Potential by End-Use (TJ/year)



Source: Navigant

Figure 4-8, Figure 4-9 and Figure 4-10 provide the breakdown of economic energy potential by end-use categories within each sector. In the residential sector, space heating decreases from 62% to 52%, while whole facility increases from 12% to 22%. Similarly, in the commercial sector, space heating decreases from 54% to 41% of the total, while whole facility increases from 35% to 47%. Product drying declines by 7 percentage points in the makeup of industrial potential.

Figure 4-8. Residential Gas Energy Economic Potential End-Use Breakdown in 2025

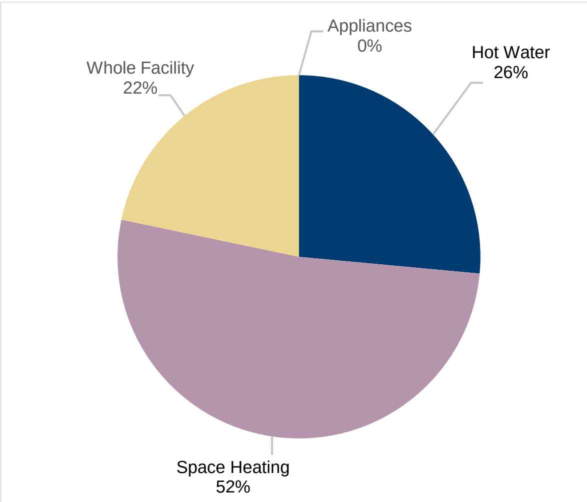


Figure 4-9. Commercial Gas Energy Economic Potential End-Use Breakdown in 2025

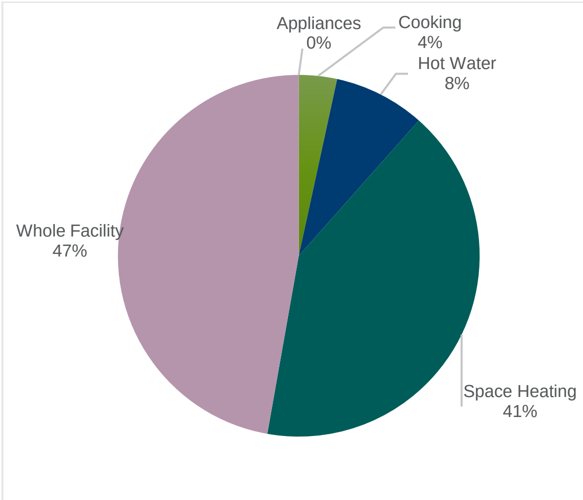
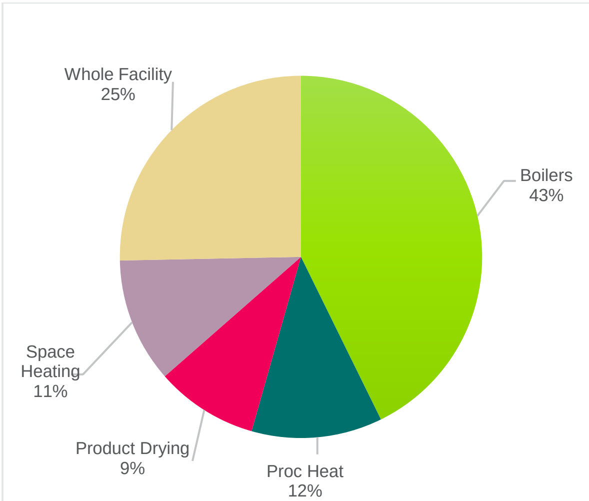


Figure 4-10. Industrial Gas Energy Economic Potential End-Use Breakdown in 2025

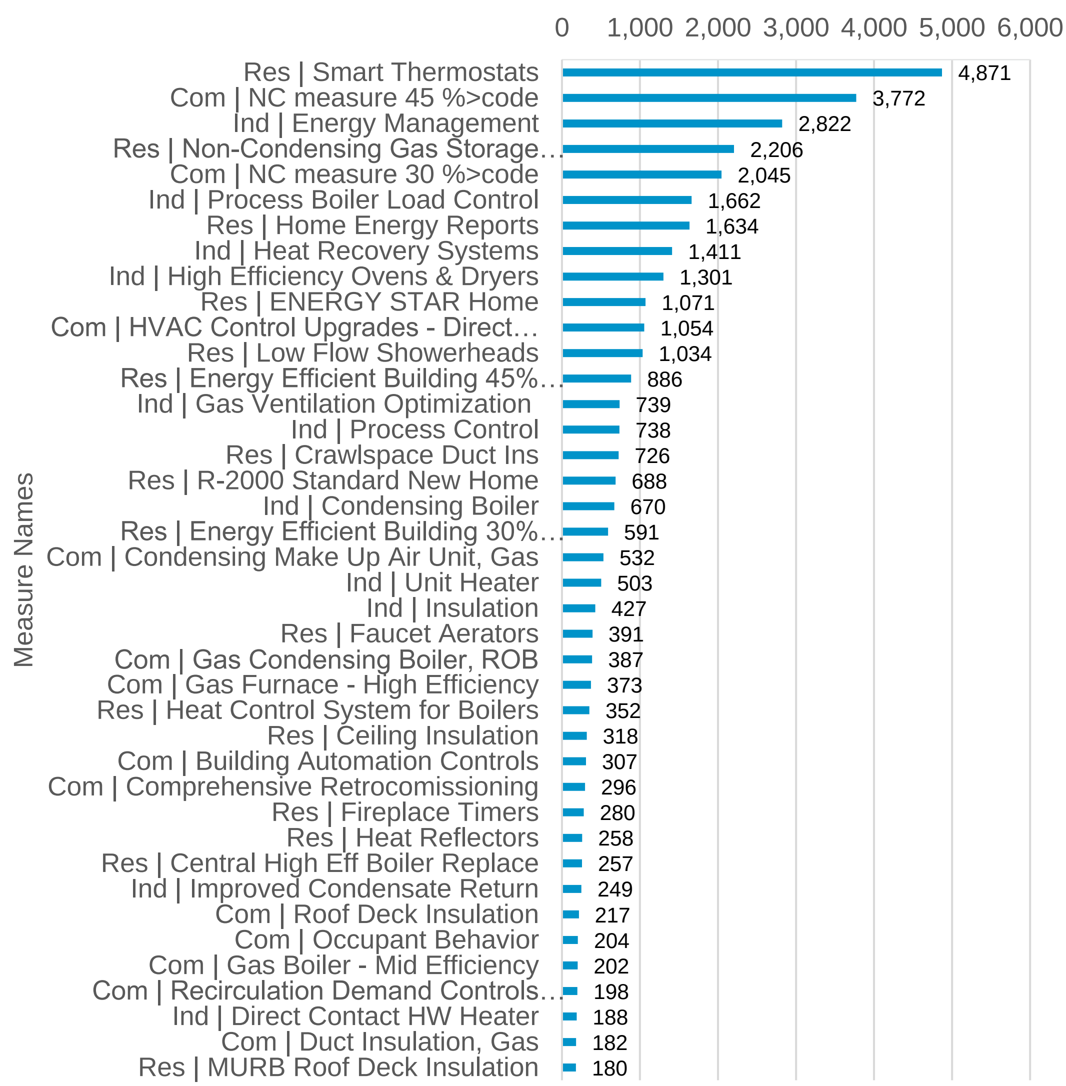


Source: Navigant

4.2.4 Results by Measure

The measure-level economic energy savings potential shown in Figure 4-11 is prior to adjustments made to competition groups as detailed in Section 3.2.4. The figure highlights the economic potential from the top 40 highest-impact measures. When compared with the top 10 technical potential measures, three residential measures (condensing and non-condensing tankless water heaters and condensing storage water heaters), and one commercial measure (wall insulation) are not economic and fall out of the top 40. Measures pertaining to the industrial sector, such as energy management and process boiler load control, move up the rankings due to their economic potential remaining similar to their respective technical potential.

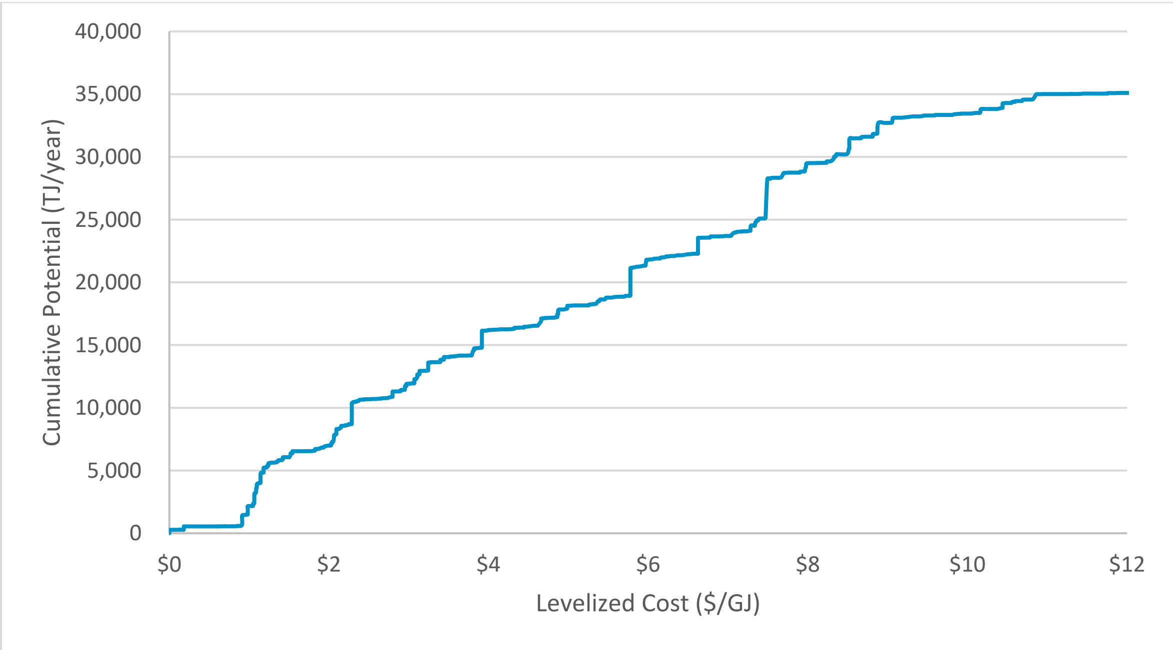
Figure 4-11. Top 40 Measures for Economic Potential in 2025 (TJ/year)



Source: Navigant

Figure 4-12 provides a supply curve of savings potential versus levelized cost of savings in $/GJ for all measures considered in the study. This curve shows only those measures with a levelized cost less than $12/GJ. While the full curve extends beyond the $12/GJ point to measures with costlier savings, savings from these measures is negligible since the curve flattens out. The savings potential seen at a cost of $0/GJ is due to code-change measures, which have zero costs in the model.

Figure 4-12. Supply Curve of Gas Economic Potential (TJ/year) vs. Levelized Cost of Savings ($/GJ) in 2025



Source: Navigant

APPENDIX A. ADDITIONAL MODEL RESULTS AND INPUT ASSUMPTIONS

A.1 Detailed Model Results

See attachment, "FortisGas_Appendix_A1_2017-01-23.xlsx," for granular results from the model.

A.2 Measure List and Characterization Assumptions

See attachment, "FortisGas_Appendix_A2_2017-01-23.xlsx," for granular measure input to the model.

A.3 Other Key Input Assumptions

See attachment, "FortisGas_Appendix_A3_2017-01-23.xlsx," for key assumptions about building stocks, end-use intensities, avoided costs, discount rates, etc. used by the model.

APPENDIX B. APPROACH TO BASELINE CALIBRATION

B.1 End-Use Definitions

Table B-1. Description of End-Uses[44],

Segment	End-Use	Definition
Residential	Appliances	Large/small appliances including ovens, refrigerators, freezers, clothes washers, etc.
	Electronics	Televisions, computers and related peripherals, and other electronic systems
	Water Heating	Heating of water for domestic hot water use
	Lighting	Interior, exterior and holiday/seasonal lighting
	Other	Miscellaneous loads
	Space Cooling	All space cooling, including both central AC and room or portable AC
	Space Heating	All space heating, including both primary heating and supplementary heating
	Ventilation	Ventilation requirements for space heating/cooling including furnace fans
	Whole Facility	The whole facility end-use reflects the total customer load. The residential whole facility end-use is used to characterize new construction and behavioral measures that impact overall energy consumption. In the residential sector this includes as home energy reports, and new construction home/building measures such as ENERGY STAR and Net Zero homes.
Commercial	Cooking	Food preparation equipment including ranges, broilers, ovens, and griddles
	HVAC Fans/Pumps	HVAC auxiliaries including fans, pumps, and cooling towers
	Hot Water	Hot water boilers, tank heaters, and others
	Lighting	Interior, exterior and holiday/seasonal lighting for main building areas and secondary areas
	Office Equipment	Computers, monitors, servers, printers, copiers and related peripherals
	Other	Miscellaneous loads including elevators, gym equipment, and other plug loads
	Refrigeration	Refrigeration equipment including fridges, coolers, and display cases
	Space Cooling	All space cooling equipment, including chillers, and DX cooling.
	Space Heating	All space heating equipment, including boilers, furnaces, unit heaters, and baseboard units
	Whole Facility	The whole facility end-use reflects the total customer load. The commercial whole facility end-use is used to characterize new construction and behavioral measures that impact overall energy consumption. In the commercial sector this includes building automation controls, new construction measures, occupant behavior, and retro-commissioning.
Industrial	Boilers	Boilers for industrial applications
	Compressed Air	Air compressors and related equipment
	Fans & Blowers	Fans and blowers for ventilation, combustion and pneumatic conveyance
	Industrial Process	Industrial processes for various applications including mechanical, electrical, and chemical processes
	Lighting	Interior, exterior, and seasonal lighting loads
	Material Transport	Feedstock and product movement by conveyance or stackers
	Process Compressors	Process compressors
	Process Heating	Process heating including heat treatment and industrial ovens
	Product Drying	Industrial drying equipment and systems
	Space Heating	All non-process space heating equipment (e.g., comfort heating)
	Pumps	Process pump systems
	Refrigeration	Industrial refrigeration

[44] While not all end-uses are applicable to FortisBC Gas, this table shows definitions for all electric and gas end-uses.

Whole Facility	The whole facility end-use reflects the total customer load. The industrial whole facility end-use is used to characterize new construction and behavioral measures that impact overall energy consumption. In the industrial sector this includes energy management, and new plant measures.

Source: Navigant

B.2 Residential Sector – Additional Detail

In order to characterize the residential sector energy usage, Navigant developed a bottom-up analysis based on the mix of fuel shares and the types of equipment used for each end-use. Navigant developed these estimates based on a review of FortisBC Gas's 2012 REUS study and BC Hydro's 2014 REUS. Both of these end-use surveys provides detailed residential household data, and detailed information in relation to each of the end-uses, existing equipment, main and secondary fuel systems, and saturation levels for common energy efficiency measures. Using the data provided by the residential survey, Navigant developed specific fuel share and equipment estimates for each residential segment. The following sections summarized the approach for developing the following:

- **Residential Stock** for each residential segment
- **Fuel shares** and **equipment shares** for each residential segment in each region
- **End-use intensities (EUIs)** for each residential segment in each region

Fuel Shares and Equipment Shares

Using the data provided by the FortisBC 2012 REUS study, Navigant developed specific fuel share and equipment estimates for each residential segment in each region. The translation of data from the 2012 REUS study to Navigant's analysis was relatively straightforward given the granularity of the REUS data. For example, the residential survey reports most information aggregated based on four types of dwellings (Single Detached, Single Attached, Apartments, and Other), which are largely consistent with the residential segments employed for this CPR.

- Table B-2 shows the mix of fuel shares for each residential segment by region[45]
- Table B-3 shows the types of equipment used for the **Space Heating**, and **Water Heating** end-uses by residential segment and region
- Table B-4 shows the types of **Appliance** equipment by residential segment and region

[45] This table shows the gas share of appliances at 100% and the electric share at 0%. This does not mean that all appliances use gas and that no appliances use electricity, but rather reflect the fact that - from the perspective of a gas utility (FortisBC Gas and PNG) - all gas appliances are fueled by gas. For the electric utilities (BC Hydro and Fortis Electric), the opposite is true – all electric appliances are fueled by electricity such that the electric fuel share is 100%.

Table B-2. FortisBC Gas Residential Fuel Shares (Percentage of FortisBC Customers Using Each Energy Type)

Building Type	End-use	Lower Mainland		Vancouver Island		Southern Interior		Northern BC	
		Gas	Electric	Gas	Electric	Gas	Electric	Gas	Electric
Single Family Detached/Duplexes	Space Heating	89%	9%	64%	32%	85%	11%	86%	9%
	Water Heating	84%	15%	70%	29%	72%	27%	75%	24%
Single Family Attached	Space Heating	76%	23%	61%	39%	89%	11%	91%	9%
	Water Heating	69%	30%	66%	34%	85%	15%	79%	21%
Apartments <= 4 Storeys	Space Heating	30%	69%	18%	80%	35%	62%	29%	71%
	Water Heating	69%	30%	50%	48%	64%	36%	63%	37%
Apartments > 4 Storeys	Space Heating	30%	69%	18%	80%	35%	62%	29%	71%
	Water Heating	69%	30%	50%	48%	64%	36%	63%	37%
Other Residential	Space Heating	89%	9%	64%	32%	85%	11%	86%	9%
	Water Heating	89%	3%	82%	10%	79%	13%	81%	11%

Source: Navigant analysis of 2012 REUS

Table B-3. Residential Equipment Shares (%)

End-use	Equipment Type	Fraction of Households Using Equipment Type (%)				
		Single Family Detached	Single Family Attached	Apartments <=4 Storeys	Apartments >4 Storeys	Other Residential
Space Heating	Gas Furnace 0.6 AFUE	8%	8%	4%	4%	1%
	Gas Furnace 0.8 AFUE	27%	28%	14%	14%	5%
	Gas Furnace 0.9 AFUE	36%	29%	13%	13%	66%
	Gas Boiler 0.7 EF	0%	0%	0%	0%	0%
	Gas Boiler 0.8 EF	8%	10%	2%	2%	19%
	Gas Boiler 0.9 EF	4%	5%	17%	17%	11%
	Gas Fireplace	89%	79%	0%	0%	79%
Water Heating	Gas Water Heater Conventional	93%	91%	5%	5%	85%
	Gas Water Heater Condensing	0%	0%	0%	0%	0%
	Gas DHW Tankless	5%	5%	0%	0%	5%

^Note - Equipment types using same energy type add to percentage of homes with end-use. Space heating system may add to >100% due to secondary systems (i.e. fireplaces).
Source: Navigant analysis of 2012 REUS and BC Hydro 2014 REUS

Table B-4. Appliances Equipment (%)

		Percentage of Households with Appliance				
End-Use	**Equipment Type**	**Single Family Detached**	**Single Family Attached**	**Apartments <=4 Storeys**	**Apartments > 4 Storeys**	**Other Res**
Appliances	C. Dryer Gas Low E	7%	7%	4%	4%	7%
	C. Dryer Gas ENERGY STAR®	4%	4%	7%	7%	4%
	Stove Gas	16%	12%	6%	6%	11%

Source: Navigant analysis of BC Hydro 2014 REUS

End-Use Intensities (EUIs)

The next step of the residential calibration to FortisBC Gas's Reference Forecast process required the roll up of the fuel share and equipment share estimates in order to establish EUIs for each residential segment in each region. Based on this approach, Navigant developed bottom-up EUI estimates for Space Heating, Water Heating, and Appliances. The EUIs for the Other end-use was estimated based on the 2010 FortisBC Gas CPR.

Table B-5 shows an example of the calibration process followed for Single Family Detached/Duplexes in the Southern Interior. The process used to calibrate the estimate of energy use builds on an estimate of the percentage of homes with a particular end-use and fuel type, using a particular type of equipment and efficiency within an end-use. The fuel shares (column B), equipment shares (column E), and an estimated level of energy use for each equipment type (column F) are multiplied to obtain an estimated UEC (column G). In the example below, column G sums the total consumption across all water heating equipment. The team summed the resulting EUCs across end-uses to obtain the segment-level intensity (GJ per year), and then calibrated to match the actual target intensity stemming from FortisBC Gas sales data.

This same process is repeated across all residential and commercial segments in each region. Ultimately, EUIs that matched the segment-level sales targets in the base year were determined for each end-use and segment, and across all regions.

With the base year EUIs established, the Reference Case EUIs were determined based on the residential and commercial sector EUI trends. The approach for developing the EUI trends is described in the body of the report.

Table B-7, Table B-8, and Table B-9 show the residential EUIs used in the Reference Case for the Southern Interior, Vancouver Island, and Northern BC regions. The EUIs presented in these tables start with the base year EUIs shown in Table B-6 and adjusted based on the EUI trends. The Lower Mainland EUIs are included the main body of the report.

Table B-5. Example of Calibration Process (Single Family Detached/Duplexes – Southern Interior)

A	B	C	D	E	F	G	H	I
End Use	*Fuel Share (%)*	*Equipment*	*Efficiency*	*Equipment Share (%)*	*Annual Energy Use (GJ)*	*End-Use Weighted Avg. Use (GJ)*	*Total Uncalibrated Consumption (GJ)*	*Total Calibrated Consumption (GJ)*
Space Heating	*85%*	…	…	…	…	…	*51.7*	*57.7*
Water Heating	*72%*	*Gas Water Heater Conventnl*	*n/a*	*83%*	*17.7*	*12.2*	*12.2*	*13.6*
		Gas Water Heater Condensing	*n/a*	*13%*	*13.7*			
		Gas DHW Tankless	*n/a*	*4%*	*10.9*			
Cooling	*0%*	…	…	…	…	…	*0.0*	*0.0*
Appliances	*100%*	…					*1.3*	*1.4*
Lighting	*0%*	…	…	…	…	…	*0.0*	*0.0*
Electronics	*0%*	…	…	…	…	…	*0.0*	*0.0*
Other	*0%*	…	…	…	…	…	*2.5*	*2.8*
Ventilation	*0%*	…	…	…	…	…	*0.0*	*0.0*
Estimated Consumption (GJ per year)							*67.7*	***75.6***
Target Consumption (GJ per year)		*- calculted based on Fortis Gas 2014 sales data*					*75.6*	***75.6***
	Uncalibrated vs. Target						***90%***	***100%***

Appliances are assigned a fuel share of 100%. This implies that all gas appliances have a fuel share of 100% gas. Similarly, electric utilities have an appliances fuel share of 100%. Penetration of gas appliances are represented by equipment shares.
Source: Navigant

Table B-6. Base Year Residential EUIs (GJ/household) by Segment and Region

Building Type	End-Use	Average Use per Household (GJ)			
		Lower Mainland	Southern Interior	Vancouver Island	Northern BC
Single Family Detached/Duplexes	Space Heating	77	58	38	76
	Water Heating	15	14	15	12
	Cooling	-	-	-	-
	Appliances	1	1	2	1
	Lighting	-	-	-	-
	Electronics	-	-	-	-
	Other	3	3	3	2
	Ventilation	-	-	-	-
	Total	95	76	58	91
Single Family Attached	Space Heating	47	39	23	49
	Water Heating	10	12	10	8
	Cooling	-	-	-	-
	Appliances	1	1	1	1
	Lighting	-	-	-	-
	Electronics	-	-	-	-
	Other	1	1	1	1
	Ventilation	-	-	-	-
	Total	59	52	36	59
Apartments <= 4 Storeys	Space Heating	21	18	5	23
	Water Heating	17	15	8	16
	Cooling	-	-	-	-
	Appliances	1	1	1	1
	Lighting	-	-	-	-
	Electronics	-	-	-	-
	Other	3	3	2	3
	Ventilation	-	-	-	-
	Total	43	37	16	43
Apartments > 4 Storeys	Space Heating	21	18	5	23
	Water Heating	17	15	8	15
	Cooling	-	-	-	-
	Appliances	1	1	1	1
	Lighting	-	-	-	-
	Electronics	-	-	-	-
	Other	4	3	2	4
	Ventilation	-	-	-	-
	Total	43	37	16	43
Other Residential	Space Heating	45	43	25	56
	Water Heating	13	11	11	11
	Cooling	-	-	-	-
	Appliances	1	1	1	1
	Lighting	-	-	-	-
	Electronics	-	-	-	-
	Other	1	1	1	1
	Ventilation	-	-	-	-
	Total	60	56	38	69

Source: Navigant analysis of Base Year EUIs, BC Hydro's 2014 REUS, FortisBC Gas Residential Load Forecast

Table B-7. Residential Gas Intensity (GJ/household) – Southern Interior

Residential Segment	End-Use	CPR Period				
		2015	2020	2025	2030	2035
Single Family Detached/Duplexes	Space Heating	58	52	48	46	44
	Water Heating	14	13	12	12	12
	Cooling	-	-	-	-	-
	Appliances	1	2	2	2	2
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	3	3	2	2	2
	Ventilation	-	-	-	-	-
	Total	76	69	65	62	60
Single Family Attached/Row	Space Heating	39	36	33	32	31
	Water Heating	12	11	11	10	10
	Cooling	-	-	-	-	-
	Appliances	1	1	1	1	1
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	1	1	1	1	1
	Ventilation	-	-	-	-	-
	Total	52	48	46	44	43
Apartments =< 4 stories	Space Heating	18	16	14	14	13
	Water Heating	15	15	16	16	16
	Cooling	-	-	-	-	-
	Appliances	1	1	1	1	1
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	3	3	3	3	3
	Ventilation	-	-	-	-	-
	Total	37	35	34	33	33
Apartments > 4 stories	Space Heating	18	16	15	14	13
	Water Heating	15	15	15	15	16
	Cooling	-	-	-	-	-
	Appliances	1	1	1	1	1
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	3	3	3	3	3
	Ventilation	-	-	-	-	-
	Total	37	35	34	33	33
Other Residential	Space Heating	43	38	36	34	32
	Water Heating	11	10	10	10	9
	Cooling	-	-	-	-	-
	Appliances	1	1	1	1	1
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	1	1	1	1	1
	Ventilation	-	-	-	-	-
	Total	56	51	48	45	43

Source: Navigant analysis of Base Year EUIs, BC Hydro's 2014 REUS, FortisBC Gas Residential Load Forecast

Table B-8. Residential Gas Intensity (GJ/household) – Vancouver Island

Residential Segment	End-Use	CPR Period				
		2015	2020	2025	2030	2035
Single Family Detached/Duplexes	Space Heating	38	34	32	30	29
	Water Heating	15	14	14	14	13
	Cooling	-	-	-	-	-
	Appliances	2	2	2	2	2
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	3	3	3	3	3
	Ventilation	-	-	-	-	-
	Total	58	53	51	48	47
Single Family Attached/Row	Space Heating	23	21	20	19	18
	Water Heating	10	10	10	9	9
	Cooling	-	-	-	-	-
	Appliances	1	1	1	1	1
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	1	1	1	1	1
	Ventilation	-	-	-	-	-
	Total	36	34	32	31	30
Apartments =< 4 stories	Space Heating	5	4	4	4	4
	Water Heating	8	9	9	9	9
	Cooling	-	-	-	-	-
	Appliances	1	1	1	1	1
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	2	2	2	2	2
	Ventilation	-	-	-	-	-
	Total	16	16	16	16	16
Apartments < 4 stories	Space Heating	5	5	4	4	4
	Water Heating	8	8	9	9	9
	Cooling	-	-	-	-	-
	Appliances	1	1	1	1	1
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	2	2	2	2	2
	Ventilation	-	-	-	-	-
	Total	16	16	16	16	15
Other Residential	Space Heating	25	22	21	20	19
	Water Heating	11	11	10	10	9
	Cooling	-	-	-	-	-
	Appliances	1	1	1	1	1
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	1	1	1	1	1
	Ventilation	-	-	-	-	-
	Total	38	35	33	31	30

Source: Navigant analysis of Base Year EUIs, BC Hydro's 2014 REUS, FortisBC Gas Residential Load Forecast

Table B-9. Residential Gas Intensity (GJ/household) – Northern BC

Residential Segment	End-Use	CPR Period				
		2015	2020	2025	2030	2035
Single Family Detached/Duplexes	Space Heating	76	68	64	60	57
	Water Heating	12	11	11	11	10
	Cooling	-	-	-	-	-
	Appliances	1	1	1	1	1
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	2	2	2	2	2
	Ventilation	-	-	-	-	-
	Total	91	83	78	74	71
Single Family Attached/Row	Space Heating	49	44	42	40	38
	Water Heating	8	8	8	8	7
	Cooling	-	-	-	-	-
	Appliances	1	1	1	1	1
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	1	1	1	1	1
	Ventilation	-	-	-	-	-
	Total	59	54	51	49	47
Apartments =< 4 stories	Space Heating	23	20	19	18	17
	Water Heating	16	16	16	17	17
	Cooling	-	-	-	-	-
	Appliances	1	1	1	1	1
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	3	3	3	3	3
	Ventilation	-	-	-	-	-
	Total	43	41	39	38	38
Apartments > 4 stories	Space Heating	23	20	19	18	17
	Water Heating	15	16	16	16	16
	Cooling	-	-	-	-	-
	Appliances	1	1	1	1	1
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	4	3	3	3	3
	Ventilation	-	-	-	-	-
	Total	43	41	39	38	38
Other Residential	Space Heating	56	51	47	45	43
	Water Heating	11	10	9	9	9
	Cooling	-	-	-	-	-
	Appliances	1	1	1	1	1
	Lighting	-	-	-	-	-
	Electronics	-	-	-	-	-
	Other	1	1	1	1	1
	Ventilation	-	-	-	-	-
	Total	69	62	58	55	53

Source: Navigant analysis of Base Year EUIs, BC Hydro's 2014 REUS, FortisBC Gas Residential Load Forecast

B.3 Commercial Sector – Additional Detail

To characterize the Commercial sector, Navigant first developed a bottom-up analysis based on the mix of fuel shares and the types of equipment used for each end-use. Navigant developed these estimates based primarily on a review of BC Hydro's 2014 CEUS. BC Hydro's CEUS was preferred over the FortisBC 2015 CEUS given the increased granularity provided by the BC Hydro data. BC Hydro's 2015 CEUS study provides detailed information for several commercial segments across the CPR regions, including commercial building characteristics, main and secondary fuel systems, fuel shares and common commercial equipment, and saturation levels for common energy efficiency measures.

The following sections summarized the approach for developing the following:

- **Fuel Shares** and **Equipment Shares** for each commercial segment
- **End-use intensities (EUIs)** for each commercial segment
- **Commercial Floor Space Stock** for each commercial segment

Fuel Shares and Equipment Shares

Fuel share estimates were developed for end-uses that generally show a split across gas and electricity supply: Cooking, Hot Water, and Space Heating. All other end-uses were treated as electric-only end-uses, with the exception of the Other end-use.

Using the data provided by BC Hydro's 2014 CEUS, Navigant developed fuel share and equipment estimates for each commercial segment. The 2014 CEUS results are disaggregated across each region and are reported for each commercial segment.

Table B-10 and Table B-11Table B-11 shows the space heating equipment shares. The team used these space heating equipment shares to develop space heating EUIs, while EUIs for other end-uses were determined based on the 2010 CPR and did not require equipment shares.

Table B-11 summarize the results of this analysis. These tables show the estimated fuel shares and equipment shares for each commercial segment and climate region.

Table B-10. Commercial Fuel Shares (Percentage of Segment Using Each Energy Type)

Building Type	End-use	Lower Mainland		Vancouver Island		Southern Interior		Northern BC	
		Gas	Electric	Gas	Electric	Gas	Electric	Gas	Electric
Accommodation	Cooking	76%	24%	75%	25%	74%	26%	58%	42%
	Hot Water	71%	29%	69%	31%	78%	22%	55%	36%
	Space Heating	51%	44%	43%	57%	67%	33%	55%	36%
Colleges/ Universities	Cooking	52%	48%	52%	48%	52%	48%	52%	48%
	Hot Water	63%	32%	32%	63%	63%	32%	63%	32%
	Space Heating	53%	42%	48%	48%	53%	42%	63%	32%
Food Service	Cooking	79%	21%	79%	21%	79%	21%	79%	21%
	Hot Water	57%	43%	32%	68%	44%	56%	60%	40%
	Space Heating	63%	37%	19%	81%	47%	41%	75%	25%
Hospitals	Cooking	52%	48%	52%	48%	52%	48%	52%	48%
	Hot Water	93%	7%	93%	7%	93%	7%	93%	7%
	Space Heating	93%	7%	93%	7%	93%	7%	93%	7%
Logistics/ Warehouses	Cooking	0%	100%	0%	100%	0%	100%	0%	100%
	Hot Water	30%	69%	18%	59%	8%	67%	43%	48%
	Space Heating	60%	30%	10%	76%	42%	33%	64%	36%
Long Term Care	Cooking	52%	48%	52%	48%	52%	48%	52%	48%
	Hot Water	88%	12%	46%	46%	50%	38%	67%	28%
	Space Heating	56%	44%	50%	50%	50%	50%	54%	46%
Offices	Cooking	13%	87%	9%	91%	6%	94%	4%	96%
	Hot Water	32%	68%	18%	82%	37%	63%	41%	59%
	Space Heating	54%	44%	24%	75%	59%	39%	53%	43%
Other	Cooking	18%	82%	22%	78%	22%	78%	20%	80%
	Hot Water	42%	54%	19%	77%	44%	48%	46%	45%
	Space Heating	60%	37%	31%	59%	52%	41%	62%	32%
Retail - Food	Cooking	26%	74%	26%	74%	26%	74%	26%	74%
	Hot Water	63%	37%	18%	74%	33%	56%	60%	40%
	Space Heating	67%	27%	24%	72%	63%	25%	50%	50%
Retail - Non Food	Cooking	14%	86%	11%	89%	9%	91%	9%	91%
	Hot Water	34%	58%	16%	81%	36%	64%	36%	64%
	Space Heating	64%	34%	32%	65%	55%	41%	71%	29%
Schools	Cooking	20%	80%	18%	82%	17%	83%	17%	83%
	Hot Water	71%	19%	40%	60%	67%	17%	78%	22%
	Space Heating	75%	25%	54%	46%	80%	20%	90%	10%

Source: Navigant analysis of BC Hydro 2014 CEUS

Table B-11 shows the space heating equipment shares. The team used these space heating equipment shares to develop space heating EUIs, while EUIs for other end-uses were determined based on the 2010 CPR and did not require equipment shares.

Table B-11. Commercial Equipment Shares (%)

End-use	Equipment Type	Percentage of Equip in End-use within Fuel Type^										
		Accommodation	Colleges/ Universities	Food Service	Hospital	Logistics/ Warehouses	Long Term Care	Office	Other Commercial	Retail - Food	Retail - Non Food	Schools
Space Heating	Gas Boiler Low E	35%	40%	6%	73%	4%	34%	8%	10%	1%	1%	40%
	Gas Boiler High E	9%	0%	2%	19%	1%	10%	2%	4%	0%	0%	11%
	Gas Rooftop or Other Forced Air (Low E)	45%	60%	64%	6%	60%	44%	64%	53%	72%	65%	35%
	Gas Rooftop or Other Forced Air (High E)	11%	0%	18%	2%	11%	12%	17%	21%	20%	25%	9%
	Gas Unit Heater (Conventional.)	0%	0%	8%	0%	20%	0%	7%	8%	5%	6%	5%
	Gas Unit Heater (Condensing)	0%	0%	2%	0%	4%	0%	2%	3%	1%	2%	1%

Source: Navigant analysis of BC Hydro 2014 CEUS

End-Use Intensities (EUIs)

The next step of the commercial calibration process required the roll up of the fuel share and equipment share estimates in order to establish EUIs for each commercial segment in each region. Based on this approach, Navigant developed bottom-up EUI estimates for the Space Heating end-use. For other end-uses including Water Heating, Cooking, and Other, EUI estimates were developed based on a review of the 2010 CPR, and adjusted to the base year (2014) according to the EUI trends established for the Reference Case for FortisBC Gas.

Table B-12 presents the EUIs established for each end-use, and commercial segment. With the EUIs established for the base year, the Reference Case EUIs were determined based on the commercial EUI trends. The approach for developing the commercial EUI trends is described in the body of the report.

Table B-12: Base Year Commercial EUIs (MJ/m2) by Segment and Region

Segment	End-Use	Lower Mainland	Southern Interior	Vancouver Island	Northern BC
Accommodation	Cooking	80	76	82	71
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	258	253	261	246
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	56	56	56	56
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	252	305	250	436
	Total	646	690	649	809
Colleges/ Universities	Cooking	37	37	37	37
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	69	69	69	69
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	65	65	65	65
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	310	372	329	811
	Total	481	543	501	982
Food Service	Cooking	839	839	839	839
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	476	476	476	476
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	19	19	19	19
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	425	368	311	1,173
	Total	1,759	1,702	1,645	2,506
Hospitals	Cooking	65	65	65	65
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	274	274	274	274
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	233	233	233	233
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	758	1,037	725	2,062
	Total	1,330	1,609	1,297	2,635
Logistics/ Warehouses	Cooking	5	5	5	5
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	18	18	18	18
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	19	19	19	19
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	201	253	207	483
	Total	242	295	248	525
Long Term Care	Cooking	56	56	56	56
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	156	156	156	156
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-

Segment	End-Use	Lower Mainland	Southern Interior	Vancouver Island	Northern BC
	Other	65	65	65	65
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	337	374	334	778
	Total	613	651	610	1,054
Offices	Cooking	9	9	9	9
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	33	33	33	32
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	19	19	19	19
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	263	330	275	485
	Total	324	390	336	545
Other Commercial	Cooking	15	14	12	14
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	26	27	28	27
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	13	14	16	14
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	276	347	297	452
	Total	330	402	353	507
Retail – Food	Cooking	75	75	75	75
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	65	65	65	65
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	19	19	19	19
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	311	278	290	639
	Total	469	436	448	797
Retail – Non Food	Cooking	13	13	15	13
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	23	23	23	23
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	6	7	7	7
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	256	315	272	367
	Total	299	357	317	410
Schools	Cooking	15	15	14	14
	HVAC Fans/Pumps	-	-	-	-
	Hot Water	39	39	39	39
	Lighting	-	-	-	-
	Office Equipment	-	-	-	-
	Other	5	5	5	5
	Refrigeration	-	-	-	-
	Space Cooling	-	-	-	-
	Space Heating	277	323	286	623
	Total	336	381	344	680

Source: Navigant analysis

Description of EUI Trending Approach

BC Hydro's 2014 CEUS surveyed commercial customers across each commercial segment in relation to upgrades made to end-use equipment in the past 5 years. The annual incidence of end-use equipment upgrades is then used to estimate the reduction in energy consumption from the adoption of higher efficiency equipment. Table B-13 summarizes an example of the incidence of water heating equipment upgrades.

Table B-13: Incidence of Water Heating Commercial Equipment Upgrades (2014 CEUS)

Segment	Equipment Upgrades	
	Past 5 years (%)	Estimate per year (%)
Accommodation	25.0%	5.0%
Colleges & Universities	33.0%	6.6%
Food Service	32.5%	6.5%
Hospital	20.0%	4.0%
Logistics & Warehouses	22.0%	4.4%
Long Term Care	29.0%	5.8%
Offices	12.0%	2.4%
Other	12.0%	2.4%
Retail - Food	27.0%	5.4%
Retail - Non Food	27.0%	5.4%
Schools	19.0%	3.8%

Source: Navigant analysis of BC Hydro 2014 CEUS

Although the 2014 CEUS did not survey the type of equipment or the efficiency of the upgrades, Navigant estimated the potential reduction in consumption by analyzing the inputs used to characterize conservation measures corresponding to each end-use. For example, the team estimated the average improvement in water heating measure efficiency at approximately 17% such that the efficient consumption is 83% of the base consumption. Navigant determined this improvement from characterization of water heating measures. The difference between the efficient and base consumption of the water heating measures listed below is, on average, 17%:

- Natural Gas On-Demand Water Heaters
- Natural Gas Storage Water Heaters
- Low-Flow Showerheads
- Faucet Aerators
- Natural Gas Hot Water Supply Boilers
- Recirculation Demand Controls for Hot Water

Navigant followed this process across all commercial segments for end-uses for which equipment upgrade information is reported in the 2014 CEUS. This includes the following end-uses:

- Lighting;

- Water Heating;
- Space Cooling;
- HVAC Fans/Pump; and
- Space Heating

Two of these end-uses – water heating and space heating – are applicable to gas consumption. For the remaining gas end-uses – cooking and other – survey information needed to develop EUI trends was not reported and are assumed to remain flat. Table B-14 summarizes the results for each end-use.

Table B-14: Commercial Measure Efficiency – Base vs. EE

End-Use	Improvement in End-Use Efficiency (%)	EE as % of Base consumption (%)
Water Heating	17%	83%
Space Heating	42%	58%

Source: Navigant analysis of measure characterization

Based on this approach, if the Water Heating EUI for the Accommodation segment is estimated at approx. 250 MJ/m2 in 2014, the EUI is estimated to decrease by 0.8% in 2015, down to 248 MJ/m2. This calculation is included below:

$$EUI_{2015} = EUI_{2014} * (EE\ equipment_{\%} * EE\ consumption_{kWh} + Base\ equipment_{\%} * Base\ consumption_{kWh})$$

$$248\frac{MJ}{m2} = 250\frac{MJ}{m2} * (5\% * 83\% + 95\% * 100\%)$$

A limitation of this approach is that the estimated decrease in EUI inherently reflects the impact of DSM programs. Navigant has not attempted to extract the impact of DSM participation from the EUI trends.

Table 2-28 in the main body of this report, shows the EUI trends determined for each end-use and commercial segment.

Table B-15,
Table B-16, and Table B-17, show the commercial EUIs used in the Reference Case for the Southern Interior, Vancouver Island, and Northern BC regions. The Lower Mainland EUIs are included in the main body. The EUIs presented in these tables were initially based on the Base Year EUIs shown in

Table B-12 and then were adjusted based on the EUI trends. The Lower Mainland EUIs are included the main body of the report.

Table B-15: Commercial Gas Intensity (MJ/m2) – Southern Interior

Commercial Segment	End-Use	CPR Period 2015	2020	2025	2030	2035
Accommodation	Cooking	76	76	76	76	76
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	253	241	234	229	226
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	56	56	56	56	56
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	305	276	260	249	242
	Total	690	648	626	611	600
Colleges/ Universities	Cooking	37	37	37	37	37
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	69	65	62	61	60
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	65	65	65	65	65
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	372	332	310	296	287
	Total	543	499	475	460	449
Food Service	Cooking	839	839	839	839	839
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	476	446	430	418	411
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	19	19	19	19	19
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	368	326	304	289	279
	Total	1,702	1,629	1,591	1,565	1,547
Hospitals	Cooking	65	65	65	65	65
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	274	263	257	253	250
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	233	233	233	233	233
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	1,037	933	877	840	815
	Total	1,609	1,494	1,432	1,391	1,363
Logistics/ Warehouses	Cooking	5	5	5	5	5
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	18	17	17	17	16
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	19	19	19	19	19
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	253	234	223	216	211
	Total	295	274	263	256	250

Commercial Segment	End-Use	CPR Period				
		2015	2020	2025	2030	2035
Long Term Care	Cooking	56	56	56	56	56
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	156	147	142	138	136
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	65	65	65	65	65
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	374	335	314	300	291
	Total	651	603	577	560	548
Office	Cooking	9	9	9	9	9
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	33	32	31	31	31
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	19	19	19	19	19
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	330	296	279	267	259
	Total	390	356	338	326	318
Other Commercial	Cooking	14	14	14	14	14
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	27	26	26	26	25
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	14	14	14	14	14
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	347	312	294	281	273
	Total	402	366	347	335	326
Retail - Food	Cooking	75	75	75	75	75
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	65	61	60	58	57
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	19	19	19	19	19
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	278	244	226	214	206
	Total	436	398	378	365	357
Retail – Non Food	Cooking	13	13	13	13	13
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	23	22	21	21	21
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	7	7	7	7	7
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	315	276	256	242	233
	Total	357	318	297	283	274
Schools	Cooking	15	15	15	15	15
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	39	38	37	36	36
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	5	5	5	5	5
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	323	290	273	262	254
	Total	381	347	329	317	309

Source: Navigant analysis of 2014 CEUS, FortisBC Gas 2016 Load Forecast

Table B-16: Commercial Gas Intensity (MJ/m2) – Vancouver Island

Commercial Segment	End-Use	CPR Period				
		2015	2020	2025	2030	2035
Accommodation	Cooking	82	82	82	82	82
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	261	248	241	236	233
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	56	56	56	56	56
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	250	226	213	204	199
	Total	649	612	592	579	570
Colleges/ Universities	Cooking	37	37	37	37	37
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	69	65	62	61	60
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	65	65	65	65	65
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	329	294	275	263	254
	Total	501	461	440	426	416
Food Service	Cooking	839	839	839	839	839
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	476	446	430	418	411
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	19	19	19	19	19
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	311	276	257	245	236
	Total	1,645	1,579	1,544	1,520	1,504
Hospitals	Cooking	65	65	65	65	65
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	274	263	257	253	250
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	233	233	233	233	233
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	725	652	613	587	570
	Total	1,297	1,213	1,168	1,138	1,118
Logistics/ Warehouses	Cooking	5	5	5	5	5
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	18	17	17	17	16
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	19	19	19	19	19
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	207	191	182	176	172
	Total	248	231	222	216	212

Commercial Segment	End-Use	CPR Period				
		2015	2020	2025	2030	2035
Long Term Care	Cooking	56	56	56	56	56
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	156	147	142	138	136
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	65	65	65	65	65
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	334	299	280	268	259
	Total	610	567	543	527	517
Office	Cooking	9	9	9	9	9
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	33	32	32	32	31
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	19	19	19	19	19
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	275	247	232	223	216
	Total	336	307	292	282	275
Other Commercial	Cooking	12	12	12	12	12
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	28	28	27	27	27
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	16	16	16	16	16
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	297	267	251	241	234
	Total	353	323	306	296	288
Retail - Food	Cooking	75	75	75	75	75
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	65	61	60	58	57
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	19	19	19	19	19
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	290	254	235	223	215
	Total	448	409	388	375	366
Retail – Non Food	Cooking	15	15	15	15	15
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	23	22	21	21	20
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	7	7	7	7	7
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	272	238	221	209	202
	Total	317	282	264	252	244
Schools	Cooking	14	14	14	14	14
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	39	38	37	36	36
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	5	5	5	5	5
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	286	257	242	231	225
	Total	344	314	297	287	279

Source: Navigant analysis of 2014 CEUS, FortisBC Gas 2016 Load Forecast

Table B-17: Commercial Gas Intensity (MJ/m2) – Northern BC

Commercial Segment	End-Use	CPR Period				
		2015	2020	2025	2030	2035
Accommodation	Cooking	71	71	71	71	71
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	246	234	227	222	219
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	56	56	56	56	56
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	436	395	372	357	347
	Total	809	755	726	707	693
Colleges/ Universities	Cooking	37	37	37	37	37
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	69	65	62	61	60
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	65	65	65	65	65
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	811	724	677	647	626
	Total	982	891	842	810	788
Food Service	Cooking	839	839	839	839	839
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	476	446	430	418	411
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	19	19	19	19	19
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	1,173	1,039	968	922	891
	Total	2,506	2,342	2,255	2,197	2,158
Hospitals	Cooking	65	65	65	65	65
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	274	263	257	253	250
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	233	233	233	233	233
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	2,062	1,855	1,744	1,671	1,621
	Total	2,635	2,417	2,300	2,222	2,170
Logistics/ Warehouses	Cooking	5	5	5	5	5
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	18	17	17	17	16
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	19	19	19	19	19
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	483	446	425	412	402
	Total	525	486	466	452	442
Long Term Care	Cooking	56	56	56	56	56
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	156	147	142	138	136
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	65	65	65	65	65
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	778	696	652	624	604
	Total	1,054	964	915	883	862

Commercial Segment	End-Use	CPR Period				
		2015	2020	2025	2030	2035
Office	Cooking	9	9	9	9	9
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	32	32	31	31	31
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	19	19	19	19	19
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	485	436	410	393	381
	Total	545	496	469	452	440
Other Commercial	Cooking	14	14	14	14	14
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	27	26	26	26	25
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	14	14	14	14	14
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	452	407	382	366	355
	Total	507	461	436	420	409
Retail - Food	Cooking	75	75	75	75	75
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	65	61	60	58	57
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	19	19	19	19	19
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	639	560	519	492	474
	Total	797	715	672	644	625
Retail – Non Food	Cooking	13	13	13	13	13
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	23	22	21	21	21
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	7	7	7	7	7
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	367	322	298	282	272
	Total	410	363	339	323	312
Schools	Cooking	14	14	14	14	14
	HVAC Fans/Pumps	-	-	-	-	-
	Hot Water	39	38	37	36	36
	Lighting	-	-	-	-	-
	Office Equipment	-	-	-	-	-
	Other	5	5	5	5	5
	Refrigeration	-	-	-	-	-
	Space Cooling	-	-	-	-	-
	Space Heating	623	560	527	505	490
	Total	680	616	582	559	544

Source: Navigant analysis of 2014 CEUS, FortisBC Gas 2016 Load Forecast

B.4 FortisBC Gas Industrial Sector – Additional Detail

This section describes the approach used to develop the Reference Case for the industrial sector.

FortisBC Gas's load forecast reports industrial sector gas sales as a whole and not broken down into individual industrial segments. To disaggregate the sector-wide forecast into industrial segments, Navigant and FortisBC worked together to develop gas sales projections which aligned with the sector-level forecast established for each region.

As a starting point, Navigant applied the electricity demand growth rates established for BC Hydro's Reference Case. FortisBC Gas reviewed those assumptions and directed Navigant to make adjustment to certain industrial segments which did not align with FortisBC Gas projections. These adjusted growth rates were used to estimate a forecast of gas consumption for each segment through 2035. A key aspect of this analysis is that this estimated forecast - determined based on adjusted growth rates – needed to reconcile with FortisBC Gas's sector-level forecast FortisBC Gas.

The steps to develop the Reference Case forecast are outlined below:

- Apply the adjusted growth rates to the base year (2014) consumption and sum the projected sales across each region to obtain a sector-level sales forecast (the "estimated" consumption forecast).
- Compare the estimated consumption across every 5-year period (e.g., 2020, 2025, 2030, and 2035) against the forecast 2035 consumption, and determine the difference (e.g., a surplus or a deficit)
- If the estimated consumption is greater than (or less than) the forecast consumption in each milestone year, reallocate the surplus or deficit across each segment according to each segment's contribution (%) to the regional total (e.g., if Pulp & Paper TMP accounts for 20% of industrial consumption then reallocate 20% of the surplus/deficit to the TMP segment) – this is the "re-adjusted" consumption
- Using the re-adjusted consumption determined in each milestone year, re-calculate the 5-year growth rates of each segment. These re-adjusted growth rates will ensure that the estimated consumption reconciles with the forecast consumption.
- These re-adjusted growth rates are used to develop the industrial sector Reference Case.

APPENDIX C. FORTISBC GAS - INTERACTIVE EFFECTS OF EFFICIENCY STACKING

The results shown throughout the body of this report assume that measures are implemented in isolation from other efficient measures and do not include adjustments for interactive effects of efficiency stacking (with some exceptions).[46] Interactive effects from efficiency stacking are different from cross-end-use interactive effects (e.g., efficient lighting impacts heating/cooling loads), which are present regardless of stacking assumptions and are included in the reported savings estimates. This appendix describes the challenges related to accurately determining the impacts of efficiency stacking, and why Navigant has modelled savings as though measures are implemented independently from others. Although the examples in this appendix focus on gas measures, the concepts are dually applicable to electric measures.

C.1 Background on Efficiency Stacking

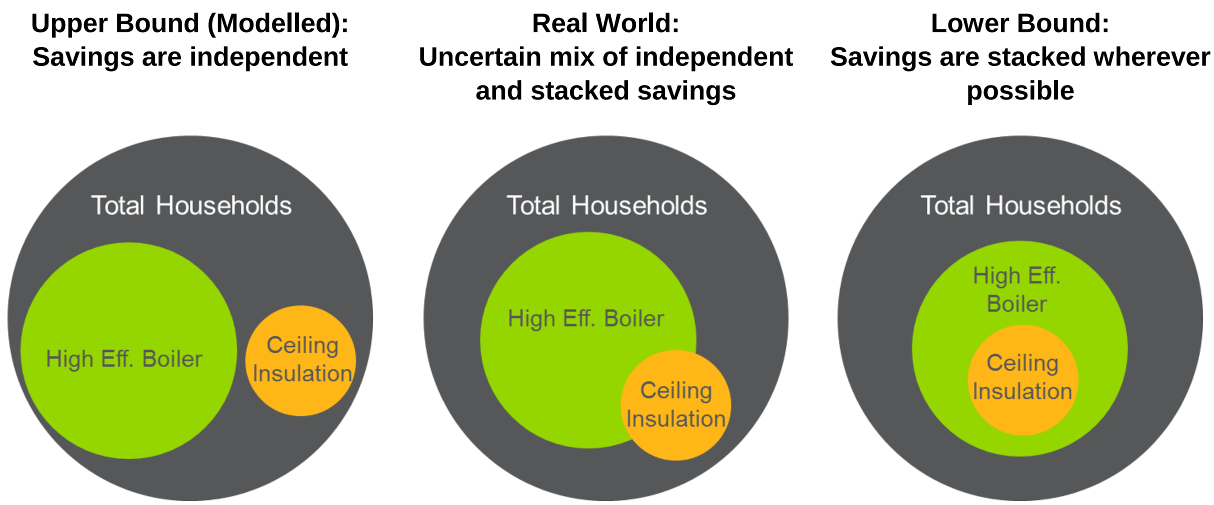
When two or more measures that impact the same end-use energy consumption are installed in the same building, the total savings that can be achieved are less than the sum of the savings from those measures independently. For example, in isolation, the installation of a high efficiency boiler might save 11% of gas consumption relative to a baseline (lower efficiency) boiler, while ceiling insulation might save 71% of gas consumption relative to a baseline insulation level. However, if both the boiler and the insulation are installed in the same facility, the savings from the high efficiency boiler decrease due to the reduced need for space heating caused by better insulation.

To generalize this concept Navigant refers to measures that actually convert energy as *engines* (boilers, light bulbs, motors, etc.). We refer to measures that impact the amount of energy that engines must convert as *drivers* (insulation, thermostats, lighting controls, etc.). Anytime an engine and driver are implemented in the same building, the expectation is that savings from the engine measure will decrease.[47]

Figure C-1 provides an illustration of three different efficiency stacking approaches. The modelled approach assumes no overlap in measure implementation and no efficiency stacking, which leads to an upper bound on savings potential. The opposite of the modelled approach is to assume all measures are stacked wherever possible, which provides a lower bound on savings. Lastly, there is the real-world approach where some measures are implemented in isolation and others are stacked. Unfortunately, the data is simply not available to accurately estimate the savings from the real-world approach.

[46] Wherever savings were derived from building energy model simulations evaluating bundled measures, interactive effects of efficiency stacking are included in the savings estimates (e.g., ENERGY STAR New Homes, Net-Zero New Homes, etc.).
[47] In practice it does not matter whether one assumes the engine's savings decrease or the driver's savings decrease, as the final savings result is the same. In this discussion, the team has chosen to always reduce the savings from the engine measures, while holding the savings from the driver measures fixed.

Figure C-1. Venn Diagrams for Various Efficiency Stacking Situations



Area of colored circle represents the number of households with a given savings opportunity. Overlapping circles indicate a household has implemented both measures.

C.2 Illustrative Calculation of Savings after Efficiency Stacking

For a very simplistic scenario looking at only two measures, it is possible to determine the stacked savings from the lower bound approach, which assumes efficient measures are stacked wherever possible. To find the high efficiency boiler's savings relative to the baseline after stacking, one must perform several steps:

1. Find the complement of the insulation's savings percentage:

   Insulation Savings Complement = 100% - Insulation Savings
   Insulation Savings Complement = 100% - 71% = 29%

2. Reduce the boiler's unstacked savings by the complement of the insulation's savings:

   Stacked Boiler Savings = Unstacked Boiler Savings x Insulation Savings Complement
   Stacked Boiler Savings =11% x 29% = 3.2%

3. Find the greatest percentage of homes where boiler and insulation stacking is possible:

   % of Homes with Stacking = Homes with Insulation / Homes with Boilers x 100%
   % of Homes with Stacking = 145,300 / 720,200 x 100% = 20.2%

4. Calculate the boiler's weighted average savings across all homes with boilers:

   Weighted Boiler Savings = Stacked Boiler Savings x % of Homes with Stacking +
   Unstacked Boiler Savings x (100% - % of Homes with Stacking)
   Weighted Boiler Savings = 3.2% x 20.2% + 11% x (100% - 20.2%) = 9.4%

Table C-1 provides an example of the technical potential from the boiler and insulation before and after stacking. As expected, the combined savings from the measures treated independently exceeds the combined savings after stacking.

Table C-1. Comparison of Savings Before and After Stacking

	High Efficiency Boiler	Ceiling Insulation	Combined Technical Potential
Applicable Households (households)	720,200	145,300	
Savings treated independently (no stacking)			
Savings Relative to Baseline (%)	11%	71%	
Total Technical Potential in Region (TJ/year)	2,540	1,860	4,400
Savings treated interactively (stacking)			
Savings Relative to Baseline (%)	9.4%	71%	
Total Technical Potential in Region (TJ/year)	2,176	1,860	4,036

C.3 Impetus for Treating Measure Savings Independently

Although it is possible to find the lower bound on savings with just one driver and one engine measure, the process quickly becomes intractable when multiple drivers and engines can be installed in the same facility. Table C-2 lists all of the engine and driver measures included in this study that could have interactive effects within the gas residential space heating end-use (which is just one of many end-uses across multiple sectors where stacking could occur).

Table C-2. Measures with Opportunity for Stacking in Residential Gas Space Heating End-use

Engine Measures	Driver Measures
Boiler Tune Up	Air Infiltration
Central High Eff Boiler Replace	Attic Duct Insulation
Combination System	Attic Insulation
Direct Vent Heaters	Basement Insulation
Efficient Fireplaces	Ceiling Insulation
Furnace Early Retirement	Crawlspace Duct Insulation
High Eff Boiler Replace	Energy Star Windows
High Eff Furnace Replace	Fireplace Timers
Vertical Direct Vent Fireplaces	Heat Reflectors
	Smart Thermostats
	Wall Insulation
	Window Film

Determining the appropriate stacking and correctly weighting the savings percentages from each of the engine measures requires:

- Case-by-case expert judgment about the combinations of driver and engine measures that might realistically be found in the same building, given historic and future construction practices;
- The conditional probability that a building has an inefficient driver “A” and an inefficient engine “B” for all drivers and engines relevant to a given end-use;
- In-depth knowledge of program design and how managers are considering pursuing participants and bundling measure offerings.

Answering the bullets above is beyond the scope of this study.

Lastly, at low levels of customer participation, it’s clear that assuming savings are independent is the best representation of what actual measure stacking would be. When customer participation is high, the “real-world” scenario is the best representation of actual measure stacking. Thus, under the plausible ranges of customer participation, the modelled (upper bound) scenario is likely to be a better representation of actual measure stacking than the lower bound scenario.

As such, this report does not attempt to quantify the impact from efficiency stacking within the modelled service territories.

APPENDIX D. SUPPORTING DATA FOR CHARTS

Table D-1. Total Gas Energy Savings Potential (TJ/year)

	Technical	Economic
2016	45,828	28,797
2017	46,269	29,990
2018	46,717	30,522
2019	47,244	31,666
2020	47,699	32,214
2021	48,128	32,865
2022	48,619	33,430
2023	49,054	34,057
2024	49,496	34,844
2025	50,005	35,389
2026	50,645	36,087
2027	51,335	36,792
2028	51,985	37,645
2029	52,642	38,390
2030	53,348	39,111
2031	54,186	40,025
2032	55,030	41,321
2033	55,879	42,221
2034	56,732	43,248
2035	57,591	44,158

Source: Navigant

Table D-2. Total Gas Energy Savings Potential as Percent of Total Consumption (%)

	Technical	Economic
2016	24.1%	15.1%
2017	24.2%	15.7%
2018	24.3%	15.9%
2019	24.4%	16.4%
2020	24.5%	16.6%
2021	24.7%	16.8%
2022	24.8%	17.1%
2023	24.9%	17.3%
2024	25.0%	17.6%
2025	25.2%	17.8%
2026	25.4%	18.1%
2027	25.6%	18.4%
2028	25.8%	18.7%
2029	26.0%	19.0%
2030	26.3%	19.2%
2031	26.6%	19.6%
2032	26.8%	20.2%
2033	27.1%	20.5%
2034	27.4%	20.9%
2035	27.7%	21.3%

Source: Navigant

Table D-3. Gas Energy Technical Savings Potential by Sector (TJ/year)

	Commercial	Industrial	Residential
2016	12,730	12,262	20,836
2017	13,152	12,240	20,877
2018	13,579	12,219	20,918
2019	14,085	12,198	20,960
2020	14,518	12,179	21,003
2021	14,909	12,145	21,074
2022	15,362	12,111	21,145
2023	15,759	12,079	21,217
2024	16,160	12,047	21,289
2025	16,628	12,016	21,361
2026	17,028	11,987	21,630
2027	17,477	11,958	21,899
2028	17,886	11,930	22,169
2029	18,300	11,903	22,438
2030	18,764	11,876	22,708
2031	19,143	11,847	23,196
2032	19,527	11,818	23,685
2033	19,915	11,790	24,174
2034	20,307	11,763	24,663
2035	20,703	11,736	25,152

Source: Navigant

Table D-4. Gas Energy Technical Savings Potential by Sector as a Percent of Sector Consumption (%)

	All	Commercial	Industrial	Residential
2016	24.1%	20.9%	21.4%	29.0%
2017	24.2%	21.3%	21.4%	28.9%
2018	24.3%	21.7%	21.4%	28.8%
2019	24.4%	22.3%	21.4%	28.7%
2020	24.5%	22.7%	21.4%	28.6%
2021	24.7%	23.0%	21.3%	28.6%
2022	24.8%	23.5%	21.3%	28.6%
2023	24.9%	23.8%	21.3%	28.6%
2024	25.0%	24.2%	21.3%	28.6%
2025	25.2%	24.6%	21.3%	28.6%
2026	25.4%	24.9%	21.3%	28.9%
2027	25.6%	25.3%	21.3%	29.1%
2028	25.8%	25.6%	21.3%	29.4%
2029	26.0%	26.0%	21.3%	29.6%
2030	26.3%	26.3%	21.2%	29.9%
2031	26.6%	26.6%	21.2%	30.4%
2032	26.8%	26.9%	21.2%	30.9%
2033	27.1%	27.2%	21.2%	31.4%
2034	27.4%	27.5%	21.2%	31.9%
2035	27.7%	27.7%	21.2%	32.4%

Source: Navigant

Table D-5. Gas Energy Technical Potential by Customer Segment (TJ/year)[48]

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
C.Accommod	575	602	630	660	688	714	742	768	795	823	849	876	902	929	957	981	1,005	1,030	1,054	1,080
C.College/Univ	588	615	642	672	700	727	757	785	813	844	872	901	929	958	989	1,015	1,041	1,067	1,094	1,121
C.Food Svc	862	903	945	991	1,033	1,071	1,112	1,150	1,188	1,230	1,266	1,306	1,342	1,380	1,420	1,452	1,485	1,518	1,551	1,584
C.Hospital	956	991	1,027	1,066	1,103	1,139	1,177	1,214	1,252	1,292	1,329	1,368	1,406	1,446	1,487	1,523	1,560	1,597	1,636	1,675
C.Logistic/WHouse	772	803	835	878	910	938	975	1,003	1,031	1,069	1,098	1,133	1,162	1,192	1,228	1,254	1,280	1,306	1,333	1,360
C.Long Term Care	438	466	496	528	559	589	622	654	688	724	757	793	828	865	904	939	975	1,012	1,051	1,090
C.Office	2,750	2,847	2,946	3,071	3,171	3,263	3,376	3,469	3,563	3,679	3,773	3,882	3,978	4,074	4,187	4,271	4,357	4,444	4,531	4,619
C.Other Commercial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C.Retail.Food	376	385	393	406	415	422	433	440	448	459	467	477	485	493	503	510	517	524	531	539
C.Retail.Non Food	930	948	965	995	1,012	1,028	1,053	1,068	1,083	1,109	1,125	1,149	1,166	1,183	1,207	1,221	1,236	1,251	1,266	1,281
C.Schools	922	939	957	986	1,004	1,020	1,046	1,062	1,078	1,104	1,122	1,147	1,165	1,183	1,209	1,225	1,241	1,258	1,274	1,291
C.Streetlights/Signals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I.Agriculture	292	292	292	293	293	294	294	294	295	295	295	296	296	297	298	298	299	299	300	301
I.Cement	140	139	139	138	137	136	134	133	132	131	131	131	131	131	131	131	131	130	130	130
I.Chemical	235	233	230	227	224	224	224	223	223	223	223	223	223	223	223	223	223	223	223	223
I.Food & Bev	814	807	800	793	787	780	773	767	761	755	749	744	739	733	728	724	719	715	710	706
I.Greenhouse	893	890	888	885	883	880	878	875	873	870	869	867	865	864	862	860	859	858	856	855
I.LNG Facility	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I.Mfg	1,317	1,324	1,331	1,338	1,345	1,349	1,353	1,358	1,362	1,366	1,372	1,378	1,383	1,389	1,395	1,401	1,407	1,413	1,420	1,426
I.Coal Mining	366	364	363	361	359	359	360	360	360	360	359	358	357	356	354	353	352	351	350	349
I.Metal Mining	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
I.Oil & Gas	676	673	669	666	663	660	657	653	650	647	645	642	639	637	634	631	629	627	624	622
I.Other Industrial	250	252	255	258	262	266	271	276	281	287	285	284	283	282	281	276	271	266	262	257
I.Kraft Pulp/Paper	4,285	4,272	4,259	4,245	4,232	4,213	4,194	4,174	4,155	4,136	4,119	4,101	4,084	4,067	4,050	4,034	4,018	4,001	3,985	3,969
I.TMP Pulp/Paper	477	477	476	475	474	473	472	472	471	470	469	469	468	467	467	466	466	465	464	464
I.Transportation	157	157	156	155	155	154	154	153	153	152	151	150	148	147	145	144	143	141	140	139
I.Wood Products	2,358	2,360	2,361	2,362	2,363	2,355	2,346	2,338	2,330	2,321	2,318	2,315	2,312	2,309	2,306	2,304	2,302	2,300	2,298	2,296
R.Apt <= 4 Stories	2,284	2,341	2,398	2,454	2,511	2,558	2,606	2,653	2,700	2,747	2,795	2,842	2,890	2,937	2,985	3,034	3,083	3,132	3,180	3,229
R.Apt > 4 Stories	1,278	1,311	1,345	1,378	1,412	1,439	1,466	1,494	1,521	1,548	1,576	1,605	1,633	1,661	1,689	1,718	1,747	1,776	1,805	1,835
R.Other Residential	372	372	371	370	369	368	366	365	364	363	362	361	360	359	358	357	356	355	354	353
R.Fam Attached	1,377	1,381	1,386	1,391	1,396	1,402	1,409	1,415	1,421	1,428	1,448	1,468	1,488	1,509	1,529	1,563	1,597	1,630	1,664	1,698
R.Fam Detached	19,087	19,124	19,162	19,200	19,238	19,304	19,370	19,437	19,503	19,570	19,820	20,070	20,321	20,571	20,822	21,277	21,733	22,189	22,645	23,101

[48] While apartment buildings are prefaced with a "R" (for residential), their savings are grouped into and reported under the commercial sector. Apartments are labelled with an "R" because they are included in the residential sector for purposes of the base year and reference case analysis.

Source: Navigant

Table D-6. Gas Energy Technical Potential by End-use (TJ/year)[49]

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Appliances	343	343	342	341	340	339	338	337	336	335	334	333	332	331	330	329	328	327	327	326
Boilers	4,920	4,904	4,888	4,872	4,857	4,837	4,818	4,800	4,781	4,763	4,745	4,727	4,710	4,693	4,676	4,659	4,642	4,625	4,609	4,592
Cooking	379	384	388	393	398	402	407	411	415	420	424	428	432	437	441	444	448	452	455	459
Hot Water	6,869	6,835	6,801	6,767	6,733	6,699	6,666	6,632	6,599	6,566	6,533	6,501	6,468	6,436	6,404	6,372	6,340	6,308	6,277	6,245
Proc Heat	1,323	1,321	1,319	1,318	1,316	1,313	1,310	1,307	1,304	1,301	1,299	1,298	1,297	1,295	1,294	1,293	1,292	1,290	1,289	1,288
Product Drying	1,915	1,915	1,916	1,916	1,916	1,910	1,905	1,899	1,893	1,888	1,885	1,883	1,880	1,877	1,875	1,873	1,871	1,869	1,867	1,865
Space Heating	24,202	24,105	24,009	23,987	23,887	23,783	23,736	23,629	23,521	23,476	23,384	23,337	23,246	23,156	23,110	23,019	22,929	22,839	22,750	22,662
Whole Facility	5,876	6,463	7,054	7,651	8,253	8,844	9,440	10,040	10,646	11,256	12,040	12,828	13,620	14,417	15,218	16,197	17,181	18,167	19,158	20,153

Source: Navigant

[49] The industrial process end use is not shown in this table because no natural gas measures are assigned to it. As a result, savings are not reported for the industrial process end use.

Table D-7. Gas Energy Economic Savings Potential by Sector (TJ/year)

	Commercial	Industrial	Residential
2016	7,233	11,382	10,181
2017	7,849	11,360	10,781
2018	8,311	11,338	10,872
2019	9,158	11,317	11,192
2020	9,631	11,296	11,287
2021	10,168	11,265	11,432
2022	10,648	11,235	11,547
2023	11,180	11,205	11,672
2024	11,881	11,176	11,787
2025	12,335	11,148	11,907
2026	12,763	11,120	12,204
2027	13,196	11,094	12,502
2028	13,775	11,068	12,801
2029	14,247	11,043	13,100
2030	14,693	11,019	13,398
2031	15,131	10,992	13,901
2032	15,950	10,966	14,405
2033	16,355	10,941	14,925
2034	16,765	10,916	15,568
2035	17,180	10,891	16,087

Source: Navigant

Table D-8. Gas Energy Economic Savings Potential by Sector as a Percent of Sector Consumption (%)

	All	Commercial	Industrial	Residential
2016	15.1%	11.9%	19.8%	14.2%
2017	15.7%	12.7%	19.8%	14.9%
2018	15.9%	13.3%	19.8%	15.0%
2019	16.4%	14.5%	19.8%	15.3%
2020	16.6%	15.0%	19.8%	15.4%
2021	16.8%	15.7%	19.8%	15.5%
2022	17.1%	16.3%	19.8%	15.6%
2023	17.3%	16.9%	19.8%	15.8%
2024	17.6%	17.8%	19.8%	15.9%
2025	17.8%	18.2%	19.7%	16.0%
2026	18.1%	18.7%	19.7%	16.3%
2027	18.4%	19.1%	19.7%	16.6%
2028	18.7%	19.8%	19.7%	17.0%
2029	19.0%	20.2%	19.7%	17.3%
2030	19.2%	20.6%	19.7%	17.6%
2031	19.6%	21.1%	19.7%	18.2%
2032	20.2%	22.0%	19.7%	18.8%
2033	20.5%	22.3%	19.7%	19.4%
2034	20.9%	22.7%	19.7%	20.1%
2035	21.3%	23.0%	19.7%	20.7%

Source: Navigant

Table D-9. Gas Energy Economic Savings Potential by Customer Segment (TJ/year)[50]

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
C.Accommod	456	484	513	579	609	635	662	689	716	744	777	808	835	862	890	914	939	964	989	1,015
C.College/Univ	455	483	511	569	598	626	654	683	713	743	771	800	829	858	888	914	941	967	995	1,023
C.Food Svc	657	751	794	901	944	983	1,022	1,067	1,106	1,146	1,183	1,220	1,257	1,295	1,333	1,366	1,400	1,433	1,467	1,500
C.Hospital	606	643	680	788	827	864	903	942	981	1,023	1,061	1,101	1,141	1,182	1,224	1,262	1,300	1,339	1,378	1,419
C.Logistic/WHouse	334	368	403	449	490	522	554	587	620	653	684	716	794	826	857	923	951	979	1,007	1,035
C.Long Term Care	362	391	421	463	495	526	558	591	625	660	694	729	765	803	846	881	917	955	993	1,033
C.Office	975	1,083	1,197	1,329	1,441	1,647	1,801	1,907	2,275	2,383	2,482	2,583	2,685	2,788	2,892	2,983	3,075	3,168	3,262	3,356
C.Other Commercial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C.Retail.Food	177	201	211	318	327	336	345	354	362	371	379	388	396	405	413	421	428	436	443	451
C.Retail.Non Food	327	404	426	486	507	527	547	567	588	618	637	656	778	831	850	866	883	900	916	933
C.Schools	412	466	487	511	532	562	582	694	715	735	755	775	795	818	839	857	875	893	912	931
C.Streetlights/Signals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I.Agriculture	292	292	292	293	293	294	294	294	295	295	295	296	296	297	298	298	299	299	300	301
I.Cement	140	139	139	138	137	136	134	133	132	131	131	131	131	131	131	131	131	130	130	130
I.Chemical	235	233	230	227	224	224	224	223	223	223	223	223	223	223	223	223	223	223	223	223
I.Food & Bev	814	807	800	793	787	780	773	767	761	755	749	744	739	733	728	724	719	715	710	706
I.Greenhouse	893	890	888	885	883	880	878	875	873	870	869	867	865	864	862	860	859	858	856	855
I.LNG Facility	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I.Mfg	1,317	1,324	1,331	1,338	1,345	1,349	1,353	1,358	1,362	1,366	1,372	1,378	1,383	1,389	1,395	1,401	1,407	1,413	1,420	1,426
I.Coal Mining	366	364	363	361	359	359	360	360	360	360	359	358	357	356	354	353	352	351	350	349
I.Metal Mining	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
I.Oil & Gas	676	673	669	666	663	660	657	653	650	647	645	642	639	637	634	631	629	627	624	622
I.Other Industrial	250	252	255	258	262	266	271	276	281	287	285	284	283	282	281	276	271	266	262	257
I.Kraft Pulp/Paper	4,285	4,272	4,259	4,245	4,232	4,213	4,194	4,174	4,155	4,136	4,119	4,101	4,084	4,067	4,050	4,034	4,018	4,001	3,985	3,969
I.TMP Pulp/Paper	477	477	476	475	474	473	472	472	471	470	469	469	468	467	467	466	466	465	464	464
I.Transportation	157	157	156	155	155	154	154	153	153	152	151	150	148	147	145	144	143	141	140	139
I.Wood Products	1,479	1,479	1,480	1,480	1,481	1,475	1,470	1,464	1,459	1,453	1,451	1,451	1,450	1,450	1,449	1,450	1,450	1,450	1,450	1,450
R.Apt <= 4 Stories	1,585	1,651	1,711	1,771	1,831	1,882	1,932	1,982	2,033	2,083	2,134	2,185	2,235	2,286	2,337	2,389	2,707	2,757	2,808	2,859
R.Apt > 4 Stories	888	924	959	994	1,029	1,059	1,088	1,117	1,146	1,175	1,205	1,235	1,265	1,295	1,325	1,356	1,535	1,565	1,595	1,625

[50] While apartment buildings are prefaced with a "R" (for residential), their savings are grouped into and reported under the commercial sector. Apartments are labelled with an "R" because they are included in the residential sector for purposes of the base year and reference case analysis.

R.Other Residential	183	204	204	204	205	205	204	204	204	208	208	207	207	207	206	206	206	206	205	208
R.Fam Attached	422	460	470	706	718	723	729	745	750	755	761	766	773	779	786	792	799	805	812	831
R.Fam Detached	9,576	10,117	10,199	10,281	10,364	10,505	10,614	10,724	10,834	10,943	11,236	11,529	11,821	12,114	12,406	12,903	13,400	13,915	14,551	15,047

Source: Navigant

Table D-10. Gas Energy Economic Savings Potential by End-Use (TJ/year)[51]

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Appliances	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Boilers	4,920	4,904	4,888	4,872	4,857	4,837	4,818	4,800	4,781	4,763	4,745	4,727	4,710	4,693	4,676	4,659	4,642	4,625	4,609	4,592
Cooking	379	384	388	393	398	402	407	411	415	420	424	428	432	437	441	444	448	452	455	459
Hot Water	3,828	4,317	4,300	4,278	4,257	4,235	4,214	4,199	4,178	4,157	4,136	4,115	4,095	4,074	4,054	4,034	4,013	3,993	3,973	3,954
Proc Heat	1,323	1,321	1,319	1,318	1,316	1,313	1,310	1,307	1,304	1,301	1,299	1,298	1,297	1,295	1,294	1,293	1,292	1,290	1,289	1,288
Product Drying	1,036	1,035	1,035	1,034	1,034	1,031	1,028	1,025	1,023	1,020	1,018	1,018	1,018	1,018	1,018	1,019	1,019	1,019	1,020	1,020
Space Heating	11,440	11,572	11,543	12,121	12,102	12,209	12,224	12,290	12,516	12,496	12,465	12,436	12,549	12,549	12,520	12,519	12,897	12,874	12,974	12,939
Whole Facility	5,871	6,457	7,049	7,650	8,251	8,838	9,430	10,026	10,627	11,233	11,999	12,769	13,544	14,324	15,108	16,058	17,010	17,967	18,927	19,905

Source: Navigant

[51] The industrial process end use is not shown in this table because no natural gas measures are assigned to it. As a result, savings are not reported for the industrial process end use.

Appendix E

CRP MARKET POTENTIAL

British Columbia Conservation Potential Review

Section 5. Market Potential

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DISCLAIMER

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5. MARKET POTENTIAL FORECAST

This section contains details of the market potential analysis that Navigant conducted for FortisBC Gas's service territory, including the following:

- Section 5.1 describes the approach to estimating market potential, including discussion of the model calibration steps and the strategy selected for simulating incentives in the analysis.
- Section 5.2 provides overall gas market potential estimates, as well as savings by sector, customer segment, end use, and certain measures.
- Section 5.3 follows with details of the associated budgets and cost effectiveness results under the TRC test across all sectors, which is consistent with the methodology Navigant used for the economic potential presented in Section 4.
- Section 5.4 provides the economic, market potential, and cost effectiveness results under the modified-TRC (mTRC) test across all sectors.
- Section 5.5 provides the economic, market potential, and cost effectiveness results under the Hybrid mTRC/TRC case (described below).

5.1 Approach to Estimating Market Potential

Market potential is a subset of economic potential that considers the likely rate of DSM acquisition, given factors like the rate of equipment turnover (a function of a measure's lifetime), simulated incentive levels, consumer willingness to adopt efficient technologies, and the likely rate at which marketing activities can facilitate technology adoption. The adoption of DSM measures can be broken down into calculation of the "equilibrium" market share and calculation of the dynamic approach to equilibrium market share, as discussed in more detail below.

Market potential differs from program potential in that market potential does not specifically take into account the various delivery mechanisms that can be used by program managers to tailor their approach depending on the specific measure or market. Rather, market potential represents a high-level assessment of savings that could be achieved over time, factoring in broader assumptions about customer acceptance and adoption rates that are not dependent on a particular program design. Additional effort is typically undertaken by program designers, using the directional guidance from a market potential study, to develop detailed plans for delivering conservation programs.

This report presents market potential results from three distinct approaches to screening measures for cost effectiveness. The objective for assessing these three approaches was to consider various possible cost effectiveness environments over the future of this long-range analysis by incorporating the different cost effectiveness approaches present at the time of the analysis. The regulatory environment for FortisBC Gas at the time of this analysis allowed the utility to spend up to 33% of its entire DSM portfolio on measures or programs that require an mTRC to be cost effective.[1] To date, FortisBC Gas's experience is that, typically, most programs in the residential sector require the mTRC. Since FortisBC Gas uses a

[1] The formulation of the mTRC benefit-cost test is the same as the TRC test, with the exception that the avoided costs stem from a zero emission energy supply alternative (ZEEA) cost and a 15% non-energy benefits adder increases benefits.

combination of TRC and mTRC benefit-cost tests to screen measures and programs within their portfolio, Navigant estimated market potential using the following benefit-cost tests to screen cost effective measures:

1. **TRC only:** This case uses the TRC test across all sectors and presents results consistent with the screening method used in the previous CPR report focusing on technical and economic potential.
2. **mTRC only:** This case uses the mTRC test across all sectors.
3. **Hybrid mTRC/TRC:** This case uses the mTRC test for the residential sector and the TRC test for the commercial and industrial (C&I) sectors, which is most analogous to FortisBC Gas's actual DSM program environment.[2]

Table 5-1 below summarizes the key methodology considerations and decision points informing the analysis in this report, with more detail provided in the report sections noted in the right-hand column of the table. Navigant and FortisBC Gas agreed upon this methodology through discussions about which approach best serves the needs of the utility for understanding market savings potential. Since this study's scope for market potential estimates are not intended to be program-specific and are most reasonable when results are considered in aggregate, the methodology presented here focuses primarily on portfolio-level or sector-level approaches. However, FortisBC Gas selected five high impact measures for measure-level calibration, which is discussed in Section 5.1.6.

[2] Model limitations prevented the team from implementing a strict 33% cap on spending directed towards measures requiring the mTRC screen. However, the cap was approximated by only allowing residential measures to screen the mTRC test for cost-effectiveness.

Table 5-1. Market Potential Methodology Overview

Methodology Parameters	Approach	Report Section
Benefit-cost test screen	Use the TRC as the primary screen for technical, economic, and market potential, with economic and market potential also calculated using the mTRC and a hybrid of mTRC/TRC tests.	5.1
Diffusion parameters	Adjust diffusion parameters within ranges recommended by industry standard data sources to produce savings that are reasonably aligned with FortisBC DSM sector-level historical achievements. Customize the diffusion parameters for the five high impact measures selected in advance by FortisBC Gas in order to align with historic savings at the measure level.	5.1.1, 5.1.2, and 5.1.6
Budget constraints	Do not apply budget constraints.	5.1.4
Incentive strategy	Set incentives as a percent of the incremental cost for all measures pertaining to each sector, such that the simulated percentages of total spending from incentives versus non-incentive costs aligns with historic values across the sector.	5.1.5 and 5.1.7
Treatment of admin and fixed costs	Exclude portfolio-level fixed costs; use a sector-level $/GJ cost derived from historic non-incentive program spending, which includes fixed and variable administrative costs.	5.3.1 and 5.3.2
Net-to-Gross (NTG)	Focus on gross savings within the report, and include discussion on impacts of NTG factors at the sector level for high-level estimates of net savings (consistent with the approach used for technical and economic potential)	5.2.6
Re-participation	Assume 100% of measures re-participate as an efficient measure at the end of their measure life	N/A
Codes and standards	Use the same assumptions about codes and standards as in technical and economic potential	5.2.5

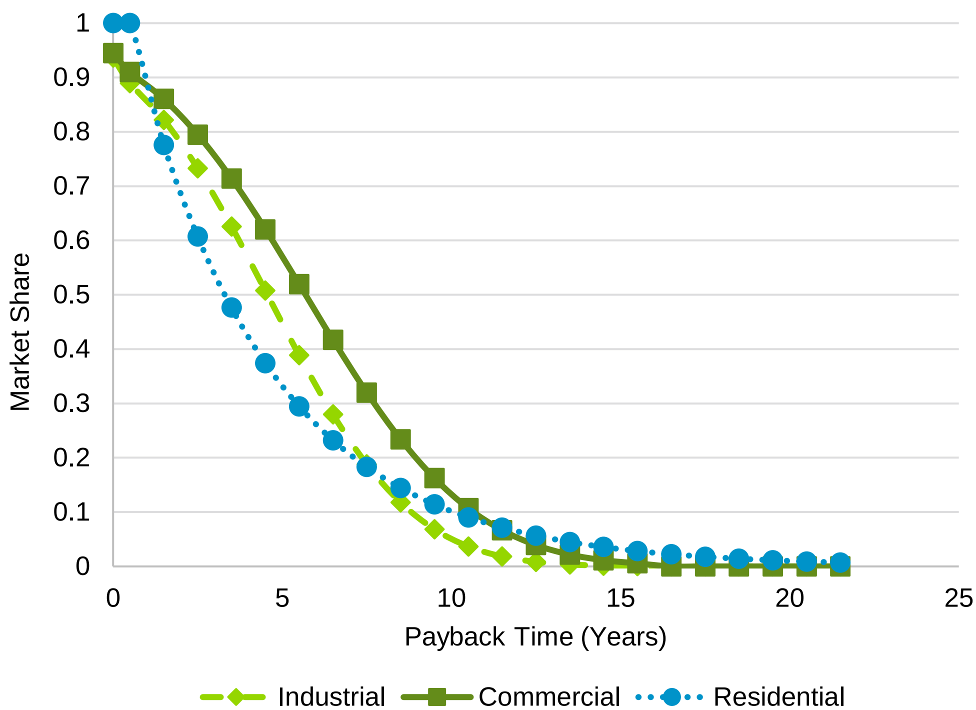
5.1.1 Calculation of "Equilibrium" Market Share

The equilibrium market share can be thought of as the percentage of individuals choosing to purchase a technology provided those individuals are fully aware of the technology and its relative merits (e.g., the energy- and cost-saving features of the technology). For DSM measures, a key differentiating factor between the base technology and the efficient technology is the energy and cost savings associated with the efficient technology. Of course, that additional efficiency often comes at a premium in initial cost. This study calculates an equilibrium market share as a function of the payback time of the efficient technology relative to the inefficient technology. In effect, measures with more favorable customer payback times will have higher equilibrium market share, which reflects consumers' economically rational decision making. While such approaches certainly have limitations, they are nonetheless directionally reasonable and simple enough to permit estimation of market share for the hundreds of technologies appearing in most potential studies.

To inform this CPR, Navigant used equilibrium "payback acceptance" curves that Navigant developed using primary research in the US Midwest in 2012.[3] To develop these curves, Navigant relied on surveys of 400 residential, 400 commercial, and 150 industrial customers. These surveys presented decision makers with numerous "choices" between technologies with low up-front costs, but high annual energy costs, and measures with higher up-front costs but lower annual energy costs. Navigant conducted statistical analysis to develop the set of curves shown in Figure 5-1, which Navigant used in this CPR. Though FortisBC-specific data were not available to estimate these curves, Navigant considers that the nature of the customer decision-making process is such that the data developed using North American customers represents the best industry-wide data available at the time of this study.

As the curves show, the proportion of customers who will accept different payback periods for an energy efficiency investment is different for residential, commercial and industrial customers.[4] The model uses this information to simulate how customers in each sector will accept measures with differing payback periods.

Figure 5-1. Payback Acceptance Curves



Source: Navigant

Since the payback time of a technology can change over time, as technology costs and/or energy costs change over time, the "equilibrium" market share can also change over time. The equilibrium market

[3] A detailed discussion of the methodology and findings of this research are contained in "Demand Side Resource Potential Study," prepared for Kansas City Power and Light, August 2013.
[4] These payback curves represent customer payback acceptance in aggregate across each sector. In practice, customer behavior can vary across sub-sectors. However, there is minimal industry-wide data available on customer payback acceptance at the sub-sector level.

share is therefore recalculated for every year of the forecast to ensure the dynamics of technology adoption take this effect into consideration. As such, "equilibrium" market share is a bit of an oversimplification and a misnomer, as it can itself change over time and is therefore never truly in equilibrium, but it is used nonetheless to facilitate understanding of the approach.

5.1.2 Calculation of the Approach to Equilibrium Market Share

Two approaches are used for calculating the approach to equilibrium market share, one for technologies being modeled as retrofit (RET) measures, and one for technologies simulated as replace-on-burnout (ROB) or new construction (NEW measures).[5] A high-level overview of each approach is provided below.

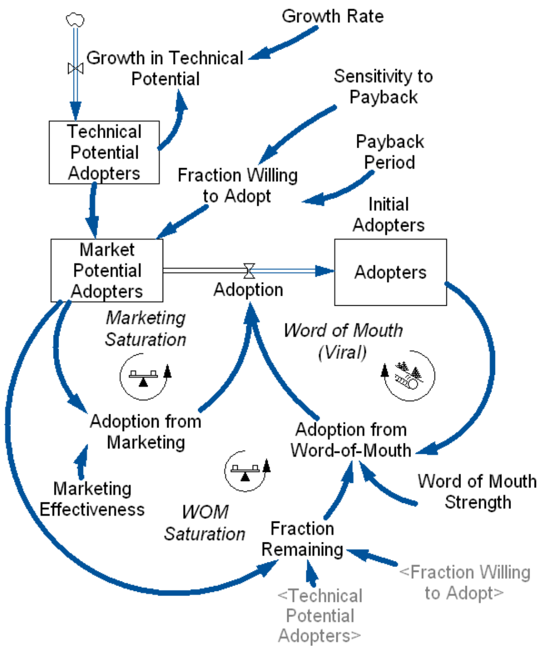
5.1.2.1 Retrofit Technology Adoption Approach

RET technologies employ an enhanced version of the classic Bass diffusion model[6,7] to simulate the S-shaped approach to equilibrium that is observed again and again for technology adoption. Figure 5-2 provides a stock/flow diagram illustrating the causal influences underlying the Bass model. In this diagram, market potential adopters "flow" to adopters by two primary mechanisms – adoption from external influences, such as marketing and advertising, and adoption from internal influences, or "word-of-mouth." Navigant estimated the "fraction willing to adopt" using the payback acceptance curves illustrated in Figure 5-1.

Navigant estimated the marketing effectiveness and word-of-mouth parameters for this diffusion model by drawing upon case studies where these parameters were estimated for dozens of technologies.[8] Recognition of the positive, or self-reinforcing, feedback generated by the "word-of-mouth" mechanism is evidenced by increasing discussion of the concepts such as social marketing as well as the term "viral," which has been popularized and strengthened most recently by social networking sites such as Twitter, Facebook and YouTube. However, the underlying positive feedback associated with this mechanism has been ever present and a part of the Bass diffusion model of product adoption since its inception in 1969.

[5] Each of these approaches can be better understood by visiting Navigant's technology diffusion simulator, available at: http://forio.com/simulate/navigantsimulations/technology-diffusion-simulation.
[6] Bass, Frank (1969). "A new product growth model for consumer durables". Management Science 15 (5): p215–227.
[7] See Sterman, John D. *Business Dynamics: Systems Thinking and Modeling for a Complex World*. Irwin McGraw-Hill. 2000. p. 332.
[8] See Mahajan, V., Muller, E., and Wind, Y. (2000). New Product Diffusion Models. Springer. Chapter 12 for estimation of the Bass diffusion parameters for dozens of technologies.

Figure 5-2. Stock/Flow Diagram of Diffusion Model for New Products and Retrofits



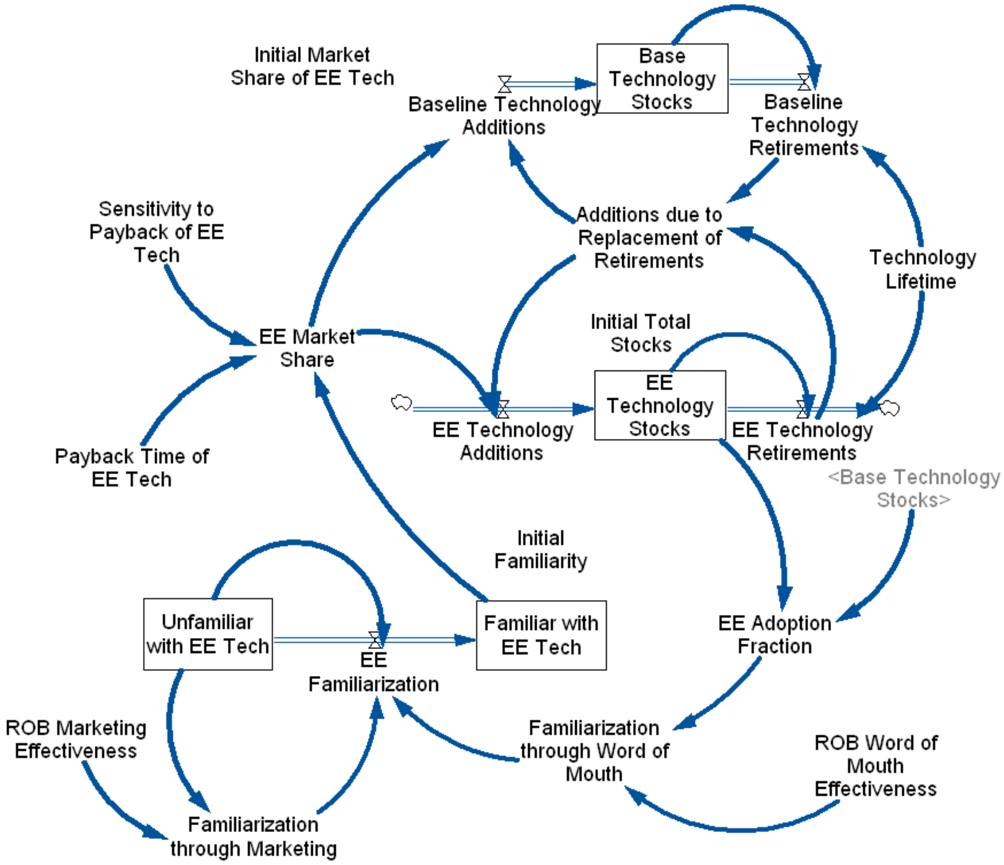
Source: Navigant

The model illustrated above generates the commonly seen S-shaped growth of product adoption and is a simplified representation of that employed in DSMSim™.

5.1.2.2 Replace-on-Burnout Technology Adoption Approach

The dynamics of adoption for ROB technologies are somewhat more complex than for NEW/RET technologies since it requires simulating the turnover of mostly long-lived technology stocks. The DSMSim™ model tracks the stock of all technologies, both base and efficient, and explicitly calculates technology retirements and additions consistent with the lifetime of the technologies. Such an approach ensures that technology "churn" is considered in the estimation of market potential, since only a fraction of the total stock of technologies are replaced each year, which affects how quickly technologies can be replaced. A model that endogenously generates growth in the familiarity of a technology, analogous to the Bass approach described above, is overlaid on the stock tracking model to capture the dynamics associated with the diffusion of technology familiarity. Figure 5-3 graphically illustrates a simplified version of the model employed in DSMSim™.

Figure 5-3. Stock/Flow Diagram of Diffusion Model for ROB Measures



Source: Navigant

5.1.3 Behavioral Measures

Behavior measures typically impose little to no direct costs to the participant[9] and their rate of adoption is highly dependent on the marketing and incentive efforts taken by program administrators. Given these unique characteristics of behavior measures, the payback acceptance curves and technology diffusion models have limited applicability to these types of measures. As such, this study models the adoption of behavior measures in terms of an equilibrium saturation level relative to economic potential and a given amount of time to reach that equilibrium state.

[9] Participants may incur indirect costs through implementation of adjustments to typical operations in response to energy information feedback (e.g., through upgrading a water heater). However, estimating these indirect costs requires additional data on the actions taken by the participant outside of the program and is beyond the scope of this analysis.

This study includes four measures that are distinctly behavioral:

- Commercial Comprehensive Retrocommissioning[10]
- Commercial Occupant Behavior[11]
- Industrial Energy Management[12]
- Residential Home Energy Reports[13]

For each of these measures, the team used multiple sources of information to define the equilibrium saturation level and the duration of time required to reach that level. Figure 5-4 illustrates the saturation trajectory as a percentage of economic potential for each of the behavior measures. Although the adoption of behavior measures is not linked to customers' payback acceptance time, the market potential for behavior measures is still dependent on cost effectiveness by means of the economic potential. As such, the realized market savings from these measures can vary between the TRC and mTRC cases if economic potential varies.

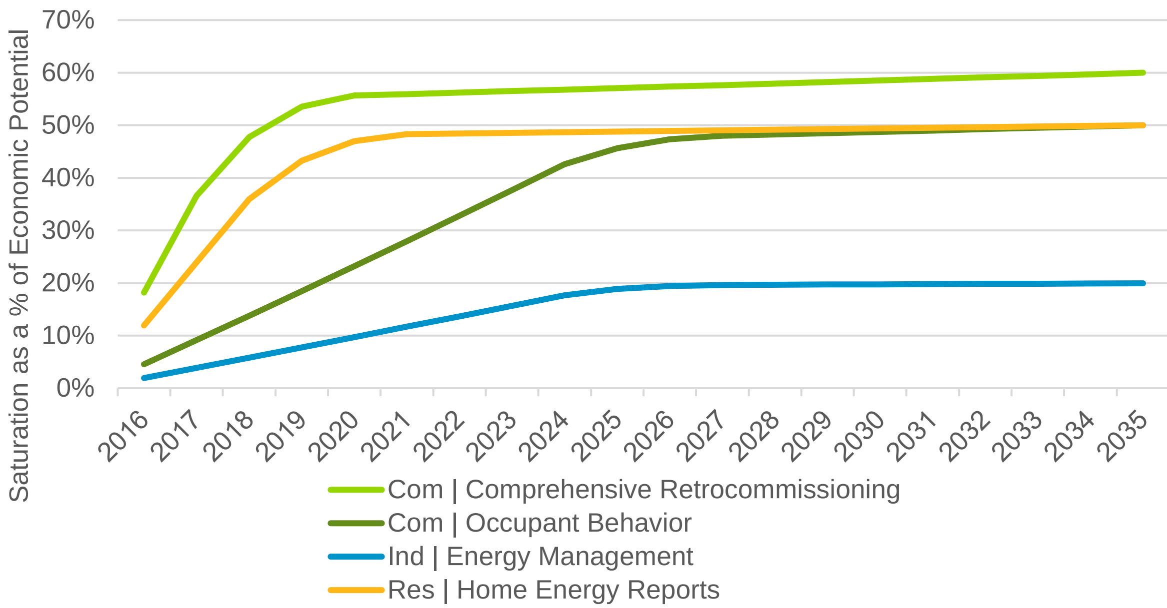
[10] Commercial comprehensive retrocommisioning is similar to FortisBC Gas's Continuous Energy Optimization offering, so the annual ramp rate was trended with historic savings from that measure. Differing from the other behavioral measures, the characterization of retrocommisioning includes some upfront costs to the participant (e.g., paying for a portion of staff training). Since it is uncertain whether comparable training would be available absent program offerings and enrollment efforts, the study treats this measure as a behavior measure that is dependent on on-going support from program administrators.

[11] The team chose the adoption trajectory for the commercial occupant behavior measure after reviewing research conducted for the California Public Utilities Commission on similar measures and after reviewing the trends in historic savings from similar measures within FortisBC Gas's Energy Specialist program.

[12] Navigant designed the rollout of industrial energy management to mimic historical participation levels within BC Hydro's more mature program focusing on industrial energy management. This trajectory implies participation of about nine customers/sites per year, which aligns well with the number of annual customers that participated in BC Hydro's programs, given the different size of each utility's customer base.

[13] The team developed the saturation curves for residential home energy report using information attained through interviews with OPower staff and their experience with typical offerings of these reports. These energy reports encompass many of Fortis Gas's current activities focused on residential behavior.

Figure 5-4. Behavior Measure Market Saturation as a Percentage of Economic Potential (%)



Source: Navigant

5.1.4 Budget Strategy

FortisBC Gas elected to view market potential without imposing any budget constraints on the simulated results. The implication of this decision is that market potential is only constrained by stock turnover and customer willingness to adopt efficient measures. Without future budget constraints, the utility spending falls out naturally from the input assumptions for per-unit-of-savings incentive and administrative costs and a given year's level of market savings, without tying spending to a given budget level. In this case, the per-unit-of-savings incentive and administrative spending levels are fixed at the same levels (in real dollars) over the study horizon. Therefore, changes in spending (in real dollars) only reflect a changing mix and magnitude of savings among measures.

5.1.5 Incentive Strategy

Per FortisBC Gas's guidance, this study calculates measure-level incentives based on a specified percentage of incremental measure costs. For example, if the specified incentive percentage was 50% and a measure's incremental cost was $100, then the calculated incentive for that measure would be $50. The incentive percentage differs by sector and is applied uniformly to all measures within a given sector.[14] Section 5.1.7 discusses how the model calibration process informed the specified incentive percentage in more detail.

[14] Navigant applied incentive percentages at the sector level, as opposed to the measure level, per the focus of this study's scope on sector-level market potential, rather than program-level potential. Actual program design would define incentive levels for each measure.

5.1.6 High Impact Measures

FortisBC Gas selected five measures that merit a more granular measure-level analysis, with the intent that Navigant would perform measure-level calibration customized to each measure's historic savings trajectories. These five high impact measures include:

1. Residential Condensing Storage Water Heater
2. Residential Condensing Tankless Water Heater
3. Residential Efficient Fireplaces
4. Residential Furnace Early Retirement
5. Residential High Efficiency Boiler Replacement

Section 5.1.7 discusses how Navigant customized the calibration of these measures in more detail.

5.1.7 Model Calibration

Any model simulating *future* product adoption faces challenges with "calibration," as there is no future world against which one can compare simulated results to actual results. Engineering models, on the other hand, can often be calibrated to a higher degree of accuracy since simulated performance can be compared directly with performance of actual hardware. Unfortunately, DSM potential models do not have this luxury, and therefore must rely on other techniques to provide both the developer and the recipient of model results with a level of comfort that simulated results are reasonable. For this CPR, Navigant took a number of steps to ensure that forecast model results were reasonable, including:

- Identifying the subset of CPR measures that were included in historic program offerings in order to have a basis for comparison with historic program achievements.
- Ensuring similar trends and magnitudes between average historic sector-level savings between 2013-2015 and simulated sector-level savings from the measure subset in 2016.[15]
- For the five high-impact measures, ensuring similar trends and magnitudes between historic measure-level savings and 2016 simulated savings. Additionally, the team calibrated long-term trends to align reasonably with FortisBC Gas's projections for these measures.
- Seeking general alignment between 2015 historic sector-level incentives as a percentage of total sector-level spending and simulated 2016 values.[16]

Before making comparisons of model results to historic achievements, it was first necessary to identify the CPR measures that were included in historic program offerings. The simulated savings from this subset of CPR measures became the basis for comparing modelled savings to historic savings during the calibration process. It is important to note that although the team reached good alignment in trends between historic and simulated results for this subset of measures, this study's results for *total* market potential significantly exceed the historically achieved program savings. This is because the study includes many additional measures that have historically not been included in programs, and those extra

[15] The team compared simulated savings to 2013-2015 historic averages, rather than a single historic year, because historic savings varied appreciably from one near to the next within each sector.
[16] The team compared the percentage of simulated spending derived from incentives to the 2015 historic percentages because 2015 was deemed to be most representative of expectations about future spending allocations between incentives and non-incentives.

measures contribute significant savings to the total market potential results.

When comparing residential results to historic program achievements, Navigant used results from the mTRC case because they are most analogous to FortisBC Gas's program environment (as described in Section 5.1). When comparing commercial and industrial results to historic program achievements, Navigant used results from the TRC case.

To obtain close agreement with FortisBC Gas's historic savings across a wide variety of metrics, Navigant adjusted incentive levels, technology diffusion coefficients and payback acceptance curves. Calibration required an iterative process of modifying the aforementioned parameters until all goals of calibration were reasonably satisfied. For example, the marketing effectiveness parameters are the key lever for calibrating the magnitude of 2016 savings for each sector, whereas the word-of-mouth parameter strongly influences how rapidly adoption and savings ramp up over time. Navigant varied these diffusion parameters within the commonly observed ranges until simulated savings were trending reasonably compared with historic savings at the sector level.[17]

For the five high impact measures, the team made several custom adjustments to align simulated savings with the historic trends. First, the team automatically included these measures in the market potential (for the mTRC and Hybrid cases, but not the TRC case) regardless of their sub-sector cost effectiveness.[18] The team made this provision to ensure that these measures, which are currently offered through FortisBC Gas's programs, would also appear in the market potential.[19] Second, Navigant customized the marketing effectiveness and payback acceptance curves for these measures to achieve similar magnitudes and trends between modelled savings and historic savings.

Lastly, the team adjusted sector-level incentive levels to be different percentages of incremental costs until the percentage of 2016 total spending attributable to incentives was similar to 2015 historic values. The calibrated incentive levels produce a weighted average incentive percentage of 56% for the simulated portfolio. This calibrated value coincides well with the initial target of having modelled incentives cover roughly 50% of incremental costs across the portfolio.

To summarize, the calibration process ensures that forecast potential is grounded against real-world results considering the many factors that determine likely adoption of DSM measures, including both economic and non-economic factors.

[17] This study uses a value of 0.255 for the word-of-mouth strength, which is the 25th percentile of values observed by Mahajan 2000. The marketing effectiveness parameter varied between 0.010 and 0.053, depending on the sector. These values span from roughly the 25th percentile to 75th percentile of observed marketing effectiveness, per Mahajan 2000.

[18] While these measures are cost effective overall, some measures are not cost effective for certain sub-sectors and regions within the analysis. Since actual programs focus on overall cost effectiveness across the sector, rather than within sub-sectors, Navigant forced the five high impact measures to pass across all sub-sectors to better reflect actual program implementation.

[19] Each of the five high impact measures are currently offered through FortisBC Gas's residential programs. Because programs look at the collective cost effectiveness of a group of measures (e.g., several water heater technologies), it is possible that a technology within the group may not be cost-effective. However, the group as a whole can be cost-effective, and therefore any technology within the group can be offered through programs.

5.2 Market Potential Results

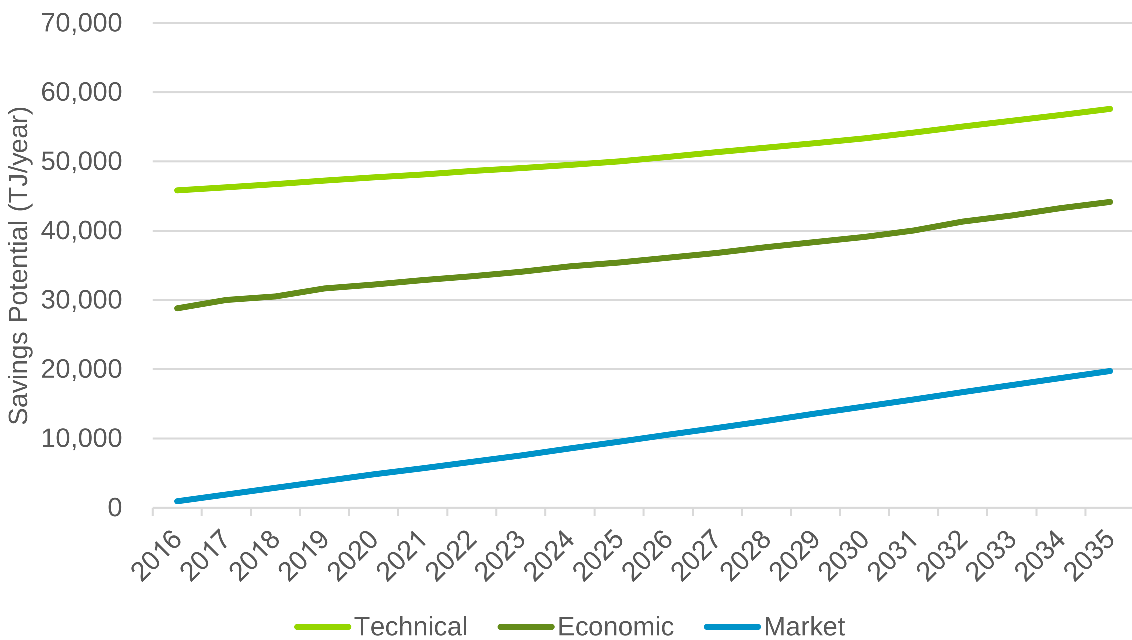
This section provides the market potential results calculated by the model at varying levels of aggregation, using the TRC benefit-cost test as a screen (as consistent with the representation of economic potential in Section 4). Results are shown by sector, customer segment, end-use category, and by highest-impact measures. The section concludes with a review of natural change and its impacts on market potential.

5.2.1 Comparison of Savings by Potential Type

Values shown below for market potential are termed “cumulative market” potential, in that they represent the accumulation of each year’s annual incremental market potential (e.g., an annual incremental market potential of 0.8% per year for ten years would result in a cumulative market potential of 8.0% of forecast consumption). Economic potential, as defined in this study, can be thought of as a bucket of potential from which programs can draw over time. Market potential represents the draining of that bucket, the rate of which is governed by a number of factors, including the lifetime of measures (for ROB technologies), market effectiveness, incentive levels, and customer willingness to adopt, among others. If the cumulative market potential ultimately reaches the economic potential, it would signify that all economic potential in the “bucket”’ had been drawn down, or harvested.

As shown in Figure 5-5 and Table B-1 in Appendix B, the market potential, which accounts for the rate of DSM acquisition, increases steadily throughout the CPR period, reaching 19,736 TJ/year in 2035. By 2035, market potential reaches nearly 46% of the economic potential. Incremental annual market potential added year-over-year to the cumulative potential averages 987 TJ/year over the study horizon.[20]

Figure 5-5. Total Cumulative Gas Savings Potential (TJ/year)

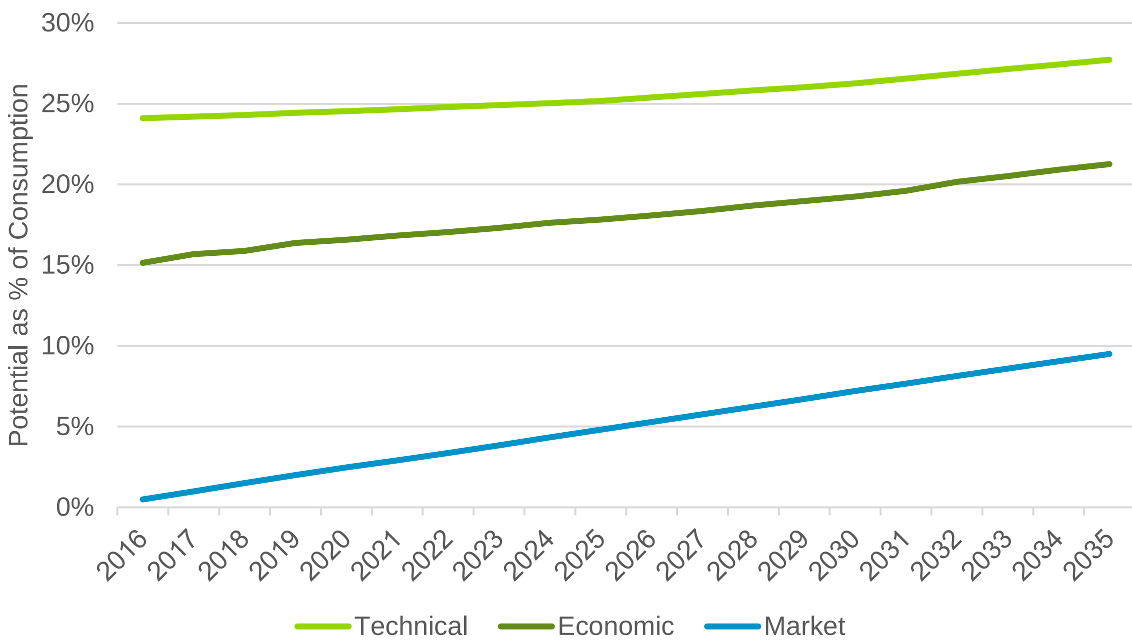


Source: Navigant

[20] The time horizon for the CPR is 2016-2035 (20 years).

Under the TRC screen, market potential grows from 0.5% in 2016 to 9.5% of forecast gas consumption by 2035, as shown in Figure 5-6 and in Appendix B. The annual incremental market potential is approximately 0.5% per year on average over the CPR time horizon.

Figure 5-6. Total Cumulative Gas Savings Potential as a Percentage of Consumption (%)

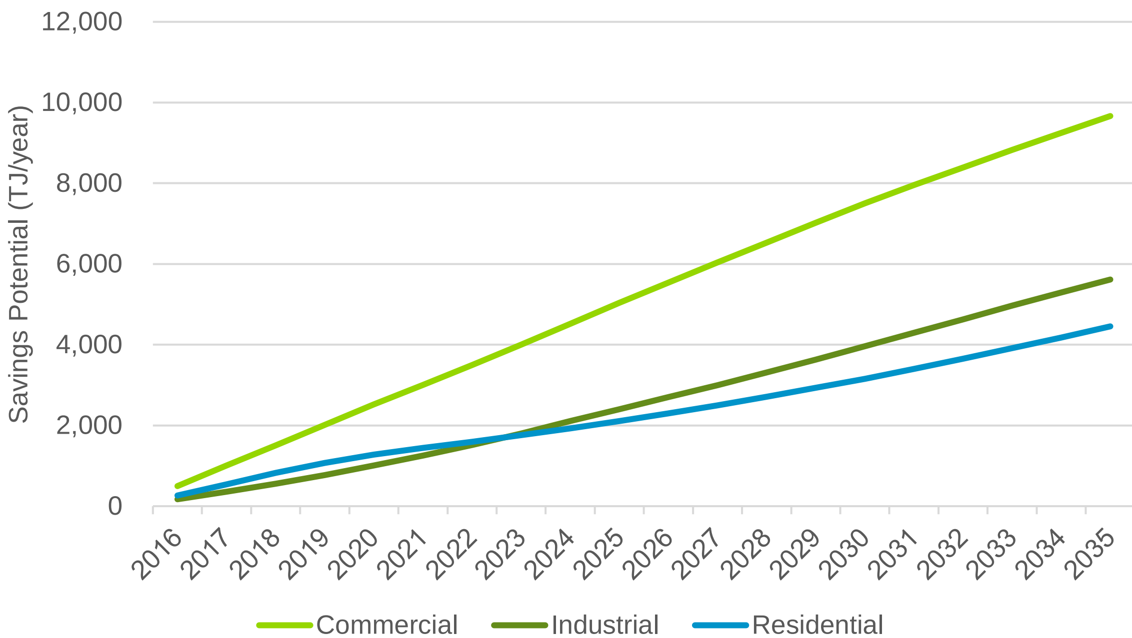


Source: Navigant

5.2.2 Results by Sector

Figure 5-7 and in Appendix B show the magnitude of gas market potential by sector. Navigant found the greatest potential exists in the commercial sector in terms of TJ/year and as a percentage of consumption. The commercial and industrial sectors captured just over 50% of economic potential by 2035, while the residential sector captured 28% of the economic potential.

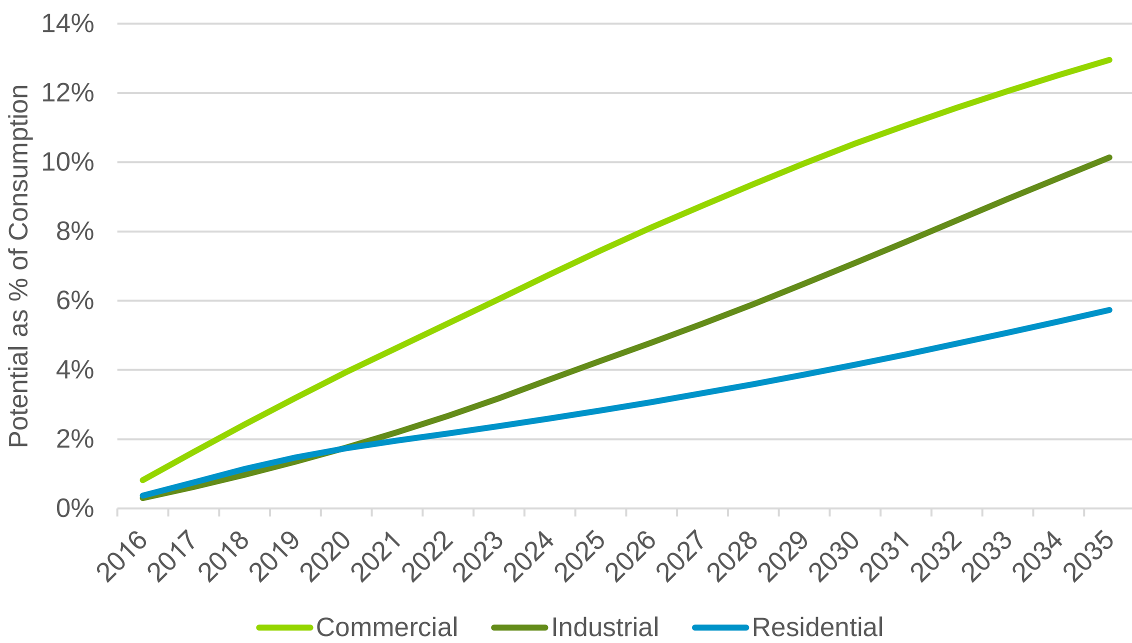
Figure 5-7. Cumulative Gas Savings Market Potential by Sector (TJ/year)



Source: Navigant

When viewed as a percentage of consumption, similar sector-level trends in the market potential are evident, as shown in Figure 5-8 and Table B-4. The commercial sector's market potential reaches 13% of commercial consumption by 2035, and the industrial sector achieves slightly over 10%. The residential sector increases to nearly 6% of consumption by the final study year, and this lower percentage reflects the lower cost-effectiveness and longer payback times of the residential sector on the whole.

Figure 5-8. Cumulative Gas Savings Market Potential as a Percentage of Consumption by Sector (%)

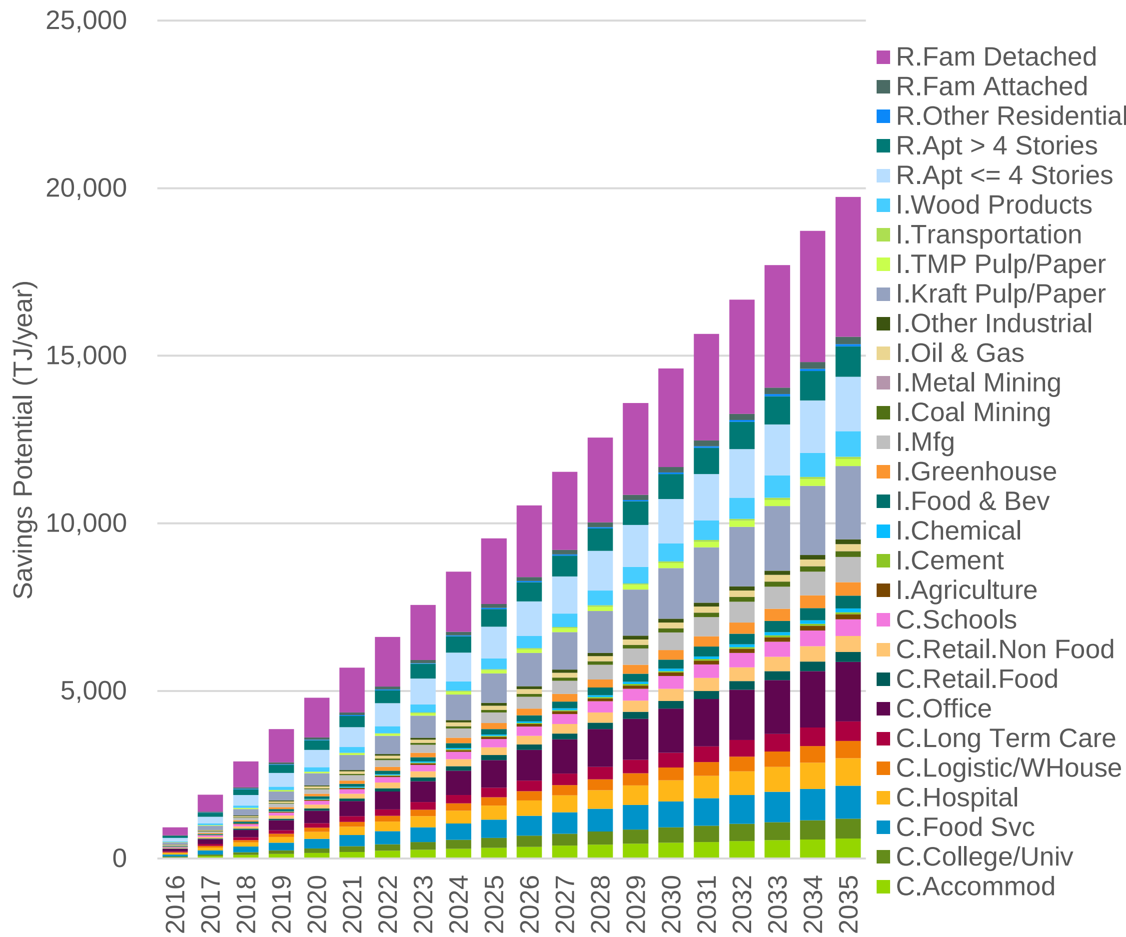


Source: Navigant

5.2.3 Results by Customer Segment

Figure 5-9 shows the gas energy market savings potential across all customer segments, and Table B-5 in Appendix B provides the associated data.[21] This figure highlights the large savings potential of the residential detached single-family home customer segment relative to other customer segments. Other segments with significant savings potential are kraft pulp and paper, apartments less than 4 stories, and offices. The segments with high savings are also segments with high consumption.

Figure 5-9. Cumulative Gas Savings Market Potential by Customer Segment (TJ/year)



Source: Navigant

[21] The LNG segment does not appear in this figure because FortisBC Gas does not supply natural gas to LNG facilities. Gas sales to LNG facilities are zero across the Reference Case forecast; hence, the savings potential is also zero.

Figure 5-10, Figure 5-11, and Figure 5-12 break out the gas energy market savings potential for each sector by customer segment. For the residential sector, detached single-family homes represents the largest savings potential of any customer segment by far, accounting for 93% of the total savings potential. Offices and apartments provide nearly half of the savings in the commercial sector. In general, the distribution of savings among customer segments aligns well with the distribution of gas consumption among segments. In the industrial sector, kraft pulp and paper accounts for the largest share of energy savings at 37%. Wood products and manufacturing also provide significant savings among industrial segments.

Figure 5-10. Residential Gas Savings Market Potential Customer Segment Breakdown in 2025

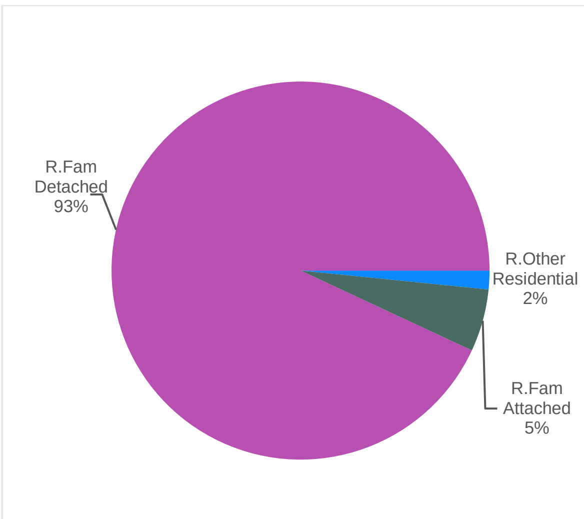


Figure 5-11. Commercial Gas Savings Market Potential Customer Segment Breakdown in 2025

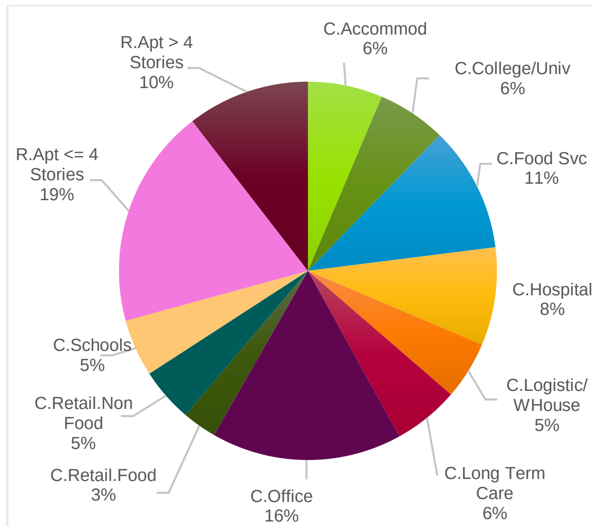
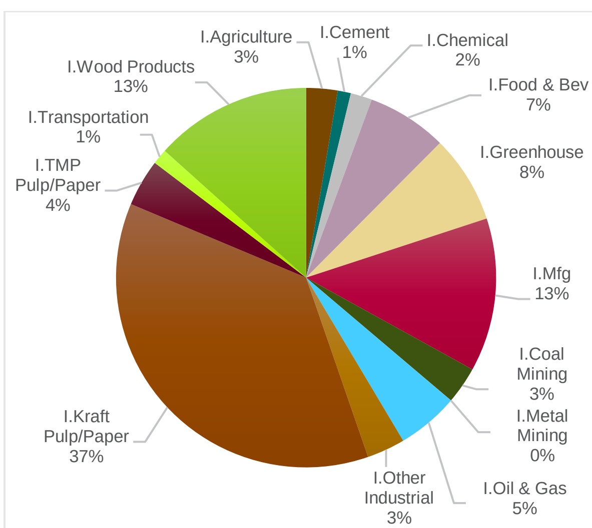


Figure 5-12. Industrial Gas Savings Market Potential Customer Segment Breakdown in 2025

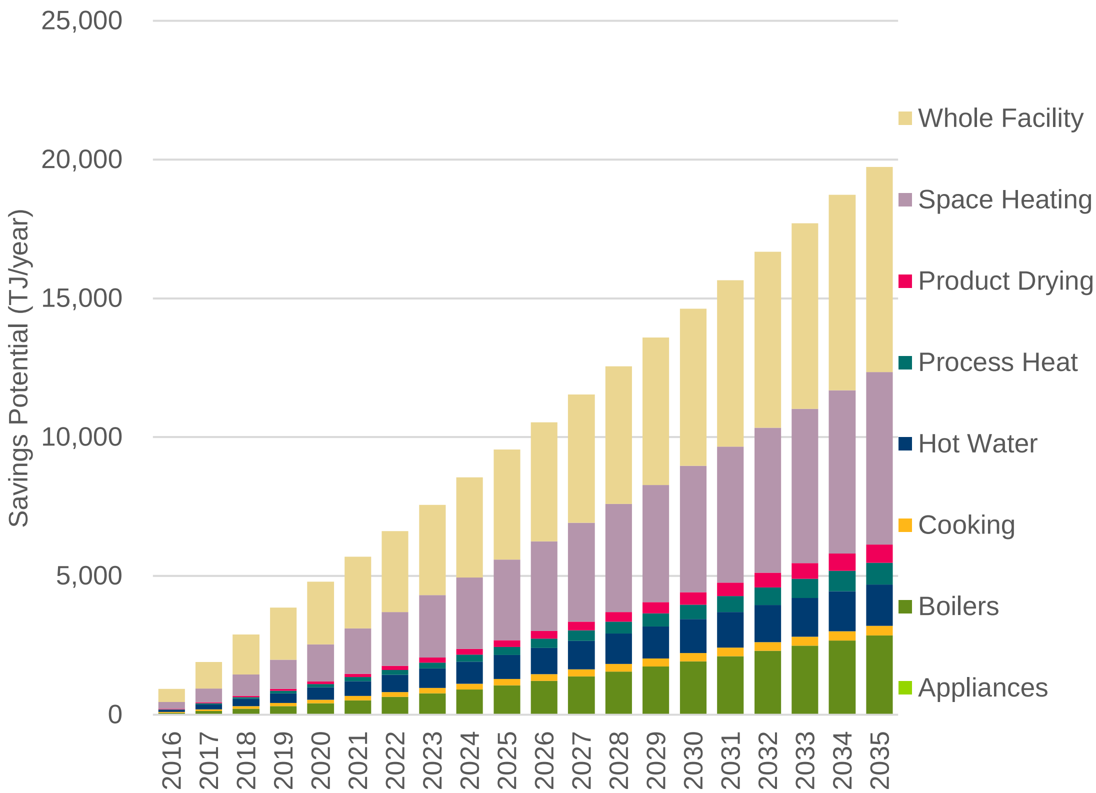


Source: Navigant

5.2.4 Results by End-use

Figure 5-13 shows the gas energy market savings potential across end-uses.[22] The data used to generate the figure are in Table B-6 in Appendix B. The dominant end-uses are space heating and whole facility. The bulk of savings potential in the space heating end-use comes from smart thermostats. The whole facility end-use primarily consists of savings from comprehensive whole-facility new construction practices, home energy reports, and energy management programs. As such, these whole-facility savings implicitly include savings from multiple end-uses.

Figure 5-13. Cumulative Gas Savings Market Potential by End-Use (TJ/year)



Source: Navigant

Figure 5-14, Figure 5-15, and Figure 5-16 break out the gas energy market savings potential for each sector. The whole facility end-use dominates the residential sector, accounting for 50% of the total savings potential. This is largely driven by home energy reports, which have by far the most market potential of all residential measures, and ENERGY STAR Homes, which is the third highest residential potential saver. In the commercial sector, the space heating and whole facility end-uses account for roughly 86% of the total market savings potential. Savings in commercial space heating come largely from HVAC control upgrades, condensing make-up air units and high efficiency furnaces. The whole-facility end-use's savings are driven by new building construction practices that are at least 45% above

[22] This study evaluated several gas appliances (convection ovens, gas ranges, and clothes washers and dryers) and found all to be non-cost-effective. As such, the appliances end use shows no market potential. For a list of measures associated with each end use, please refer to Appendix A.2 of the technical and economic potential report.

code. In the industrial sector, the boiler end-use plays the largest role, consisting of high savings measures like process boiler load control and heat recovery systems.

Figure 5-14. Residential Gas Savings Market Potential End-Use Breakdown in 2025

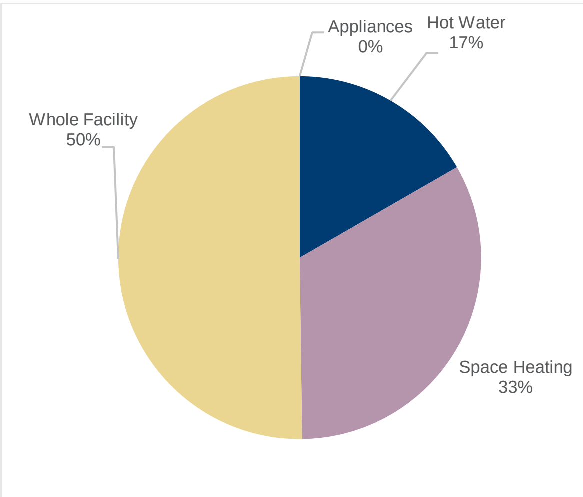


Figure 5-15. Commercial Gas Savings Market Potential End-Use Breakdown in 2025

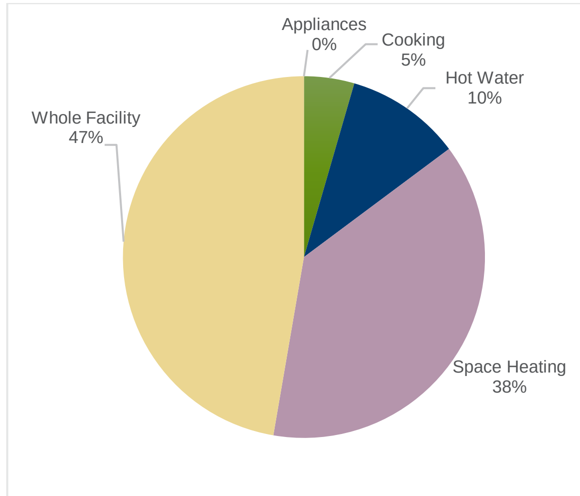
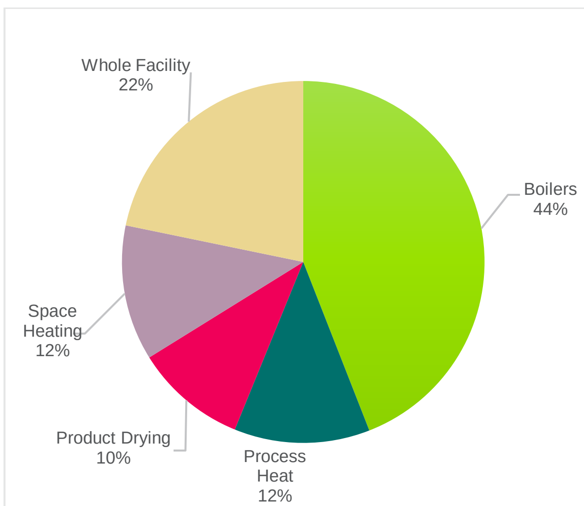


Figure 5-16. Industrial Gas Savings Market Potential End-Use Breakdown in 2025



Source: Navigant

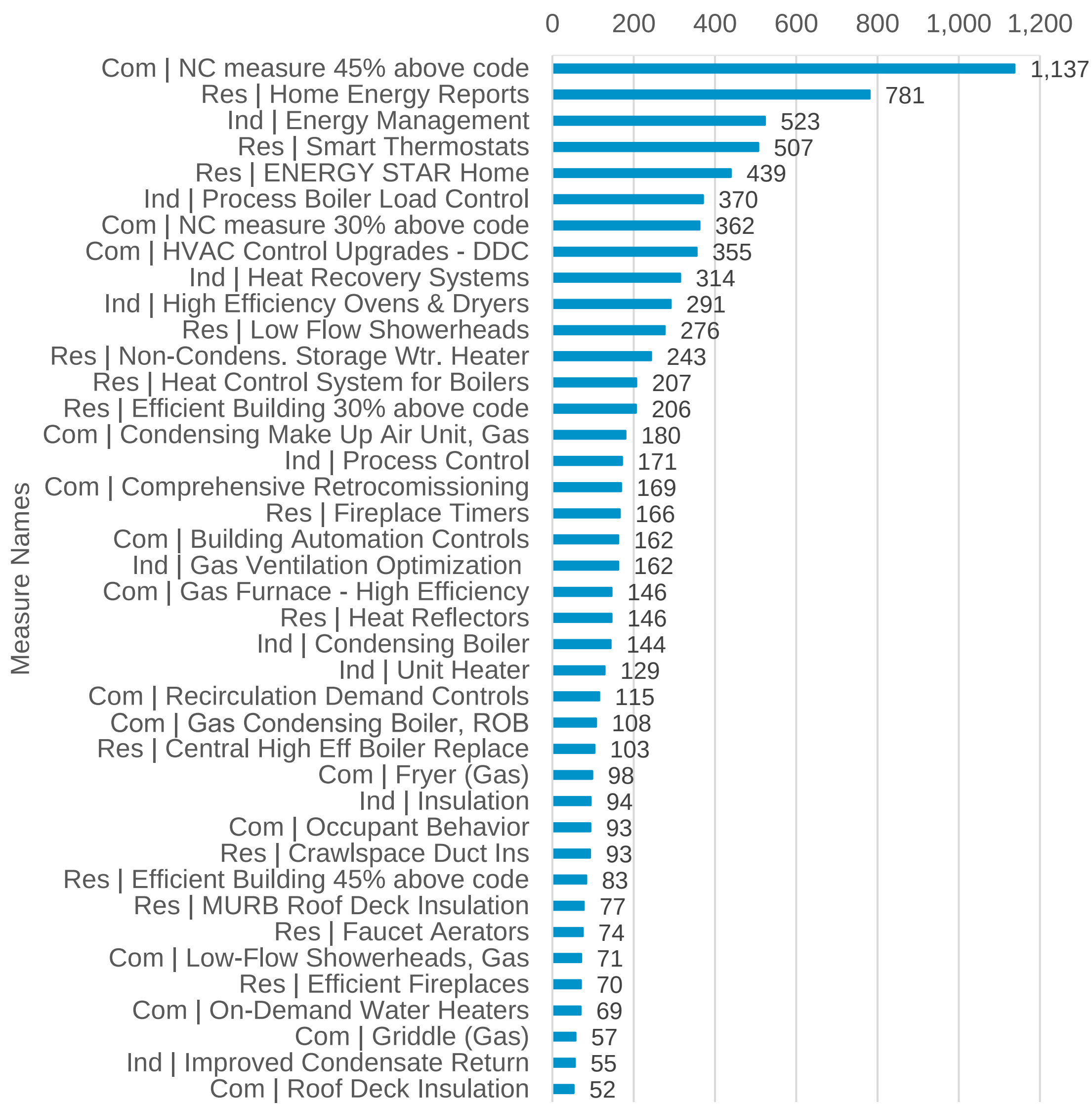
5.2.5 Results by Measure

Figure 5-17 and Table B-7 present the top 40 measures ranked by their gas energy market savings potential in 2025. Wherever a group of measures were similar in nature, Navigant consolidated their potential into a representative measure name to produce a more succinct view at the measure level. Unlike similar figures for economic and technical potential, these rankings already account for competition among measures providing the same service. Thus, one can add the potential shown without encountering issues of double counting.

When code-change measures become applicable, they “steal” savings potential from other related measures that may display significant savings in absence of the code. In this way, the sum of the total savings potential between the code and the related energy-efficient measure is the same before and after a code takes effect. This ensures there is no double counting of savings from codes and the energy efficient measures impacted by the code.

The top ten measures come from the whole-facility, space heating, boiler, and industrial process heating end-uses. Notably, five of the top ten measures are associated with the whole facility end-use. New construction practices 45% better than code ranks as the highest impact market potential measure. Smart thermostats, which has the highest economic savings potential, ranks fourth in terms of market potential. Home energy reports move from the 7th position in economic potential to the 2nd position in market potential.

Figure 5-17. Top 40 Measures for Gas Energy Market Savings Potential in 2025 (TJ/year)



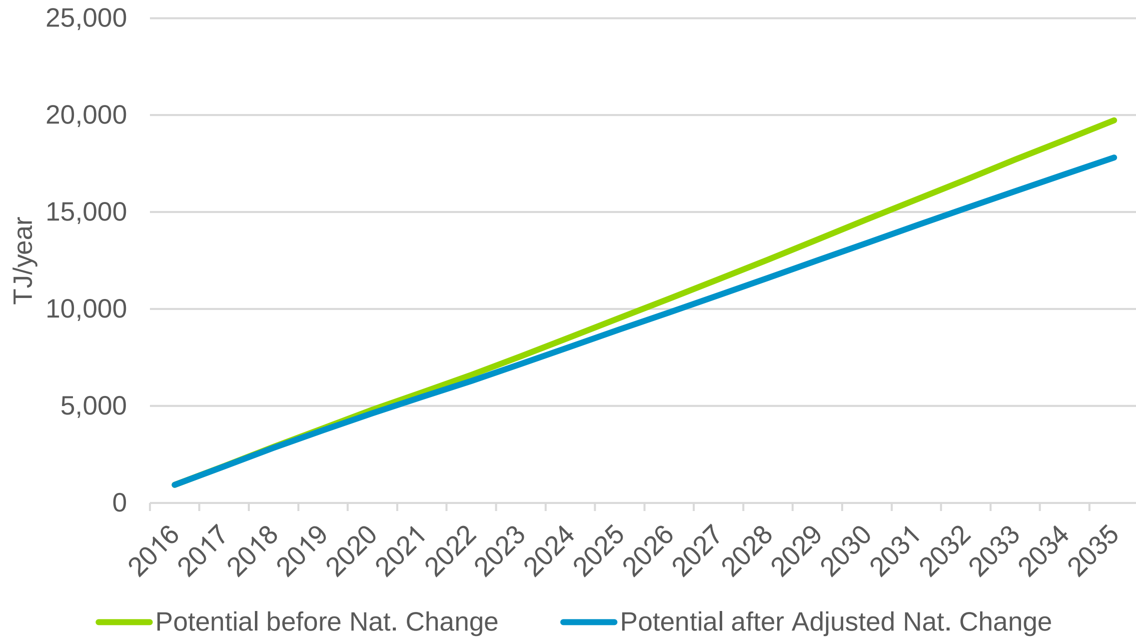
Source: Navigant

5.2.6 Adjustments for Natural Change

As discussed in Section 2.3.2, Navigant estimated natural change to account for differences in end-use consumption in the Reference Case compared to the frozen EUI case. Natural change accounts for changes in consumption that are naturally occurring and are not the result of utility-sponsored programs or incentives. Adding natural change to the frozen EUI case required adjusting the market potential forecasts accordingly.

Figure 5-18 and Table B-8 in Appendix B show the total market potential across all sectors before and after adjusting for natural change. The total natural change across all sectors is negative in all years, indicating an overall natural tendency toward increased energy conservation rather than growth. The adjusted natural change is computed by accounting for the percentage of the gross natural change that could reasonably be attributed to energy savings for each end-use. Market potential after adjustment for natural change is on average about 10% lower than potential before natural change by 2034.

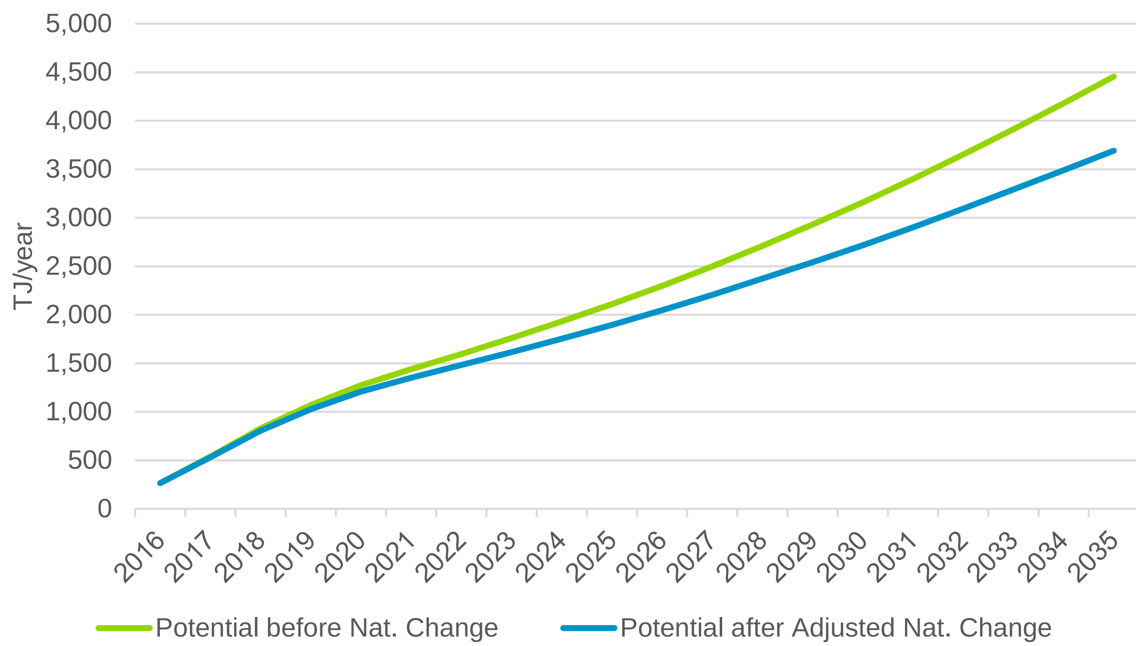
Figure 5-18. Gas Energy Market Savings Potential with Natural Change – All Sectors (TJ/year)



Source: Navigant

Figure 5-19 and Table B-9 show the effect of adjustments for natural change in the residential sector. Space heating and hot water end-uses account for significant natural conservation. In contrast, appliances account for a minor amount of natural growth. When aggregated to the sector level, natural conservation has a much larger effect than natural growth. On average across the study period, the residential technical potential after adjusted natural change is roughly 12% lower than the potential prior to natural change.

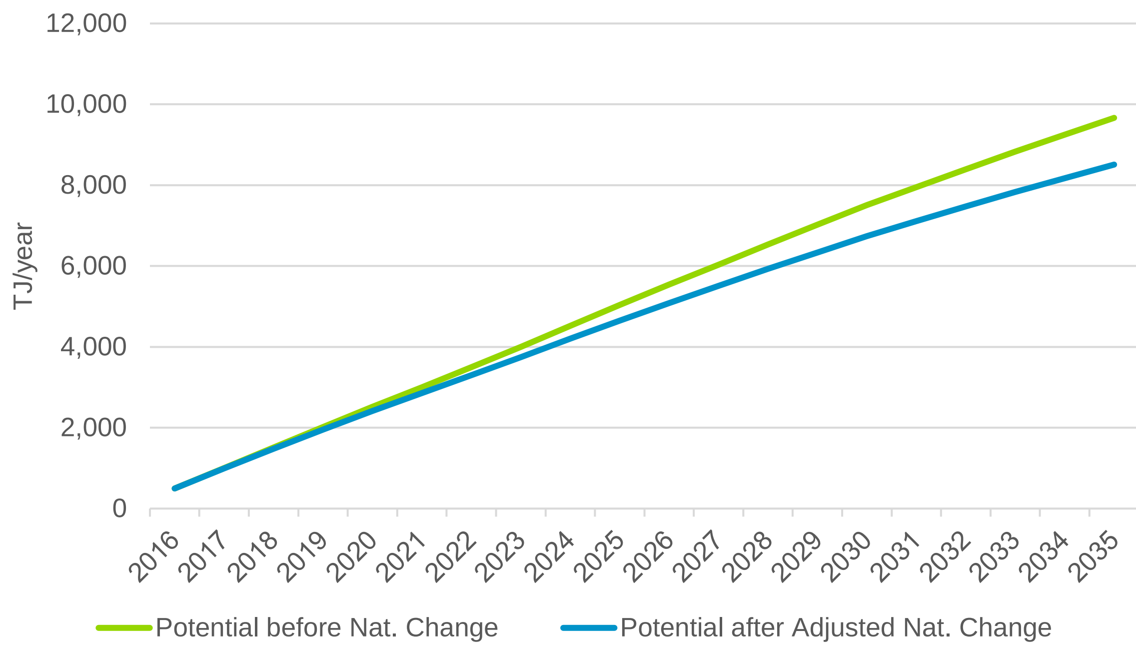
Figure 5-19. Residential Gas Energy Market Savings Potential with Natural Change (TJ/year)



Source: Navigant

The effect of adjustments for natural change on the commercial sector's market potential is slightly less than for the residential sector, as seen in Figure 5-20 and Table B-10. Space heating and hot water are the commercial end-uses contributing to natural change, and both exhibit natural conservation. On average across the study period, the commercial technical potential adjusted for natural change is roughly 9% lower than the potential prior to natural change.

Figure 5-20. Commercial Gas Energy Market Savings Potential with Natural Change (TJ/year)



Source: Navigant

For the industrial sector, there is no forecasted natural change, so adjustments to the market potential results presented in previous sections are not necessary.

5.3 Market Potential Budget Estimates

The following section describes the approach that Navigant used to develop the budget estimates for the market potential savings presented in this report, as well as the results of the market potential budget and cost effectiveness assessments when using the TRC test as an economic measure screen.

5.3.1 Approach to Budget Estimation

Navigant developed estimates of the portfolio-level DSM spending that FortisBC Gas would need to support the market potential savings forecast over the study period. Navigant calculated these estimates in the DSMSim™ model using incentive levels calibrated to align simulated 2016 incentive values with historic sector-level incentives as a percentage of total sector-level spending (as described in Section 5.1.7). The incentive budgets reflect the amount of spending that would result from the level of adoption for each measure that makes up the market potential estimates. Incentive budgets grow over time due to changes in the mix of DSM measures and cost inflation. The sector and total administration budgets result from the amount of savings potential in a given year multiplied by the historical per-unit-of-savings administrative expenditures ($/GJ) reported by FortisBC Gas, which the study escalates over time at the assumed inflation rate.[23]

5.3.2 Total Market Potential Budget

Table 5-2 presents the estimated spending levels for incentives, administrative costs (non-incentives), and the total portfolio. As can be seen from the table, the total simulated funding for market potential is roughly $21 million in 2016, and more than doubles to almost $54 million by 2035 as the portfolio mix changes and low-hanging fruit is harvested.

Table 5-2. Budgets by Sector – TRC Case (Million $)

Sector	Spending Type	2016	2020	2025	2030	2035	2016-2035 Total*
Commercial	Incentives	$9.52	$14.21	$18.58	$21.55	$23.05	$351.38
	Non-Incentives	$1.51	$1.62	$1.85	$1.90	$1.81	$34.83
	Total	$11.03	$15.83	$20.43	$23.45	$24.86	$386.22
Industrial	Incentives	$2.33	$3.94	$6.53	$8.93	$9.75	$131.07
	Non-Incentives	$1.14	$1.67	$2.35	$2.87	$3.08	$46.02
	Total	$3.47	$5.61	$8.89	$11.81	$12.83	$177.09
Residential	Incentives	$2.73	$4.28	$5.39	$7.83	$10.82	$123.04
	Non-Incentives	$3.55	$2.99	$2.85	$4.04	$5.36	$72.87
	Total	$6.27	$7.27	$8.24	$11.87	$16.18	$195.92
Portfolio	Incentives	$14.58	$22.43	$30.50	$38.31	$43.62	$605.50
	Non-Incentives	$6.19	$6.27	$7.06	$8.81	$10.25	$153.73
	Total	$20.77	$28.71	$37.56	$47.13	$53.87	$759.23

*The 2016-2035 Total column represents the sum of all forecasted years (2016-2035), not just those shown in the table.
Source: Navigant

The costs borne by the utility to acquire market savings—on a dollar-per-savings basis—increase 2 to 3 percent per year, on average and in real terms, for each sector. This contrasts with recent program experience, where per-unit-of-savings utility costs have shown declining trends. There are several factors creating this difference:

- Actual program implementation may be dynamically allocating incentive spending to measures providing lower cost savings than the incentive strategy employed in this analysis (refer to Section 5.1.5). Though the modeling approach captures customers' tendency to favor the adoption of economically attractive measures over less economically attractive measures, it does not preferentially incentivize the most economic measures.

[23] The study includes administrative costs directly tied to programs and measures providing energy savings. Outreach and enabling costs and portfolio-level administrative costs (i.e., not tied to a program) were not included in this study. This study's portfolio total administrative costs are a summation of sector-level administrative costs, so this analysis is likely to underrepresent total administrative budgets at the portfolio level. However, this underrepresentation may be partially offset by not accounting for efficiencies gained through program experience, which would reduce per-unit-of-savings administrative costs over time.

- Actual programs may not be experiencing significant saturation yet in the uptake of certain low cost measures. This study's upward trend in the percentage of spending directed to incentives indicates that low-cost savings are harvested early in the study horizon and the remaining savings opportunities become increasingly costlier.
- This study did not attempt to estimate the reduction in per-unit-of-savings administrative costs that could be realized as experience in program administration leads to greater efficiency in administrative spending.
- Compliancy to codes and efficiency standards enacted during the study horizon reduces the savings potential and cost-effectiveness of impacted measures, resulting in higher costs to the utility to capture those measures' savings potential.

5.3.3 TRC Cost Effectiveness

Table 5-3 shows the benefit-cost test ratios by sector and for the portfolio for each benefit-cost test. The benefit-cost test ratios are greater than 1.0 for all benefit-cost test types at the sector and portfolio level across all analysis years, with an exception for the RIM test, which very rarely has a benefit-cost test greater than 1.0 for DSM measures.

Table 5-3. Benefit-Cost Test Ratios for the Portfolio and by Sector

Sector	Year	Total Resource Cost Test	Utility Cost Test	Participant Cost Test	Rate Impact Measure Test
Commercial	2016	1.86	2.78	2.63	0.75
	2020	1.83	2.71	2.38	0.80
	2025	1.82	2.69	2.21	0.84
	2030	1.78	2.63	2.05	0.88
	2035	1.76	2.60	1.92	0.92
	2016-2035	1.84	2.71	2.27	0.83
Industrial	2016	2.07	2.23	3.50	0.75
	2020	2.47	2.67	3.60	0.85
	2025	2.81	3.05	3.60	0.95
	2030	2.99	3.25	3.48	1.02
	2035	3.22	3.50	3.47	1.10
	2016-2035	2.75	2.98	3.54	0.94
Residential	2016	1.16	1.59	3.14	0.51
	2020	1.70	2.43	3.45	0.61
	2025	1.93	2.75	3.41	0.67
	2030	1.98	2.78	3.28	0.70
	2035	2.02	2.81	3.16	0.74
	2016-2035	1.79	2.51	3.38	0.65
Portfolio	2016	1.68	2.33	2.84	0.69
	2020	1.89	2.63	2.77	0.75
	2025	2.03	2.79	2.68	0.82
	2030	2.07	2.82	2.59	0.86
	2035	2.12	2.88	2.53	0.90
	2016-2035	1.99	2.72	2.72	0.80

Source: Navigant

Table 5-4 presents the net benefits by sector and for the portfolio under each benefit-cost test. As with the benefit-cost test ratios, net benefits are positive in all cases, with the exception of the RIM test. The analysis estimates that the total net present value for the portfolio over the 2016-2035 analysis timeframe is more than $450 million from the TRC perspective.

Table 5-4. Cost Test Net Benefits for the Portfolio and by Sector (Million $)

Sector	Year	Total Resource Cost Test	Utility Cost Test	Participant Cost Test	Rate Impact Measure Test
Commercial	2016	$14.16	$19.58	$24.35	-$10.19
	2020	$19.47	$27.13	$30.87	-$10.97
	2025	$24.78	$34.46	$35.74	-$10.27
	2030	$26.94	$38.16	$35.94	-$8.37
	2035	$27.92	$39.81	$33.75	-$5.40
	2016-2035*	$218.08	$302.17	$319.53	-$96.98
Industrial	2016	$4.00	$4.27	$6.52	-$2.52
	2020	$8.89	$9.35	$11.43	-$2.54
	2025	$17.45	$18.19	$18.91	-$1.46
	2030	$25.53	$26.56	$24.69	$0.84
	2035	$31.01	$32.13	$26.79	$4.22
	2016-2035*	$143.16	$149.48	$156.42	-$13.26
Residential	2016	$1.39	$3.72	$10.82	-$9.43
	2020	$7.25	$10.40	$18.81	-$11.27
	2025	$10.96	$14.44	$23.02	-$11.18
	2030	$16.32	$21.09	$31.98	-$13.80
	2035	$22.94	$29.27	$42.01	-$15.94
	2016-2035*	$96.08	$130.83	$220.95	-$116.74
Portfolio	2016	$19.55	$27.57	$41.69	-$22.14
	2020	$35.61	$46.88	$61.11	-$24.77
	2025	$53.18	$67.09	$77.68	-$22.92
	2030	$68.78	$85.80	$92.61	-$21.34
	2035	$81.87	$101.22	$102.56	-$17.12
	2016-2035*	$457.31	$582.48	$696.90	-$226.97

**Total net benefits for 2016-2035 represent the total present values in 2016 dollars. Other yearly values represent non-discounted single-year net benefits.*
Source: Navigant

5.4 mTRC Results

This section describes the approach taken for estimating DSM potential using the mTRC benefit-cost test as a screen, rather than the TRC benefit-cost test. Given that the economic potential results will differ under the mTRC test from the results presented in Section 4, this section provides the results for both economic and market potential using the mTRC, as well as the sector and portfolio cost effectiveness.

5.4.1 Approach to Estimating mTRC Results

The primary change between the TRC benefit-cost test and mTRC benefit-cost test is the application of different values for avoided costs, with the mTRC avoided costs roughly six times higher than the TRC avoided costs.[24] The use of higher avoided costs increases the benefits calculated for each measure and results in more measures screening as cost-effective. Based on input from FortisBC Gas, Navigant also included the five high impact measures in the mTRC market potential, regardless of cost-effectiveness,[25] to capture additional market dynamics with these measures (as described in Section 5.1.7). All other calculations are the same between the TRC and mTRC tests.

5.4.2 mTRC Economic Potential Results

Figure 5-21 shows the cumulative gas economic potential by sector in TJ/year. The data used to generate the figure are in Table B-11 in Appendix B. The use of the mTRC screen instead of the TRC screen increases the proportion of technical savings potential that are economic. Economic potential increases from 71% of technical potential based on the TRC screen, to 94% based on the mTRC screen.

mTRC economic potential for the commercial and residential sectors increases significantly over the study period to 25% and 67%, respectively. This increase in economic potential over time is a result of whole-facility, high-impact measures such as new construction practices 45% more efficient than code and ENERGY STAR homes. Industrial sector economic potential stays roughly the same as the TRC case (see Section 4.2), decreasing by 4% over the study period, primarily because industrial gas consumption is not forecast to increase over time.

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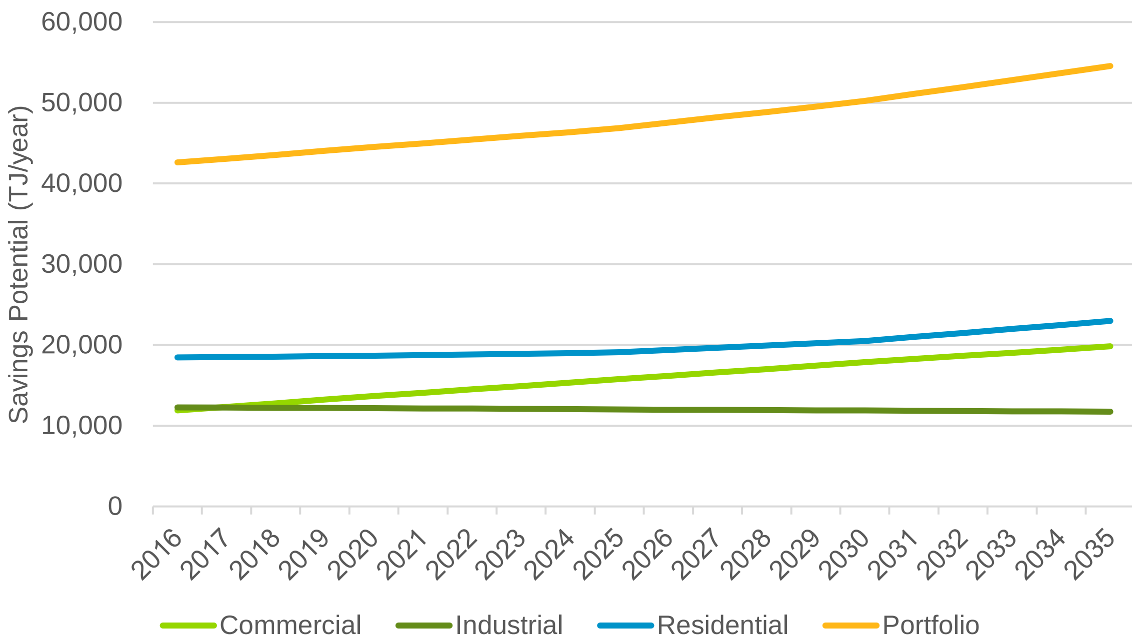
[24] The formulation of the mTRC benefit-cost test is the same as the TRC test, with the exception that the avoided costs stem from a zero emission energy supply alternative (ZEEA) cost and benefits are increased by a 15% non-energy benefits adder.

[25] As stated in Section 5.1.7, while these measures are cost effective overall, some measures are not cost effective for certain sub-sectors and regions within the analysis. Since actual programs focus on overall cost effectiveness across the sector, rather than within sub-sectors, Navigant forced the five high impact measures to pass across all sub-sectors to better reflect actual program implementation.

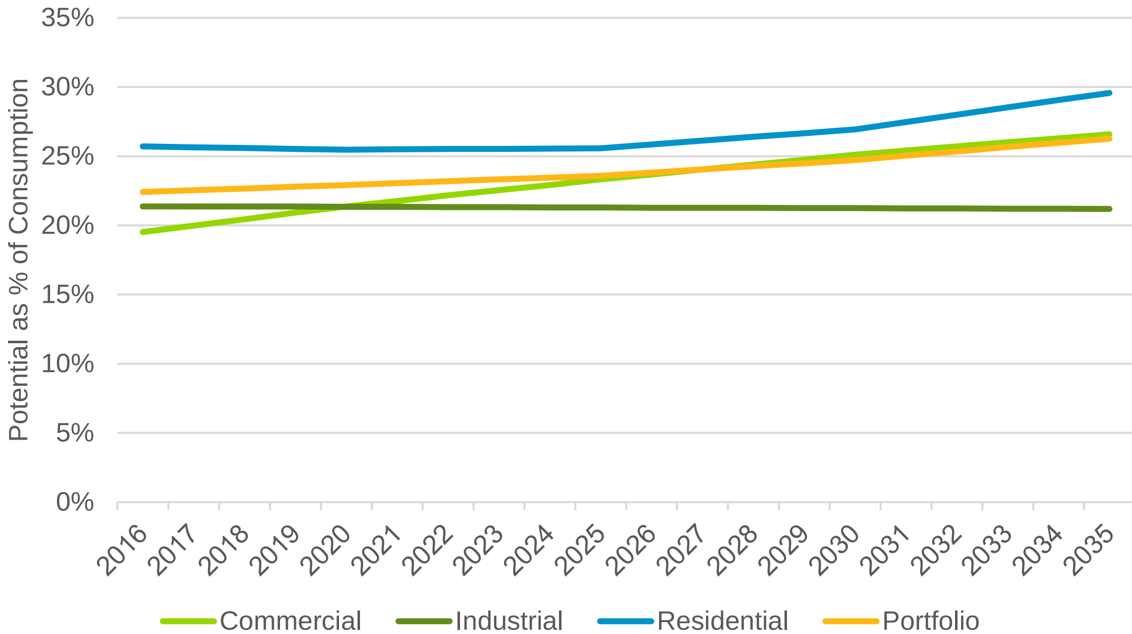
Figure 5-21. mTRC Cumulative Gas Savings Economic Potential by Sector (TJ/year)



Source: Navigant

Figure 5-22 shows the cumulative gas economic potential as a percent of sector consumption. The data used to generate the figure are in Table B-12 in Appendix B. Whole-facility, new construction measures in the residential and commercial sectors enable the increase in savings potential as a percent of sector consumption over time. Industrial savings as a percent of consumption do not increase because limited growth in the sector result in limited opportunities for high-impact measures. While the overall shape of the mTRC economic savings curves are similar to the TRC economic curves, the use of the mTRC screen increases the percentage of technical savings that are economic. Economic savings as a percent of consumption in 2016 increase from 15.1% (based on the TRC screen) to 22.4% (based on the mTRC screen). The 2035 economic savings increase from 21.3% to 26.3%.

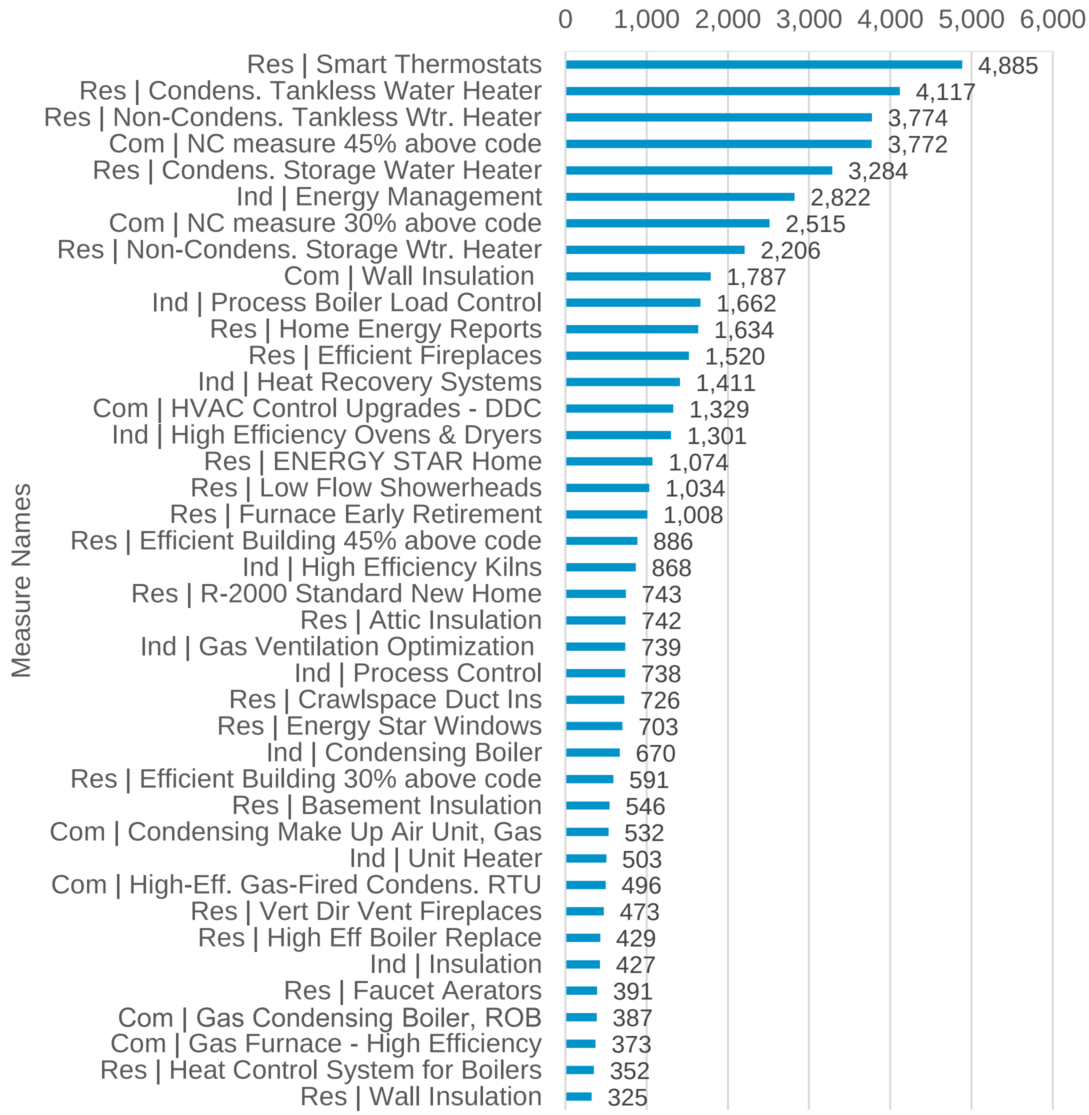
Figure 5-22. mTRC Cumulative Gas Savings Economic Potential as Percent of Sector Consumption (%)



Source: Navigant

Figure 5-23 and Table B-13 list the top 40 gas saving measures with the highest economic potential prior to adjustments made to competition groups. There are no changes in ranking or savings potential in results when compared with the top 10 technical potential measures. The four measures (residential condensing and non-condensing tankless water heaters, residential condensing storage water heaters, and commercial wall insulation) that were not economic using the TRC screen are economic using the mTRC screen.

Figure 5-23. mTRC Top 40 Measures for Gas Energy Economic Savings Potential in 2025 (TJ/year)

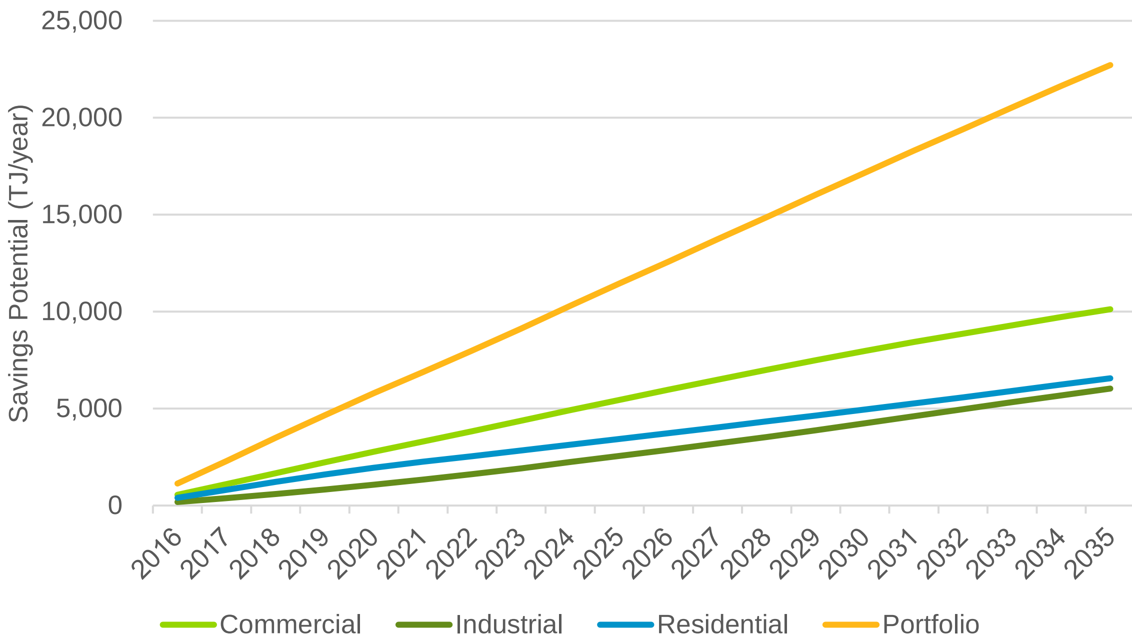


Source: Navigant

5.4.3 mTRC Market Potential Results

The following figures show the market potential results for the mTRC case. Figure 5-24 and Table B-14 show the cumulative gas market potential by sector in TJ/year. The commercial sector contributes approximately 46% of the cumulative gas savings market potential over the study period, down from approximately 50% using a TRC screen. The residential and industrial sectors contribute 30% and 24%, respectively. Relative to the TRC market potential savings, the residential sector's market potential increased 45%, while the commercial and industrial sectors only increased 5% and 7%, respectively.

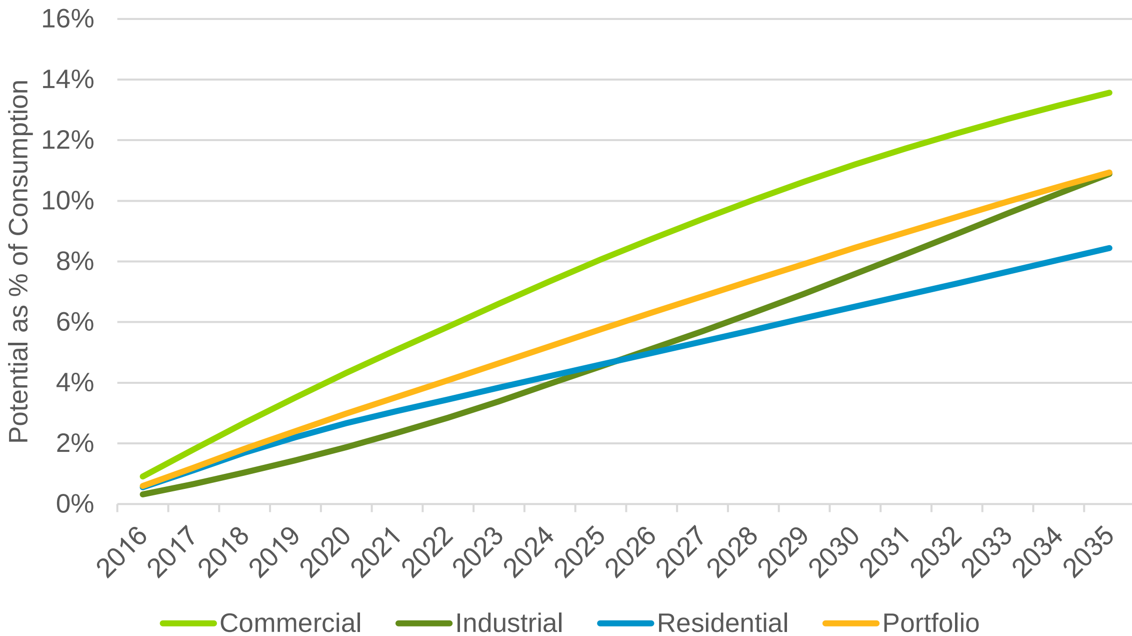
Figure 5-24. mTRC Cumulative Gas Savings Market Potential by Sector (TJ/year)



Source: Navigant

Figure 5-25 and Table B-15 show the cumulative gas market potential as a percent of sector consumption, with portfolio savings increasing from just under 0.6% to 10.9% of gas consumption over the timeframe of the analysis. Compared to the TRC market potential savings, the 2035 savings increased from 9.5% using the TRC screen to 10.9% using the mTRC screen. The residential sector saw the largest increase as a percent of consumption, rising from 5.8% using the TRC screen to 8.4% using the mTRC screen.

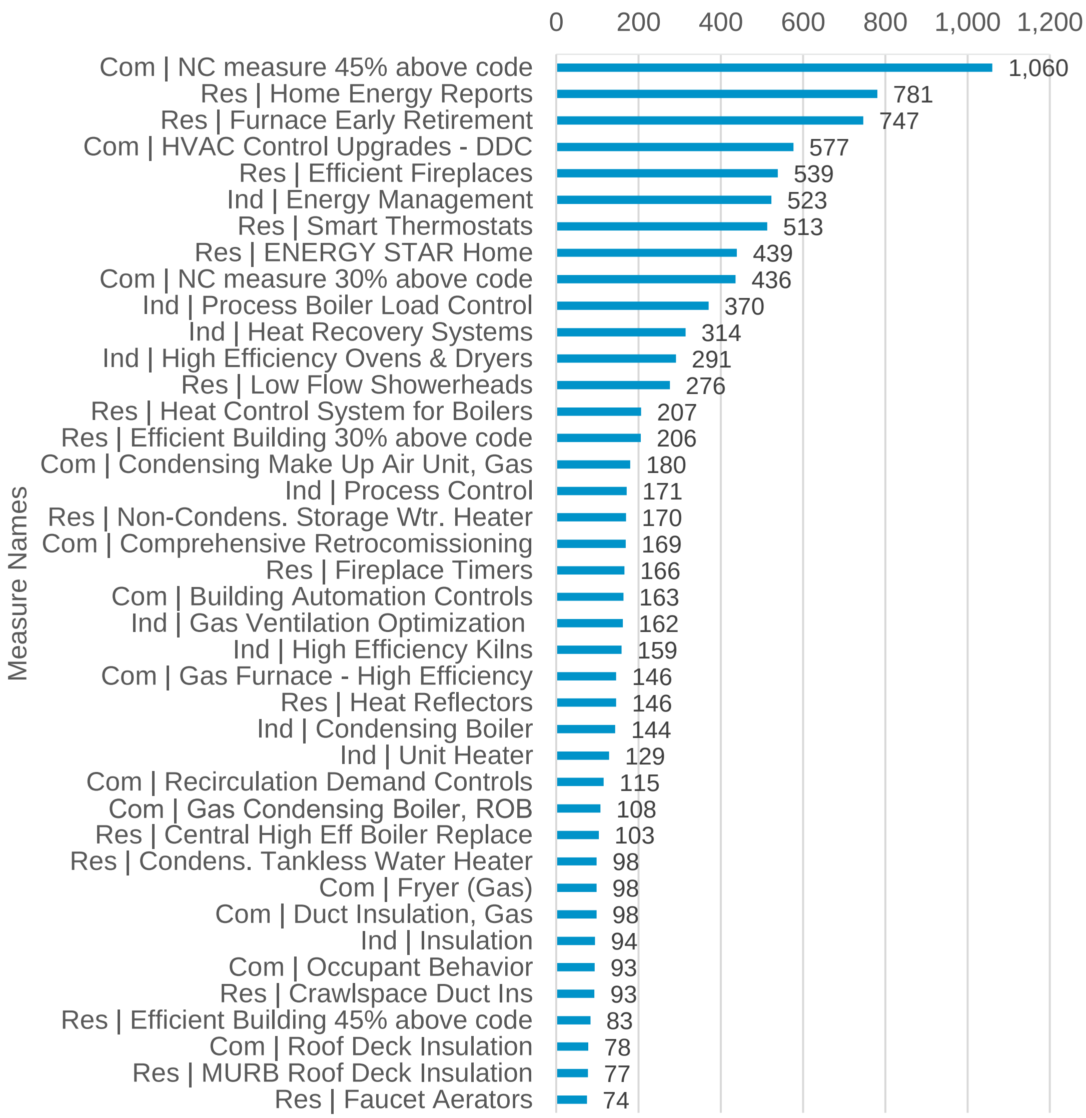
Figure 5-25. mTRC Cumulative Gas Savings Market Potential as Percent of Sector Consumption (%)



Source: Navigant

Figure 5-26 and Table B-16 list the top 40 gas saving measures with the highest market potential. Compared with the TRC market potential results, new construction practices 45% better than code and home energy reports remain as the top two measures. Residential furnace early replacement which is uneconomic using the TRC screen becomes economic and ranks third. Similarly, residential efficient fireplaces increase significantly in market savings using the mTRC and move into the top five measures.

Figure 5-26. mTRC Top 40 Measures for Gas Energy Market Savings Potential in 2025 (TJ/year)



Source: Navigant

5.4.4 mTRC Cost Effectiveness

The following tables present cost effectiveness results for the mTRC case, including the portfolio and sector-level budget estimates and benefit-cost test ratios. Table 5-5 shows the mTRC case's total portfolio budget is $1,388 million over the 2016-2035 timeframe, as compared to $760 million under the TRC case over the same timeframe. Although market potential savings increase by 15% using the mTRC screen instead of the TRC screen, the portfolio budget increased by approximately 85%. This is because the least costly savings are captured using the TRC screen (i.e., the "low hanging fruit"), whereas the measures captured using the mTRC screen are significantly more costly on a $/GJ basis.

The vast majority of the increased budget is from an increase in residential incentive costs. Residential incentives more than triple in magnitude, while commercial and industrial incentives increase by 14% and 34%, respectively.

Table 5-5. Budgets by Sector – mTRC Case (Million $/year)

Sector	Spending Type	2016	2020	2025	2030	2035	2016-2035 Total*
Commercial	Incentives	$13.77	$18.32	$21.65	$23.21	$23.16	$402.89
	Non-Incentives	$1.68	$1.76	$1.93	$1.93	$1.78	$36.33
	Total	$15.44	$20.08	$23.58	$25.14	$24.94	$439.22
Industrial	Incentives	$3.45	$5.70	$9.21	$12.67	$14.32	$187.59
	Non-Incentives	$1.21	$1.78	$2.52	$3.10	$3.36	$49.48
	Total	$4.66	$7.47	$11.73	$15.76	$17.67	$237.06
Residential	Incentives	$26.45	$32.93	$33.64	$31.43	$30.01	$606.37
	Non-Incentives	$5.32	$5.01	$4.71	$5.43	$6.43	$105.38
	Total	$31.78	$37.94	$38.35	$36.86	$36.44	$711.75
Portfolio	Incentives	$43.67	$56.94	$64.50	$67.31	$67.49	$1,196.85
	Non-Incentives	$8.21	$8.55	$9.17	$10.45	$11.57	$191.19
	Total	$51.88	$65.49	$73.67	$77.77	$79.05	$1,388.04

*The 2016-2035 Total column represents the sum of all forecasted years (2016-2035), not just those shown in the table.
Source: Navigant

Given that the change in avoided costs for the mTRC does not apply to the UCT, PCT, or RIM benefit-cost tests, these test ratios are only presented in Section 5.3.

Table 5-6 shows the mTRC benefit-cost test ratios by sector and for the portfolio. Compared with the TRC benefit-cost test ratio, the 2016-2035 portfolio benefit-cost ratio increases from 1.99 to 4.67. The mTRC benefit-cost ratios for the residential, commercial, and industrial sector also have increases of similar magnitude. The increase in benefit-cost ratios is a result of the higher avoided costs used for mTRC test.

Table 5-6. mTRC Benefit-Cost Test Ratios for the Portfolio and by Sector

Sector	Year	Benefit-Cost Ratio
Commercial	2016	6.86
	2020	6.54
	2025	6.32
	2030	5.98
	2035	5.65
	2016-2035	6.41
Industrial	2016	7.88
	2020	8.50
	2025	8.86
	2030	8.59
	2035	8.33
	2016-2035	8.55
Residential	2016	2.07
	2020	2.44
	2025	2.74
	2030	3.42
	2035	4.00
	2016-2035	2.66
Portfolio	2016	3.98
	2020	4.35
	2025	4.86
	2030	5.32
	2035	5.47
	2016-2035	4.67

Source: Navigant

Table 5-7 presents the mTRC net benefits by sector and for the portfolio. The net benefits increase from $460 million using the TRC screen to approximately $3,310 million using the mTRC screen. The residential, commercial, and industrial sectors increase in net benefits almost proportionally to the overall portfolio.

Table 5-7. mTRC Net Benefits for the Portfolio and by Sector (Million $/year)

Sector	Year	Net Benefits
Commercial	2016	$137.22
	2020	$165.37
	2025	$184.18
	2030	$183.98
	2035	$171.44
	2016-2035	$1,683.70
Industrial	2016	$34.95
	2020	$61.06
	2025	$100.57
	2030	$130.88
	2035	$141.95
	2016-2035	$832.10
Residential	2016	$48.88
	2020	$74.72
	2025	$82.88
	2030	$103.21
	2035	$126.07
	2016-2035	$801.37
Portfolio	2016	$221.05
	2020	$301.15
	2025	$367.63
	2030	$418.07
	2035	$439.47
	2016-2035	$3,317.18

*Total net benefits for 2016-2035 represent prevent values. Other yearly values represent non-discounted single year net benefits.

Source: Navigant

5.5 Hybrid mTRC/TRC Results

The “Hybrid” case uses results from the mTRC test for the residential sector and results from the TRC test for the commercial and industrial (C&I) sectors, which is most analogous to FortisBC Gas’s actual DSM program environment. Because sector-level results are identical to the mTRC case’s residential results and the TRC case’s C&I results, the reader can refer to Sections 5.2 and 5.4 for sector-level results. This section focuses exclusively on portfolio-level results, which are a weighted combination of TRC and mTRC results.

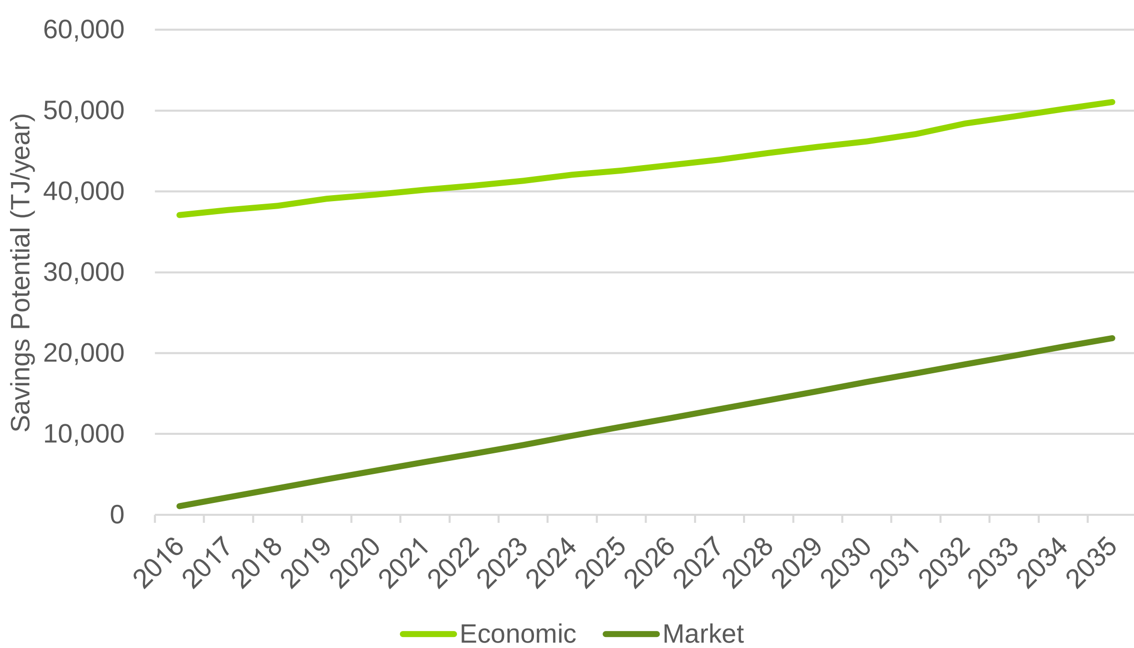
5.5.1 Approach to Estimating Hybrid mTRC/TRC Results

FortisBC Gas uses both the mTRC and TRC tests as cost effectiveness screens for measures within their existing DSM portfolio. As noted in Section 5.1, FortisBC Gas's regulatory environment at the time of this analysis allowed the utility to spend up to 33% of its entire DSM portfolio on measures or programs that require the mTRC to be cost effective. To date, FortisBC Gas's experience is that typically most programs in the residential sector require the mTRC. Since FortisBC Gas uses a combination of TRC and mTRC benefit-costs tests to screen measures and programs within their portfolio, Navigant estimated "Hybrid" market potential using the mTRC test for the residential sector and the TRC test for the C&I sectors to most closely simulate FortisBC Gas's actual DSM portfolio.

5.5.2 Hybrid mTRC/TRC Economic and Market Potential Results

Since the results from the Hybrid case are a weighted combination of the TRC and mTRC results, all results in this section will fall somewhere between the bounds set by those two cases. Figure 5-27 and Table B-17 in Appendix B show the economic and market gas savings potential for the Hybrid case. On average across the study period, the Hybrid case's economic potential is 20% larger than the TRC case and 9% smaller than the mTRC case, while the market potential is 12% larger than the TRC case and 5% smaller than the mTRC case. The Hybrid results more closely resemble the mTRC case because over two-thirds of the increase in market potential between the TRC and mTRC cases occurred in the residential sector, and those residential increases are captured in the Hybrid results.

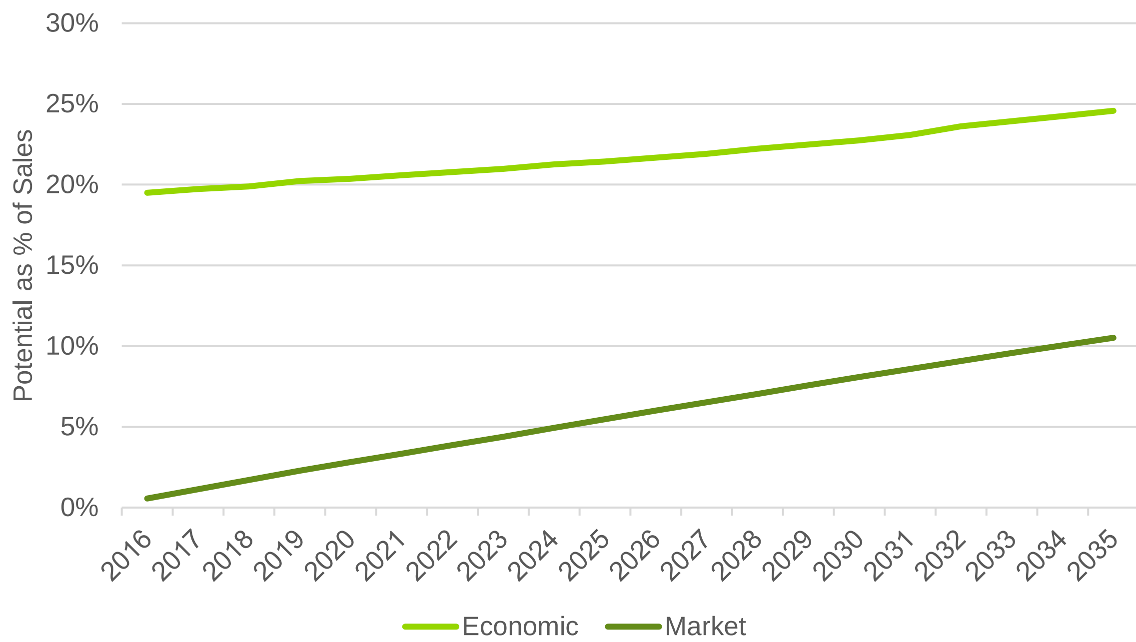
Figure 5-27. Hybrid Cumulative Gas Savings Economic and Market Potential by Sector (TJ/year)



Source: Navigant

Figure 5-28 and Table B-18 present the Hybrid case's economic and market potential as a percentage of total gas consumption. Market potential reaches just over 10% of total gas consumption by 2035, and it captures 43% of the economic potential.

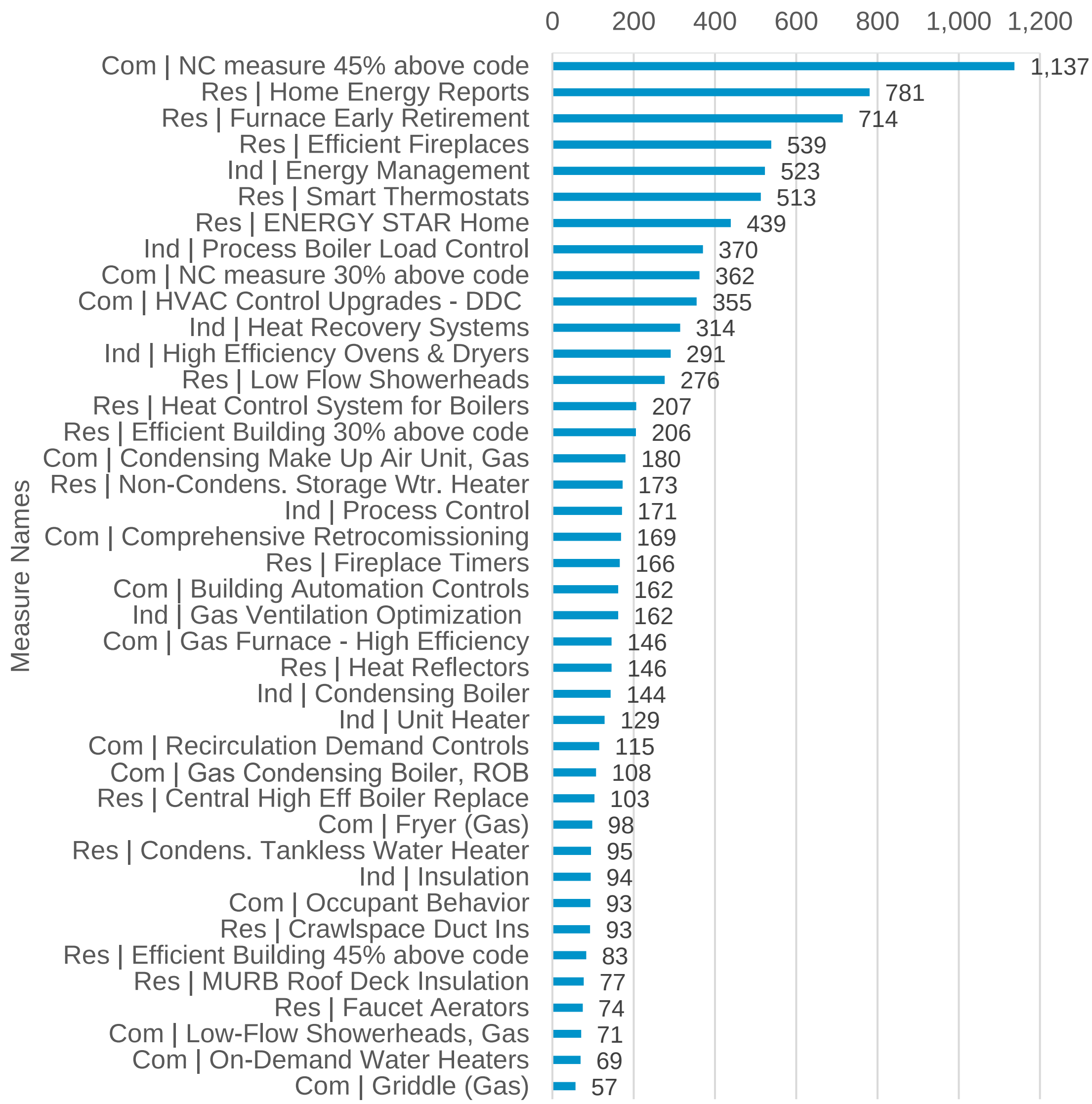
Figure 5-28. Hybrid Cumulative Gas Savings Economic and Market Potential as Percentage of Consumption (%)



Source: Navigant

Figure 5-29 and Table B-19 list the top 40 gas saving measures with the highest market potential for the Hybrid case. This table looks very similar to the TRC case except that residential measures have moved up the ranks. In particular, furnace early retirements and efficient fireplaces appear in the top ten, whereas they do not in the TRC case.

Figure 5-29. Hybrid Top 40 Measures for Gas Energy Market Savings Potential in 2025 (TJ/year)



Source: Navigant

5.5.3 Hybrid mTRC/TRC Cost Effectiveness

The following tables present cost-effectiveness results for the hybrid mTRC/TRC case. Table 5-8 shows that total spending for the Hybrid case begins at just over $46M/year and increases to $74M/year by 2035. The total 20-year spending in the Hybrid case is 71% larger than the TRC case and 8% smaller than the mTRC case. The costs borne by the utility to acquire market savings—on a dollar-per-savings basis—increase 0 to 3 percent per year, on average and in real terms, across the various sectors. This contrasts with recent program experience, where per-unit-of-savings utility costs have shown declining trends (see Section 5.3.2 for a discussion on this difference in cost trends).

Table 5-8. Budget for Portfolio – Hybrid Case (Million $/year)

Sector	Spending Type	2016	2020	2025	2030	2035	2016-2035 Total*
Portfolio	Incentives	$38.30	$51.08	$58.75	$61.91	$62.81	$1,114.66
	Non-Incentives	$7.97	$8.29	$8.92	$10.21	$11.33	$186.88
	Total	$46.27	$59.37	$67.67	$72.12	$74.13	$1,301.53

**The 2016-2035 Total column represents the sum of all forecasted years (2016-2035), not just those shown.*
Source: Navigant

The benefit-cost ratios and net benefits from the Hybrid case, which are presented in Table 5-9, are more similar to the TRC case than the mTRC case. Since the residential sector has lower benefit-cost ratios compared to the other sectors in both the TRC and mTRC cases, using the slightly higher residential results from the mTRC case does not significantly lift the benefit-cost ratios of the Hybrid portfolio. However, the additional net benefits that the residential mTRC case adds to the Hybrid portfolio is approximately $705 million in present value over the study period (expressed in 2016 dollars).

Table 5-9. Hybrid Portfolio Benefit-Cost Test Ratios and Net Benefits (Million $/year)

Sector	Year	Benefit-Cost Ratio	Net Benefits
Portfolio	2016	2.02	$67.04
	2020	2.26	$103.08
	2025	2.43	$125.10
	2030	2.73	$155.67
	2035	3.00	$185.00
	2016-2035*	2.41	$1,162.60

**Total net benefits for 2016-2035 represent present values in 2016 dollars. Other yearly values represent non-discounted, single-year net benefits.*
Source: Navigant

APPENDIX A. ADDITIONAL MODEL RESULTS

A.1 Detailed Model Results

For granular Base Case results from the model, see attachments

- “FortisGas_Appendix_A1_2017-02-10.xlsx”
- “FortisGas_Appendix_A1_mTRC_2017-02-10.xlsx”

APPENDIX B. SUPPORTING DATA FOR CHARTS

Table B-1. Total Cumulative Gas Savings Potential (TJ/year)

	Technical	Economic	Market
2016	45,828	28,797	934
2017	46,269	29,990	1,900
2018	46,717	30,522	2,895
2019	47,244	31,666	3,858
2020	47,699	32,214	4,799
2021	48,128	32,865	5,695
2022	48,619	33,430	6,611
2023	49,054	34,057	7,563
2024	49,496	34,844	8,556
2025	50,005	35,389	9,551
2026	50,645	36,087	10,537
2027	51,335	36,792	11,537
2028	51,985	37,645	12,554
2029	52,642	38,390	13,585
2030	53,348	39,111	14,625
2031	54,186	40,025	15,648
2032	55,030	41,321	16,678
2033	55,879	42,221	17,705
2034	56,732	43,248	18,726
2035	57,591	44,158	19,736

Source: Navigant

Table B-2. Total Cumulative Gas Savings Potential as a Percentage of Consumption (%)

	Technical	Economic	Market
2016	24.1%	15.1%	0.5%
2017	24.2%	15.7%	1.0%
2018	24.3%	15.9%	1.5%
2019	24.4%	16.4%	2.0%
2020	24.5%	16.6%	2.5%
2021	24.7%	16.8%	2.9%
2022	24.8%	17.1%	3.4%
2023	24.9%	17.3%	3.8%
2024	25.0%	17.6%	4.3%
2025	25.2%	17.8%	4.8%
2026	25.4%	18.1%	5.3%
2027	25.6%	18.4%	5.8%
2028	25.8%	18.7%	6.2%
2029	26.0%	19.0%	6.7%
2030	26.3%	19.2%	7.2%
2031	26.6%	19.6%	7.7%
2032	26.8%	20.2%	8.1%
2033	27.1%	20.5%	8.6%
2034	27.4%	20.9%	9.1%
2035	27.7%	21.3%	9.5%

Source: Navigant

Table B-3. Cumulative Gas Savings Market Potential by Sector (TJ/year)

	Commercial	Industrial	Residential
2016	498	172	265
2017	1,004	357	539
2018	1,511	557	828
2019	2,017	772	1,069
2020	2,519	1,005	1,276
2021	3,003	1,253	1,440
2022	3,496	1,519	1,596
2023	4,001	1,803	1,760
2024	4,520	2,106	1,930
2025	5,040	2,403	2,108
2026	5,541	2,699	2,297
2027	6,038	3,000	2,499
2028	6,533	3,311	2,710
2029	7,022	3,633	2,930
2030	7,505	3,962	3,159
2031	7,952	4,296	3,400
2032	8,394	4,632	3,652
2033	8,827	4,966	3,912
2034	9,251	5,295	4,180
2035	9,666	5,615	4,455

Source: Navigant

Table B-4. Cumulative Gas Savings Market Potential as a Percentage of Consumption by Sector (%)

	Commercial	Industrial	Residential
2016	0.8%	0.3%	0.4%
2017	1.6%	0.6%	0.7%
2018	2.4%	1.0%	1.1%
2019	3.2%	1.4%	1.5%
2020	3.9%	1.8%	1.7%
2021	4.6%	2.2%	2.0%
2022	5.3%	2.7%	2.2%
2023	6.0%	3.2%	2.4%
2024	6.8%	3.7%	2.6%
2025	7.5%	4.3%	2.8%
2026	8.1%	4.8%	3.1%
2027	8.7%	5.3%	3.3%
2028	9.4%	5.9%	3.6%
2029	10.0%	6.5%	3.9%
2030	10.5%	7.1%	4.2%
2031	11.1%	7.7%	4.4%
2032	11.6%	8.3%	4.8%
2033	12.1%	8.9%	5.1%
2034	12.5%	9.5%	5.4%
2035	13.0%	10.1%	5.7%

Source: Navigant

Table B-5. Cumulative Gas Savings Market Potential by Customer Segment (TJ/year)

	2016	2020	2025	2030	2035
C.Accommod	36	168	322	468	592
C.College/Univ	25	135	296	457	599
C.Food Svc	58	284	541	776	978
C.Hospital	44	212	422	631	822
C.Logistic/WHouse	22	118	250	386	518
C.Long Term Care	29	140	283	435	582
C.Office	71	370	823	1,323	1,776
C.Other Commercial	0	0	0	0	0
C.Retail.Food	11	66	147	228	298
C.Retail.Non Food	23	118	234	358	478
C.Schools	22	114	247	379	494
C.Streetlights/Signals	0	0	0	0	0
I.Agriculture	5	27	64	106	151
I.Cement	2	12	27	44	63
I.Chemical	3	19	44	73	108
I.Food & Bev	12	69	164	269	380
I.Greenhouse	13	77	181	289	407
I.LNG Facility	0	0	0	0	0
I.Mfg	23	135	314	525	753
I.Coal Mining	6	32	76	121	169
I.Metal Mining	0	0	0	0	1
I.Oil & Gas	11	59	126	171	216
I.Other Industrial	5	31	78	113	138
I.Kraft Pulp/Paper	59	355	880	1,512	2,185
I.TMP Pulp/Paper	7	41	96	152	213
I.Transportation	2	13	32	51	70
I.Wood Products	23	135	321	534	765
R.Apt <= 4 Stories	100	509	946	1,324	1,620
R.Apt > 4 Stories	56	286	528	740	909
R.Other Residential	4	21	34	49	67
R.Fam Attached	14	71	113	161	216
R.Fam Detached	246	1,184	1,962	2,949	4,172

Source: Navigant

Table B-6. Cumulative Gas Savings Market Potential by End-Use (TJ/year)

	2016	2020	2025	2030	2035
Appliances	0	0	0	0	0
Boilers	66	410	1,059	1,924	2,853
Cooking	30	133	226	295	347
Hot Water	82	445	871	1,222	1,490
Process Heat	19	117	291	527	787
Product Drying	15	94	240	441	658
Space Heating	248	1,340	2,899	4,560	6,208
Whole Facility	474	2,261	3,965	5,656	7,392

Source: Navigant

Table B-7. Top 40 Measures for Gas Energy Market Savings Potential in 2025 (TJ/year)

Rank	Measure	Market Potential
1	Com | NC measure 45 %>code	1,137
2	Res | Home Energy Reports	781
3	Ind | Energy Management	523
4	Res | Smart Thermostats	507
5	Res | ENERGY STAR Home	439
6	Ind | Process Boiler Load Control	370
7	Com | NC measure 30 %>code	362
8	Com | HVAC Control Upgrades - Direct Digital Data Control	355
9	Ind | Heat Recovery Systems	314
10	Ind | High Efficiency Ovens & Dryers	291
11	Res | Low Flow Showerheads	276
12	Res | Non-Condensing Gas Storage Water Heater	243
13	Res | Heat Control System for Boilers	207
14	Res | Energy Efficient Building 30% better than code	206
15	Com | Condensing Make Up Air Unit, Gas	180
16	Ind | Process Control	171
17	Com | Comprehensive Retrocomissioning	169
18	Res | Fireplace Timers	166
19	Com | Building Automation Controls	162
20	Ind | Gas Ventilation Optimization	162
21	Com | Gas Furnace - High Efficiency	146
22	Res | Heat Reflectors	146
23	Ind | Condensing Boiler	144
24	Ind | Unit Heater	129
25	Com | Recirculation Demand Controls for CDHW, Gas	115
26	Com | Gas Condensing Boiler, ROB	108
27	Res | Central High Eff Boiler Replace	103
28	Com | Fryer (Gas)	98
29	Ind | Insulation	94
30	Com | Occupant Behavior	93
31	Res | Crawlspace Duct Ins	93
32	Res | Energy Efficient Building 45% better than code	83
33	Res | MURB Roof Deck Insulation	77
34	Res | Faucet Aerators	74
35	Com | Low-Flow Showerheads, Gas	71
36	Res | Efficient Fireplaces	70
37	Com | Natural Gas On-Demand Water Heaters, ROB	69
38	Com | Griddle (Gas)	57
39	Ind | Improved Condensate Return	55
40	Com | Roof Deck Insulation	52

Source: Navigant

Table B-8. Gas Energy Market Savings Potential with Natural Change – All Sectors (TJ/year)

	Potential before Nat. Change	Potential after Adjusted Nat. Change
2016	934	934
2017	1,900	1,882
2018	2,895	2,842
2019	3,858	3,754
2020	4,799	4,629
2021	5,695	5,460
2022	6,611	6,300
2023	7,563	7,167
2024	8,556	8,061
2025	9,551	8,946
2026	10,537	9,828
2027	11,537	10,716
2028	12,554	11,611
2029	13,585	12,512
2030	14,625	13,412
2031	15,648	14,306
2032	16,678	15,201
2033	17,705	16,087
2034	18,726	16,960
2035	19,736	17,816

Source: Navigant

Table B-9. Residential Gas Energy Market Savings Potential with Natural Change (TJ/year)

	Potential before Nat. Change	Potential after Adjusted Nat. Change
2016	265	265
2017	539	532
2018	828	806
2019	1,069	1,027
2020	1,276	1,209
2021	1,440	1,350
2022	1,596	1,481
2023	1,760	1,616
2024	1,930	1,753
2025	2,108	1,894
2026	2,297	2,046
2027	2,499	2,207
2028	2,710	2,372
2029	2,930	2,542
2030	3,159	2,715
2031	3,400	2,901
2032	3,652	3,094
2033	3,912	3,290
2034	4,180	3,489
2035	4,455	3,691

Source: Navigant

Table B-10. Commercial Gas Energy Market Savings Potential with Natural Change (TJ/year)

	Potential before Nat. Change	Potential after Adjusted Nat. Change
2016	498	498
2017	1,004	994
2018	1,511	1,479
2019	2,017	1,954
2020	2,519	2,415
2021	3,003	2,857
2022	3,496	3,300
2023	4,001	3,748
2024	4,520	4,202
2025	5,040	4,648
2026	5,541	5,083
2027	6,038	5,509
2028	6,533	5,928
2029	7,022	6,337
2030	7,505	6,735
2031	7,952	7,109
2032	8,394	7,476
2033	8,827	7,831
2034	9,251	8,175
2035	9,666	8,510

Source: Navigant

Table B-11. mTRC Cumulative Gas Savings Economic Potential by Sector (TJ/year)

	Commercial	Industrial	Residential	Portfolio
2016	11,896	12,262	18,459	42,618
2017	12,325	12,240	18,512	43,077
2018	12,761	12,219	18,564	43,544
2019	13,235	12,198	18,617	44,051
2020	13,679	12,179	18,671	44,529
2021	14,081	12,145	18,753	44,979
2022	14,506	12,111	18,835	45,453
2023	14,916	12,079	18,918	45,913
2024	15,320	12,047	19,001	46,368
2025	15,774	12,016	19,084	46,873
2026	16,178	11,987	19,364	47,528
2027	16,598	11,958	19,644	48,200
2028	17,011	11,930	19,924	48,866
2029	17,429	11,903	20,205	49,537
2030	17,878	11,876	20,485	50,239
2031	18,262	11,847	20,984	51,093
2032	18,650	11,818	21,483	51,951
2033	19,042	11,790	21,982	52,815
2034	19,438	11,763	22,482	53,683
2035	19,838	11,736	22,982	54,556

Source: Navigant

Table B-12. mTRC Cumulative Gas Savings Economic Potential as Percent of Sector Consumption (%)

	Commercial	Industrial	Residential	Portfolio
2016	19.5%	21.4%	25.7%	22.4%
2017	20.0%	21.4%	25.6%	22.5%
2018	20.4%	21.4%	25.6%	22.7%
2019	20.9%	21.4%	25.5%	22.8%
2020	21.4%	21.4%	25.5%	22.9%
2021	21.8%	21.3%	25.5%	23.0%
2022	22.2%	21.3%	25.5%	23.2%
2023	22.6%	21.3%	25.5%	23.3%
2024	22.9%	21.3%	25.6%	23.4%
2025	23.3%	21.3%	25.6%	23.6%
2026	23.7%	21.3%	25.9%	23.8%
2027	24.0%	21.3%	26.1%	24.0%
2028	24.4%	21.3%	26.4%	24.3%
2029	24.7%	21.3%	26.7%	24.5%
2030	25.1%	21.2%	26.9%	24.7%
2031	25.4%	21.2%	27.5%	25.0%
2032	25.7%	21.2%	28.0%	25.3%
2033	26.0%	21.2%	28.5%	25.7%
2034	26.3%	21.2%	29.0%	26.0%
2035	26.6%	21.2%	29.6%	26.3%

Source: Navigant

Table B-13. mTRC Top 40 Measures for Gas Energy Economic Savings Potential in 2025 (TJ/year)

Rank	Measure	Economic Potential
1	Res | Smart Thermostats	4,885
2	Res | Condensing Gas Tankless Water Heater	4,117
3	Res | Non-Condensing Gas Tankless Water Heater	3,774
4	Com | NC measure 45 %>code	3,772
5	Res | Condensing Gas Storage Water Heater	3,284
6	Ind | Energy Management	2,822
7	Com | NC measure 30 %>code	2,515
8	Res | Non-Condensing Gas Storage Water Heater	2,206
9	Com | Wall Insulation	1,787
10	Ind | Process Boiler Load Control	1,662
11	Res | Home Energy Reports	1,634
12	Res | Efficient Fireplaces	1,520
13	Ind | Heat Recovery Systems	1,411
14	Com | HVAC Control Upgrades - Direct Digital Data Control	1,329
15	Ind | High Efficiency Ovens & Dryers	1,301
16	Res | ENERGY STAR Home	1,074
17	Res | Low Flow Showerheads	1,034
18	Res | Furnace Early Retirement	1,008
19	Res | Energy Efficient Building 45% better than code	886
20	Ind | High Efficiency Kilns	868
21	Res | R-2000 Standard New Home	743
22	Res | Attic Insulation	742
23	Ind | Gas Ventilation Optimization	739
24	Ind | Process Control	738
25	Res | Crawlspace Duct Ins	726
26	Res | Energy Star Windows	703
27	Ind | Condensing Boiler	670
28	Res | Energy Efficient Building 30% better than code	591
29	Res | Basement Insulation	546
30	Com | Condensing Make Up Air Unit, Gas	532
31	Ind | Unit Heater	503
32	Com | High Efficiency Gas-Fired Condensing Rooftop Unit (RTU)	496
33	Res | Vert Dir Vent Fireplaces	473
34	Res | High Eff Boiler Replace	429
35	Ind | Insulation	427
36	Res | Faucet Aerators	391
37	Com | Gas Condensing Boiler, ROB	387
38	Com | Gas Furnace - High Efficiency	373
39	Res | Heat Control System for Boilers	352
40	Res | Wall Insulation	325

Source: Navigant

Table B-14. mTRC Cumulative Gas Savings Market Potential (TJ/year)

	Commercial	Industrial	Residential	Portfolio
2016	554	183	397	1,134
2017	1,113	380	803	2,296
2018	1,673	593	1,229	3,494
2019	2,223	822	1,609	4,654
2020	2,769	1,070	1,955	5,794
2021	3,294	1,335	2,257	6,886
2022	3,827	1,618	2,549	7,994
2023	4,367	1,921	2,843	9,131
2024	4,911	2,244	3,137	10,292
2025	5,453	2,562	3,432	11,446
2026	5,974	2,880	3,729	12,583
2027	6,488	3,205	4,032	13,726
2028	6,995	3,539	4,337	14,871
2029	7,492	3,886	4,644	16,021
2030	7,980	4,240	4,951	17,171
2031	8,431	4,601	5,264	18,296
2032	8,870	4,964	5,583	19,418
2033	9,298	5,326	5,906	20,531
2034	9,716	5,684	6,233	21,632
2035	10,123	6,032	6,562	22,718

Source: Navigant

Table B-15. mTRC Cumulative Gas Savings Market Potential as Percent of Sector Consumption (%)

	Commercial	Industrial	Residential	Portfolio
2016	0.9%	0.3%	0.6%	0.6%
2017	1.8%	0.7%	1.1%	1.2%
2018	2.7%	1.0%	1.7%	1.8%
2019	3.5%	1.4%	2.2%	2.4%
2020	4.3%	1.9%	2.7%	3.0%
2021	5.1%	2.3%	3.1%	3.5%
2022	5.9%	2.8%	3.5%	4.1%
2023	6.6%	3.4%	3.8%	4.6%
2024	7.3%	4.0%	4.2%	5.2%
2025	8.1%	4.5%	4.6%	5.8%
2026	8.7%	5.1%	5.0%	6.3%
2027	9.4%	5.7%	5.4%	6.8%
2028	10.0%	6.3%	5.7%	7.4%
2029	10.6%	6.9%	6.1%	7.9%
2030	11.2%	7.6%	6.5%	8.5%
2031	11.7%	8.2%	6.9%	9.0%
2032	12.2%	8.9%	7.3%	9.5%
2033	12.7%	9.6%	7.7%	10.0%
2034	13.1%	10.2%	8.1%	10.5%
2035	13.6%	10.9%	8.4%	10.9%

Source: Navigant

Table B-16. mTRC Top 40 Measures for Gas Market Savings Potential in 2025 (TJ/year)

Rank	Measure	Market Potential
1	Com | NC measure 45 %>code	1,060
2	Res | Home Energy Reports	781
3	Res | Furnace Early Retirement	747
4	Com | HVAC Control Upgrades - Direct Digital Data Control	577
5	Res | Efficient Fireplaces	539
6	Ind | Energy Management	523
7	Res | Smart Thermostats	513
8	Res | ENERGY STAR Home	439
9	Com | NC measure 30 %>code	436
10	Ind | Process Boiler Load Control	370
11	Ind | Heat Recovery Systems	314
12	Ind | High Efficiency Ovens & Dryers	291
13	Res | Low Flow Showerheads	276
14	Res | Heat Control System for Boilers	207
15	Res | Energy Efficient Building 30% better than code	206
16	Com | Condensing Make Up Air Unit, Gas	180
17	Ind | Process Control	171
18	Res | Non-Condensing Gas Storage Water Heater	170
19	Com | Comprehensive Retrocomissioning	169
20	Res | Fireplace Timers	166
21	Com | Building Automation Controls	163
22	Ind | Gas Ventilation Optimization	162
23	Ind | High Efficiency Kilns	159
24	Com | Gas Furnace - High Efficiency	146
25	Res | Heat Reflectors	146
26	Ind | Condensing Boiler	144
27	Ind | Unit Heater	129
28	Com | Recirculation Demand Controls for CDHW, Gas	115
29	Com | Gas Condensing Boiler, ROB	108
30	Res | Central High Eff Boiler Replace	103
31	Res | Condensing Gas Tankless Water Heater	98
32	Com | Fryer (Gas)	98
33	Com | Duct Insulation, Gas	98
34	Ind | Insulation	94
35	Com | Occupant Behavior	93
36	Res | Crawlspace Duct Ins	93
37	Res | Energy Efficient Building 45% better than code	83
38	Com | Roof Deck Insulation	78
39	Res | MURB Roof Deck Insulation	77
40	Res | Faucet Aerators	74

Source: Navigant

Table B-17. Hybrid Cumulative Gas Savings Economic and Market Potential by Sector (TJ/year)

	Economic	Market
2016	37,075	1,067
2017	37,721	2,164
2018	38,213	3,296
2019	39,092	4,398
2020	39,598	5,479
2021	40,186	6,513
2022	40,718	7,564
2023	41,303	8,647
2024	42,057	9,763
2025	42,567	10,875
2026	43,246	11,969
2027	43,933	13,070
2028	44,768	14,181
2029	45,495	15,299
2030	46,198	16,418
2031	47,108	17,512
2032	48,399	18,609
2033	49,278	19,699
2034	50,162	20,779
2035	51,052	21,843

Source: Navigant

Table B-18. Hybrid Cumulative Gas Savings Economic and Market Potential as Percent of Sector Consumption (%)

	Economic	Market
2016	19.5%	0.6%
2017	19.7%	1.1%
2018	19.9%	1.7%
2019	20.2%	2.3%
2020	20.4%	2.8%
2021	20.6%	3.3%
2022	20.8%	3.9%
2023	21.0%	4.4%
2024	21.3%	4.9%
2025	21.4%	5.5%
2026	21.7%	6.0%
2027	21.9%	6.5%
2028	22.2%	7.0%
2029	22.5%	7.6%
2030	22.7%	8.1%
2031	23.1%	8.6%
2032	23.6%	9.1%
2033	23.9%	9.6%
2034	24.3%	10.0%
2035	24.6%	10.5%

Source: Navigant

Table B-19. Hybrid Top 40 Measures for Gas Energy Market Savings Potential in 2025 (TJ/year)

Rank	Measure	Market Potential
1	Com | NC measure 45 %>code	1,137
2	Res | Home Energy Reports	781
3	Res | Furnace Early Retirement	714
4	Res | Efficient Fireplaces	539
5	Ind | Energy Management	523
6	Res | Smart Thermostats	513
7	Res | ENERGY STAR Home	439
8	Ind | Process Boiler Load Control	370
9	Com | NC measure 30 %>code	362
10	Com | HVAC Control Upgrades - Direct Digital Data Control	355
11	Ind | Heat Recovery Systems	314
12	Ind | High Efficiency Ovens & Dryers	291
13	Res | Low Flow Showerheads	276
14	Res | Heat Control System for Boilers	207
15	Res | Energy Efficient Building 30% better than code	206
16	Com | Condensing Make Up Air Unit, Gas	180
17	Res | Non-Condensing Gas Storage Water Heater	173
18	Ind | Process Control	171
19	Com | Comprehensive Retrocomissioning	169
20	Res | Fireplace Timers	166
21	Com | Building Automation Controls	162
22	Ind | Gas Ventilation Optimization	162
23	Com | Gas Furnace - High Efficiency	146
24	Res | Heat Reflectors	146
25	Ind | Condensing Boiler	144
26	Ind | Unit Heater	129
27	Com | Recirculation Demand Controls for CDHW, Gas	115
28	Com | Gas Condensing Boiler, ROB	108
29	Res | Central High Eff Boiler Replace	103
30	Com | Fryer (Gas)	98
31	Res | Condensing Gas Tankless Water Heater	95
32	Ind | Insulation	94
33	Com | Occupant Behavior	93
34	Res | Crawlspace Duct Ins	93
35	Res | Energy Efficient Building 45% better than code	83
36	Res | MURB Roof Deck Insulation	77
37	Res | Faucet Aerators	74
38	Com | Low-Flow Showerheads, Gas	71
39	Com | Natural Gas On-Demand Water Heaters, ROB	69
40	Com | Griddle (Gas)	57

Source: Navigant

Appendix F

AVOIDED COST OF GAS CALCULATION METHODOLOGY

Estimate of the Effect of Simplifying Assumptions on the Avoided Cost of Gas Used for the TRC

March 2018

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1. INTRODUCTION

FEI intends this appendix to satisfy the requirements of a BC Utilities Commission directive to provide additional detail regarding the avoided cost of gas FEI calculates and uses as a benefit in the cost effectiveness analysis for Demand-side Management (DSM) activities. The directive issued by the Commission in its decision on FEIs 2014-2015 PBR Application reads as follows:

> **…the Commission Panel directs FEU to provide an estimate of the effect of each of its simplifying assumptions on the avoided cost of gas used for the TRC in the next EEC Expenditure Request.** This should include an estimate of the avoided FEU capacity cost and the effect on the avoided cost of gas estimate of (i) use of a weighted average for FEI's commodity rates for the most recent calendar year, (ii) use of the marginal or most expensive gas in FEU portfolio for the most recent calendar year using the current receipt point allocation, and (iii) use of the customer load profile to determine the avoided cost of gas for each customer class. In each case, FEU is to provide a detailed explanation of the methodology used.[1]

2. OVERVIEW OF CURRENT METHOD FOR CALCULATING AVOIDED COST

FEI's Energy Supply group provides avoided costs of gas calculation for evaluating DSM programs. FEI developed the method several years ago. The Commission reviewed this method during prior DSM funding request proceedings and approved those applications. FEI has been following the same method to update the avoided costs annually.

The avoided cost on a per unit basis includes two components – an estimate of the commodity cost and an estimate of the midstream cost. The commodity cost reflects the cost of base load supply, which is based on the daily average load (100 percent load factor) of FEI core customers. The midstream cost reflects the cost of gas storage for seasonal load shaping, and the transportation cost to bring gas to FEI's system from various supply locations.

FEI calculates the commodity cost based on the 10-year Alberta Energy Company/Nova Inventory Transfer (AECO/NIT) price forecast according to GLJ Petroleum Consultants, and then a Station 2 discount factor and T-South transportation fuel are applied to derive a Sumas price.

FEI estimates the midstream costs by calculating an approximation of the pipeline transportation charges required by FEI to move the commodity supply to core markets as well as the storage costs associated with meeting winter load requirements. The midstream costs after the first year are increased by an assumed annual inflation factor of 2 percent to account for the expected future cost increases of these resources.

[1] Order G-138-14.

The avoided costs calculated based on the commodity and midstream costs represent the expected marginal costs of gas for each year. Attachment A to this document provides a detailed explanation of the method. Attachment B provides the results of 2017 avoided cost calculation.

3. RESPONSE TO THE COMMISSION DIRECTIVES

FEI's response for each of the simplifying assumptions cited in the Commission Directive are as follows:

"…an estimate of the avoided FEU capacity cost"

Response:

FEI does not have sufficient evidence at present to confirm that DSM offers peak demand reductions that will avoid or substantially delay major infrastructure projects and thus no reliable means to estimate avoided capacity costs. A number of issues make the impact of DSM on peak demand uncertain and the determination of such impacts difficult. The location of installed DSM measures on the gas system, the mix of natural gas uses in any given area, the frequency of DSM measure installations within a gas service area and the potential installation of measures that decrease overall demand while increasing peak demand are all uncertainties that make reliable estimation of peak reductions very challenging. Complicating these issues is the fact that for a large portion of FEI's customers, demand data is collected only on a monthly basis, which is not granular enough to allow for an analysis of the impact of end use trends using actual data. More frequent (hourly, for example) collection of customer demand data is required to reliably confirm if customer usage during extremely cold temperatures is actually reducing peak consumption.

In its 2017 LTGRP, FEI explored a method for modelling the impact of end use trends on peak demand; however, the end use profiles used in this analysis were adopted from electric utility studies and are not based on actual customer data. As such, while the results of this method exploration suggest that continued investigation is warranted, they are not reliable for system capacity planning and thus not reliable for use in calculating and reporting avoided capacity costs.

i. Use of a weighted average for FEI's commodity rates for the most recent calendar year.

Response:

FEI assumes the Commission is referring to commodity recovery charges (commodity rate) in the above directive. FEI does not use this commodity rate to determine avoided natural gas costs for DSM cost effectiveness testing purposes. The quarterly commodity rate remained at $2.05 per GJ for each quarter in 2017; therefore, the weighted average commodity rate for 2017 is the same as the quarterly rate. The commodity rate of $2.05 per GJ is lower than the $2.67 per GJ of commodity cost included in 2017 avoided cost. The two costs are different because the commodity rates are based on 12-month forward-looking gas cost projections and the amortization of commodity deferral accounts, while the commodity costs included in the avoided costs are based on long-term price forecasts available at the beginning of the year. Therefore, the commodity costs calculated for avoided costs could be higher or lower than the commodity rates paid by FEI's customers. If used for calculating the avoided cost of gas, such a weighted average for commodity rates could result in a higher or lower avoided cost of gas at any given time. In this case, for 2017, the commodity costs calculated for avoided costs is higher than the commodity rate paid by FEI's customers.

FEI reviews the commodity rates every quarter based on forward prices and the balance of deferral accounts. Forward prices change frequently based on market conditions. The price forecast published by GLJ, which forecasts annual prices, is not affected by the daily market conditions but rather by the outlook for future gas supply and demand fundamentals over the long term.

FEI uses the natural gas avoided cost for DSM cost effectiveness testing purposes. DSM cost effectiveness tests involve multi-year calculations across a future time horizon because DSM measures typically last multiple years. As such, using a long-term price forecast to inform the natural gas avoided cost for DSM cost effectiveness testing purposes remains more appropriate than using a shorter-term forward price curve.

ii. *Use of the marginal or most expensive gas in FEU portfolio for the most recent calendar year using the current receipt point allocation.*

Response

FEI purchased 121 PJs of base load commodity supply at Station 2 and AECO/NIT in 2017. The table below provides the weighted average monthly and daily prices at each market hub, which shows the most expensive gas (marginal cost) was $2.30/GJ at AECO /NIT (monthly priced).

Market Indicator	Total Cost	Total Quantity	Volume Weighted Average ($/GJ)
Station 2 off AECO 7a	$ 108,834,953	55,055,000	$ 1.98
Station 2 Daily	$ 52,966,215	36,252,264	$ 1.46
AECO 7a (Monthly)	$ 40,599,969	17,642,000	$ 2.30
AECO 5a (Daily)	$ 25,194,143	12,335,302	$ 2.04

The marginal cost is lower than the commodity cost of $2.67/GJ included in the avoided cost calculation and if used in the calculation would reduce the avoided cost of gas. The commodity costs for the avoided cost calculation are based on forecasted prices while actual purchase prices are driven by the market conditions that change frequently. FEI does not consider the marginal cost of a particular year to be a good approximation of future commodity costs.

iii. *Use of the customer load profile to determine the avoided cost of gas for each customer class.*

Response

FEI uses load factors to represent the load profile for each customer class. Since all FEI customers pay the same commodity costs, load factors are only used to allocate midstream costs among different customer groups. The following table provides the allocation of 2017 midstream costs using customer load factors.

	2017 Midstream Cost ($/GJ)
RS1 - Residential	$ 1.067
RS2 - Small Commercial	$ 1.079
RS3 - Large Commercial	$ 0.900
RS4 - Seasonal	$ 0.663
RS5 - Industrial	$ 0.663
RS6 - NGV	$ 0.332
RS7 -Interruptible	$ 0.663

The load factors used in this analysis are based on the three-year average from 2013 to 2015 for customers in RS1, RS2 and RS3. The same load factors were used to allocate 2017 storage and transport recovery charges using the simplified process for the calculation of avoided costs. Since RS4 is seasonal and RS7 is interruptible, the method deems the midstream costs for these rate schedules to be the same as RS5. The table shows that the customer classes with higher load factors, such as industrial customers, have a lower midstream cost relative to those with lower load factors, such as residential customers. FEI does not currently apply a load factor to the avoided midstream costs by rate class because the differences are not material when compared to the overall avoided cost of gas.

ATTACHMENT A – AVOIDED COST CALCULATION METHOD

The following process explains the method to estimate avoided costs:

(1) A forecast for the AECO /NIT spot price is accessed through GLJ petroleum consultants.

(2) The forecast is then converted from a calendar year to a gas year (Nov-Oct) CAD$/GJ unit basis by applying 2/12 of the forecast to the first t year and 10/12 to the following year.

(3) Based on the average of monthly prices of the previous four years, a summer/winter factor is then applied to the forecasted AECO/NIT Price.

(4) Summer/winter Station 2 – AECO/NIT price differential indicated by the latest forward prices is used to derive the forecasted Station 2 prices.

(5) Based on the Enbridge Energy fuel ratios (i.e. line losses and compressor fuel use across the pipeline) from the most recent full year, the Enbridge Energy T-South fuel rate is determined for both winter and summer.

(6) The fuel rate is then applied to the forecasted winter Station 2 price to arrive at a forecasted Winter Sumas Price; the forecasted Summer Sumas Price is based on the Stn2 price plus fuel.

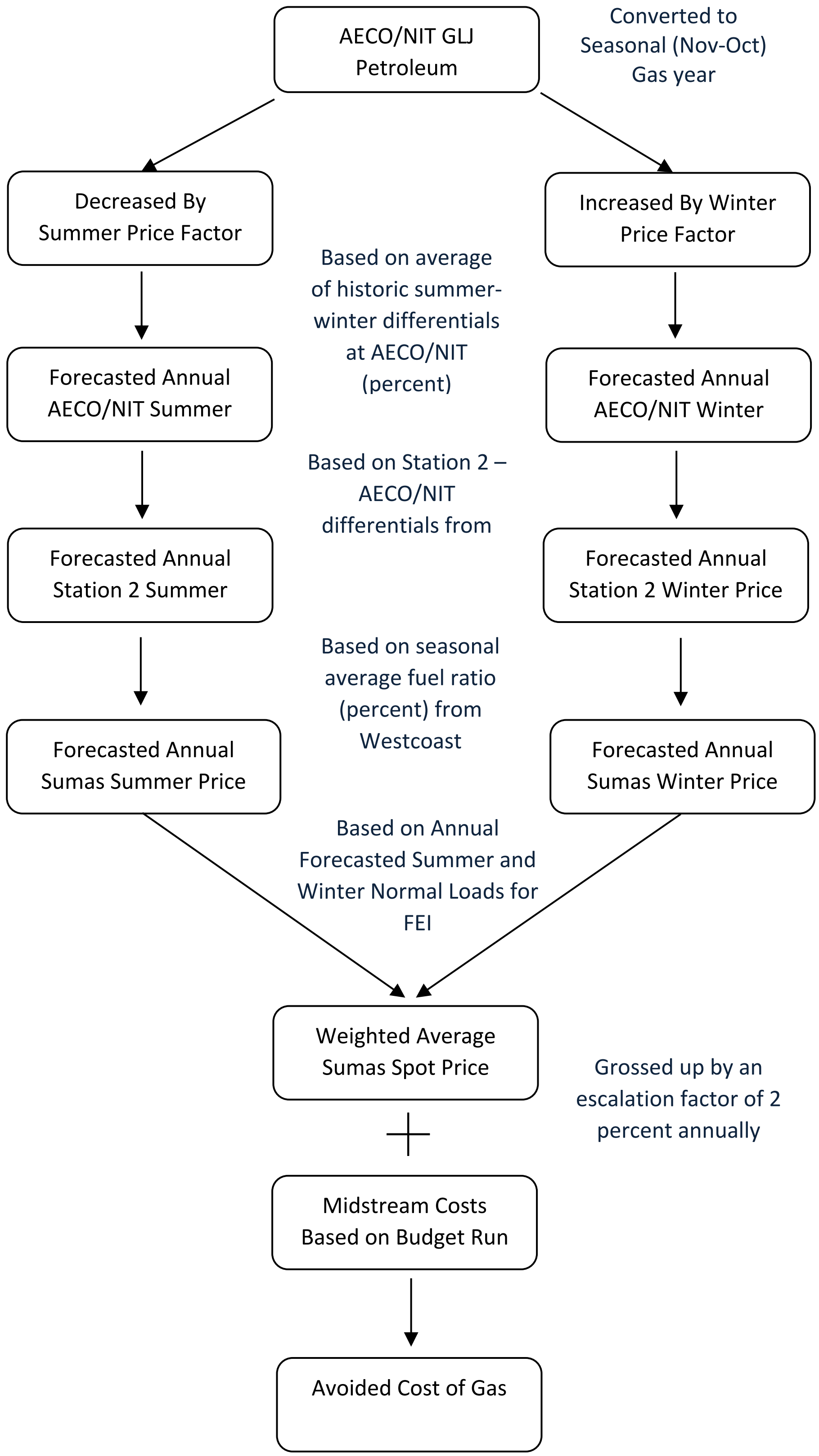
(7) The normal year summer load and normal year winter load are taken from the annual load forecast received from forecasting for the Annual Contracting Plan.

(8) From this, a weighted Sumas spot price is calculated using the estimated loads and forecasted Sumas summer/winter prices.

(9) The Midstream costs, provided by the gas accounting group, are then added to calculate an avoided commodity cost value for each year of the analysis. An annual escalation factor of 2 percent is applied to the midstream costs after the current year to account for estimated cost inflation.

Please see the next page for a process flowchart.

Avoided Cost Calculation Process Flow Chart



ATTACHMENT B - 2017 AVOIDED COST OF GAS CALCULATION

Sumas Spot Price - Avoided Cost Price Calculation

	2017	2018	2019	2020	2021	2022	2023	2024	2025
AECO-C Spot Price CDN$/GJ									
Source: *GLJ effective January 1, 2017*	$ 3.28	$ 2.94	$ 3.10	$ 3.31	$ 3.48	$ 3.66	$ 3.84	$ 3.94	$ 4.02
Based on Gas Contract Year	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	2023/2024	2024/2025	2025/2026
Gas Year	*N17-O18*	*N18-O19*	*N19-O20*	*N20-O21*	*N21-O22*	*N22-O23*	*N23-O24*	*N24-O25*	*N25-O26*
AECO-C Spot Then Current CDN$/GJ	$ 3.00	$ 3.07	$ 3.27	$ 3.45	$ 3.63	$ 3.81	$ 3.93	$ 4.01	$ 4.08
Summer % of Annual	96%	96%	96%	96%	96%	96%	96%	96%	96%
Winter % of Annual	106%	106%	106%	106%	106%	106%	106%	106%	106%
AECO-C Summer Price CDN$/GJ	$ 2.87	$ 2.94	$ 3.14	$ 3.31	$ 3.48	$ 3.65	$ 3.76	$ 3.84	$ 3.91
AECO-C Winter Price CDN$/GJ	$ 3.17	$ 3.25	$ 3.46	$ 3.65	$ 3.84	$ 4.03	$ 4.16	$ 4.24	$ 4.32
Stn. 2 Price ($CDN/GJ)									
Stn. 2 - AECO Winter differential	($0.52)	($0.32)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)
Stn. 2 - AECO Summer differential	($0.41)	($0.34)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)
Stn. 2 Winter Price ($CDN/GJ)	$ 2.65	$ 2.93	$ 3.13	$ 3.32	$ 3.51	$ 3.70	$ 3.83	$ 3.91	$ 3.99
Stn. 2 Summer Price ($CDN/GJ)	$ 2.46	$ 2.61	$ 2.81	$ 2.98	$ 3.15	$ 3.32	$ 3.43	$ 3.51	$ 3.58
Sumas Price (CDN$/GJ)									
T-South Fuel Summer	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%
T-South Fuel Winter	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%
Sumas Summer Price CDN$/GJ	$ 2.53	$ 2.68	$ 2.88	$ 3.06	$ 3.23	$ 3.41	$ 3.52	$ 3.60	$ 3.68
Sumas Winter Price CDN$/GJ	$ 2.74	$ 3.03	$ 3.24	$ 3.43	$ 3.63	$ 3.82	$ 3.95	$ 4.04	$ 4.12
FEU Normal Summer Allocation Units (TJ)	42,285	42,263	42,170	42,063	41,905	41,749	41,594	41,441	41,316
FEU Normal Winter Allocation Units (TJ)	81,934	81,945	82,336	81,686	81,377	81,070	81,267	80,467	80,232
Sumas Spot CDN$/GJ - Weighted									
To be used for Avoided Cost Calculation	**2.67**	**2.91**	**3.12**	**3.30**	**3.49**	**3.68**	**3.81**	**3.89**	**3.97**
Midstream Costs	$ 1.02	$ 1.04	$ 1.07	$ 1.09	$ 1.11	$ 1.13	$ 1.15	$ 1.18	$ 1.20
Avoided Commodity and Midstream Costs	**$ 3.69**	**$ 3.95**	**$ 4.18**	**$ 4.39**	**$ 4.60**	**$ 4.81**	**$ 4.96**	**$ 5.07**	**$ 5.17**

Assumptions

Escalation Factor for Midstream Costs	*Escalation factor of 2% assumed (represents inflation and increasing transport/storage costs)*
GLJ AECO-C Spot Escalation Factor	*2% beyond 2026*
Stn. 2 / AECO Differential	*used fwd prices differential from Jan. 3/17 for Stn. 2 and AECO*
Fuel Ratios	*Fuel ratio averages from Nov. 2015 to Oct. 2016*
Normal FEI Loads	*Used 2017 FEU normal LDC forecast; Summer/Winter load split from 2039 to 2051 assumed same as 2038*
Summer/Winter Differential	*Seasonal differential is the average from last 4 years*

Sumas Spot Price - Avoided Cost Price Calculation

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
AECO-C Spot Price CDN$/GJ										
Source: *GLJ effective January 1, 2017*	$ 4.09	$ 4.18	$ 4.26	$ 4.35	$ 4.43	$ 4.52	$ 4.61	$ 4.70	$ 4.80	$ 4.89
Based on Gas Contract Year	2026/2027	2027/2028	2028/2029	2029/2030	2030/2031	2031/2032	2032/2033	2033/2034	2034/2035	2035/2036
Gas Year	*N26-O27*	*N27-O28*	*N28-O29*	*N29-O30*	*N30-O31*	*N31-O32*	*N32-O33*	*N33-O34*	*N34-O35*	*N34-O36*
AECO-C Spot Then Current CDN$/GJ	$ 4.16	$ 4.25	$ 4.33	$ 4.42	$ 4.51	$ 4.60	$ 4.69	$ 4.78	$ 4.88	$ 4.97
Summer % of Annual	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%
Winter % of Annual	106%	106%	106%	106%	106%	106%	106%	106%	106%	106%
AECO-C Summer Price CDN$/GJ	$ 3.99	$ 4.07	$ 4.15	$ 4.23	$ 4.32	$ 4.40	$ 4.49	$ 4.58	$ 4.67	$ 4.77
AECO-C Winter Price CDN$/GJ	$ 4.41	$ 4.49	$ 4.58	$ 4.68	$ 4.77	$ 4.86	$ 4.96	$ 5.06	$ 5.16	$ 5.27
Stn. 2 Price ($CDN/GJ)										
Stn. 2 - AECO Winter differential	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)
Stn. 2 - AECO Summer differential	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)
Stn. 2 Winter Price ($CDN/GJ)	$ 4.08	$ 4.16	$ 4.25	$ 4.35	$ 4.44	$ 4.53	$ 4.63	$ 4.73	$ 4.83	$ 4.94
Stn. 2 Summer Price ($CDN/GJ)	$ 3.66	$ 3.74	$ 3.82	$ 3.90	$ 3.99	$ 4.07	$ 4.16	$ 4.25	$ 4.34	$ 4.44
Sumas Price (CDN$/GJ)										
T-South Fuel Summer	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%
T-South Fuel Winter	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%
Sumas Summer Price CDN$/GJ	$ 3.76	$ 3.84	$ 3.92	$ 4.01	$ 4.09	$ 4.18	$ 4.27	$ 4.37	$ 4.46	$ 4.56
Sumas Winter Price CDN$/GJ	$ 4.21	$ 4.30	$ 4.39	$ 4.49	$ 4.59	$ 4.68	$ 4.78	$ 4.89	$ 4.99	$ 5.10
FEU Normal Summer Allocation Units (TJ)	41,290	41,266	41,242	41,219	41,204	41,201	41,181	41,129	41,079	41,029
FEU Normal Winter Allocation Units (TJ)	80,180	80,628	80,081	80,034	80,002	80,489	79,945	79,839	79,736	80,129
Sumas Spot CDN$/GJ - Weighted										
To be used for Avoided Cost Calculation	**4.06**	**4.14**	**4.23**	**4.33**	**4.42**	**4.51**	**4.61**	**4.71**	**4.81**	**4.91**
Midstream Costs	$ 1.22	$ 1.25	$ 1.27	$ 1.30	$ 1.32	$ 1.35	$ 1.38	$ 1.41	$ 1.43	$ 1.46
Avoided Commodity and Midstream Costs	**$ 5.28**	**$ 5.39**	**$ 5.51**	**$ 5.62**	**$ 5.74**	**$ 5.87**	**$ 5.99**	**$ 6.12**	**$ 6.24**	**$ 6.38**

Sumas Spot Price - Avoided Cost Price Calculation

	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045
AECO-C Spot Price CDN$/GJ										
Source: *GLJ effective January 1, 2017*	$ 4.99	$ 5.09	$ 5.19	$ 5.30	$ 5.40	$ 5.51	$ 5.62	$ 5.73	$ 5.85	$ 5.97
Based on Gas Contract Year	**2036/2037**	**2037/2038**	**2038/2039**	**2039/2040**	**2040/2041**	**2041/2042**	**2042/2043**	**2043/2044**	**2044/2045**	**2045/2046**
Gas Year	*N34-O37*	*N34-O38*	*N34-O39*	*N34-O39*	*N34-O39*	*N34-O39*	*N34-O39*	*N34-O39*	*N34-O39*	*N34-O39*
AECO-C Spot Then Current CDN$/GJ	$ 5.07	$ 5.18	$ 5.28	$ 5.39	$ 5.49	$ 5.60	$ 5.71	$ 5.83	$ 5.95	$ 6.06
Summer % of Annual	96%	96%	96%	96%	96%	96%	96%	96%	96%	96%
Winter % of Annual	106%	106%	106%	106%	106%	106%	106%	106%	106%	106%
AECO-C Summer Price CDN$/GJ	$ 4.86	$ 4.96	$ 5.06	$ 5.16	$ 5.26	$ 5.37	$ 5.48	$ 5.59	$ 5.70	$ 5.81
AECO-C Winter Price CDN$/GJ	$ 5.37	$ 5.48	$ 5.59	$ 5.70	$ 5.81	$ 5.93	$ 6.05	$ 6.17	$ 6.29	$ 6.42
Stn. 2 Price ($CDN/GJ)										
Stn. 2 - AECO Winter differential	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)
Stn. 2 - AECO Summer differential	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)
Stn. 2 Winter Price ($CDN/GJ)	$ 5.04	$ 5.15	$ 5.26	$ 5.37	$ 5.48	$ 5.60	$ 5.72	$ 5.84	$ 5.96	$ 6.09
Stn. 2 Summer Price ($CDN/GJ)	$ 4.53	$ 4.63	$ 4.73	$ 4.83	$ 4.93	$ 5.04	$ 5.15	$ 5.26	$ 5.37	$ 5.48
Sumas Price (CDN$/GJ)										
T-South Fuel Summer	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%
T-South Fuel Winter	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%
Sumas Summer Price CDN$/GJ	$ 4.65	$ 4.75	$ 4.86	$ 4.96	$ 5.07	$ 5.17	$ 5.28	$ 5.40	$ 5.51	$ 5.63
Sumas Winter Price CDN$/GJ	$ 5.21	$ 5.32	$ 5.43	$ 5.55	$ 5.66	$ 5.78	$ 5.91	$ 6.03	$ 6.16	$ 6.29
FEU Normal Summer Allocation Units (TJ)	40,982	40,935	40,890	34%	34%	34%	34%	34%	34%	34%
FEU Normal Winter Allocation Units (TJ)	79,536	79,440	79,346	66%	66%	66%	66%	66%	66%	66%
Sumas Spot CDN$/GJ - Weighted										
To be used for Avoided Cost Calculation	**5.02**	**5.13**	**5.24**	**5.35**	**5.46**	**5.58**	**5.69**	**5.82**	**5.94**	**6.06**
Midstream Costs	$ 1.49	$ 1.52	$ 1.55	$ 1.58	$ 1.61	$ 1.65	$ 1.68	$ 1.71	$ 1.75	$ 1.78
Avoided Commodity and Midstream Costs	**$ 6.51**	**$ 6.65**	**$ 6.79**	**$ 6.93**	**$ 7.08**	**$ 7.23**	**$ 7.38**	**$ 7.54**	**$ 7.70**	**$ 7.86**

Sumas Spot Price - Avoided Cost Price Calculation

	2046	2047	2048	2049	2050	2051
AECO-C Spot Price CDN$/GJ						
Source: *GLJ effective January 1, 2017*	$ 6.08	$ 6.21	$ 6.33	$ 6.46	$ 6.59	$ 6.72
Based on Gas Contract Year	2046/2047	2047/2048	2048/2049	2049/2050	2050/2051	2051/2052
Gas Year	*N34-O39*	*N34-O39*	*N34-O39*	*N34-O39*	*N34-O39*	*N34-O39*
AECO-C Spot Then Current CDN$/GJ	$ 6.19	$ 6.31	$ 6.44	$ 6.56	$ 6.70	$ 1.12
Summer % of Annual	96%	96%	96%	96%	96%	96%
Winter % of Annual	106%	106%	106%	106%	106%	106%
AECO-C Summer Price CDN$/GJ	$ 5.93	$ 6.05	$ 6.17	$ 6.29	$ 6.42	$ 1.07
AECO-C Winter Price CDN$/GJ	$ 6.55	$ 6.68	$ 6.81	$ 6.95	$ 7.09	$ 1.19
Stn. 2 Price ($CDN/GJ)						
Stn. 2 - AECO Winter differential	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)
Stn. 2 - AECO Summer differential	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)	($0.33)
Stn. 2 Winter Price ($CDN/GJ)	$ 6.22	$ 6.35	$ 6.48	$ 6.62	$ 6.76	$ 0.86
Stn. 2 Summer Price ($CDN/GJ)	$ 5.60	$ 5.72	$ 5.84	$ 5.96	$ 6.09	$ 0.74
Sumas Price (CDN$/GJ)						
T-South Fuel Summer	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%
T-South Fuel Winter	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%
Sumas Summer Price CDN$/GJ	$ 5.75	$ 5.87	$ 5.99	$ 6.12	$ 6.25	$ 0.76
Sumas Winter Price CDN$/GJ	$ 6.42	$ 6.56	$ 6.69	$ 6.84	$ 6.98	$ 0.88
FEU Normal Summer Allocation Units (TJ)	34%	34%	34%	34%	34%	34%
FEU Normal Winter Allocation Units (TJ)	66%	66%	66%	66%	66%	66%
Sumas Spot CDN$/GJ - Weighted						
To be used for Avoided Cost Calculation	**6.19**	**6.32**	**6.46**	**6.59**	**6.73**	**0.84**
Midstream Costs	$ 1.82	$ 1.85	$ 1.89	$ 1.93	$ 1.97	$ 2.01
Avoided Commodity and Midstream Costs	**$ 8.03**	**$ 8.20**	**$ 8.37**	**$ 8.55**	**$ 8.73**	**$ 8.91**

Appendix G

FEI C&EM 4 YEAR EVALUATION PLAN 2019-2022

DSM Evaluation Plan

2019-2022

June 2018

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1. INTRODUCTION

This DSM Evaluation Plan presents the studies and timing for FEI's Evaluation, Measurement & Verification (EM&V) activities through the 2019-2022 time period. These activities are aligned with the 2019-2022 DSM Plan. As with the DSM Plan, the Evaluation Plan may be adjusted during the period in consideration of changes in market conditions and other factors that can impact the DSM Plan, as well as the feedback received from EM&V activities throughout this time period. The Evaluation Plan has been prepared in consideration of the Companies' EM&V Framework.

1.1 *EVALUATION, MEASUREMENT & VERIFICATION*

EM&V activities are split between the evaluation activities, and the measurement and verification activities. Evaluation activities[1] are conducted to look at a program as a whole to determine its effectiveness. The timing of evaluation activities vary depending on the program's progress, acceptance and objectives. The scope and cost of evaluation studies should be practical and feasible within the confines of resources and time available. Evaluation study objectives should align with the program's objectives in order to provide feedback for future program improvements. Typically, evaluation activities can commence after the program has been in the market for a minimum of 1 year or covers a full heating season. The evaluation activities are focused on identifying energy savings, assessing participant awareness and satisfaction, confirming research results, and providing feedback for program improvements and implementation.

Measurement and Verification (M&V) studies are conducted mainly to assess pilot programs, demonstration projects, and custom programs. M&V activities use measurement technologies and engineering techniques to identify the energy savings that result from an Energy Conservation Measure (ECM). The Companies' M&V studies adhere to the IPMVP[2] protocol and industry best practices to assess the actual savings attributable to the implementation of the new ECM. These activities require a greater allocation of the overall program budget than other evaluation activities do since M&V studies may rely on real-time monitoring of each measure being studied and are therefore more resource intensive.

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[1] Types of evaluation studies include; Communications which focus on advertising and media outreach; evaluation studies, where quality assurance or inspection is conducted to gain more insight on the incented measure; Market studies, research and interviews with industry stakeholder to assess market penetration; Process where surveys and interviews are used to assess customer satisfaction and program success, quality assurance and sit visits to confirm program compliance, Impact evaluations to measure the achieved energy savings attributable from the program, and Measurement & Verification activities to monitor real time energy savings associated with energy conservation measures

[2] International Performance Measurement and Verification Protocol. Concepts and Options for Determining Energy and Water Savings. Prepared by the Efficiency Valuation Organization. www.evo-world.org. January 2012.

1.2 *EVALUATION PLAN*

Table D-1 provides a list of programs and pilot studies currently planned for evaluation from 2019 to 2022. The Evaluation Plan allows for variation in the proposed activities and budget. The extent and detail of the evaluation activities presented in the Evaluation Plan is subject to the availability of the resources, timing and budget.

Overall expenditures for the programs have been reported in Section 6.2 of the 2019-2022 DSM Expenditure Plan, but are reported here in order to provide an easy-to-view summary of the evaluation expenditure and the 4 Year Evaluation Plan. Included in the table is: a list all proposed evaluation activities for 2019-2022; the Program Name and Area where EM&V activities occur; the general type of evaluation activity undertaken, Program Partners; and the Companies' proposed 4 year budget. The total proposed expenditure for program evaluation and M&V activities to be conducted from 2019 to 2022 is approximately $9.2 million. The proposed budget aligns with the Companies EM&V Framework, historical evaluation expenditure, and industry general practice[3] for budget spending on EM&V activities. The evaluation budget shown in Table D-1 represents approximately 2.9 percent of the Companies' total DSM portfolio expenditure.

[3] Two separate sources report that spending on EM&V activities across the industry averages from just under 2 percent for larger portfolios greater than $US 55 million to between 2 and 3 percent for portfolios between $US 20 million and $US 55 million:

- E Source Poster: How Much do Utilities Spend on Evaluation? 2015. Prepared from data available in E Source DSM Insights 2015, and
- CEE Annual Industry Report – State of the Efficiency Program Industry, Section 4. Consortium for Energy Efficiency, 2014, 2015 and 2016.

Table D-1: FEU Evaluation Plan for 2019-2022

Program	Program Area	Service Region	Type of Evaluation or Activities	Program Partners	Proposed 4 Year Budget (000's)
Home Renovation Rebate Program	Residential	FEU	Evaluation studies, Market studies, Process & Impact	BCH Hydro, Fortis BC Inc., Municipal, Provincial and Federal Government	$1,635
New Home Program	Residential	FEU	Market studies, Process & Impact	BC Hydro, FortisBC Inc., NRCan, MEMPR, Municipal Government	$205
Rental Apartment Efficiency Program	Residential/Commercial	FEU	Process & Impact	Fortis BC Inc.	$180
Prescriptive Program	Commercial	FEU	Market studies, Process & Impact	Fortis BC Inc.	$550
Performance Program - Existing Buildings	Commercial	FEU	Market studies, Process & Impact	Fortis BC Inc.	$150
Performance Program - New Buildings	Commercial	FEU	Process & Impact	Fortis BC Inc.	$260
Performance Program	Industrial	FEU	Measurement & Verification	Fortis BC Inc.	$180
Prescriptive Program	Industrial	FEU	Measurement & Verification	Fortis BC Inc.	$60
Strategic Energy Management Program	Industrial	FEU	Measurement & Verification	BC Hydro	$180
Direct Install Program	Low Income	FEU	Process & Impact	BC Hydro, FortisBC Inc.	$480
Self Install Program	Low Income	FEU	Process & Impact	BC Hydro, FortisBC Inc.	$21

Table D-1: FEU Evaluation Plan for 2019-2022 (continued)

Program Name	Program Area	Service Region	Type of Evaluation or Activities	Program Partners	Proposed 4 Year Budget (000's)
Prescriptive Program	Low Income	FEU	Process & Impact	None	$52
Support Program	Low Income	FEU	Process	None	$260
General Residential Education Program	Customer Education and Outreach	FEU	Process	FortisBC Inc., Community Power, Municipalities	$419
Residential Customer Engagement Tool	Customer Education and Outreach	FEU	Process	FortisBC Inc.	$153
Commercial Education Program	Customer Education and Outreach	FEU	Process	BC Hydro, FortisBC Inc., Community Power, Municipal	$216
School Education Program	Customer Education and Outreach	FEU	Process	FortisBC Inc.	$201
Pilot Program	Innovative Technology	FEU	Measurement & Verification	None	$600
Customer Research	Enabling Activities	FEU	Communications	None	$80
Commercial Energy Specialist	Enabling Activities	FEU	Process & Impact	FortisBC Inc.	$175
Community Energy Specialist	Enabling Activities	FEU	Process & Impact	FortisBC Inc.	$110
Codes & Standards	Enabling Activities	FEU	Process	none	$610
Trade Ally Network	Enabling Activities	FEU	Process	none	$2,400

Appendix H

EMV FRAMEWORK

Evaluation, Measurement & Verification Framework (Final)

Revised, May 2018

Acknowledgements

The authors wish to acknowledge and express our appreciation to the many individuals who contributed to the development of the FortisBC Evaluation Measurement & Verification Framework.

Feedback and comments from FortisBC Internal Stakeholders, EEC Advisory Group members, BC Hydro, PowerSense, and Habart & Associates assisted in the development of the FortisBC Evaluation, Measurement & Verification Framework.

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1. INTRODUCTION

1.1 BACKGROUND

FortisBC Energy Inc. (FEI), provides primarily natural gas distribution throughout most of BC. FortisBC Inc. (FBC) is an integrated electric utility that generates, transmits and distributes electricity to customers in the southern interior of British Columbia (BC). Collectively these utilities, referred to as "FortisBC" or "the Companies", have developed a framework for evaluation, measurement and verification ("EM&V") activities to examine the effectiveness of its Demand Side Management (DSM) programs.

FEI and FBC have been involved with delivering DSM programs, and thus program evaluation since the 1990s[1]. This Framework was original created in 2013 to guide DSM program evaluation activities as FEI's DSM activities and expenditures increased substantially between 2009 and 2013. FBC also adopted the Framework shortly thereafter. Minor updates to the Framework have been completed since 2013 as the Companies gained greater experience conducting higher levels of EM&V activity that followed the increase in DSM program spending for FEI.

Provincial and Federal regulations also influence a utilities' EM&V activities. In BC, the Demand-Side Measures Regulation, made pursuant to the Utilities Commission Act, sets out many of the definitions, cost effectiveness requirements and calculation considerations, and other demand side activity portfolio requirements for BC utilities, many of which are unique to this jurisdiction. For example, the need to consider non-energy benefits and the methodology for assigning value to such benefits are set out in the Province's Demand-Side Measures Regulation[2].

[1] The Companies' earlier EEC activities were referred to in previous regulatory filings with the BCUC as Demand Side Management (DSM) activities.

[2] http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/10_326_2008

2. EVALUATION FRAMEWORK

2.1 PURPOSE OF THE EVALUATION FRAMEWORK

The EM&V Framework documents the background, objectives, principles and general practices that will guide the Companies' approach, resources and timeframes for EM&V activities. The purpose of the Framework is to provide reliable and consistent guidance relating to when evaluations should be conducted, the types of evaluation that can be conducted, and a discussion of approaches for conducting those evaluations. It is expected that this document will be updated from time to time in consultation with industry and stakeholders as industry practices evolve and are adopted by the Companies.

The Framework is not a step-by-step evaluation manual, rather it is a guideline that allows for flexibility while complying with industry standards and practices. The intended audience includes government, policy staff, program managers, program planners and evaluators, and other internal and external stakeholders. Section 2.2 provides a detail explanation of the Companies' evaluation objectives and role of the framework.

2.2 EVALUATION OBJECTIVES

The Companies' have five overriding objectives for conducting evaluations on C&EM programs, which include:

1. *Determining whether DSM program objectives are being met.* Program design targets and objectives are determined based on available industry sources. Evaluation activities are conducted to determine if program design targets are being met, such as the amount of energy savings, the number and nature of participants, emission reductions and other targets.
2. *Ensuring that the Companies and ratepayers are obtaining value from their DSM investments.* Evaluation results provide inputs to the cost-benefit analyses in determining the effectiveness of DSM programs. The Companies prescribed cost-benefit analyses are also defined by; the industry standards[3], provincial regulations[4], and the British Columbia Utilities Commission's (BCUC's) directives. The cost and savings data obtained from evaluation activities can also be used for the Companies' resource planning purposes and for DSM program planning.
3. *Providing feedback to program and company management on the performance of DSM programs.* Evaluations help program managers understand how their programs are performing and provide information to help them improve their programs over time to be

[3] The Companies use the cost-effectiveness methodologies articulated in the *California Standard Practices Manual (SPM): Economic Analysis of Demand-Side Programs and Projects.*

[4] The Modified Total Resource Cost Test (MTRC) is defined in the *Utilities Commission Act Demand-Side Measures Regulation*

more effective, or perhaps determine if some programs should be altered, expanded or discontinued.

4. *Examining the relationship between a program's activities and a market effect through the use of Market Transformation evaluation.* Evaluations are conducted to assess changes within a market that are caused, at least in part, by the energy efficiency programs attempting to change that market.

5. *Providing assurance to both internal and external stakeholders for the continued support of DSM programs.* Proper evaluation activities ensure that results from DSM programs are credible. This assurance is critical for ongoing support from:
    - External interest groups including customers, BCUC, government, First Nations, communities and other interest groups, trade allies and market participants; and
    - Internal stakeholders including senior management, departments competing for resources, departments responsible for oversight, such as finance and internal audit, and shareholders.

2.3 *EVALUATION PRINCIPLES*

The Companies will conduct their EM&V activities based on the following principles:

- All DSM programs will be evaluated on a program by program basis[5]. The type of evaluations, level of resources dedicated to each evaluation and the extent of the evaluation study will depend upon:
    - Size of investment in the DSM program being evaluated.
    - Amount of risk that a program may not meet cost effectiveness expectations.
    - Amount of data and information available on the effectiveness and evaluation of similar programs by FortisBC and elsewhere in the marketplace,
    - Budget constraints (see Section 4.1 for additional discussion on budgets).

  Subject to the same considerations as above, programs with explicit energy savings targets will have impact evaluations, unless there is a valid reason and an explicit decision is made not to do so.

- Transparency:
    - Reasons for decisions on evaluation methodologies will be documented

[5] DSM programs for which we do not report direct energy savings, such as Educational or Research Programs, may not be subject to the same impact evaluation activities as programs that we do report energy savings for.

  - Assumptions made during the conducting of an evaluation study will be documented.
  - Evaluation activities will be auditable.
  - Summaries of completed evaluations will be presented in the Companies' DSM Annual Reports. Final evaluation reports will be made available to the BC Utilities Commission, if requested.

- The use of third party evaluators
  - In most cases, FEI retains external consultants to conduct evaluation activities. Some aspects of evaluation may also be conducted internally by FEI. Measurement and verification activities may be outsourced or conducted by FEI staff. (See Section 4.3 for additional discussion on staffing resources).
  - Third party evaluators are retained based on a combination of the consultant's qualifications, the level of detail evaluation work required and the program size.
  - Evaluation staff and Program Managers work collectively to select the suitable external consultant to ensure that evaluation objectives and industry best practices are maintained while providing the best result for program development where applicable. The selection process and format is determined by the evaluation staff.

- The evaluation process will be integral to DSM planning:
  - Evaluation activities will be an important consideration during portfolio and program planning, and as part of the program business case process.
  - Early consideration of evaluation requirements help ensure that the necessary and timely data is collected throughout the program development and implementation process.

- Continuous Improvement:
  - The Companies will continue to monitor the energy efficiency marketplace for industry best practices, standards and protocols for evaluation practices and will adopt those that make practical sense for evaluation activities in BC.
  - The Companies will strive to become industry leaders in evaluation activities.
  - This framework is expected to remain stable over time, but will be updated as necessary.

- Timeliness
    - FEI will strive to conduct and complete evaluations at appropriate times within the program lifecycle, given resource constraints and program growth.

2.4 EVALUATION PLANS

This framework is not intended to be or to replace an evaluation plan. Evaluation Plans will be prepared by FortisBC for inclusion with the Companies applications to the BCUC for DSM funding. These plans will detail the programs that the Companies intend to evaluate, the types of evaluations the Companies intend to undertake, and general time frames for the evaluation activities during the period of the funding request. Progress made toward completing the evaluation plan, and any needed adjustments to the plan, will be provided in the Companies' Annual DSM reports.

3. TYPES OF EVALUATION STUDIES

There are a range of EM&V studies that are undertaken to evaluate FortisBC DSM programs. The type, timing and frequency of studies, and the evaluation practices implemented for each study will depend on a variety of factors including the type of program being evaluated, the level of program spending, experience with similar programs, the number of program participants, the quality of data upon which any energy savings assumptions are based, and more. For clarity, the evaluation component of EM&V refers to the broad spectrum of evaluation activities that can make up an evaluation plan while Measurement and Verification refers more specifically to the range of methodologies used to measure and verify actual energy savings from implementing a program of demand side measures. Hence measurement and verification is a subset of evaluation activities.

3.1 *PROCESS EVALUATIONS*

Process evaluations examine the effectiveness of program delivery. Objectives for process evaluations include improving program implementation and program delivery as well as ensuring high satisfaction levels among customers, trade allies and other program participants. Areas reviewed include incentive and rebate levels; communication and promotional initiatives; program operations and implementation; customer awareness and acceptance as a customer service (satisfaction) of energy efficient technologies and measures; and trade ally (distribution & implementation) awareness and acceptance. Process evaluations are generally first conducted within 6 to 18 months following the launch of a new program and for long duration programs on a periodic basis thereafter.

3.2 *MARKET EVALUATIONS*

Market evaluations test a DSM program's effectiveness at increasing the market penetration of an efficient technology or measure. Objectives for market evaluations include measuring increases in market penetration of energy efficient technologies and assessing the share of measures attributable to the program. Market effects often have a larger impact on the adoption rate of a product or technology than they receive credit for, and taking credit for this can often negate some of the free rider impacts. Evaluation activities include:

- assessing market potential and market penetration over time through a review of the availability, accessibility and affordability of energy efficient technologies and measures,
- identifying barriers and assessing the program's effectiveness at overcoming barriers, and
- assessing how much of the remaining market the program can be expected to address.

When a market evaluation is determined to be necessary, the timing must allow a sufficient period for program implementation and uptake. These evaluations are therefore generally conducted between two and three years following a program launch.

3.3 *IMPACT EVALUATIONS*

Impact evaluations measure energy savings achieved by a DSM program. Objectives for impact studies include:

- evaluating the realized energy savings,
- estimating free-rider and spill-over (market) effects to determine net savings impacts, and
- determining the cost effectiveness of the program according to a set of cost-benefit analysis based on industry and/or regulatory standards.

Impact evaluations will draw on information available from measurement and verification studies, energy consumption data (billing analysis), results or key findings of similar programs and evaluations in other jurisdictions, and/or benchmarking studies as appropriate and where such information exists. As with process evaluations, an impact evaluation may include comments on appropriateness of program design and/or suggestions for changes to increase effectiveness.

The timing of impact evaluations must allow a sufficient period of program operation for implementation and uptake, including the adoption of process improvements that might be identified during the early program period. Generally, impact evaluations are conducted between two and three years following a program's launch. However, depending on the program life cycle, impact evaluations may be conducted annually to provide a preliminary check on the engineering estimates or when findings are required to launch the program for a second year.

For some programs, impact evaluations may occur in two stages. The first stage will involve participant survey work to improve the Companies' knowledge about the implementation of individual measures, and a second stage that involves a billing or other more detailed analysis.

3.4 *PILOT STUDIES*

Pilot studies are an important component of the Companies' DSM portfolio and are conducted to provide necessary research into potential new efficiency measures or technologies in support of developing new programs or initiatives. New measures can include new emerging technology but also existing technology with low adaption rate or used in a new application. Research objectives can include understanding how the market may respond to the introduction of a new measure, obtaining adequate performance data for a new measure (valid for local conditions), or both. FortisBC limits pilot study activity to the assessment of new efficiency measures or technologies that are market ready, but not yet widely available or adopted within BC.

Studies focused on obtaining an understanding of the market include typical market research investigations such as participant surveys. Studies focused on obtaining measure performance data include measurement and verification studies. In both cases, the pilot is used to test the idea on a small scale and hence reduce risk and cost if the program concept requires modifying prior to the launch of a full scale program or if performance results are insufficient for the development of a full program.

3.5 *MEASUREMENT AND VERIFICATION ACTIVITIES*

M&V refers to a range of activities or studies used to determine the performance of an installed DSM measure. M&V activities may also be implemented as part of the evaluation of full scale programs if such activities are viewed as helpful to meet evaluation objectives.

Wherever practical, the Companies intend to follow the International Performance Measurement and Verification Protocol (IPMVP)[6] in conducting M&V activities for evaluating DSM programs and pilots. FortisBC's review of industry standards, guidelines and protocols indicates that IPMVP is growing in use as a standard resource for guiding the design of M&V activities and provides both a comprehensive and flexible approach. It should be noted that while IPMVP summarizes common industry practices for M&V activities and sets out a range of methodologies that can be followed under ideal study conditions and in absence of budget or timing constraints, it also acknowledges that ideal study conditions and large M&V budgets are seldom available. As such, the Protocol provides guidelines for the evaluator to follow under less than ideal conditions and in the face of budget and timing constraints. The Protocol therefore allows room for judgment by the evaluator under less than ideal evaluation circumstances.

The following M&V principles[7] are embedded in the IPMVP:

Accurate M&V reports should be as accurate as the M&V budget will allow. M&V costs should normally be small relative to the monetary value of the savings being evaluated. M&V expenditures should also be consistent with the financial implications of over- or under-reporting of a project's performance. Accuracy tradeoffs should be accompanied by increased conservativeness in any estimates and judgments.

[6] International Performance Measurement and Verification Protocol. Concepts and Options for Determining Energy and Water Savings. Prepared by the Efficiency Valuation Organization. www.evo-world.org. January 2012.

[7] These principles have been reproduced from Chapter 3 of the IPMVP (see also the preceding footnote).

Complete The reporting of energy savings should consider all effects of a project. M&V activities should use measurements to quantify the significant effects, while estimating all others.

Conservative Where judgments are made about uncertain quantities, M&V procedures should be designed to under-estimate savings.

Consistent The reporting of a project's energy conservation effectiveness should be consistent between:

- different types of energy efficiency projects;
- different energy management professionals for any one project;
- different periods of time for the same project; and
- energy efficiency projects and new energy supply projects.

'Consistent' does not mean 'identical,' since it is recognized that any empirically derived report involves judgments which may not be made identically by all reporters. By identifying key areas of judgment, IPMVP helps to avoid inconsistencies arising from lack of consideration of important dimensions.

Relevant The determination of savings should measure the performance parameters of concern, or least well known, while other less critical or predictable parameters may be estimated.

Transparent All M&V activities should be clearly and fully disclosed.

3.6 *EVALUATION METHODOLOGIES*

A range of evaluation methodology types can be utilized to determine the energy savings achieved from the implementation of an efficiency measure. One way to think of this range of methodologies is as of a tool box, with each methodology being a different tool that the evaluator can bring out of the tool box to apply to the evaluation problem. The best tool (or methodology) to use depends on the circumstances of the required evaluation and the available resources. In many cases, more than one methodology will be applied to evaluate the energy savings achieved from an efficiency measure or program of measures. Common evaluation methodologies are summarized as follows:

Billing Analysis

Billing analysis uses customer billing information to assess the effect of a DSM program (or measure) on customer billed energy consumption. The analysis typically requires a baseline billing history period in the absence of the measure being installed and typically one year of billing data following the measure installation. The fundamental assumption is that the only, or major, change in energy consumption over this period has resulted from the measure being evaluated. This approach requires both data cleaning to ensure the quality of the billing data (i.e.: no missed billing reads or estimated bills) and weather adjusting. Combining a participant survey with the billing analysis can provide additional information regarding the changes in occupancy or usage patterns. When possible, a billing analysis should include both participants and non-participants, so that outside influences, such as price changes for fuels, can also be accounted in the analysis. Billing analysis is generally more effective for programs with higher customer savings. Lower savings levels (1-3% for example) can be more difficult to explain using billing analysis due to the potential for other factors to influence energy use patterns.

Metering

Metering involves the installation of energy use meters around the measure being studied to determine specific energy inputs and outputs both prior to and subsequent to the installation of an energy efficiency measure. In the residential sector, metering is primarily used in pilot projects to improve the accuracy of determining the energy impact associated with a DSM measure. Metering can also be used as part of monitoring studies to determine energy usage of appliances over time.

In the commercial and industrial sector metering is commonly used to determine the impact of both custom and pilot programs, where there is insufficient information about the impact of specific measures. Metering analysis can be done on a short-term "spot" basis or on a longer term basis. Long term metering of end-use before and after the installation is preferable to spot metering where economic, and where the participant behavior is not expected to be affected by the measurement.

Simulation Modeling

The effects of efficiency improvements in both residential and commercial buildings can be estimated through simulation of energy use under various scenarios using computer based energy models. In the residential sector, HOT2000 is a commonly used model developed for this purpose, while commercial energy use modeling often requires more complex models such as DOE2. Simulation modeling may be used as part of program design, to obtain initial estimates of energy impact, and/or as part of an initial impact evaluation where billing or metering data is not yet available to refine the modeling estimates.

Engineering Estimates

This method is based on an engineering analysis of the difference in efficiency between the "standard" measure and the installed efficiency measure. It may be based on standard efficiency measurements, such as the difference in EF rating for hot water tanks or the difference in AFUE ratings for furnaces. At a more basic level, it may require analysis of the differences in design of the energy efficient equipment being installed.

Statistically Adjusted Engineering Estimates

This approach utilizes engineering models and statistical approaches to examine the amount and nature of customer end-use loads. The results of simulated end-use loads from engineering methods become inputs into statistical models and are adjusted on the basis of customers' observed loads (statistical data). The resulting end-use loads, called statistically adjusted engineering (SAE) loads, depend on a variety of conditioning variables such as weather and the size and type of the customer's dwelling, or perhaps income and other household characteristics identified as part of the statistical analysis.

Surveys

Survey data is often the basis of both process and impact evaluations. Surveys may take the form of mail, telephone, internet panels, and more recently social media analysis, and may be done with participants and non-participants in any given program. Data collected includes awareness of the program, satisfaction, persistence, usage of the efficiency measure and information to help establish levels of free riders and spillover.

Field Studies and Laboratory Research

This type of analysis can be undertaken are as part of pilot program projects when the utility is conducting a detailed review of a small number of a specific efficiency measures that are “market ready” but not in wide use in the utility’s service territory. Typically, the research combines survey data from the customer where the pilot project is being conducted (to understand parameters such as usability and satisfaction with the technology), and metering of baseline and post implementation periods to determine the change in energy use.

Site Visits

Site visits can be used to examine programs across all customer classes to confirm that the target efficiency measure has been successfully installed and is in operation. Site visits can be combined with interviews of homeowners or facility operators to provide additional data valuable to the evaluation process.

Statistical Analysis

Mathematical approaches such as regression analysis and conditional demand analysis are often used in evaluation studies. These approaches can approximate some of the benefits of metering, but through the use of surveys or audits combined with billing histories can include a much larger group of customers at a much lower evaluation cost. Offsetting the cost advantages of this approach, however, are increased uncertainties due to potential changes in energy use unrelated to the efficiency measure being studied.

3.7 OTHER EVALUATION CONSIDERATIONS

Evaluation activities need to consider a number of issues not yet discussed.

Multi – Fuel Impacts

DSM programs may impact the use of electricity, natural gas and other fuels. Often, a program aimed primarily at reducing natural gas consumption may also impact electricity consumption or vice versa. For example a furnace efficiency program that encourages the installation of a variable speed fan might reduce both natural gas and electricity consumption. Natural gas and electricity are the most commonly used energy fuels in BC's built environment; however, the potential exists for the consumption of other fuels, such as propane or heating oil, to similarly be impacted by a DSM program. The potential for such multi-fuel impacts needs to be addressed as part of program evaluation activities.

Persistence of Savings

For natural gas programs, the persistence of energy savings over time is often a function of the life span of the measure or technology. In some cases, however, persistence can be more complex. There may be a need to determine if the equipment or technology being installed will maintain its efficiency rating over time. Also, circumstances may require a shorter (than life span) duration of savings to be assessed such as may occur if the program accelerates the installation of a high efficiency measure that would otherwise require installment at a later date. These complexities must also be addressed as part of the evaluation activities.

Interactive Effects

Impact evaluations should look more broadly than just the energy savings that result from the change in efficiency of the energy conservation measure. Changes in the measure can cause a number of other changes. For example, the evaluation of the residential furnace program (from 2005 to 2007) illustrated that upgrading a furnace has larger impacts than just replacing one technology with another. This evaluation illustrated that the new furnace changed the usage of secondary heat for a share of participants, and also that increases in comfort may result in homeowners selecting lower temperatures in their dwellings. The changes can affect the overall efficiency of energy use, and can also result in changing the balance of all fuel types in use in the building usage including natural gas, electricity and wood.

Attribution of Savings from Joint Programs

The Companies also undertake and participate in integrated electricity and natural gas programs, both within the FortisBC utilities and between the FortisBC natural gas utility and BC Hydro. Attributing for the energy savings and carbon emission reductions that result from such projects among partner organizations needs to be fair, consistent and transparent. The Companies apply the following principles, which incorporate current practice based on established industry standards and provincial regulation, while considering the regulatory environment in BC. These principles align with current best practices as described in the 2014

ACEEE report, "Successful Practices in Combined Gas and Electric Utility Energy Efficiency Programs"(U1406).

- *Double-counting of savings will continue to be avoided by each utility reporting only energy savings associated with their respective delivered energy source for integrated programs. In its reporting to the Provincial Government and BCUC, the partner electric utilities will report only electric savings. In its reporting to the BCUC, the FEI will report only gas savings.*

- *Non-primary fuel savings (i.e., natural gas savings for the partner electric utilities and electricity savings for the FEI) resulting from program activities are tracked in order to inform cost-effectiveness calculations, but are not included in formal reporting.*

- *When attributing savings in the cost benefit analysis of EEC programs, any claimed savings will be matched with appropriate associated costs. That is, if it makes sense to conduct an all-fuel cost-effectiveness test for a particular joint program, the test should include the appropriate costs and energy savings from both electricity and gas measures. However, if it is appropriate to calculate the cost effectiveness only for the FEI portion (for example) of an integrated program, then only the costs and energy savings related to the gas portion of the program will be included. As program design affects the inputs to the cost-effectiveness test, each utility will develop an understanding of the other's deemed partner cost approaches by collaborating during the development of business cases to ensure claimed savings match with costs as per industry standards and best practices where they exist.*

Related Studies

In addition to evaluation programs, FEI undertakes a number of studies which are used to support both program development and evaluation. These include:

- Sector End Use Studies conducted periodically to provide a "snapshot" of customers' products and equipment. These studies often include supporting analysis such as "Conditional Demand Analysis" (CDA) components that provide estimates of the amount of natural gas usage by end uses.
- Conservation potential reviews, which are systematic assessments of the current status of energy efficiency in the installed appliance stock in the marketplace and projections of the main end uses where efficiency improvements are possible, along with estimates of potential energy reductions.

3.8 FEEDING EM&V STUDY RESULTS INTO DSM PLANNING

Evaluation and program management staff at FortisBC review the results of evaluation studies and reports to determine if changes to programs are needed. In the case of M&V activities, this review will assist staff in determining if new programs should be developed based on pilot study results or if adjustments need to be made to the data used to determine program or project cost effectiveness. For program design and development, project managers need to consider additional factors such as human, technical and budgetary resources, portfolio priorities and any feedback received from stakeholders.

4. EVALUATION RESOURCES

Effective management of evaluation activities requires both financial and staffing resources.

4.1 EVALUATION BUDGETS

Industry practice for budget spending on EM&V activities appears to range from just below 2 percent to 3 percent of spending on overall energy efficiency and conservation program budgets. The Companies examined the results of recent industry surveys on evaluation expenditures. Survey results obtained from E Source, an energy efficiency consultancy serving gas and electric utilities throughout North America, indicate that for utilities with DSM expenditures of between US$ 20 and 55 Million, DSM budgets are between 2 percent and 3 percent, and that the proportion of DSM expenditures on evaluation decreases as the size of the portfolio increases[8]. Utilities with expenditures greater than $US 55 million tend to spend just under 2 percent on evaluation. The Consortium for Energy Efficiency (CEE) found that in 2014 US and Canadian natural gas utilities spent about 2 percent of their overall DSM budgets on evaluation and in 2015 this value dropped to 1 percent for Canadian Utilities[9].

This level of spending is in keeping with the principle that evaluation budgets should be a small component of overall programming budgets. That is, an evaluation budget, and therefore evaluation efforts, should not be so extensive that they unnecessarily cause a program to fail a cost-benefit test and thereby prevent the program from being implemented. As such, the Companies will plan EM&V budgets to be between 2 and 3 percent of the overall DSM portfolio spending.

On a program by program basis, there may be occasions when either higher or lower budgets for individual programs may be appropriate. A new program for which there is very little industry data available and for which energy efficiency performance may have a higher degree of uncertainty, may warrant a higher spending level. Pilot studies that examine the actual performance of a newer technology or measure, for example. In other cases, a program being implemented may benefit from similar programs in other jurisdictions having similar geographic and climate settings may be abundant, evaluation data may be well established and smaller budgets are appropriate.

4.2 EVALUATION ORGANIZATION

Wherever possible, the evaluation of programs that span across FEI's and FBC's separate utility service territories will be conducted as a single evaluation in order to take advantage of evaluation cost efficiencies and incorporate consistency across service areas. Similarly,

[8] E Source Poster: How Much do Utilities Spend on Evaluation? 2015. Prepared from data available in E Source DSM Insights 2015.

[9] CEE Annual Industry Report – State of the Efficiency Program Industry, Section 4. Consortium for Energy Efficiency, 2014, 2015 and 2016.

evaluations of joint electric and gas DSM programs will be conducted as a single for the partners involved in delivering the program.

Evaluations will be conducted or managed by staff who are independent from the program managers and other staff responsible for designing and implementing DSM programs. Staff responsible for evaluation activities will have separate reporting lines from that of program development and implementation staff wherever practical within the utilities.

4.3 *STAFFING RESOURCES*

The companies recognize that a combination of internal staffing resources and external professional consulting services will be needed to undertake the full range of evaluation activities that are required for the level of DSM program activity being implemented. The level of internal staff resourcing for evaluation activities will be sufficient to ensure that a base level of evaluation activity can be managed as appropriate for the level of program activity being delivered by the Companies.

Evaluation studies are generally outsourced by the Companies to external consultants. For M&V projects, external consultants will be retained whenever specialized expertise is required that FEI does not have in house and whenever increased levels of activity occur such that they cannot be completed by internal staff. Staffing and consultant resources will also be managed within the appropriate budgeting parameters (see Section 4.1).

Sufficient internal staff resources are needed to plan evaluation activities, manage evaluation projects, review third party consultation studies / reports and conduct some evaluation analysis.

- Development of RFPs
- Working with purchasing to obtain quotes from qualified service providers
- Developing selection criteria for the proposals
- Managing the selection criteria
- Managing the evaluation projects
- Maintaining communications with interested parts of the organization (esp. EEC)

Evaluation staff will be involved in the program planning process to determine the major evaluation issues for each program and ensuring that sufficient evaluation resources are available.

Staff Resources for Measurement and Verification Activities:

Internal engineering expertise is required to develop technical measurement and verification process requirements, develop measurement and verification plans, inspect measurement and verification work being done by third parties, be able to conduct measurement and verification activities when necessary. Number of internal staff must be sufficient to manage base level work load, provide consistent project management, and must be managed relative to overall EEC budgeting requirements.

4.4 *ROLE OF STAKEHOLDER ADVISORY GROUPS*

Advisory Groups made up of key stakeholders external to the Companies have been established by FortisBC to provide insight and feedback on the Companies' portfolios of DSM activities. Advisory Group members are not expected to have a high level of expertise in EM&V and are not expected to provide input on individual evaluation or measurement and verification projects. FEI will make any final evaluation report summaries available to Advisory Group members if requested. Members will also be able to contact FortisBC staff for more detailed discussions/explanations if desired. A list of evaluation activities will also be included in the Companies' Annual Reports for their DSM programs. From time to time, the Companies may review EM&V issues and results with the Advisory Groups for discussion and feedback.

The companies submit evaluation plans through either their Revenue Requirements Application or other filings for approval by the BCUC. Any stakeholder can participate in the review of the evaluation plans through the BCUC's regulatory review process[10].

[10] Visit www.bcuc.com

Appendix I

AMORTIZATION PERIOD ANALYSIS FEI

FEI DSM deferral impacts - Current Treatment: Amortizing DSM Expenditures over 10 Years

		Approved	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Line General Assumptions	**Reference**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**
1 ROE	Approved	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%
2 Equity	Approved	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%
3 STD Rate	Approved	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%
4 STD %	Approved	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%
5 LTD Rate	Approved	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%
6 LTD %	Approved	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%
7 Return on Rate Base	Line 1 x Line 2 + Line 3 x Line 4 + Line 5 x Line 6	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%
8 AFUDC Rate	Line 1 x Line 2 + (Line 3 x Line 4 + Line 5 x Line 6) x (1 - Line 9)	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%
9 Tax Rate		27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%
10 Inflation Rate		N/A	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
11 Delivery Margin	2018 Approved	822,033	838,474	855,243	872,348	889,795	907,591	925,743	944,258	963,143	982,406	1,002,054	1,022,095	1,042,537	1,063,387	1,084,655	1,106,348	1,128,475	1,151,045	1,174,066	1,197,547	1,221,498
12 DSM Expenditures		40,260	66,350	72,585	88,822	96,811	107,110	102,990	86,512	84,452	80,333	78,273	76,213	80,333	70,033	61,794	59,734	59,734	59,734	59,734	59,734	59,734
13 DSM Embedded in Rates in Expenditure Year		15,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
14																						
15 **Rate Base DSM Deferral**																						
16 Opening Deferral	Prior Year Closing	88,558	100,731	126,742	157,177	188,386	227,333	266,795	308,257	340,434	354,333	362,308	363,054	358,664	351,001	345,689	332,067	313,671	296,358	282,599	272,088	263,585
17 Adjustments	Transfer from non-rate base	12,822	18,957	27,280	31,959	44,145	50,141	57,870	54,778	42,411	40,866	37,774	36,228	34,682	37,774	30,045	23,861	22,315	22,315	22,315	22,315	22,315
18 Gross Additions	Line 12, Limited by Line 13	15,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
19 Tax	Line 9 x Line 18	(4,050)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)
20 Net Additions	Sum of Lines 18 and 19	10,950	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900
21 Amortization		(11,599)	(14,847)	(18,745)	(22,650)	(27,099)	(32,578)	(38,308)	(44,501)	(50,412)	(54,790)	(58,928)	(62,518)	(64,245)	(64,985)	(65,567)	(64,157)	(61,529)	(57,973)	(54,727)	(52,717)	(50,862)
22 Closing Deferral	Line 16 + Line 17 + Line 20 + Line 21	100,731	126,742	157,177	188,386	227,333	266,795	308,257	340,434	354,333	362,308	363,054	358,664	351,001	345,689	332,067	313,671	296,358	282,599	272,088	263,585	256,938
23																						
24 Rate Base	(Line 16 + Line 17 + Line 22) / 2	101,056	123,215	155,599	188,761	229,932	272,134	316,461	351,735	368,589	378,753	381,568	378,973	372,173	367,232	353,900	334,800	316,172	300,636	288,501	278,994	271,419
25																						
26 **Non-Rate Base DSM Deferral**																						
27 Opening Deferral	Prior Year Closing	12,822	18,957	27,280	31,959	44,145	50,141	57,870	54,778	42,411	40,866	37,774	36,228	34,682	37,774	30,045	23,861	22,315	22,315	22,315	22,315	22,315
28 Adjustments	Transfer to rate base	(12,822)	(18,957)	(27,280)	(31,959)	(44,145)	(50,141)	(57,870)	(54,778)	(42,411)	(40,866)	(37,774)	(36,228)	(34,682)	(37,774)	(30,045)	(23,861)	(22,315)	(22,315)	(22,315)	(22,315)	(22,315)
29 Gross Additions	line 12 > Line 13	25,260	36,350	42,585	58,822	66,811	77,110	72,990	56,512	54,452	50,333	48,273	46,213	50,333	40,033	31,794	29,734	29,734	29,734	29,734	29,734	29,734
30 Tax	Line 9 x Line 29	(6,820)	(9,815)	(11,498)	(15,882)	(18,039)	(20,820)	(19,707)	(15,258)	(14,702)	(13,590)	(13,034)	(12,477)	(13,590)	(10,809)	(8,584)	(8,028)	(8,028)	(8,028)	(8,028)	(8,028)	(8,028)
31 Net Additions	Sum of Lines 29 and 30	18,440	26,536	31,087	42,940	48,772	56,290	53,283	41,254	39,750	36,743	35,239	33,735	36,743	29,224	23,210	21,706	21,706	21,706	21,706	21,706	21,706
32 AFUDC	Line 31 / 2 x Line 8	517	745	872	1,205	1,369	1,580	1,495	1,158	1,116	1,031	989	947	1,031	820	651	609	609	609	609	609	609
33 Closing Deferral	Line 27 + Line 28 + Line 31 + Line 32	18,957	27,280	31,959	44,145	50,141	57,870	54,778	42,411	40,866	37,774	36,228	34,682	37,774	30,045	23,861	22,315	22,315	22,315	22,315	22,315	22,315
34																						
35 **Tax Expense**																						
36 Equity Return	Line 24 x Line 1 x Line 2	3,404	4,151	5,242	6,359	7,746	9,168	10,661	11,849	12,417	12,759	12,854	12,767	12,538	12,371	11,922	11,279	10,651	10,128	9,719	9,399	9,143
37 Add: Amortization	- Line 21	11,599	14,847	18,745	22,650	27,099	32,578	38,308	44,501	50,412	54,790	58,928	62,518	64,245	64,985	65,567	64,157	61,529	57,973	54,727	52,717	50,862
38 Taxable Income After Tax	Sum of Lines 36 through 37	15,003	18,997	23,987	29,009	34,845	41,746	48,969	56,350	62,829	67,550	71,782	75,285	76,783	77,357	77,489	75,435	72,180	68,101	64,446	62,116	60,006
39																						
40 Tax Rate	Line 9	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%
41																						
42 Taxable Income Before Tax	Line 38 / (1 - Line 40)	20,552	26,024	32,858	39,739	47,732	57,186	67,081	77,192	86,068	92,534	98,332	103,130	105,182	105,968	106,149	103,336	98,877	93,289	88,282	85,091	82,200
43																						
44 Tax Expense	Line 40 x Line 42	5,549	7,026	8,872	10,729	12,888	15,440	18,112	20,842	23,238	24,984	26,550	27,845	28,399	28,611	28,660	27,901	26,697	25,188	23,836	22,974	22,194
45																						
46 **Revenue Requirement**																						
47 Amortization	- Line 21	11,599	14,847	18,745	22,650	27,099	32,578	38,308	44,501	50,412	54,790	58,928	62,518	64,245	64,985	65,567	64,157	61,529	57,973	54,727	52,717	50,862
48 Tax Expense	Line 44	5,549	7,026	8,872	10,729	12,888	15,440	18,112	20,842	23,238	24,984	26,550	27,845	28,399	28,611	28,660	27,901	26,697	25,188	23,836	22,974	22,194
49 Earned Return	Line 24 x Line 7	6,510	7,938	10,024	12,161	14,813	17,532	20,388	22,660	23,746	24,401	24,582	24,415	23,977	23,659	22,800	21,569	20,369	19,368	18,587	17,974	17,486
50 Total Revenue Requirement	Sum of Lines 47 through 49	23,659	29,811	37,641	45,541	54,800	65,551	76,808	88,003	97,397	104,176	110,060	114,779	116,622	117,256	117,027	113,627	108,595	102,530	97,150	93,666	90,543
51 Cumulative Revenue Requirement Change vs. 2018 Approved	Line 50 - Line 50 Year 2018		6,152	13,982	21,882	31,141	41,892	53,149	64,345	73,738	80,517	86,401	91,120	92,963	93,597	93,369	89,968	84,936	78,871	73,491	70,007	66,884
52 Forecast Delivery Margin	Line 11	822,033	838,474	855,243	872,348	889,795	907,591	925,743	944,258	963,143	982,406	1,002,054	1,022,095	1,042,537	1,063,387	1,084,655	1,106,348	1,128,475	1,151,045	1,174,066	1,197,547	1,221,498
53																						
54 Incremental Delivery Rate Impact	Line 51 / Line 52 - Sum of prior years Line 54		0.73%	0.90%	0.87%	0.99%	1.12%	1.13%	1.07%	0.84%	0.54%	0.43%	0.29%	0.00%	-0.12%	-0.19%	-0.48%	-0.61%	-0.67%	-0.59%	-0.41%	-0.37%

FEI DSM deferral impacts - Scenario 1: Amortizing DSM Expenditures over 8 Years

			Approved	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Line	**General Assumptions**	**Reference**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**
1	ROE	Approved	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%
2	Equity	Approved	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%
3	STD Rate	Approved	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%
4	STD %	Approved	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%
5	LTD Rate	Approved	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%
6	LTD %	Approved	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%
7	Return on Rate Base	Line 1 x Line 2 + Line 3 x Line 4 + Line 5 x Line 6	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%
8	AFUDC Rate	Line 1 x Line 2 + (Line 3 x Line 4 + Line 5 x Line 6) x (1 - Line 9)	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%
9	Tax Rate		27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%
10	Inflation Rate		N/A	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
11	Delivery Margin	2018 Approved	822,033	838,474	855,243	872,348	889,795	907,591	925,743	944,258	963,143	982,406	1,002,054	1,022,095	1,042,537	1,063,387	1,084,655	1,106,348	1,128,475	1,151,045	1,174,066	1,197,547	1,221,498
12	DSM Expenditures		40,260	66,350	72,585	88,822	96,811	107,110	102,990	86,512	84,452	80,333	78,273	76,213	80,333	70,033	61,794	59,734	59,734	59,734	59,734	59,734	59,734
13	DSM Embedded in Rates in Expenditure Year		15,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
14																							
15	**Rate Base DSM Deferral**																						
16	Opening Deferral	Prior Year Closing	88,558	100,731	123,077	149,332	175,582	208,879	242,485	277,478	302,266	308,267	308,190	302,282	293,517	282,673	276,103	263,350	247,891	234,751	224,124	215,815	209,438
17	Adjustments	Transfer from non-rate base	12,822	18,957	27,280	31,959	44,145	50,141	57,870	54,778	42,411	40,866	37,774	36,228	34,682	37,774	30,045	23,861	22,315	22,315	22,315	22,315	22,315
18	Gross Additions	Line 12, Limited by Line 13	15,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
19	Tax	Line 9 x Line 18	(4,050)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)
20	Net Additions	Sum of Lines 18 and 19	10,950	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900
21	Amortization		(11,599)	(18,511)	(22,925)	(27,610)	(32,748)	(38,434)	(44,777)	(51,891)	(58,310)	(62,843)	(65,581)	(66,893)	(67,427)	(66,244)	(64,698)	(61,220)	(57,355)	(54,843)	(52,524)	(50,592)	(48,853)
22	Closing Deferral	Line 16 + Line 17 + Line 20 + Line 21	100,731	123,077	149,332	175,582	208,879	242,485	277,478	302,266	308,267	308,190	302,282	293,517	282,673	276,103	263,350	247,891	234,751	224,124	215,815	209,438	204,800
23																							
24	Rate Base	(Line 16 + Line 17 + Line 22) / 2	101,056	121,383	149,845	178,437	214,303	250,752	288,917	317,261	326,472	328,661	324,123	316,014	305,436	298,275	284,749	267,551	252,479	240,595	231,127	223,784	218,277
25																							
26	**Non-Rate Base DSM Deferral**																						
27	Opening Deferral	Prior Year Closing	12,822	18,957	27,280	31,959	44,145	50,141	57,870	54,778	42,411	40,866	37,774	36,228	34,682	37,774	30,045	23,861	22,315	22,315	22,315	22,315	22,315
28	Adjustments	Transfer to rate base	(12,822)	(18,957)	(27,280)	(31,959)	(44,145)	(50,141)	(57,870)	(54,778)	(42,411)	(40,866)	(37,774)	(36,228)	(34,682)	(37,774)	(30,045)	(23,861)	(22,315)	(22,315)	(22,315)	(22,315)	(22,315)
29	Gross Additions	line 12 > Line 13	25,260	36,350	42,585	58,822	66,811	77,110	72,990	56,512	54,452	50,333	48,273	46,213	50,333	40,033	31,794	29,734	29,734	29,734	29,734	29,734	29,734
30	Tax	Line 9 x Line 29	(6,820)	(9,815)	(11,498)	(15,882)	(18,039)	(20,820)	(19,707)	(15,258)	(14,702)	(13,590)	(13,034)	(12,477)	(13,590)	(10,809)	(8,584)	(8,028)	(8,028)	(8,028)	(8,028)	(8,028)	(8,028)
31	Net Additions	Sum of Lines 29 and 30	18,440	26,536	31,087	42,940	48,772	56,290	53,283	41,254	39,750	36,743	35,239	33,735	36,743	29,224	23,210	21,706	21,706	21,706	21,706	21,706	21,706
32	AFUDC	Line 31 / 2 x Line 8	517	745	872	1,205	1,369	1,580	1,495	1,158	1,116	1,031	989	947	1,031	820	651	609	609	609	609	609	609
33	Closing Deferral	Line 27 + Line 28 + Line 31 + Line 32	18,957	27,280	31,959	44,145	50,141	57,870	54,778	42,411	40,866	37,774	36,228	34,682	37,774	30,045	23,861	22,315	22,315	22,315	22,315	22,315	22,315
34																							
35	**Tax Expense**																						
36	Equity Return	Line 24 x Line 1 x Line 2	3,404	4,089	5,048	6,011	7,219	8,447	9,733	10,688	10,998	11,072	10,919	10,646	10,289	10,048	9,592	9,013	8,505	8,105	7,786	7,539	7,353
37	Add: Amortization	- Line 21	11,599	18,511	22,925	27,610	32,748	38,434	44,777	51,891	58,310	62,843	65,581	66,893	67,427	66,244	64,698	61,220	57,355	54,843	52,524	50,592	48,853
38	Taxable Income After Tax	Sum of Lines 36 through 37	15,003	22,600	27,973	33,621	39,968	46,881	54,510	62,579	69,308	73,915	76,500	77,539	77,716	76,292	74,290	70,233	65,860	62,948	60,310	58,131	56,206
39																							
40	Tax Rate	Line 9	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%
41																							
42	Taxable Income Before Tax	Line 38 / (1 - Line 40)	20,552	30,959	38,319	46,056	54,750	64,221	74,671	85,724	94,943	101,253	104,795	106,217	106,460	104,509	101,768	96,209	90,220	86,230	82,617	79,631	76,995
43																							
44	Tax Expense	Line 40 x Line 42	5,549	8,359	10,346	12,435	14,783	17,340	20,161	23,145	25,635	27,338	28,295	28,679	28,744	28,218	27,477	25,977	24,359	23,282	22,307	21,500	20,789
45																							
46	**Revenue Requirement**																						
47	Amortization	- Line 21	11,599	18,511	22,925	27,610	32,748	38,434	44,777	51,891	58,310	62,843	65,581	66,893	67,427	66,244	64,698	61,220	57,355	54,843	52,524	50,592	48,853
48	Tax Expense	Line 44	5,549	8,359	10,346	12,435	14,783	17,340	20,161	23,145	25,635	27,338	28,295	28,679	28,744	28,218	27,477	25,977	24,359	23,282	22,307	21,500	20,789
49	Earned Return	Line 24 x Line 7	6,510	7,820	9,654	11,496	13,806	16,155	18,613	20,440	21,033	21,174	20,882	20,359	19,678	19,216	18,345	17,237	16,266	15,500	14,890	14,417	14,062
50	Total Revenue Requirement	Sum of Lines 47 through 49	23,659	34,690	42,924	51,541	61,337	71,929	83,551	95,476	104,978	111,355	114,758	115,931	115,849	113,678	110,520	104,433	97,980	93,626	89,721	86,510	83,704
51	Cumulative Revenue Requirement Change vs. 2018 Approved	Line 50 - Line 50 Year 2018		11,032	19,266	27,882	37,679	48,270	59,893	71,817	81,319	87,696	91,099	92,272	92,190	90,019	86,861	80,775	74,322	69,967	66,062	62,851	60,045
52	Forecast Delivery Margin	Line 11	822,033	838,474	855,243	872,348	889,795	907,591	925,743	944,258	963,143	982,406	1,002,054	1,022,095	1,042,537	1,063,387	1,084,655	1,106,348	1,128,475	1,151,045	1,174,066	1,197,547	1,221,498
53																							
54	Incremental Delivery Rate Impact	Line 51 / Line 52 - Sum of prior years Line 54		1.32%	0.94%	0.94%	1.04%	1.08%	1.15%	1.14%	0.84%	0.48%	0.16%	-0.06%	-0.18%	-0.38%	-0.46%	-0.71%	-0.71%	-0.51%	-0.45%	-0.38%	-0.33%

FEI DSM deferral impacts - Scenario 2: Amortizing DSM Expenditures over 5 Years

Line General Assumptions	Reference	Approved 2018	1 2019	2 2020	3 2021	4 2022	5 2023	6 2024	7 2025	8 2026	9 2027	10 2028	11 2029	12 2030	13 2031	14 2032	15 2033	16 2034	17 2035	18 2036	19 2037	20 2038
1 ROE	Approved	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%
2 Equity	Approved	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%
3 STD Rate	Approved	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%
4 STD %	Approved	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%
5 LTD Rate	Approved	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%
6 LTD %	Approved	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%
7 Return on Rate Base	Line 1 x Line 2 + Line 3 x Line 4 + Line 5 x Line 6	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%
8 AFUDC Rate	Line 1 x Line 2 + (Line 3 x Line 4 + Line 5 x Line 6) x (1 - Line 9)	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%
9 Tax Rate		27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%
10 Inflation Rate		N/A	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
11 Delivery Margin	2018 Approved	822,033	838,474	855,243	872,348	889,795	907,591	925,743	944,258	963,143	982,406	1,002,054	1,022,095	1,042,537	1,063,387	1,084,655	1,106,348	1,128,475	1,151,045	1,174,066	1,197,547	1,221,498
12 DSM Expenditures		40,260	66,350	72,585	88,822	96,811	107,110	102,990	86,512	84,452	80,333	78,273	76,213	80,333	70,033	61,794	59,734	59,734	59,734	59,734	59,734	59,734
13 DSM Embedded in Rates in Expenditure Year		15,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
14																						
15 **Rate Base DSM Deferral**																						
16 Opening Deferral	Prior Year Closing	88,558	100,731	112,083	126,736	140,894	163,264	186,423	209,797	222,296	216,929	207,925	196,486	185,974	178,245	177,626	170,206	158,767	148,564	141,144	136,197	134,342
17 Adjustments	Transfer from non-rate base	12,822	18,957	27,280	31,959	44,145	50,141	57,870	54,778	42,411	40,866	37,774	36,228	34,682	37,774	30,045	23,861	22,315	22,315	22,315	22,315	22,315
18 Gross Additions	Line 12, Limited by Line 13	15,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
19 Tax	Line 9 x Line 18	(4,050)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)
20 Net Additions	Sum of Lines 18 and 19	10,950	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900
21 Amortization		(11,599)	(29,506)	(34,527)	(39,702)	(43,675)	(48,882)	(56,397)	(64,179)	(69,679)	(71,769)	(71,113)	(68,640)	(64,311)	(60,292)	(59,365)	(57,200)	(54,418)	(51,635)	(49,162)	(46,070)	(44,524)
22 Closing Deferral	Line 16 + Line 17 + Line 20 + Line 21	100,731	112,083	126,736	140,894	163,264	186,423	209,797	222,296	216,929	207,925	196,486	185,974	178,245	177,626	170,206	158,767	148,564	141,144	136,197	134,342	134,033
23																						
24 Rate Base	(Line 16 + Line 17 + Line 22) / 2	101,056	115,885	133,049	149,794	174,151	199,914	227,045	243,435	240,818	232,860	221,092	209,344	199,450	196,822	188,939	176,417	164,823	156,012	149,828	146,427	145,345
25																						
26 **Non-Rate Base DSM Deferral**																						
27 Opening Deferral	Prior Year Closing	12,822	18,957	27,280	31,959	44,145	50,141	57,870	54,778	42,411	40,866	37,774	36,228	34,682	37,774	30,045	23,861	22,315	22,315	22,315	22,315	22,315
28 Adjustments	Transfer to rate base	(12,822)	(18,957)	(27,280)	(31,959)	(44,145)	(50,141)	(57,870)	(54,778)	(42,411)	(40,866)	(37,774)	(36,228)	(34,682)	(37,774)	(30,045)	(23,861)	(22,315)	(22,315)	(22,315)	(22,315)	(22,315)
29 Gross Additions	line 12 > Line 13	25,260	36,350	42,585	58,822	66,811	77,110	72,990	56,512	54,452	50,333	48,273	46,213	50,333	40,033	31,794	29,734	29,734	29,734	29,734	29,734	29,734
30 Tax	Line 9 x Line 29	(6,820)	(9,815)	(11,498)	(15,882)	(18,039)	(20,820)	(19,707)	(15,258)	(14,702)	(13,590)	(13,034)	(12,477)	(13,590)	(10,809)	(8,584)	(8,028)	(8,028)	(8,028)	(8,028)	(8,028)	(8,028)
31 Net Additions	Sum of Lines 29 and 30	18,440	26,536	31,087	42,940	48,772	56,290	53,283	41,254	39,750	36,743	35,239	33,735	36,743	29,224	23,210	21,706	21,706	21,706	21,706	21,706	21,706
32 AFUDC	Line 31 / 2 x Line 8	517	745	872	1,205	1,369	1,580	1,495	1,158	1,116	1,031	989	947	1,031	820	651	609	609	609	609	609	609
33 Closing Deferral	Line 27 + Line 28 + Line 31 + Line 32	18,957	27,280	31,959	44,145	50,141	57,870	54,778	42,411	40,866	37,774	36,228	34,682	37,774	30,045	23,861	22,315	22,315	22,315	22,315	22,315	22,315
34																						
35 **Tax Expense**																						
36 Equity Return	Line 24 x Line 1 x Line 2	3,404	3,904	4,482	5,046	5,867	6,735	7,649	8,201	8,113	7,844	7,448	7,052	6,719	6,630	6,365	5,943	5,552	5,256	5,047	4,933	4,896
37 Add: Amortization	- Line 21	11,599	29,506	34,527	39,702	43,675	48,882	56,397	64,179	69,679	71,769	71,113	68,640	64,311	60,292	59,365	57,200	54,418	51,635	49,162	46,070	44,524
38 Taxable Income After Tax	Sum of Lines 36 through 37	15,003	33,409	39,009	44,748	49,541	55,616	64,045	72,380	77,791	79,614	78,561	75,692	71,030	66,923	65,730	63,144	59,970	56,891	54,209	51,003	49,421
39																						
40 Tax Rate	Line 9	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%
41																						
42 Taxable Income Before Tax	Line 38 / (1 - Line 40)	20,552	45,766	53,437	61,298	67,865	76,187	87,733	99,150	106,563	109,060	107,618	103,688	97,302	91,675	90,040	86,498	82,151	77,933	74,259	69,867	67,700
43																						
44 Tax Expense	Line 40 x Line 42	5,549	12,357	14,428	16,551	18,323	20,570	23,688	26,771	28,772	29,446	29,057	27,996	26,272	24,752	24,311	23,354	22,181	21,042	20,050	18,864	18,279
45																						
46 **Revenue Requirement**																						
47 Amortization	- Line 21	11,599	29,506	34,527	39,702	43,675	48,882	56,397	64,179	69,679	71,769	71,113	68,640	64,311	60,292	59,365	57,200	54,418	51,635	49,162	46,070	44,524
48 Tax Expense	Line 44	5,549	12,357	14,428	16,551	18,323	20,570	23,688	26,771	28,772	29,446	29,057	27,996	26,272	24,752	24,311	23,354	22,181	21,042	20,050	18,864	18,279
49 Earned Return	Line 24 x Line 7	6,510	7,466	8,572	9,650	11,220	12,879	14,627	15,683	15,515	15,002	14,244	13,487	12,850	12,680	12,172	11,366	10,619	10,051	9,653	9,434	9,364
50 Total Revenue Requirement	Sum of Lines 47 through 49	23,659	49,328	57,527	65,903	73,218	82,332	94,712	106,633	113,965	116,217	114,414	110,122	103,433	97,725	95,848	91,921	87,217	82,728	78,865	74,368	72,167
51 Cumulative Revenue Requirement Change vs. 2018 Approved	Line 50 - Line 50 Year 2018		25,670	33,868	42,244	49,559	58,673	71,053	82,974	90,307	92,559	90,755	86,464	79,774	74,066	72,189	68,262	63,559	59,070	55,206	50,709	48,509
52 Forecast Delivery Margin	Line 11	822,033	838,474	855,243	872,348	889,795	907,591	925,743	944,258	963,143	982,406	1,002,054	1,022,095	1,042,537	1,063,387	1,084,655	1,106,348	1,128,475	1,151,045	1,174,066	1,197,547	1,221,498
53																						
54 Incremental Delivery Rate Impact	Line 51 / Line 52 - Sum of prior years Line 54		3.06%	0.90%	0.88%	0.73%	0.89%	1.21%	1.11%	0.59%	0.05%	-0.36%	-0.60%	-0.81%	-0.69%	-0.31%	-0.49%	-0.54%	-0.50%	-0.43%	-0.47%	-0.26%

FEI DSM deferral impacts - Scenario 3: Amortizing DSM Expenditures over 16 Years

Line	General Assumptions	Reference	Approved 2018	1 2019	2 2020	3 2021	4 2022	5 2023	6 2024	7 2025	8 2026	9 2027	10 2028	11 2029	12 2030	13 2031	14 2032	15 2033	16 2034	17 2035	18 2036	19 2037	20 2038
1	ROE	Approved	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%	8.75%
2	Equity	Approved	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%	38.50%
3	STD Rate	Approved	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%	2.10%
4	STD %	Approved	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%	5.10%
5	LTD Rate	Approved	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%	5.26%
6	LTD %	Approved	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%	56.40%
7	Return on Rate Base	Line 1 x Line 2 + Line 3 x Line 4 + Line 5 x Line 6	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%	6.44%
8	AFUDC Rate	Line 1 x Line 2 + (Line 3 x Line 4 + Line 5 x Line 6) x (1 - Line 9)	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%	5.61%
9	Tax Rate		27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%	27.00%
10	Inflation Rate		N/A	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
11	Delivery Margin	2018 Approved	822,033	838,474	855,243	872,348	889,795	907,591	925,743	944,258	963,143	982,406	1,002,054	1,022,095	1,042,537	1,063,387	1,084,655	1,106,348	1,128,475	1,151,045	1,174,066	1,197,547	1,221,498
12	DSM Expenditures		40,260	66,350	72,585	88,822	96,811	107,110	102,990	86,512	84,452	80,333	78,273	76,213	80,333	70,033	61,794	59,734	59,734	59,734	59,734	59,734	59,734
13	DSM Embedded in Rates in Expenditure Year		15,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
14																							
15	**Rate Base DSM Deferral**																						
16	Opening Deferral	Prior Year Closing	88,558	100,731	132,309	169,704	208,774	257,170	307,677	361,880	408,427	438,097	463,122	481,579	495,430	504,980	514,561	513,710	504,231	490,881	476,254	461,416	446,889
17	Adjustments	Transfer from non-rate base	12,822	18,957	27,280	31,959	44,145	50,141	57,870	54,778	42,411	40,866	37,774	36,228	34,682	37,774	30,045	23,861	22,315	22,315	22,315	22,315	22,315
18	Gross Additions	Line 12, Limited by Line 13	15,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
19	Tax	Line 9 x Line 18	(4,050)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)	(8,100)
20	Net Additions	Sum of Lines 18 and 19	10,950	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900	21,900
21	Amortization		(11,599)	(9,279)	(11,786)	(14,789)	(17,649)	(21,533)	(25,567)	(30,131)	(34,642)	(37,740)	(41,217)	(44,278)	(47,032)	(50,092)	(52,795)	(55,240)	(57,565)	(58,843)	(59,053)	(58,742)	(58,140)
22	Closing Deferral	Line 16 + Line 17 + Line 20 + Line 21	100,731	132,309	169,704	208,774	257,170	307,677	361,880	408,427	438,097	463,122	481,579	495,430	504,980	514,561	513,710	504,231	490,881	476,254	461,416	446,889	432,965
23																							
24	Rate Base	(Line 16 + Line 17 + Line 22) / 2	101,056	125,999	164,646	205,218	255,044	307,494	363,714	412,543	444,468	471,042	491,238	506,618	517,546	528,657	529,158	520,901	508,714	494,725	479,993	465,310	451,085
25																							
26	**Non-Rate Base DSM Deferral**																						
27	Opening Deferral	Prior Year Closing	12,822	18,957	27,280	31,959	44,145	50,141	57,870	54,778	42,411	40,866	37,774	36,228	34,682	37,774	30,045	23,861	22,315	22,315	22,315	22,315	22,315
28	Adjustments	Transfer to rate base	(12,822)	(18,957)	(27,280)	(31,959)	(44,145)	(50,141)	(57,870)	(54,778)	(42,411)	(40,866)	(37,774)	(36,228)	(34,682)	(37,774)	(30,045)	(23,861)	(22,315)	(22,315)	(22,315)	(22,315)	(22,315)
29	Gross Additions	line 12 > Line 13	25,260	36,350	42,585	58,822	66,811	77,110	72,990	56,512	54,452	50,333	48,273	46,213	50,333	40,033	31,794	29,734	29,734	29,734	29,734	29,734	29,734
30	Tax	Line 9 x Line 29	(6,820)	(9,815)	(11,498)	(15,882)	(18,039)	(20,820)	(19,707)	(15,258)	(14,702)	(13,590)	(13,034)	(12,477)	(13,590)	(10,809)	(8,584)	(8,028)	(8,028)	(8,028)	(8,028)	(8,028)	(8,028)
31	Net Additions	Sum of Lines 29 and 30	18,440	26,536	31,087	42,940	48,772	56,290	53,283	41,254	39,750	36,743	35,239	33,735	36,743	29,224	23,210	21,706	21,706	21,706	21,706	21,706	21,706
32	AFUDC	Line 31 / 2 x Line 8	517	745	872	1,205	1,369	1,580	1,495	1,158	1,116	1,031	989	947	1,031	820	651	609	609	609	609	609	609
33	Closing Deferral	Line 27 + Line 28 + Line 31 + Line 32	18,957	27,280	31,959	44,145	50,141	57,870	54,778	42,411	40,866	37,774	36,228	34,682	37,774	30,045	23,861	22,315	22,315	22,315	22,315	22,315	22,315
34																							
35	**Tax Expense**																						
36	Equity Return	Line 24 x Line 1 x Line 2	3,404	4,245	5,547	6,913	8,592	10,359	12,253	13,898	14,973	15,868	16,549	17,067	17,435	17,809	17,826	17,548	17,137	16,666	16,170	15,675	15,196
37	Add: Amortization	- Line 21	11,599	9,279	11,786	14,789	17,649	21,533	25,567	30,131	34,642	37,740	41,217	44,278	47,032	50,092	52,795	55,240	57,565	58,843	59,053	58,742	58,140
38	Taxable Income After Tax	Sum of Lines 36 through 37	15,003	13,524	17,332	21,703	26,241	31,892	37,820	44,028	49,615	53,608	57,766	61,344	64,467	67,902	70,621	72,788	74,703	75,509	75,223	74,418	73,336
39																							
40	Tax Rate	Line 9	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%	27.0%
41																							
42	Taxable Income Before Tax	Line 38 / (1 - Line 40)	20,552	18,526	23,743	29,730	35,947	43,688	51,808	60,313	67,966	73,436	79,131	84,033	88,311	93,016	96,742	99,709	102,332	103,437	103,045	101,942	100,460
43																							
44	Tax Expense	Line 40 x Line 42	5,549	5,002	6,411	8,027	9,706	11,796	13,988	16,284	18,351	19,828	21,365	22,689	23,844	25,114	26,120	26,921	27,630	27,928	27,822	27,524	27,124
45																							
46	**Revenue Requirement**																						
47	Amortization	- Line 21	11,599	9,279	11,786	14,789	17,649	21,533	25,567	30,131	34,642	37,740	41,217	44,278	47,032	50,092	52,795	55,240	57,565	58,843	59,053	58,742	58,140
48	Tax Expense	Line 44	5,549	5,002	6,411	8,027	9,706	11,796	13,988	16,284	18,351	19,828	21,365	22,689	23,844	25,114	26,120	26,921	27,630	27,928	27,822	27,524	27,124
49	Earned Return	Line 24 x Line 7	6,510	8,117	10,607	13,221	16,431	19,810	23,432	26,578	28,635	30,347	31,648	32,639	33,343	34,059	34,091	33,559	32,774	31,873	30,923	29,978	29,061
50	Total Revenue Requirement	Sum of Lines 47 through 49	23,659	22,398	28,804	36,037	43,786	53,139	62,987	72,993	81,628	87,915	94,230	99,605	104,219	109,265	113,007	115,720	117,969	118,644	117,798	116,244	114,325
51	Cumulative Revenue Requirement Change vs. 2018 Approved	Line 50 - Line 50 Year 2018		(1,260)	5,145	12,379	20,127	29,481	39,329	49,335	57,969	64,256	70,572	75,947	80,560	85,607	89,348	92,062	94,310	94,985	94,140	92,586	90,666
52	Forecast Delivery Margin	Line 11	822,033	838,474	855,243	872,348	889,795	907,591	925,743	944,258	963,143	982,406	1,002,054	1,022,095	1,042,537	1,063,387	1,084,655	1,106,348	1,128,475	1,151,045	1,174,066	1,197,547	1,221,498
53																							
54	Incremental Delivery Rate Impact	Line 51 / Line 52 - Sum of prior years Line 54		-0.15%	0.75%	0.82%	0.84%	0.99%	1.00%	0.98%	0.79%	0.52%	0.50%	0.39%	0.30%	0.32%	0.19%	0.08%	0.04%	-0.11%	-0.23%	-0.29%	-0.31%

Appendix J

WEIGHTED AVERAGE MEASURE LIFE

Program Area and Program	Total Cost (non-inflated) 2019-2022 ($1000s)	Measure Lifetime (yrs)	Weighted Life by Expenditures (yrs)
Residential			
Home Renovation Rebate Program	71,942	17.1	
New Home Program	31,819	19.4	
Rental Apartment Efficiency Program	1,726	10.0	
SUB-TOTAL	**105,488**	N/A	**17.7**
Commercial			
Prescriptive Program	52,900	17.3	
Performance Program - Existing Buildings	10,550	5.7	
Performance Program - New Buildings	17,301	19.2	
Rental Apartment Efficiency Program	5,025	8.7	
SUB-TOTAL	**85,777**	N/A	**15.8**
Industrial			
Performance Program	8,028	10.0	
Prescriptive Program	2,225	12.7	
Strategic Energy Management Program	2,540	5.0	
SUB-TOTAL	**12,793**	N/A	**9.5**
Low Income			
Direct Install Program	9,090	12.0	
Self Install Program	1,986	10.0	
Prescriptive Program	12,311	17.5	
SUB-TOTAL	**23,387**	**N/A**	**14.7**
ALL PROGRAMS WITH DIRECT SAVINGS	**227,445**	**N/A**	**16.2**
Non-Program Specific Expenses (Residential)	3,244		
Non-Program Specific Expenses (Commercial)	3,119		
Non-Program Specific Expenses (Industrial)	690		
Support Program (Low Income)	3,200		
Non-Program Specific Expenses (Low Income)	805		
Innovative Technologies	**9,762**		
Conservation Education and Outreach	**31,459**		
Enabling Activities	**34,252**		
Portfolio Level Activities	**6,840**		
ENTIRE PORTFOLIO	**320,816**		