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July 12, 2023

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

Attention: Patrick Wruck, Commission Secretary

Dear Patrick Wruck:

Re: FortisBC Energy Inc. (FEI)

Application for Acceptance of Demand Side Management (DSM) Expenditures Plan for the period covering 2024 to 2027 (Application)

In accordance with British Columbia Utilities Commission (BCUC) Order G-178-23 setting out the Regulatory Timetable for the above noted Application, and pursuant to section 44.2 of the *Utilities Commission Act*, FEI hereby applies to the BCUC for acceptance of the attached DSM Expenditures Plan covering the period 2024 to 2027.

In addition, FEI confirms, in compliance with Order G-178-23, the public notice requirements under Directive 2 were completed.

If further information is required, please contact Sarah Commander, Regulatory Projects Manager, at (250) 469-6081.

Sincerely,

FORTISBC ENERGY INC.

Original signed:

Sarah Walsh

Attachments

cc (email only): Members of the Energy Efficiency and Conservation Advisory Group;
Registered Interveners in the proceedings for:

- FEI Annual Review for 2023 Delivery Rates
- FEI 2023 DSM Expenditures

FORTISBC ENERGY INC.

2024-2027 Demand Side Expenditures Plan

July 12, 2023

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1. INTRODUCTION

FortisBC Energy Inc. (FEI or the Company) submits this Application for Acceptance of Demand-Side Management (DSM) Expenditures for 2024-2027 (Application) to the British Columbia Utilities Commission (BCUC) pursuant to section 44.2(1)(a) of the *Utilities Commission Act*, R.S.B.C. 1996, c. 473 (UCA). FEI's proposed DSM expenditure schedule is set out in Table 1-1 of the Application, with total DSM expenditures of $626.7 million for 2024 to 2027. FEI's proposed DSM expenditures are supported by the 2024-2027 DSM Plan Report (Appendix A), which provides details on each of FEI's program areas including cost-effectiveness test results. Further supporting measure level information can be found in the Additional Cost-Effectiveness Results, Measure Details and Sources Report (Appendix B), including participation and savings details.

The 2024-2027 DSM Plan (DSM Plan) is the result of a collaborative working effort between FEI DSM program personnel and Posterity Group, an energy efficiency consulting firm that also assisted FEI with its 2023 DSM Expenditures Plan Application[1] and its 2022 Long-Term Gas Resource Plan (2022 LTGRP),[2] and FortisBC Inc. (FBC) with its 2023-2027 DSM Expenditure Plan Application.[3] In Section 1 of Appendix A, FEI provides further detail on the approach undertaken in its development.

The DSM Plan continues many of the cost-effective programs previously accepted in FEI's 2023 DSM Plan,[4] but makes a significant transition away from conventional high-efficiency gas space and water heating equipment, such as furnaces and boilers,[5] to advanced DSM programming, such as gas heat pumps, dual fuel hybrid heating systems and deeper retrofits. The changes to FEI's DSM Plan reflect provincial government policy direction in the 2021 CleanBC Roadmap to 2030[6] (Roadmap) and the recent amendments to the *Demand-Side Measures Regulation* (DSM Regulation), which became effective June 30, 2023.[7] The DSM Plan is consistent with British Columbia's energy objectives, meets the adequacy and cost-effectiveness requirements of the DSM Regulation (as amended) and, in FEI's submission, is in the public interest.

1.1 GOVERNMENT POLICY AND THE DEMAND-SIDE MEASURES REGULATION

Government focus on reducing greenhouse gas (GHG) emissions is an important factor driving FEI's 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,

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1 Order G-45-23.
2 FEI's 2022 LTGRP was filed with the BCUC on May 9, 2022.
3 Order G-371-22.
4 Order G-45-23.
5 Gas space and water heating equipment generally excludes kitchen appliances, laundry machines, and equipment for industrial process loads.
6 CleanBC Roadmap to 2030, p. 41: https://www2.gov.bc.ca/assets/gov/environment/climate-change/action/cleanbc/cleanbc_roadmap_2030.pdf.
7 Ministerial Order No. M193, dated June 27, 2023, amending the *Demand-Side Measures Regulation*, B.C. Reg. 326/2008, included as Appendix H to the Application.

provincial GHG reduction policies have evolved, but have continued to support carbon emissions reductions through increasing gas energy efficiency.

The Roadmap introduced the concept of "a GHG emissions cap that will require gas utilities to undertake activities and invest in technologies to further lower GHG emissions from the fossil natural gas used to heat homes and buildings and power some of our industries."[8] The Roadmap states that utilities will determine how best to meet the target, including by supporting greater energy efficiency, and that "the B.C. Utilities Commission will have a mandate to review gas utilities' plans, investments and expenditures to ensure they're aligned with the GHG emissions cap and cost effective".[9] While the GHG emissions cap has not yet been implemented, this policy direction from Government highlights the importance of FEI's DSM portfolio as a tool to reduce emissions.

The Roadmap calls for enhanced energy efficiency programs, including more support for building-envelope improvements and high-efficiency heat pumps, including gas heat pumps and dual fuel hybrid heating systems. Further, the Roadmap contemplates that all new space and water heating equipment sold and installed in British Columbia will be at least 100 percent efficient after 2030. Finally, and importantly for this Application, the Roadmap indicated that there will be updated regulations to shift the focus of utility-funded efficiency programs to support market readiness for future standards and codes and that consumers will see more support for building-envelope improvements, such as insulation and better windows, and high-efficiency heat pumps (electric, gas and hybrid).[10]

Amendments to the DSM Regulation to further the Roadmap's goals were issued by the Province on June 27, 2023.[11] Consistent with the Roadmap, the amended DSM Regulation phases out support for conventional gas space and water heating equipment with efficiencies less than 100 percent. Also consistent with the Roadmap, the DSM Regulation increases support for advanced DSM measures, including by requiring the BCUC to make determinations of cost-effectiveness using the Utility Cost Test (UCT) with the avoided cost of renewable natural gas (RNG), as well as hydrogen, synthesis gas and lignin (together, referred to as renewable and low-carbon gas). FEI has designed its DSM Plan to meet these new requirements.

The key amendments to the DSM Regulation are summarized below:

- **Cost-Effectiveness to be Determined Using the Utility Cost Test (UCT):** The BCUC must determine the cost-effectiveness of the DSM Plan using the UCT, thus replacing the Total Resource Cost Test (TRC) and Modified Total Resource Cost Test (mTRC). The UCT compares the benefits of DSM to the costs to the Utility. Further detail on the UCT and how it is applied is provided in Section 6 of the Application.

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[8] CleanBC Roadmap to 2030, p 29 [CleanBC Roadmap to 2030 (gov.bc.ca).]
[9] *Ibid*, p 29.
[10] *Ibid*, p. 41.
[11] Ministerial Order No. M193, dated June 27, 2023, amending the *Demand-Side Measures Regulation*, B.C. Reg. 326/2008.

- **Avoided Cost of Gas is the Cost of Renewable and Low-Carbon Gas in the GGRR:** The avoided cost of gas now reflects a price consistent with the maximum cost of renewable and low-carbon gas set out in the *Greenhouse Gas Reduction Regulation* (GGRR). This value is used within the UCT to measure cost-effectiveness. In Section 6.1.1 of the Application, FEI provides additional detail on how this value is defined.

- **Limited Support for High-Efficiency Conventional Gas Space and Water Heating Equipment:** With some limited exceptions, the amended DSM Regulation effectively deems most conventional high-efficiency gas space and water heating equipment or "class B demand-side measures" as not cost effective.[12] Where permitted, FEI has included measures for conventional high-efficiency gas space and water heating equipment within its DSM programs, which are described further in Section 5.4 of the Application.

- **Addition of Minimum Seasonal Coefficient of Performance (SCOP) Requirement:** The amended DSM Regulation adds a SCOP requirement for dual fuel hybrid systems and gas heat pumps. A SCOP is an average efficiency rating for heat pumps over a full heating season. Previously, there were no minimum requirements for any mechanical systems.

- **Introduction of Indigenous-Specific Programming:** The amended DSM Regulation mandates dedicated programs for Indigenous communities. In its past DSM Plans, FEI included these offers under several program areas, such as Residential, Commercial and Low Income. In Section 5.4 of the Application and Section 7 of Appendix A to the Application, FEI provides further details on new and expanded activities for Indigenous communities.

- **Cost-Effectiveness of Indigenous and Low Income Program Areas and other "class A demand-side measures" Evaluated at the Portfolio Level:** Indigenous and Low Income program areas are considered "class A demand-side measures" which must be considered cost-effective if the portfolio as a whole has a positive UCT. Prior to the amendments to the DSM Regulation, Low Income programs (which included Indigenous programming) were subject to the mTRC test.

- **Increase to the Low Income Threshold:** The threshold for customers to be eligible for low-income programs is now 1.6 x the Statistics Canada Low Income Cut-Off (LICO).[13] Prior to the amendments to the DSM Regulation, the threshold was 1.3 x the Statistics Canada LICO.

- **Support for Legacy Expenditures:** Legacy Expenditures enable the fulfilment of committed incentives under a prior DSM Plan for conventional high-efficiency gas space and water heating equipment, which would otherwise no longer be eligible for incentives

[12] A Class B demand-side measure must have a UCT of 50 or greater to be cost effective.
[13] https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1110024101.

outside of section 5 of the amended DSM Regulation. Section 12 of Appendix A to the Application sets out where FEI expects to incur Legacy Expenditures.

FEI's 2024-2027 DSM Plan reflects the provincial government's amendments to the DSM Regulation as further described below.

1.2 FEI's DSM Programs Reflect the Amendments to the DSM Regulation

Consistent with the amendments to the DSM Regulation, the DSM Plan continues many of the cost-effective programs previously accepted in FEI's 2023 DSM Plan,[14] with significant transition to advanced DSM programming, such as gas heat pumps, dual fuel hybrid heating systems and deeper retrofits. The DSM Plan also phases-out many of the expenditures for conventional high-efficiency gas space and water heating equipment.

Two new program areas have been added to the DSM Plan: (1) the Indigenous Program Area; and (2) the Legacy Expenditures Program Area.

The Indigenous Program Area reflects expenditures for Indigenous communities as defined in section 3 of the amended DSM Regulation. FEI's previous DSM plans embedded Indigenous related offers within the Residential, Commercial, and Low Income Program Areas. This DSM Plan brings all Indigenous DSM expenditures together in one program area.

The Legacy Expenditures Program Area includes previously committed expenditures for conventional high-efficiency gas space and water heating equipment as permitted by section 5 of the amended DSM Regulation. These legacy expenditures support customer commitments for purchases of eligible high-efficiency gas equipment made prior to 2024. This includes committed expenditures in residential, commercial, and low-income sectors, as well as Indigenous communities.

Tables 1-1 and 1-2 below set out FEI's proposed 2024-2027 DSM expenditures and associated savings by program area. FEI is requesting acceptance of total DSM expenditures for 2024-2027 of $626.7 million. These are the values that FEI will report actual spending against in its Annual DSM Reports.

[14] Order G-45-23.

Table 1-1: FEI DSM Expenditures – 2024-2027 Forecast, Including Inflation ($000s)

Program Area	2024	2025	2026	2027	Total
Residential	33,197	40,830	48,263	56,621	178,910
Commercial	8,726	12,958	17,799	21,151	60,635
Industrial	7,585	8,071	8,963	9,600	34,219
Low Income	8,366	9,753	11,826	14,676	44,621
Indigenous	2,704	4,247	5,481	6,452	18,885
Conservation Education and Outreach	14,652	14,794	15,433	15,986	60,865
Innovative Technologies	35,117	20,807	15,239	18,059	89,222
Enabling Activities	15,042	12,451	11,486	11,265	50,244
Portfolio Activities	5,281	5,687	5,507	5,749	22,223
Legacy Expenditures	36,200	16,995	8,401	5,282	66,878
Total	**166,870**	**146,593**	**148,398**	**164,842**	**626,703**

Notes to Table: These are the same values shown in Exhibits 1 of Appendix A.

Table 1-2: FEI DSM Savings – 2024-2027 Forecast

Program Area	Yearly Incremental Natural Gas Savings (GJ)				
	2024	2025	2026	2027	Total
Residential	166,655	187,759	208,552	232,596	795,562
Commercial	93,986	138,321	185,927	222,140	640,373
Industrial	365,533	394,550	473,459	516,985	1,750,526
Low Income	50,684	56,992	64,579	75,588	247,843
Indigenous	16,076	22,237	27,421	29,225	94,959
Conservation Education and Outreach[15]	20,000	30,000	30,000	30,000	110,000
Legacy Expenditures	147,185	57,878	31,361	21,340	257,765
Total	**860,118**	**887,737**	**1,021,299**	**1,127,874**	**3,897,028**

Notes to Table: These are the same values shown in Exhibits 4 of Appendix A.

As described in the next section, FEI's DSM programs for 2024 through 2027 continue to support provincial policy to reduce carbon emissions.

[15] Savings are attributed to the Customer Engagement Tool measure only and savings are included within the portfolio.

1.3 FEI's DSM Programs Continue to Support Provincial Policy to Reduce Carbon Emissions

As shown in Table 1-3 below, the DSM Plan continues to align with, and support, the Province's policy to reduce GHG emissions. The decline in GHG emission reductions in 2024 compared to 2023 is due to the phasing out of incentives for conventional high-efficiency gas space and water heating equipment. The increase in GHG emissions reductions from 2024 to 2027 generally reflects the increase in advanced DSM as FEI's programs increase participation in these measures as well as increased program supports in the Industrial Program Area.

Table 1-3: Planned Energy Savings & GHG Emission Reductions from DSM

Indicator	Year	Total Incremental Gas Savings (GJ/yr)	GHG Emission Reductions (t CO2e/yr)[1]
Net Incremental Annual Gas Savings and GHG Reductions	2023	1,601,386	82,632
	2024	860,118	44,382
	2025	887,737	45,807
	2026	1,021,299	52,699
	2027	1,127,874	58,198
	2024 – 2027	**3,897,028**	**201,087**
Lifetime Net Gas Savings and GHG Reductions[2]		14,433,377	744,762

Notes to Table:

1 Net incremental gas savings are after consideration of free ridership and spill over. GHG reductions are based on the long run combustion emission factor of 0.0516 t CO2e/GJ for natural gas from the Ministry of Environment & Climate Change Strategy.

2 Lifetime in this context refers to including the entire stream of savings from measures supported between 2024 and 2027 into the future (by measure life) and annualizing that to present time to show the total value of the stream of savings.

1.4 The DSM Plan Reflects Stakeholder Feedback

The 2024-27 DSM Plan Report (Appendix A) was developed with the help of information gathered through consultation with various program stakeholders and interested parties, including FortisBC's Energy Efficiency and Conservation Advisory Group (EECAG), as described in detail in Section 4.1. As with previous plans, FEI undertook an in-depth and varied consultation process to ensure that the plan includes a fair representation of stakeholder and customer interests. FEI considered and assessed key learning from these consultations as part of its program planning, including ideas for program design and how to evolve and expand program reach. The feedback received from these consultations suggest general endorsement for how DSM is managed and operated by FEI.

1.5 *CONSISTENT WITH ENERGY OBJECTIVES, AND MEETS COST EFFECTIVE AND ADEQUACY REQUIREMENTS*

FEI's proposed DSM expenditures schedule is consistent with British Columbia's energy objectives and meets the adequacy and cost-effectiveness requirements of the amended DSM Regulation.

2. APPROVALS SOUGHT

FEI seeks an order pursuant to section 44.2(3) of the UCA accepting the 2024-2027 DSM expenditures schedule set out in Table 1-1 of the Application, with total DSM expenditures of $626.7 million for 2024-2027.

In addition, FEI is seeking the following approvals:

- continuation of its existing funding transfer rules, as set out in Section 8.1.1 of the Application;
- continuation of the previous funding carryover rules with one proposed change, as set out in Section 8.1.2 of the Application;
- continuation of the variance allowance rule on total portfolio expenditures, as set out in Section 8.1.3 of the Application; and
- forecast rate base additions accounting treatment, as set out in Section 8.2 of the Application.

A draft Order is attached as Appendix C.

3. FEI HAS RESPONDED TO BCUC DIRECTIVES

BCUC Decision and Order G-45-23 on FEI's 2023 DSM Plan Expenditures Application provided the following directive at page 25:

> In follow-up to the Panel Discussion on cost-effectiveness, the **Panel directs FEI to provide information on the avoided cost of gas used in the calculation of DSM cost-effectiveness in future DSM expenditure schedule applications.**

FEI provides the following response.

In accordance with section 3 of the June 2023 update to the DSM Regulation, the avoided cost of gas that FEI used to calculate cost-effectiveness in the DSM Plan (with the exception of Legacy Expenditures) is equal to $34.07 per GJ in the 2023/2024 fiscal year (and increases each year by the annual average All-items Consumers Price Index for British Columbia), plus the avoided cost which is calculated based on the estimated avoided cost of distribution in 2023 of $0.59/GJ (increases by 2.4 percent each year to account for estimated inflation).

For Legacy Expenditures, the avoided cost of gas used to calculate cost-effectiveness in the 2024-2027 DSM Plan has four components: (1) the commodity cost; (2) midstream cost; (3) avoided cost of distribution; and (4) carbon tax. 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. The avoided cost of distribution is similar as above. The carbon tax reflects the current Government of British Columbia carbon tax rate of $65/tonne of carbon.

The 35-year forecast of avoided cost of gas is included in Table 3-1.

Table 3-1: Avoided Cost of Gas Used in the 2024-2027 DSM Plan, Including Inflation

Year	FEI Incremental Cost of Gas, Utility Cost Test ($/GJ)	FEI Incremental Cost of Gas, Legacy Expenditures ($/GJ)	Year	FEI Incremental Cost of Gas, Utility Cost Test ($/GJ)	FEI Incremental Cost of Gas, Legacy Expenditures ($/GJ)
2024	$34.07	$6.14	2047	$59.80	$8.91
2025	$35.49	$6.59	2048	$61.24	$9.03
2026	$36.34	$6.82	2049	$62.71	$9.16
2027	$37.21	$6.88	2050	$64.21	$9.28
2028	$38.11	$7.00	2051	$65.75	$9.41
2029	$39.02	$7.11	2052	$67.33	$9.54
2030	$39.96	$7.20	2053	$68.95	$9.67

Year	FEI Incremental Cost of Gas, Utility Cost Test ($/GJ)	FEI Incremental Cost of Gas, Legacy Expenditures ($/GJ)	Year	FEI Incremental Cost of Gas, Utility Cost Test ($/GJ)	FEI Incremental Cost of Gas, Legacy Expenditures ($/GJ)
2031	$40.92	$7.29	2054	$70.60	$9.80
2032	$41.90	$7.38	2055	$72.30	$9.94
2033	$42.91	$7.47	2056	$74.03	$10.08
2034	$43.94	$7.56	2057	$75.81	$10.22
2035	$44.99	$7.65	2058	$77.63	$10.37
2036	$46.07	$7.75	2059	$79.49	$10.52
2037	$47.17	$7.84	2060	$81.40	$10.52
2038	$48.31	$7.94	2061	$83.35	$10.52
2039	$49.47	$8.04	2062	$85.35	$10.52
2040	$50.65	$8.14	2063	$87.40	$10.52
2041	$51.87	$8.24	2064	$89.50	$10.52
2042	$53.11	$8.35	2065	$91.65	$10.52
2043	$54.39	$8.46	2066	$93.84	$10.52
2044	$55.69	$8.57	2067	$96.10	$10.52
2045	$57.03	$8.68	2068	$98.40	$10.52
2046	$58.40	$8.80	2069	$100.77	$10.52

Please refer to Section 6.1 of the Application for additional details.

4. THE 2024-2027 DSM PLAN

In the following sections, FEI describes:

- FEI's consultation with stakeholders as part of the development of the 2024-2027 DSM Plan;
- FEI's forecast of DSM expenditures by program area and the major changes to each program area as a result of the amended DSM Regulation;
- FEI's new and previously accepted programs; and
- FEI's DSM guiding principles.

4.1 *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;
- 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 approximately 80 consultation interactions related to the DSM Plan. Examples of consulted entities include: communities, customers, contractors, manufacturers, Indigenous groups, energy advisors, interest groups, partners, program implementers and the EECAG. Consultation was undertaken through workshops, webinars, surveys and individual outreach. FEI also provided confidential draft versions of the DSM Plan to EECAG members for review and input.

Key learning from these consultations was considered and assessed within program plans and included ideas for program design and how to evolve and expand program reach. Consultations consistently endorsed how DSM is managed and operated by FEI. None of the consultations suggested that any significant change in approach was required.

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

Table 4-1: Stakeholder Feedback and Incorporation into DSM Plan

Key Feedback	FEI Actions to Incorporate in DSM Plan
Expand Indigenous-specific support	• Proposed to establish a dedicated program area for programs to support Indigenous customers • Proposed new Strategic Energy Management offer for Indigenous communities • Increased year-over-year funding for Indigenous programming (residential and commercial) • Proposed offer for dual fuel hybrid heating systems in residential retrofit and new construction projects • Proposed offer for non-prescriptive residential retrofits
Further support for energy efficient opportunities in the Industrial sector	• Proposed increasing support for Strategic Energy Management • Proposed expanding offers for pipe and tank insulation • Proposed expanding support for steam trap audit, replacement, and maintenance
Support hybrid systems and gas heat pump adoption	• Proposed new residential dual fuel hybrid heat pump offer for existing homes • Proposed expanding support for dual fuel hybrid heat pumps in residential new construction • Proposed new commercial dual fuel hybrid heat pump rooftop unit offer • Proposed to expand and improve existing commercial gas heat pump offer • Proposed new commercial hydronic heating hybrid offer • Proposed continuing research in Innovative Technology program area on dual fuel hybrid systems and gas heat pumps
Provide dedicated assistance for customers throughout life-cycle of project across all sectors (i.e., energy concierge type support in residential, commercial, and industrial - particularly in harder to reach groups such as low-income households and Indigenous communities)	• Proposed new residential offer that provides optional specialized consulting support for customers pursuing deeper retrofits • Proposed continuing implementation support in Rental Apartment Program • Proposed a new Strategic Energy Management offer for Indigenous communities • Proposed a new Strategic Energy Management offer for commercial customers

Key Feedback	FEI Actions to Incorporate in DSM Plan
	• Proposed expanding funding for the Self Install offer with access to dedicated support and continued investment for the Direct Install offer for low income customers
Provide strong incentives to encourage complex retrofits	• Proposed new residential offer to encourage deeper retrofits • Proposed increasing commercial and industrial performance incentives to encourage more building envelope, comprehensive retrofits, including but not limited to custom dual fuel hybrid retrofits
More education, training and resources for customers, contractors and consultants	• Proposed new digital tools to educate customers on their energy use and retrofit options • Proposed additional education opportunities for contractors in the Trade Ally Network and mechanical engineers to support the adoption of advanced DSM measures • Proposed additional funding for education initiatives in the residential, commercial, and school sectors
Support trades outside of mechanical contractors	• Proposed expanding support and education opportunities for Energy Advisors and general contractors • Proposed proving incentives for customers to access Energy Advisors in residential retrofit and new construction offers
Continue to support specific offers for rental apartments	• Proposed eligible direct install measures in Rental Apartment Program
Maintain simplicity in program offers and reduce barriers wherever possible	• Minimized new program additions and including new supports within existing programming
Review of Evaluation, Measurement and Verification best practice	• Received feedback indicated that FortisBC's Evaluation Framework is in alignment with industry standards and guidelines • Proposed continuing consistent approach to conduct process and impact evaluations
Desire for alignment with BC Hydro and Provincial program offers	• Proposed to continue to partner with BC Hydro and Ministry of Energy, Mines and Low Carbon Innovation on Home Renovation Rebate, Continuous Optimization (i.e. recommissioning), and Strategic Energy Management programs • Proposed to continue to partner with BC Hydro on programs for low income customers, charities, non-profit housing providers, and Indigenous Communities • Proposed to continue to pursue dialogue with other program entities to streamline offers where possible

Based on the consultation process, FEI considers that the DSM Plan includes a fair representation of stakeholder and customer interests and is well positioned to achieve the forecast energy savings.

4.2 DSM EXPENDITURES FORECAST BY PROGRAM AREA

FEI's proposed DSM expenditures and savings for the 2024-2027 period, as set out in Appendix A, include the following program areas: Residential, Commercial, Industrial, Low Income, Indigenous, Conservation Education and Outreach, Innovative Technologies, Enabling Activities, Legacy Expenditures, and Portfolio Activities. The 2024-27 DSM Plan Report (Appendix A) provides program details and projected cost-effectiveness results for FEI's proposed portfolio of DSM program area activity over the DSM Plan period.

Table 4-2 and Table 4-3 below provide forecast 2024-2027 DSM expenditures and associated savings by program area in comparison to FEI's 2023 accepted DSM expenditures and savings. Please refer to Table 4-4 for an explanation of key changes by program area.

Table 4-2: 2024–2027 DSM Plan Expenditures Compared to the 2023 DSM Plan Expenditures

Program Area	Total Utility Expenditure (000s)[1]					
	2023	2024	2025	2026	2027	2024 - 2027 Total
Residential	$43,994	$33,197	$40,830	$48,263	$56,621	$178,910
Commercial	$26,570	$8,726	$12,958	$17,799	$21,151	$60,635
Industrial	$6,848	$7,585	$8,071	$8,963	$9,600	$34,219
Low Income	$13,251	$8,366	$9,753	$11,826	$14,676	$44,621
Indigenous	-	$2,704	$4,247	$5,481	$6,452	$18,885
Conservation Education and Outreach	$9,713	$14,652	$14,794	$15,433	$15,986	$60,865
Innovative Technologies	$25,960	$35,117	$20,807	$15,239	$18,059	$89,222
Enabling Activities	$12,010	$15,042	$12,451	$11,486	$11,265	$50,244
Portfolio Activities	$2,730	$5,281	$5,687	$5,507	$5,749	$22,223
Legacy Expenditures[2]	-	$36,200	$16,995	$8,401	$5,282	$68,878
All Programs	**$141,077**	**$166,870**	**$146,593**	**$148,398**	**$164,842**	**$626,703**
Year-over-year variance	0	18%	-12%	1%	11%	

Notes to Table:

[1] Totals include inflation and may slightly differ due to rounding; accepted 2023 expenditures are pursuant to Order G-45-23.

[2] Indigenous and Legacy Expenditures are new program areas not included in the 2023 DSM Plan based on amended DSM Regulation.

Table 4-3: 2024–2027 DSM Plan Savings Compared to the 2023 DSM Plan Savings

Program Area	Utility Incremental Savings (GJ/Year)[1]					
	2023	2024	2025	2026	2027	2024-2027 Total
Residential	250,319	166,655	187,759	208,552	232,596	795,562
Commercial	563,816	93,986	138,321	185,927	222,140	640,373
Industrial	628,423	365,533	394,550	473,459	516,985	1,750,526
Low Income	77,408	50,684	56,992	64,579	75,588	247,843
Indigenous		16,076	22,237	27,421	29,225	94,959
Conservation Education and Outreach[2]	81,420	20,000	30,000	30,000	30,000	110,000
Innovative Technologies	-	-	-	-	-	-
Enabling Activities	-	-	-	-	-	-
Portfolio Activities	-	-	-	-	-	-
Legacy Expenditures[3]	-	147,185	57,878	31,361	21,340	257,765
ALL Programs	**1,601,386**	**860,119**	**887,737**	**1,021,299**	**1,127,874**	**3,897,028**
Year over year variance	0	-46%	3%	15%	10%	

Notes to Table:

[1] Totals may slightly differ due to rounding, accepted 2023 savings are pursuant to Order G-45-23.

[2] These projected energy savings start in 2024 and are applicable only to the Customer Engagement Tool and the portfolio overall. All other energy savings from the Conservation Education and Outreach Program area are not estimated.

[3] Indigenous and Legacy Expenditures are new program areas not included in the 2023 DSM Plan based on amended DSM Regulation.

As shown in Table 4-2, the DSM Plan includes initially higher expenditures in 2024, followed by a levelling out of expenditures in 2025 and 2026, before increasing again in 2027. A key driver of the expenditure levels is the amount of support necessary to accelerate the adoption of advanced DSM measures that currently have low rates of market adoption. The incentive levels proposed for advanced DSM measures cover a higher percentage of a project's overall and incremental cost when compared to FEI's past support for conventional high-efficiency gas space and water heating equipment, such as furnaces and boilers. Higher incentive levels for advanced DSM measures are proposed to encourage early adoption and increase participation to drive market transformation and increase accessibility. FEI considers multiple factors when determining incentive levels for measures across various program areas. These factors include influencing the adoption of the measure, assessing the overall cost-effectiveness of programs which may encompass multiple measures, engaging with key stakeholders such as contractors, customers, and interest groups to understand barriers and decision-making criteria while leveraging program expertise to ensure offers are comparable.

As shown in Table 4-3 above, FEI is forecasting a decrease in DSM Plan savings compared to 2023. The initial savings decline is due to discontinuing incentives for conventional high-efficiency gas space and water heating equipment. Further, while an individual advanced DSM project may save a customer more energy (e.g., dual fuel hybrids save more gas than a conventional gas furnace), the lower customer participation forecast (i.e., adoption rate) reduces the overall portfolio energy savings that FEI is able to achieve. FEI has forecast savings increasing from 2024 to 2027, ultimately reaching levels closer to previous DSM Plans, as Industrial energy efficiency continues to grow and forecast participation in advanced DSM increases. FEI expects energy savings to continue to grow in future DSM Plan periods as the new advanced DSM measures become more market mature.

The following table sets out the specific key considerations by program area that resulted in the forecast expenditures and savings for 2024-2027. Further details on the forecast expenditures for each program area can be found in Appendix A.

Table 4-4: Explanation of Key Changes for the 2024-2027 DSM Plan by Program Area

Program Area	Key Changes
Residential	• The discontinuation of conventional high-efficiency gas space and water heating equipment programming leads to a reduction of forecast expenditures and expected savings from this area when compared to 2023, particularly within the New Home program. • FEI plans for expenditures to increase over the plan period with substantial expenditures in dual fuel hybrid system offers across residential programs.
Commercial	• The discontinuation of conventional high-efficiency gas space and water heating equipment programming leads to a reduction of forecast expenditures and expected savings from this area when compared to 2023, particularly in prescriptive and new construction offers. • The Small New Construction Offer is incorporated into the Performance - New Buildings Program. Overall, the Performance - New Building Program is expected to have a ramp down in expenditures due to buildings with conventional space and water heating systems no longer being eligible for incentives. • Expenditures increase over the plan period primarily due to support for dual fuel hybrid systems and deeper retrofits and gas heat pumps, across commercial programs. • Additional expenditures and savings are expected with the new commercial Strategic Energy Management (SEM) offer within the Performance – Existing Buildings Program.
Industrial	• FEI's plan includes an increase in expenditures within the prescriptive offers such as steam trap replacements and insulation, as well as an increase in expenditures in industrial SEM. • Savings from the forecast expenditures within this Program Area are contributing to the climb back in estimated incremental annual savings of 1 PJ by 2027.
Low Income	• Conventional high-efficiency gas space and water heating equipment, such as furnaces, are discontinued from the Direct Install Program.

Program Area	Key Changes
	• Forecast expenditures in new construction are expected to decline; previously this expenditure was under the Performance Program and will now be seen under the Support Program. • Additional expenditures include expenditures in dual fuel hybrid systems and gas heat pumps, and the continuation of conventional high-efficiency gas water heating.
Indigenous	• The increasing expenditures in this Program Area are driven by forecast expenditures in dual fuel hybrid systems, increased incentives for New Construction Indigenous offers, and the continuation of conventional high-efficiency gas space and water heating equipment where allowable until the end of the plan period. • Additional expenditures include the Indigenous-focused Strategic Energy Management offer and increased support in the other existing Programs.
Conservation, Education and Outreach	• FEI has increased investment within this Program Area for online and digital tools to enhance and potentially expand customer engagement and assessment tools.
Innovative Technologies	• This Program Area continues support for pilots, including for residential and commercial deep energy retrofits, residential and commercial dual fuel hybrid heating, and residential and commercial heat pumps. • The forecast expenditures fluctuate due to pilot lifecycles.
Enabling Activities	• FEI is increasing expenditures for capacity-building to support the transition to advanced DSM, and a continuation of supporting offers in the Commercial and Community Energy Specialists Program. • In line with the reduction in expected expenditures for conventional high-efficiency gas space and water heating equipment within the New Home Program, there is a decline in incentive expenditures in Codes and Standards, which supported adoption of Part 9 of the BC Energy Step Code.
Portfolio Level Activities	• Expenditures for all evaluation activities, which were previously included separately in each program, are now consolidated in this Program Area. • The expenditures for evaluation activities increases proportionately with the overall portfolio expenditure.
Legacy Incentives	• Legacy expenditures decline from 2024 to 2027 as expenditures in this Program Area have already been committed and there are no new commitments or offers being proposed on conventional high-efficiency gas space and water heating equipment.

4.3 *NEW AND PREVIOUSLY APPROVED PROGRAMS*

The program area structure listed in the DSM Plan includes the existing programs from the 2023 DSM Plan, in addition to the new Indigenous and Legacy Expenditures Program Areas. In some cases, measures have been removed or added within programs, as detailed in Table 4-4 of the Application. Any new or removed measures are cited in the applicable program area section of Appendix A. The Legacy Expenditures Program Area section does not introduce new programming or measures, but outlines class B demand-side measures within 2023 programs which will continue to see expenditures within the DSM Plan period.

Table 4-5 below lists the programs and activities from the DSM Plan compared to how they have been most recently labeled in the 2023 DSM Plan. Appendix A provides additional program details and descriptions.

Table 4-5: Program Area Structure

2023 DSM Plan	2024-2027 DSM Plan
Residential	
Home Renovation Rebate Program	Home Renovation Rebate Program
New Home Program	New Home Program
Commercial	
Prescriptive	Prescriptive
Performance Program – Existing Buildings	Performance Program – Existing Buildings
Performance Program – New Buildings	Performance Program – New Buildings
Rental Apartment Efficiency Program (RAP)	Rental Apartment Efficiency Program (RAP)
Industrial	
Prescriptive Program	Prescriptive Program
Performance Program	Performance Program, **now includes Strategic Energy Management Program**
Strategic Energy Management Program	Included within Performance Program, **no longer stand-alone program**
Low Income	
Self Install Program	Self Install Program
Direct Install Program	Direct Install Program
Prescriptive Program	Prescriptive Program
Support Program	Support Program, **now includes expenditures previously under Performance Program**
Performance Program	Included within Support Program, **no longer stand-alone program**
Indigenous	
Program Area not included in 2023. During 2023 and prior DSM Plans, measures for Indigenous communities were included in programs within the Residential, Commercial, Low Income, Conservation Education and Outreach and Enabling Activities Program Areas.	**Direct Install**
	Prescriptive Program
	Performance Program
	Conservation Education and Outreach Program
	Community Energy Specialist
Conservation Education & Outreach	
Customer Engagement Tool	Customer Engagement Tool
Residential Education Program	Residential Education Program
Commercial Education Program	Commercial Education Program

2023 DSM Plan	2024-2027 DSM Plan
School Education Program	School Education Program
Innovative Technologies	
Technology Screening Studies	Technology Screening Studies
Pilot Projects – Dual fuel Hybrid Heating	**Condensed into Pilot Projects**
Pilot Projects – Gas Heat Pump	
Pilot Projects – Other Projects	
Pilot Projects – Deep Retrofits	Deep Energy Retrofits
Enabling Activities	
Trade Ally Network	Trade Ally Network
Codes and Standards	Codes and Standards
Conservation Potential Review	Conservation Potential Review
Reporting Tool & Customer Application Portal	Reporting Tool & Customer Application Portal
Customer Research	Customer Research
Commercial Energy Specialist Program	Commercial Energy Specialist Program
Community Energy Specialist Program	Community Energy Specialist Program
Portfolio Level Activities	
Portfolio Level Activities	Portfolio Level Activities
Previously provided under each program separately, now included as a line item under the portfolio section.	**Evaluation**
Legacy Expenditures	
Class B measures previously embedded within the Residential, Commercial and Low Income Program Areas, which are now subject to s. 5 of the DSM Regulation.	**Legacy Expenditures**

4.4 *DSM GUIDING PRINCIPLES*

FEI's DSM Plan was guided by FEI's DSM guiding principles, which are listed below.

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 expenditures schedule plans and results will be analyzed on a program, sector and portfolio level basis, with acceptance based at the portfolio level.
4. The UCT result 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 expenditures schedules will be multi-year so as to create the funding certainty necessary to support effective implementation in the marketplace.

10. Programs will support market transformation by incenting eligible 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 (EECAG), 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.

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

5. DSM PLAN MEETS THE REQUIREMENTS OF THE LEGAL FRAMEWORK

5.1 *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 2024-2027 DSM Plan Report (Appendix A), all proposed activity qualifies as "demand side measures" as defined under the UCA. Section 44.2(2) of the UCA provides that demand-side measure expenditures must be the subject of a BCUC-accepted expenditures schedule before they are included in permanent rates.

Pursuant to section 44.2(3) and (4), the BCUC must accept the expenditures 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 expenditures schedule put forward by a public utility other than BC Hydro and Power Authority (BC Hydro) is in the public interest, the BCUC 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*[16];
- 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 set out in the UCA are addressed below in Sections 5.2, 5.3, 5.4, 5.5 and 6 of the Application.

5.2 *DSM PLAN SUPPORTS BRITISH COLUMBIA ENERGY OBJECTIVES*

BC'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 5-1 below.

[16] 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 5-1: 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%;	As described in Appendix A to the Application, the DSM Plan will implement demand-side measures as defined in the *Clean Energy Act*.
(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;	The DSM Plan includes expenditures on Innovative Technology projects, such as development and adoption of gas heat pumps. See Appendix A, Section 9.
(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;	The DSM Plan programs will result in gas savings and commensurate reductions in greenhouse gas emissions of 201,087 tonnes CO_2e, which will contribute to the Province's efforts to achieve its GHG reduction targets.
(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. Local government and institutional strategic energy planning are supported through Community Education and Outreach and Enabling Activities. See Appendix A, Sections 8 and 10. Expenditures to support and further develop the BC Energy Step Code are included within the Residential, Commercial, Low Income and Indigenous Program Areas and the Community Energy Specialists program. See Appendix A, Sections 3, 4, 6, 7, and 10.
(k) to encourage economic development and the creation and retention of jobs;	FEI's DSM Programs have a broad impact on the provincial economy through improving the productivity of businesses. FEI programs also create new opportunities for investment and employment to support energy efficiency in BC. See Appendix D, Section 7.3.

5.3 EXPLANATION OF DIFFERENCES BETWEEN DSM PLAN AND LONG-TERM GAS RESOURCE PLAN

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

FEI filed its 2022 LTGRP with the BCUC on May 9, 2022. The 2022 LTGRP is currently under review by the BCUC and covers a planning horizon from its 2019 base year until 2042.

The DSM Plan is broadly informed by both the results from the 2021 Conservation Potential Review (CPR) and the 2022 LTGRP. Section 5 of the 2022 LTGRP examines the impact of FEI's long-term forecast for DSM activity on gas demand, projected gas delivery rates, and GHG emissions across alternate future scenarios over the 20-year LTGRP planning horizon and examines the impact of three different levels of DSM expenditures within the LTGRP planning scenario – FEI's Diversified Energy (Planning) Scenario. This analysis of long-range DSM potential presented in the LTGRP is based on the findings of FEI's 2021 CPR (included as Appendix D to the Application and Appendix C-1 of the 2022 LTGRP).

The selection of the High DSM setting in the 2022 LTGRP Diversified Energy (Planning) Scenario was based on both the availability of cost-effective demand-side measures, the objectives of FortisBC's Clean Growth Pathway to 2050,[17] and the need for FEI to reduce GHG emissions in alignment with the Roadmap. Section 9.2.1 of the 2022 LTGRP also acknowledges that, since the 2021 CPR was completed, additional information had emerged on key advanced energy efficiency technologies (e.g., deep energy retrofits, gas heat pumps and hybrid heating systems) that were not modelled in the 2021 CPR. FEI includes these important technologies along with the measures included in the 2022 LTGRP High DSM expenditures setting as part of FEI's plan to realize energy savings and reduce GHG emissions over the planning horizon.

The 2022 LTGRP was also prepared and filed before the June 2023 amendments to the DSM Regulation. Accordingly, the 2022 LTGRP and CPR scenarios included savings related to conventional gas space and water heating systems that will be phased out beginning in 2024. Similarly, the LTGRP and CPR used a TRC and mTRC economic screen for DSM measures, while the amended DSM Regulation is subject to a UCT using the avoided cost of renewable and low-carbon gas stipulated in the GGRR.

FEI will include the recent developments of emerging advanced DSM measures and the changes to the DSM Regulation as part of its next CPR and LTGRP. The following section compares the DSM Plan against the 2022 LTGRP DSM Settings. These settings include a low, medium, and high scenario which reflect different rate of expenditures which produce a modelled savings potential.

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[17] Details can be found at: https://www.cdn.fortisbc.com/libraries/docs/default-source/about-us-documents/clean-growth-pathway-brochure.pdf

5.3.1 The 2024-2027 DSM Plan and 2022 LTGRP DSM Settings

Since the 2017 LTGRP, FEI has been increasing its annual investments in DSM programs to reduce energy demand from customers consistent with its commitment to the Clean Growth Pathway. Over the 2019-2023 planning period, FEI forecasts an investment of $496 million in DSM programs. Under the amended DSM Regulation, FEI is proposing to keep expenditures relatively consistent with 2023 DSM Plan expenditures as FEI manages the transition out of high-efficiency conventional gas space and water heating equipment and to advanced DSM measures like dual fuel hybrids, gas heat pumps and deeper retrofits. Due to the removal of incentives for most high-efficiency conventional gas space and water heating systems, FEI is no longer forecasting expenditures and energy savings in line with the High DSM setting in the 2022 LTGRP's Diversified Energy (Planning) Scenario.

In developing the DSM Plan, FEI still considers the inputs and results of the 2022 LTGRP DSM analysis – which was based on the 2021 CPR. While there is generally alignment with the LTGRP on measures not impacted by the changes to the DSM Regulation, the DSM Plan also addresses policy and technology advancements that are changing rapidly and have evolved since the CPR and the 2022 LTGRP analysis were completed. Table 5-2 compares the savings proposed in the DSM Plan to the 2022 LTGRP DSM Scenarios by sector.

Table 5-2: Comparison of 2024-2027 DSM Plan and LTGRP Diversified Energy Planning DSM Settings

Forecast Scenario	Incremental Energy Savings (PJ/yr)				Expenditures, Including Inflation ($Ms)
	Residential[1]	Commercial	Industrial	Total	Total
2024-2027 DSM Plan	1.4	0.8	1.8	**3.9**	**$626.7**
2022 LTGRP Low DSM Setting	0.7	0.9	0.6	**2.1**	**$57.3**
2022 LTGRP Med DSM Setting	2.6	1.0	0.9	**4.3**	**$365.1**
2022 LTGRP High DSM Setting	1.8	2.7	1.3	**5.8**	**$887.2**

[1] Includes savings in the Low Income, Indigenous, Conservation, Education and Outreach Program Areas.

The overall expenditures proposed in the DSM Plan generally fall between the 2022 LTGRP Medium and High DSM Settings, while the energy savings generally align with the Medium DSM Setting. The DSM Plan expenditures and savings are less than the 2022 LTGRP High DSM Setting from 2024 to 2027 for the following reasons:

- The Roadmap, which was published after the 2022 LTGRP's DSM analysis was completed, signaled a policy shift away from supporting many traditional high-efficiency gas equipment DSM measures and towards advanced DSM activities. While the technical potential for space and domestic water heating measures remains the same, the available measures FEI can incent to meet that potential are early in their commercialization, requiring a period of ramp up and significant expenditure investment to accelerate initial market adoption.

- The DSM Plan incorporates a faster transition toward more advanced gas DSM measures through higher expenditures for program incentives and innovative technology pilots than was incorporated in the CPR and the 2022 LTGRP DSM analysis. The faster transition is a direct consequence of the amended DSM Regulation.

- Non-space and non-water heating measures (including the Industrial sector) in the DSM Plan remain consistent with the savings and expenditures assumptions of the High DSM Scenario.

- The 2022 LTGRP analysis provides a long-term outlook of DSM potential, using 2019 as a base year for its analysis. It does not address the design of DSM programs, including ramp up requirements for new measures and programs or potential ramp down of old measures.

The 2022 LTGRP projects that, as part of a long-term plan for implementing DSM activities, FEI will continue a portfolio of DSM initiatives that is cost-effective and adequate pursuant to the DSM Regulation, consisting of residential, commercial, industrial, low income, Indigenous, innovative technologies, conservation education and outreach, as well as enabling DSM activities. The 2022 LTGRP contemplates that FEI will implement this long-term plan via successive DSM plans that consider the prevailing market, regulatory and end-use technology conditions.

While the expenditures and savings of the DSM Plan are below the High DSM Scenario in the LTGRP, it continues to be a cost-effective and adequate portfolio that includes many of the initiatives presented in the 2022 LTGRP and reflects a consistent level of expenditures when compared to prior years.

5.3.2 Adequacy Pursuant to the DSM Regulation

The adequacy requirements of the DSM Regulation apply to long-term resource plans filed under section 44.1 of the UCA. Consistent with FEI's 2022 LTGRP, Table 5-3 below shows how the DSM Plan meets the adequacy requirements of section 3 of the DSM Regulation.

Table 5-3: DSM Plan Adequacy with DSM Regulation

DSM Regulation	DSM Plan Compliance
Section 3 – Adequacy (1) 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 of the following:	
(a) a demand-side measure intended specifically (i) to assist residents of low-income households to reduce their energy consumption, or	The Low Income Program Area, as described in Section 6 of Appendix A, and Appendix B to the Application, outlines FEI's plans to continue to offer

DSM Regulation	DSM Plan Compliance
(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*, (B) Repealed (C) the low-income households occupying the housing, (D) a housing provider referred to in clause (A), (E) Repealed	programs that help low-income households and housing providers save energy.
(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 Section 4 of Appendix A, and Appendix B to the Application, 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 (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.	Conservation Education and Outreach, as described in Section 8 of Appendix A, and Appendix B to the Application, includes continuation of the School Education Program which includes programming for grade schools and post-secondary institutions in FEI's service area.
(e) one or more demand-side measures to provide resources as set out in paragraph (g) of the definition of "class A demand-side measure", 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;	Enabling Activities, as described in Section 10 of Appendix A to the Application, includes Codes & Standards, which forecasts expenditures of $6.3 million to meet the 1 percent adequacy requirement. This equates to 1 percent of the overall forecast portfolio expenditures over the DSM Plan period.

DSM Regulation	DSM Plan Compliance
(f) one or more demand-side measures intended to result in the adoption by local governments and first nations of a step.	Measures to support the BC Energy Step Code are included within the following programs listed in the DSM Plan: • Residential New Home Program • Commercial Performance Program – New Buildings • Enabling Activities – Codes & Standards • Enabling Activities – Community Energy Specialist Program
(g) a demand-side measure intended specifically to reduce energy consumption in any of the following: (i) housing owner or operated by an Indigenous governing body or located on reserve land; (ii) a public building owned or operated by an Indigenous governing body.	Section 7 of Appendix A to the Application describes the Indigenous Program Area, a new program area in the DSM Plan that incorporates programming supporting Indigenous customers, including buildings owned by Indigenous governing bodies. In the 2023 DSM Plan, this programming was included in the Residential, Commercial, and Low Income Program Areas.

5.4 MEASURES IN THE DSM PLAN COMPLY WITH THE AMENDED DSM REGULATION

As noted above, under the amended DSM Regulation, “class B demand-side measures”, which are measures for conventional high-efficiency gas space and water heating equipment, are effectively deemed to be not cost-effective as they must have a UCT of 50 or greater to be cost effective. Accordingly, FEI is not proposing any class B demand-side measures, unless they are Legacy Expenditures permitted by section 5 of the DSM Regulation. Outside the Legacy Expenditures program area, all FEI measures that encourage the acquisition or installation of gas-fired space or domestic water heating equipment are excluded from the definition of “class B demand-side measure” in section 1.1 of the DSM Regulation. These points are detailed in Tables 5-4 and 5-5 below.

5.4.1 FEI’s Proposed Non-Legacy Demand-Side Measures Are Excluded from the Definition of Class B Demand-Side Measures

Table 5-4 below sets out how the DSM Plan complies with the treatment of class B demand-side measures in the DSM Regulation.

1 **Table 5-4: DSM Plan Compliance with the Definition of Class B Demand-Side Measure**

DSM Regulation	DSM Plan Compliance
Section 1.1(1) – Meaning of Class B Demand-Side Measures A demand-side measure is a class B demand-side measure if it	
(a) Directly or indirectly encourages the acquisition or installation of gas-fired space or domestic water heating equipment; and (b) Is not excluded under subsection (2) from the definition of "class B demand-side measure".	All of FEI's measures that encourage the acquisition or installation of gas-fired space or domestic water heating equipment are either excluded from the definition of "class B demand-side measure" or are a legacy expenditure permitted under section 5 of the DSM Regulation.
Section 1.1(2) – Exclusions from the Definition of Class B Demand-Side Measures The following demand-side measures are excluded from the definition of "class B demand measure":	
(a) a demand-side measure that encourages the acquisition or installation of a domestic water heating system that (i) consists of an electric heat pump and gas-fired equipment, and (ii) has a modelled seasonal coefficient of performance equal to or greater than 1;	While FEI is not proposing any prescriptive[18] measure as characterized by this subsection, should any measure be proposed as part of a performance program, the modelled measure seasonal coefficient of performance will be greater than 1.
(b) a demand-side measure that encourages the acquisition or installation of gas-fired heat pump that has a modelled seasonal coefficient of performance equal to or greater than 1;	FEI is proposing to include incentives for gas-fired heat pumps in the Residential, Commercial and Low Income Program Areas, as described further in Sections 3, 4, and 6 of Appendix A, and within Appendix B to the Application. The minimum eligibility requirements for eligible gas-fired heat pumps will result in a modelled measure seasonal coefficient of performance greater than 1.
(c) a demand-side measure that encourages the acquisition or installation of a gas-fired radiant tube or unit heater for use in a building that is (i) described in Article 1.3.3.2 or Sentence 1.3.3.3 (1) (d) of Division A of the building code[19], whether or not the building code applies to the building, and (ii) used for an industrial occupancy, as defined in the building code; (d) demand-side measure that encourages the acquisition or installation of a gas-fired radiant tube heater for use in a farm building, as defined in the building code;	FEI is proposing to include incentives for gas-fired radiant tube or unit heaters as part of the Commercial and Industrial Program Areas, described in Sections 4 and 5 of Appendix A, and Appendix B to the Application. The eligibility requirements of that measure will limit participation to garages, warehouses, agricultural facilities, and industrial facilities. Other commercial buildings will not be eligible for gas-fired radiant tube or unit heater incentives.

[18] A prescriptive incentive is a fixed incentive for a well-characterized energy efficiency measure. A performance or custom incentive is a variable or calculated incentive for a complex project or for a measure that requires additional analysis to understand its costs and savings.
[19] Refers to large commercial and industrial occupancies.

DSM Regulation	DSM Plan Compliance
(e) a demand-side measure that encourages the acquisition or installation of an integrated dual-energy space heating system for use in a location in climate zone 6, 7A, 7B or 8[20];	FEI is proposing to include incentives for dual fuel heat pump systems in the Residential, Commercial, Low Income and Indigenous Program Areas for customers in climate zones 6, 7A, 7B or 8, as described in Sections 3, 4, 6 and 7 of Appendix A, and Appendix B to Application.
(f) a demand-side measure that encourages the acquisition or installation of an integrated hybrid gas-fired heat pump system that has a modelled seasonal coefficient of performance equal to or greater than 1;	FEI is proposing to include incentives for gas-fired heat pumps in combination with conventional high-efficiency equipment in the Residential, Commercial, Low Income, Indigenous and Innovative Technologies Program Areas, as described in Sections 3, 4, 6, 7 and 9 of Appendix A, and Appendix B to the Application. The minimum eligibility requirements for eligible gas-fired heat pump combined with conventional high-efficiency equipment will result in a modelled measure seasonal coefficient of performance greater than 1.
(g) a demand-side measure referred to in section 3 (1) (a) or (g) (i) that, by an offer made before January 1, 2028 to provide money or services in kind, encourages the acquisition or installation of gas-fired domestic water heating equipment for use in a building described in Article 1.3.3.3 of the building code[21], whether or not the building code applies to the building, and (ii) that does not encourage the acquisition of installation of gas-fired space heating equipment other than (A) Gas-fired space heating equipment described in paragraph (b),(c),(d),(e) or (f) or (B) By a demand side measure described in paragraph (h) or (i);	FEI is proposing to include incentives in the Low Income and Indigenous Program Areas for conventional high-efficiency domestic hot water equipment for Part 9 customers,[22] as described in Sections 6 and 7 in Appendix A, and Appendix B to the Application. Conventional high-efficiency gas-fired domestic hot water incentives are not being proposed for any other customers, except those noted as a "legacy expenditure", as defined in section 5 of the DSM Regulation. See Section 11 of Appendix A to the Application for additional details.
(h) a demand-side measure referred to in section 3(1) (g) that (i) encourages the acquisition or installation of gas-fired space heating equipment for use in locations in climate zones 6, 7a, 7b and 8[23], and	FEI is proposing to include incentives for conventional high-efficiency gas-fired space heating equipment in the Indigenous Program Area for Part 9 customers (as defined in the BC Building Code) in climate zones 6,

[20] See https://www.betterhomesbc.ca/faqs/climate-zone/ for an explanation of each Climate Zone and a list of municipalities that are included in each zones.
[21] Article 1.3.3.3 of the BC building code defines Part 9 building, see Section 1.3. Divisions A, B and C of this Code (Division A – Part 1) (bcpublications.ca) for further detail.
[22] Part 9 buildings as defined in the BC building code Section 1.3. Divisions A, B and C of this Code (Division A - Part 1) (bcpublications.ca).
[23] See https://www.betterhomesbc.ca/faqs/climate-zone/ for an explanation of each Climate Zone and a list of municipalities that are included in each zones.

DSM Regulation	DSM Plan Compliance
(ii) does not encourage the acquisition or installation of gas-fired domestic water heating equipment other than (A) Gas-fired domestic water heating equipment described in paragraph (a) or (f) or (B) By a demand side measure described in paragraph (g);	7a, 7b and 8. See Section 7 of Appendix A, and Appendix B to the Application for additional details. Conventional high-efficiency gas-fired space heating incentives are not being proposed for any other customers, as defined in section 5 of the DSM Regulation. See Section 12 of Appendix A to the Application for additional details.
(i) a program that (i) encourages the acquisition or installation of integrated dual-energy space heating systems or use in locations in climate zones 4 and 5, but only if all of the integrated dual-energy space heating systems acquired or installed, when considered in aggregate, are, in the commission's opinion, likely to have an annual average seasonal coefficient of performance equal to or greater than 1.5, and (ii) does not encourage the acquisition or installation of gas-fired domestic water heating equipment other than (A) Gas-fired domestic water heating equipment described in paragraph (a) or (f), or (B) By a demand side measure described in paragraph (g).	FEI is proposing to include incentives for dual fuel heat pump systems in the Residential, Commercial and Low Income Program Areas for customers in climate zones 4 and 5, as described in Sections 3, 4 and 6 of Appendix A, and Appendix B to the Application. Eligibility requirements for equipment result in modelled measure seasonal coefficient of performance greater than 1.5.
Section 1.1(3) – New Construction	
For certainty, the definition of "class B demand-side measure" includes a demand-side measure that, by an offer of money or services in kind for the purpose of increasing energy efficiency in a new building may encourage the acquisition or installation of gas-fired space or domestic water heating equipment for use in a new building.	To be eligible for incentives in FEI's residential and commercial new construction offers, the buildings will be required to have a dual fuel heating system, gas heat pump or integrated gas heat pump system for space or water heating. To be eligible for incentives in FEI's low-income new construction offers, the buildings will be required to have a dual fuel heating system, gas heat pump or integrated gas heat pump system for space heating.

5.4.2 Legacy Expenditures Comply with the Amended DSM Regulation

Section 5 of the DSM Regulation is a transition provision, which enables the utility to fulfil commitments for incentives made under a prior DSM Plan for conventional high-efficiency gas space and water heating equipment that would otherwise no longer be deemed cost effective. Table 5-5 below sets out how the DSM Plan legacy expenditures comply with section 5 of the amended DSM Regulation.

Table 5-5: DSM Plan Compliance with DSM Regulation

DSM Regulation	DSM Plan Compliance
Section 5 – Transition	
(1) In this section: **"filed"** means filed under section 44.2 (1) of the Act; "**legacy expenditure**" means an expenditure a) in relation to a legacy measure, b) made by a public utility after the test period of the pre-filed expenditure schedule that includes an expenditure on the legacy measure, c) to provide a customer money or services in kind in return for the customer's action i. taken in relation to the legacy measure during the test period of the legacy measure, or ii. taken in relation to the legacy measure in response to a written commitment to the customer made by the public utility during the test period of the legacy measure; "**legacy measure**" means a demand-side measure in relation to which an expenditure is included in a pre-filed expenditure schedule; "**public utility**" does not include the authority; "**pre-filed expenditure schedule**" means a schedule (a) referred to in subsection (2) (a) , or (b) accepted before June 30, 2023 under section 44.2 (3) of the Act; "**test period**", when used in reference to a pre-filed expenditure schedule, means the period addressed by the pre-filed expenditure schedule. (2) In considering the following under section 44.2 (5) (d) or (5.1) (d) of the Act, the commission must apply sections 1, 3 and 4 of this regulation, as they read immediately before June 30, 2023: (a) an expenditure schedule filed before May 1, 2023 and in relation to which the commission has not, before June 30, 2023, made a final determination under section 44.2 (3) of the Act; (b) a legacy expenditure that is the subject of an expenditure schedule filed after May 1, 2023.	FEI intends to support two types of legacy expenditures: a) Those for customers with written commitments from FEI made prior to December 31, 2023 for class B demand-side measures. b) Those for customers participating in DSM programs that do not provide written commitments but meet the program terms and conditions and purchase and/or install a class B demand-side measure before December 31, 2023. These include incentives for residential, low income, Indigenous, and commercial customers primarily related to the installation of conventional high-efficiency space and water heating equipment including furnaces, domestic water heaters, boilers and roof-top units. To comply with this provision of the amended DSM Regulation, FEI is proposing a Legacy Expenditures Program Area that includes the above legacy expenditures. The cost-effectiveness of these measures are subject to the provisions of the pre-June 30, 2023 DSM Regulation,[24] including using the TRC and mTRC tests. No new written commitments will be made for class B demand-side measures after December 31, 2023. Class B demand-side measures purchased and/or installed after December 31, 2023 from programs that do not have written commitments will similarly not be eligible for incentives. See Section 12 of Appendix A, and Appendix B to the Application, for additional details regarding these expenditures.

[24] Demand Side Measures Regulation (BC Reg. 326/2008), Section 3.1 a, amended March 24, 2017.

5.5 *INTERESTS OF PERSONS WHO MAY RECEIVE SERVICE*

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 per the DSM Regulation. Individual customers that avail themselves of DSM measures will reduce their gas consumption and GHG emissions.

6. THE DSM PLAN IS COST-EFFECTIVE

6.1 Cost-Effectiveness under the DSM Regulation

The amended DSM Regulation replaces the TRC test with the UCT for the purposes of determining whether a utility's DSM activities are cost-effective. Further discussion of the UCT, and how it is calculated is provided below. FEI's proposed DSM portfolio for 2024-2027 is cost effective, with a portfolio UCT cost-effectiveness result of 2.1 based on the methodology set out in section 4 of the DSM Regulation. A score of 2.1 passes the threshold of 1.0 at the portfolio level, meaning the benefits from DSM to the avoided acquisition of renewable and low-carbon gases exceed the Utility's incentive and administration cost for the proposed DSM portfolio of programs.

Legacy Expenditures proposed for 2024-2027 under section 5 of the DSM Regulation are subject to the cost-effectiveness methodology set out in section 4 of the DSM Regulation effective prior to June 30, 2023. The proposed Legacy Expenditures in a Program Area have a blended TRC test cost-effectiveness result of 1.5.

FEI's approach to evaluating the cost-effectiveness of its DSM programs at the portfolio level is comprehensive and benefits customers and should be used for the 2024-2027 Plan period. In the sections below, FEI explains the cost-effectiveness test and demonstrates that the DSM Plan meets the requirements of the DSM Regulation.

6.1.1 Utility Cost Test

Section 4 (1.1) of the amended DSM Regulation requires the BCUC make determinations of cost-effectiveness by applying the UCT using the avoided cost of natural gas equal to the avoided cost of distribution plus $34.07 per GJ, escalating by the Consumer Price Index (equal to the maximum purchase cost of renewable and low-carbon gas outlined in section 9 of the GGRR).

The UCT is calculated as follows:[25]

$$UCT = \frac{\sum_{2024}^{2027}[NPV\ of\ NG\ Savings\ Using\ Avoided\ Cost\ of\ RNG\ Energy\ \&Distribution(\$)]}{\sum_{2024}^{2027}[Incentives + Non\ Incentive\ Costs\ (\$)]}$$

The first UCT formula uses the "NPV of natural gas savings using the avoided cost of RNG Energy & Distribution ($)", which is calculated for each year from 2024-2027 as follows:

[25] For simplicity, RNG refers to renewable and low-carbon gases set out in the GGRR.

$$NPV\ of\ NG\ Savings\ Using\ Avoided\ Cost\ of\ RNG\ Energy\ \&\ Distribution\ (\$)$$

$$= NG\ Savings\ (GJ) \times Cumulative\ Cost\ of\ RNG\ at\ the\ Measure\ Lifetime\ (\$)$$

The avoided cost of RNG starts at $34.07/GJ in Year 1 (2024) and is inflated by the Consumer Price Index forecast for each year of the DSM Plan. The avoided cost of distribution starts at $0.60/GJ in Year 1 (2024). The avoided cost is calculated based on the estimated avoided cost of distribution in 2023 of $0.59/GJ, increased by 2.4 percent to account for estimated inflation in 2024.

The UCT 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.

As noted above, the cost-effectiveness of class A demand-side measures and public awareness programs must be determined by the cost-effectiveness of the portfolio as a whole. Under section 1 of the amended DSM Regulation, class A demand-side measures include the following:

- programs supporting low income customers and organizations;
- programs supporting Indigenous customers and organizations;
- education programs;
- energy efficiency training;
- community engagement programs;
- technology innovation programs; and
- resources supporting the development of energy conservation or efficiency standards.

FEI has class A demand-side measures within its Low Income, Indigenous, Conservation Education and Outreach, Innovative Technologies and Enabling Initiatives Program Areas.

6.1.2 Portfolio-Level Analysis

Section 4(1) of the DSM Regulation stipulates that the BCUC, 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. However, per section 4(4) and 4(5) of the DSM Regulation, the BCUC must assess “class A demand-side measures” and public awareness programs[26] at the portfolio level.

[26] Which the BCUC concludes are likely to meet the goals in the definition of public awareness program.

Determining cost-effectiveness at the portfolio level is the appropriate method for testing the cost-effectiveness of the DSM Plan for the following reasons:

- The BCUC first determined that assessment of cost-effectiveness be based on the overall portfolio in its decision on FEI's 2008 DSM Application[27] and, since then, has reached the same determination in each of its subsequent decisions with respect to FEI's DSM expenditures applications. The BCUC has taken a similar portfolio approach for DSM portfolios filed by FortisBC Inc., Pacific Northern Gas, and BC Hydro.
- Assessment at the portfolio level allows for a more equitable balance of expenditures and savings across sectors and enabling activities. The continued use of the portfolio approach will provide flexibility for FEI to implement programs that meet customer needs.
- As more programs, such as the Low Income and Indigenous programs, must now be assessed at the portfolio level, the portfolio level cost-effectiveness becomes more relevant. Per sections 4(4) and 4(5) of the DSM Regulation, the BCUC must, at a minimum, use the portfolio approach in assessing the cost-effectiveness of "class A demand-side measure"[28] and "public awareness programs".[29]
- The portfolio approach permits FEI to encourage increasing levels of efficiency in gas DSM. Advanced DSM measures that are relatively new to the market may have a higher initial cost because it is not yet benefitting from economies of scale. A program based on such measures are more likely to have low UCT results. Although the near-term results of such a program might be lower relative to past DSM Plans, the long-term prospects for such measures to provide benefits to customers is significant. The portfolio level cost-effectiveness analysis can absorb some of these types of programs without failing the cost-effectiveness test.

To ensure that the portfolio meets a UCT 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 adjust as needed. For information purposes, FEI will also continue to report on individual DSM program cost-

[27] Order G-36-09.

[28] A "class A demand-side measure" means: (a) A demand-side measure referred to in section 3 (1) (a), (c), (d), or (g), (b) A charity program, (c) The funding of energy efficiency training, (d) A community engagement program (e) An energy management program (f) A technology innovation program, and (g) 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 efficiency use of energy in British Columbia, but does not include a class B demand-side measure;

[29] 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, about ways to increase energy conservation and energy efficiency or to encourage the public, including the public utility's customers, to conserve energy or use energy efficiently, or (b)to increase participation by the public utility's customers in other demand-side measures proposed by the public utility in an expenditure portfolio or a plan portfolio.

effectiveness results in its DSM Annual Reports, along with the individual program cost-effectiveness projections provided in the DSM Plan.

6.1.3 Legacy Expenditures

In accordance with section 5 of the amended DSM Regulation, the cost-effectiveness of Legacy Expenditures is subject to section 3 of the prior DSM Regulation.[30] The cost-effectiveness approach for Legacy Expenditures is outlined in Section 5.1 of FEI's 2023 DSM Expenditures Plan Application, included for reference in this Application as Appendix E.

6.2 COST-EFFECTIVENESS RESULTS

As discussed above in Section 6.1 and consistent with the DSM Regulation, FEI uses the UCT to determine the cost-effectiveness of its DSM Plan on a portfolio basis. FEI's proposed DSM portfolio for 2024-2027 is cost-effective, with a Portfolio UCT cost-effectiveness result of 2.1. The Legacy Expenditures proposed result in a Program Area blended TRC test cost-effectiveness of 1.5. For detailed Portfolio and Program Area cost-effectiveness results, please refer to Appendix B, Exhibits 1 and 2.

[30] Demand Side Measures Regulation (BC Reg. 326/2008), Section 3.1 a, amended March 24, 2017.

7. EVALUATION, MEASUREMENT AND 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 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 impact and process evaluations at a schedule consistent with the EM&V Framework. Two key aspects of FEI's EM&V activities are addressed in the following sections: the Evaluation Plan and FEI's EM&V Framework.

7.1 *EVALUATION PLAN*

In Appendix F to the Application, FEI provides its DSM Evaluation Plan covering 2024-2027 and addressing 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. The total proposed expenditure for the program evaluation and M&V activities to be conducted from 2024-2027 is approximately $11.3 million or 2 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 considered 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$32 and US$100 million, evaluation budgets are on average 2.7 percent, and that the proportion of DSM expenditures on evaluation decreases as the size of the portfolio increases.[31] Utilities with expenditures greater than US$100 million tend to spend just under 2.1 percent on evaluation. The Consortium for Energy Efficiency (CEE) found that Canadian utilities spent about 3 percent of their overall DSM budgets on evaluation.[32]

FEI has carefully considered evaluation needs and considers its DSM Evaluation Plan is sufficient to conduct the appropriate number of program evaluations, while also being effective in keeping evaluation expenditures at a reasonable level consistent with its EM&V Framework and in comparison to other jurisdictions.

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[31] E Source Poster: How Much do Utilities Spend on Evaluation? 2019. Prepared from data available in E Source DSM Insights 2019.

[32] CEE Annual Industry Report – State of the Efficiency Program Industry, Section 4. Consortium for Energy Efficiency, 2020.

7.2 EM&V FRAMEWORK

In Appendix G to the Application, FEI provides its current 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 BCUC's directive from the 2012-2013 RRA Decision.[33] The EM&V Framework was finalized in 2013 and updated in 2018 and 2023 – taking into consideration feedback received from the EECAG and FEI's evaluation partners. FEI has since been conducting EM&V activities consistent with the 2023 update of the EM&V Framework. FEI will continue to review industry standards and best practices to ensure the EM&V Framework is up to date.[34]

[33] https://fbcdotcomprod.blob.core.windows.net/libraries/docs/default-source/about-us-documents/regulatory-affairs-documents/gas-utility/g-44-12_feu-2012-13rr-decision-web.pdf.

[34] 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.

8. ADDITIONAL APPROVALS SOUGHT

8.1 *FUNDING TRANSFERS AND VARIANCES*

The following sections detail FEI's request to continue the funding transfer rules, and the allowed percentage variance within the DSM portfolio that were previously approved by the BCUC as part of FEI's 2023 DSM Expenditure Plan Application. FEI is also proposing to continue the funding carryover rules that were previously approved as part of its 2019-2022 DSM Expenditure Plan Application with one proposed change. In particular:

- Section 8.1.1 details FEI's request to continue the rules for transfers between Program Areas within the same year (funding transfer);
- Section 8.1.2 details FEI's proposed rules for transfers within a Program Area from one year to the next (funding carryover); and
- Section 8.1.3 details FEI's request to continue the allowed percentage variance above the approved DSM expenditures.

8.1.1 Funding Transfers

As part of the DSM Plan, FEI is proposing to continue the funding transfer rules, as approved by the BCUC in its Decision and Order G-45-23. These rules will continue to provide FEI with flexibility to manage its DSM portfolio more effectively. In summary, FEI is requesting that the following funding transfer rules be in place for its 2024-27 DSM Plan:

> In cases where a proposed transfer out of an approved program area is greater than twenty five percent of that program area's accepted expenditures for the year in question, BCUC approval is required.

FEI will continue to report on these funding transfers in its annual reporting on DSM to the BCUC and will take into consideration all of the recommendations set out in Decision and Order G-371-22 regarding funding transfer applications.

8.1.2 Funding Carryover

FEI is requesting to continue the funding carryover rules that were previously approved as part of its 2019-2022 DSM Expenditure Plan[35] for its 2024-2027 DSM Plan, with one proposed change. FEI is requesting to be permitted to carryover overspent (or negative amounts) into the following year. For clarity, FEI would be permitted to carryover unspent **and overspent** expenditures in a program area to the same program area in the following year. In effect, FEI is requesting that the

[35] Order G-10-19.

BCUC accept the total expenditures per program area over the time period of the expenditures schedule.

FEI considers that carrying over negative amounts is consistent with the spirit and intent of the funding carryover rules approved as part of FEI's 2019-2022 DSM Plan. The ability to carryover funding amounts from one year to the next within the DSM funding period was applied for and approved to provide FEI with additional flexibility to manage the portfolio expenditures as it strives to meet the overall expenditures targets set out in the DSM Plan.

Although the carryover rules focused on carrying over unspent amounts in the early years of the Plan to future years, the primary purpose of the carryover funding transfer request was to assist FEI to achieve the four-year total expenditures for the plan. Carrying forward negative amounts to future years of the DSM Plan will similarly help FEI to manage timing of expenditures and decrease the likelihood of underspending during the plan period. While spending may be higher than planned in one year, it may be lower than planned in the following year. Therefore, FEI considers that the funding carryover rules should include the flexibility to manage both positive and negative carry over amounts.

In summary, FEI is requesting the following funding carryover rule be in place for its 2024-27 DSM Plan:

> *FEI is permitted to carryover unspent and overspent expenditures in a Program Area to the same Program Area in the following year.*

In Decision and Order G-371-22 regarding FBC's 2023-2027 DSM Plan Application, the BCUC approved this same carryover rule for FBC.

8.1.3 Total Portfolio Variance Allowance

FEI is seeking approval to continue the allowed variance of no more than five percent above the accepted DSM expenditures amount in the final year of a DSM expenditures schedule without prior approval from the BCUC. This was previously approved as part of its 2023 DSM Plan in Order G-45-23. In the case of the DSM Plan, this would mean FEI has flexibility to vary from the 2027 approved expenditures by up to $31.3 million.

FEI will continue to seek to spend the accepted expenditures amount, however, it is difficult to accurately forecast to the level of precision where FEI will spend exactly 100 percent of its DSM portfolio. Actual DSM Plan expenditures are determined by many factors outside FEI's control, including changes in market conditions and customer responses to programs. In FEI's view, a variance allowance of five percent provides the necessary flexibility to respond to any conditions outside of FEI's control that might require additional spending above approved.

Therefore, FEI is requesting to continue the following variance allowance rule for the DSM Plan:

FEI is permitted to exceed total accepted expenditures in the final year of a DSM expenditure schedule by no more than five percent without prior approval from the BCUC.

Overall, the funding transfer rules and the variance allowance described above will all serve to provide FEI with the flexibility to manage its DSM portfolio more effectively.

8.2 *ACCOUNTING TREATMENT*

FEI is proposing to continue the amount it includes in its rate base DSM deferral account on a forecast basis at the previously approved $60 million, effective for 2024-27. This is consistent with FEI's actual historical DSM spending and with the spirit of the Decisions accompanying Orders G-44-12, G-10-19, and G-45-23 (as described further below).

Under the current approved treatment, $60 million of expenditures are forecast in the rate base DSM deferral account each year and the difference between the $60 million forecast and actual/projected 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. 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 year.

FEI received approval from the BCUC to increase its then-existing $30 million rate base account limit to $60 million per year as part of its 2023 DSM Application, as expenditures had been consistently greater than $60 million per year under the DSM portfolio over the preceding five years (2019 to 2023). The BCUC approved FEI to include $60 million in forecast annual additions to the rate base DSM deferral account for 2023.[36]

FEI's expenditures are forecast to continue to exceed $60 million for all years of the DSM Plan and FEI expects that at least that level of expenditures to be maintained for the foreseeable future. Aligning the amount forecast in the rate base DSM deferral account each year more closely with the actual expenditures ultimately reduces the financing costs added to the deferral account, as well as the overall costs to customers on the non-rate base portion of the DSM Plan expenditures.

As per existing approved practice, FEI will account for the balance of spending, up to the approved FEI funding amount and greater than $60 million, in FEI's non-rate base DSM deferral account. Further, consistent with this 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 of 10 years.

[36] Appendix A to Order G-45-23, page 24.

9. CONCLUSION

The DSM Plan is a continuation of the cost-effective programs previously accepted in FEI's 2023 DSM Plan[37] while also addressing the new requirements of the amendments made to the DSM Regulation effective June 30, 2023. Key changes include phasing-out conventional high-efficiency gas space and water heating measures, the addition of the Indigenous Program Area, and new supports for advanced DSM programming such as deeper retrofits, gas heat pumps, and dual fuel hybrid heating systems.

As set out in the Application, FEI's proposed DSM expenditure schedule is consistent with British Columbia's energy objectives, meets the adequacy and cost-effectiveness requirements of the DSM Regulation, and responds to government policy encouraging an increase in DSM to support GHG emission reduction targets.

FEI submits that the Application demonstrates that the proposed DSM expenditure schedule is in the public interest and FEI requests that it be accepted by the BCUC.

[37] Order G-10-19.

Appendix A

FEI 2024-2027 DSM PLAN REPORT

POSTERITY GROUP

FortisBC Energy Inc. (FEI)
2024 - 2027 DSM Expenditures Plan Report

Final Report

Date: July 12th, 2023

Posterity Group
135 Laurier Ave. West – Suite 408
Ottawa, ON, K1P 5J2

Contents

List of Exhibits

1 Introduction

1.1 Background and Objectives

This Demand Side Management (DSM) Plan covers the 2024-2027 FortisBC Energy Inc. (FEI) Conservation and Energy Management (C&EM) proposed budget for the following energy efficiency program areas and supporting initiatives:

- Residential
- Commercial
- Industrial
- Low Income
- Indigenous
- Conservation Education and Outreach
- Innovative Technologies
- Enabling Activities
- Portfolio Level Activities
- Legacy Expenditures

This DSM Plan covers FEI's gas service territory. In addition, this plan includes details of the programs and measures under each program area, along with their associated costs, energy savings, and the results of their cost-effectiveness.

Many of the programs in this DSM Plan are part of FEI's existing DSM portfolio previously accepted in the FEI 2023 DSM Expenditures Plan Application and prior applications to the BCUC. The activities and measures within some of the programs have been updated, and several new initiatives have been added within the previously approved program areas. The updates reflect FEI's response to amendments made within the B.C. Demand-Side Measures (DSM) Regulation, ongoing changing market conditions, and integrating operational lessons learned from current implementation activities.

This DSM Plan is subject to changes based on market conditions, customer feedback, 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 at the time of writing this DSM Plan and are subject to adjustments, as required.

1.2 Approach

The DSM Plan project team completed the following major steps to develop this DSM Plan:

- Reviewed amendments to B.C. DSM Regulation (2023).[1]
- Reviewed current programs, the most recent DSM plan, recent annual DSM reports, and other relevant regulatory filings.
- Reviewed and extracted guidance from 2021 Long Term Gas Resource Plan (LTGRP), 2021 Conservation Potential Report (CPR), and a 2023 modelling refresh of the CPR.
- In collaboration with FEI program managers, discussed and finalized strategic direction (for each program and for the overall portfolio) and program functions.
- Conducted interviews with program managers to discuss each program's successes, barriers, possible improvements, and planned activities.
- Developed draft DSM portfolio budget and program options.
- Gathered feedback from internal and external stakeholders such as program managers, FEI management team, and Energy Efficiency & Conservation Advisory Group (EECAG).[2]
- Revised and finalized budget, program offerings, measures, and cost effectiveness results.

1.3 Report Organization

The remainder of this DSM Plan is organized in the following sections:

- Section 2 provides a summary of the overall **DSM Portfolio**.
- Section 3 describes the individual programs and their savings and cost-effectiveness results for the **Residential Program Area**.
- Section 4 describes the individual programs and their savings and cost-effectiveness results for the **Commercial Program Area**.
- Section 5 describes the individual programs and their savings and cost-effectiveness results for the **Industrial Program Area**.
- Section 6 describes the individual programs and their savings results for the **Low Income Program Area**.
- Section 7 describes the individual programs and their savings results for the **Indigenous Program Area.**[3]

[1] Ministerial Order No. M193, dated June 27, 2023, amending the *Demand-Side Measures Regulation*, B.C. Reg. 326/2008

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

[3] Includes expenditures as per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 3.1 (g), as amended June 27, 2023

- Section 8 describes the individual programs and their budgets for the **Conservation Education and Outreach**.
- Section 9 describes the **Innovative Technologies** activities that are required for the 2024-2027 DSM Plan period and their budgets.
- Section 10 describes the **Enabling Activities** that are required for the 2024-2027 DSM Plan period and their budgets.
- Section 11 describes the **Portfolio Level Activities** that are required for the 2024-2027 DSM Plan period and their budgets. Section 13 provides a summary of the DSM Plan findings.
- Section 12 describes the **Legacy Expenditures** committed per the amended DSM Regulation.[4]

1.4 Notes

The following general notes apply to all sections of this report:

- Totals in the tables may not add exactly due to rounding.
- A "Non-Program Specific Expense" line item is included in the 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.

[4] Includes expenditures as per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 5, amended June 27, 2023

2 DSM Program Portfolio Results

2.1 Introduction

This section presents an overview and summary of FEI's 2024-2027 DSM Plan. It shows the total proposed expenditures, estimated gas savings and where applicable, the associated cost-effectiveness.

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
- Indigenous Energy Efficiency Program Area
- Conservation Education and Outreach Initiatives
- Innovative Technologies Program Area
- Enabling Activities
- Portfolio Activities
- Legacy Expenditures
- Summary

2.2 Cost Effectiveness

In 2023, the BC Ministry of Energy, Mines, and Low Carbon Innovation (EMLI) amended the DSM Regulation primary cost-effectiveness test.[5]

The test to determine cost-effectiveness has been changed from the Total Resource Cost test (TRC) to the Utility Cost Test (UCT). The UCT can be expressed in terms of a unitless ratio ($ benefits divided by $ costs). The UCT equations are applied identically when calculating the UCT at a measure level, program level, program area level, and portfolio level.[6]

$$UCT = \frac{\sum_{2024}^{2027}[NPV\ of\ NG\ Savings\ Using\ Avoided\ Cost\ of\ RNG\ Energy\ \&Distribution(\$)]}{\sum_{2024}^{2027}[Incentives + Non\ Incentive\ Costs\ (\$)]}$$

[5] BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 4, as amended June 27, 2023

[6] For simplicity, RNG in the equation below refers to renewable and low-carbon gases set out in the GGRR.

The first UCT formula uses the "NPV of natural gas savings using the avoided cost of RNG Energy & Distribution ($)", which is calculated for each year from 2024-2027 as follows:

$$NPV\ of\ NG\ Savings\ Using\ Avoided\ Cost\ of\ RNG\ Energy\ \&\ Distribution\ (\$)$$

$$= NG\ Savings\ (GJ) \times Cumulative\ Cost\ of\ RNG\ at\ the\ Measure\ Lifetime\ (\$)$$

The avoided cost of renewable natural gas (RNG), as well as hydrogen, synthesis gas and lignin (together, referred to as renewable and low-carbon gas) is calculated based on the $34.07/GJ maximum cost under Section 9 of the Greenhouse Gas Reduction Regulation (GGRR) (converted to F24), increased by 2.4% to account for estimated inflation in 2024.

The avoided cost of distribution starts at $0.60/GJ in Year 1 (2024). The avoided cost is calculated based on the estimated avoided cost of distribution in 2023 of $0.59/GJ, increased by 2.4 percent to account for estimated inflation in 2024.

The Discounted Avoided Cost of RNG Energy & Distribution is calculated by discounting each year after 2024 by the company pre-tax Weighted Average Cost of Capital (discount rate) which is currently 3.62%.

Legacy Expenditures are subject to the cost-effectiveness requirements of the DSM Regulation before it was amended in 2023. For those expenditures, TRC is the determining test for cost-effectiveness.

2.3 Overall Portfolio Results

The overall DSM program results are summarized in the following exhibits. All exhibits presented in this document present expenditures in 2024 dollars, excluding inflation, **except for Exhibit 1**.

- Exhibit 1 provides a summary of expenditures, including inflation, and represents the total budget proposed by FEI for the 2024-2027 DSM Plan.
- Exhibit 2 presents the results for the total DSM program portfolio including gas and emissions savings, and cost-effectiveness.

Exhibit 3 and Exhibit 4 present the results for the total DSM program portfolio broken down by program area. Additional cost effectiveness results can be found in Appendix B, Additional Cost-Effectiveness Results and Measure Details and Sources.

The inflation rate is assumed to be 2% for administration, communications, and evaluation expenditures for all years. For labour expenditures, the inflation rate for each year is assumed to be 3.3% (2025), 3.0% (2026) and 3.0% (2027). Note that the inflation rate was only applied to non-incentive expenditure. Incentive expenditures are forecasted for the year they are provided and do not inflate.

Exhibit 1 – Total DSM Expenditures by Program Area ($000s), Including Inflation

Program Area	2024	2025	2026	2027	Total
Residential	33,197	40,830	48,263	56,621	178,910
Commercial	8,726	12,958	17,799	21,151	60,635
Industrial	7,585	8,071	8,963	9,600	34,219
Low Income	8,366	9,753	11,826	14,676	44,621
Indigenous	2,704	4,247	5,481	6,452	18,885
Conservation Education and Outreach	14,652	14,794	15,433	15,986	60,865
Innovative Technologies	35,117	20,807	15,239	18,059	89,222
Enabling Activities	15,042	12,451	11,486	11,265	50,244
Portfolio Activities	5,281	5,687	5,507	5,749	22,223
Legacy Expenditures	36,200	16,995	8,401	5,282	66,878
Total ($000s)	166,870	146,593	148,398	164,842	626,703

Exhibit 2 – DSM Portfolio Expenditures (Not Including Inflation), Gas Savings, and Cost-Effectiveness

	2024	2025	2026	2027	Total
Utility Expenditures - Incentives ($000s)	$125,465	$101,844	$102,163	$117,605	$447,078
Utility Expenditures - Non-Incentives ($000s)	$41,405	$42,621	$43,113	$43,090	$170,230
Utility Expenditures - Total ($000s)	$166,870	$144,465	$145,277	$160,696	$617,307
Yearly Incremental Gas Savings (GJ)					3,897,028
NPV of Gas Savings, Using the Avoided Cost of RNG ($000s)					$1,329,621
UCT[7]					2.1
Blended TRC (Legacy Expenditures)[8]					1.5

[7] Only includes gas savings persisting until 2027, and therefore may be less than the sum of net incremental annual gas savings from individual program years.

[8] This is determined from committed legacy expenditures as per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 5(2), as amended June 27, 2023, resulting in cost effectiveness testing under the BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 3, as amended March 24, 2017.

Exhibit 3 – Portfolio Expenditures by Program Area, Not Including Inflation

Program Area	Incentive Expenditures ($000s)					Non-Incentive Expenditures ($000s)					Total Expenditures ($000s)				
	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total
Residential	$30,397	$37,036	$44,042	$52,288	$163,763	$2,800	$3,592	$3,904	$3,914	$14,209	$33,197	$40,628	$47,947	$56,202	$177,973
Commercial	$5,481	$9,214	$13,634	$16,890	$45,219	$3,246	$3,556	$3,867	$3,867	$14,535	$8,726	$12,770	$17,501	$20,756	$59,753
Industrial	$6,515	$6,945	$7,813	$8,424	$29,697	$1,070	$1,070	$1,070	$1,070	$4,280	$7,585	$8,015	$8,883	$9,494	$33,977
Low Income	$6,324	$7,521	$9,412	$12,116	$35,373	$2,042	$2,124	$2,248	$2,333	$8,747	$8,366	$9,645	$11,660	$14,449	$44,120
Indigenous	$2,225	$3,723	$4,935	$5,903	$16,786	$480	$495	$504	$495	$1,973	$2,704	$4,218	$5,439	$6,398	$18,759
Conservation Education and Outreach	-	-	-	-	-	$14,652	$14,141	$14,450	$14,655	$57,898	$14,652	$14,141	$14,450	$14,655	$57,898
Innovative Technologies	$31,270	$16,413	$10,213	$12,838	$70,733	$3,847	$4,175	$4,680	$4,755	$17,458	$35,117	$20,588	$14,893	$17,593	$88,190
Enabling Activities	$8,561	$4,959	$3,911	$4,005	$21,435	$6,482	$7,139	$7,065	$6,621	$27,306	$15,042	$12,098	$10,976	$10,626	$48,742
Portfolio Activities	-	-	-	-	-	$5,281	$5,428	$5,144	$5,257	$21,111	$5,281	$5,428	$5,144	$5,257	$21,111
Legacy Expenditures	$34,693	$16,033	$8,204	$5,142	$64,072	$1,507	$902	$180	$125	$2,714	$36,200	$16,934	$8,384	$5,267	$66,785
Total	**$125,465**	**$101,844**	**$102,163**	**$117,605**	**$447,078**	**$41,405**	**$42,621**	**$43,113**	**$43,090**	**$170,230**	**$166,870**	**$144,465**	**$145,277**	**$160,696**	**$617,307**

Exhibit 4 – Portfolio Gas Savings and Cost-Effectiveness by Program Area

Program	Yearly Incremental Gas Savings (GJ)					NPV of Gas Savings ($000s)					UCT	Blended TRC
	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total		
Residential	166,655	187,759	208,552	232,596	795,562	$67,699	$81,016	$94,528	$109,960	$353,202	2.0	-
Commercial	93,986	138,321	185,927	222,140	640,373	$40,270	$57,401	$76,788	$91,947	$266,405	4.5	-
Industrial	365,533	394,550	473,459	516,985	1,750,526	$74,821	$85,505	$98,284	$114,310	$372,920	11.0	-
Low Income	50,684	56,992	64,579	75,588	247,843	$20,238	$23,619	$27,588	$33,361	$104,807	-	-
Indigenous	16,076	22,237	27,421	29,225	94,959	$20,377	$10,114	$13,914	$14,892	$59,297	-	-
Conservation Education and Outreach[9]	20,000	30,000	30,000	30,000	110,000	$3,466	$5,200	$5,200	$5,200	$19,066	-	-
Innovative Technologies	Savings Not Estimated											
Enabling Activities	Savings Not Estimated											
Portfolio Level Activities	Savings Not Estimated											
Legacy Expenditures	147,185	57,878	31,361	21,340	257,765	$91,704	$34,477	$16,590	$11,155	$153,926	-	1.5
Total	**860,118**	**887,737**	**1,021,299**	**1,127,874**	**3,897,028**	**$318,575**	**$297,331**	**$332,891**	**$380,825**	**$1,329,621**	**2.1**	**1.5**

[9] Savings are attributed to the Customer Engagement Tool measure only.

3 Residential Program Area

In this DSM Plan, the Residential Program Area consists of two programs:

- Home Renovation Program
- New Home Program

The **Home Renovation 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. This program is a collaboration between FEI, other BC utilities and EMLI's CleanBC Better Homes program.

Retail offers directed towards the home renovation segment are included in this program. FEI collaborates with FBC, BC Hydro, retailers, and distributors to offer point-of-sale incentives on several low-cost and easy to install measures such as washers, dryers, draft proofing, water savers and connected thermostats.

The **New Home Program** aligns with and provides incentives for the tiers of the BC Energy Step Code for Part 9 Buildings, as per the Demand-Side Measures (DSM) Regulation Section 3.[10] This section supports the BC Utilities' ability to provide incentives for builders who adopt and comply with the Energy Step Code in municipalities across BC. FEI, in partnership with FortisBC Inc. (FBC), supports local governments in their adoption of the Step Code as part of an ongoing initiative for market transformation to high performance homes. FEI and its program partners[11] support this adoption through builder and trades outreach, training, and customer education about the benefits of high-performance homes and other initiatives.[12] Rebates for ENERGY STAR appliances in new homes are available for additional energy savings.

The Home Renovation and New Home programs enable FEI customers to reduce their energy consumption and support industry to improve overall home performance. The rebates, policy support, customer and industry engagement are critical to promoting BC's culture of conservation and fostering market transformation to higher efficiency solutions in the residential sector.

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[10] Includes expenditures as per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 3(1)(f), amended June 27, 2023

[11] These initiatives may be partially co-funded by program partners FortisBC Electric (FBC), BC Hydro, the BC Ministry of Energy, Mines and Low Carbon Innovation (EMLI) and BC Housing.

[12] Industry support funds may be provided through the Program funding envelope, or where appropriate, the Enabling Activities funding envelopes.

3.1 Key Changes in New Plan

Compared with the previous DSM Plan, the 2024-2027 DSM Plan has the following key updates in the Residential Program Area:

- Removal of conventional high-efficiency gas equipment incentives.
- Greater focus on building envelope and whole home performance-based rebates to drive the market towards deeper energy retrofits.
- Addition of the following new measures: hybrid dual-fuel systems, high-efficiency Heat Recovery Ventilators (HRV), whole home performance, space, and water heating controls,[13] and contractor incentives for HVAC optimization including quality installation and commissioning.

The Residential Program Area will continue to partner with electric utilities (FBC and BC Hydro), 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.

3.2 Program Budget and Savings

Exhibit 5 shows the annual incentive, non-incentive, and total expenditures for the Residential Program Area by program. Exhibit 6 shows the gas savings and cost-effectiveness for each residential program.

[13] This measure includes connected thermostats, fireplace timers, water heater controls, and HVAC zone controls.

Exhibit 5 – Residential Program Area Expenditures by Program ($000s), Not Including Inflation

Program	Incentive Expenditures ($000s)					Non-Incentive Expenditures ($000s)					Total Expenditures ($000s)				
	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total
Home Renovation	27,494	33,416	39,178	46,112	146,200	683	748	723	668	2,822	28,177	34,164	39,901	46,780	149,022
New Home	2,902	3,621	4,864	6,176	17,564	655	655	655	655	2,620	3,557	4,276	5,519	6,831	20,184
Labour	-	-	-	-	-	1,412	2,129	2,454	2,504	8,499	1,412	2,129	2,454	2,504	8,499
Non-Program Specific Expenditures	-	-	-	-	-	50	60	72	86	268	50	60	72	86	268
Total	**30,397**	**37,036**	**44,042**	**52,288**	**163,763**	**2,800**	**3,592**	**3,904**	**3,914**	**14,209**	**33,197**	**40,628**	**47,947**	**56,202**	**177,973**

Exhibit 6 – Residential Gas Savings and Cost-Effectiveness by Program

Program	Yearly Incremental Gas Savings (GJ)					NPV of Gas Savings ($000s)					UCT
	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total	
Home Renovation	157,048	176,678	194,310	214,520	742,556	59,735	71,377	81,837	93,885	306,834	2.1
New Home	9,607	11,080	14,243	18,076	53,006	7,964	9,639	12,690	16,074	46,368	2.3
Total	**166,655**	**187,759**	**208,552**	**232,596**	**795,562**	**67,699**	**81,016**	**94,528**	**109,960**	**353,202**	**2.0**

4 Commercial Program Area

In this DSM Plan, the Commercial Program Area consists of four programs:

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

The **Prescriptive Program** offers rebates for the purchase and installation of specific qualifying measures. 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 includes various adaptations of the archetype to suit 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 are adapted to suit the requirements of different target markets, and for the purpose of customer engagement some rebates are grouped in ways that are logical for a particular target market.

The **Performance Program – Existing Buildings** provides incentives to encourage commercial customers to identify, assess, and implement building energy-efficiency projects for existing buildings. The program is administered jointly with FBC and BC Hydro, providing customers with a one-stop program in both the shared FBC/FEI service area and the FEI service territory to evaluate and implement building-scale energy efficiency measures, recommissioning projects, as well as identifying no-cost, low-cost opportunities through a Strategic Energy Management (SEM) offer. FEI staff provide technical and engineering support, customer outreach and engagement for the Performance Program – Existing Buildings. Under the program, smaller commercial customers are also provided with energy assessments and customers with a portfolio of buildings can take advantage of portfolio-wide energy studies.

The **Performance Program - New Buildings** encourages the design of high-performance commercial buildings. Capital incentives are available for customers that design new buildings that exceed BC Building Code. This program includes support for large 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, while allowing for a non-step code pathway as well.

The **Rental Apartment Efficiency Program (RAP)**, in collaboration with FBC, provides the direct installation of in-suite measures, such as low-flow showerheads, and faucet aerators for rental suites in multi-unit residential buildings (MURBs). This program area also contributes to meeting the "adequacy" component of the DSM Regulation Section 3, whereby a public utility's DSM portfolio is considered adequate when there is "a demand side measure intended specifically to improve the energy efficiency of rental accommodations"[14]. 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 FEI. Next, participants are

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[14] BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 3(1)(b), amended June 27, 2023

provided with energy assessments, which may recommend building-level energy efficiency upgrades such as high efficiency heating systems and control upgrades. Lastly, participants are provided with support in implementing the energy efficiency recommendations and applying for rebates.

4.1 Key Changes in New Plan

Compared to the previous DSM Plan, the 2024-2027 DSM Plan has the following key updates in the Commercial Program Area:

- Removal of conventional high-efficiency gas equipment incentives.
- Incorporating the Small Commercial New Construction Program into the Performance Program – New Buildings Program in place of the Small Commercial New Construction stand-alone offer.
- New incentives and additional support for advanced DSM measures such as hybrid dual-fuel systems and gas heat pumps, as well as a performance pathway to enable building envelope and whole building performance-based programming to drive the market towards deeper energy retrofits.
- The addition of the commercial Strategic Energy Management (SEM) offer under the Performance Program.

The Commercial Program Area will continue to seek out and develop partnerships with utilities, government, trade associations, and others to increase program awareness and expand activities in support of its objective to maximize gas efficiency in the commercial market.

4.2 Program Budget and Savings

Exhibit 7 shows the annual incentive, non-incentive, and total expenditures for the Commercial Program Area by program. Exhibit 8 shows the gas savings and cost-effectiveness for each commercial program.

Exhibit 7 – Commercial Program Area Expenditures by Program ($000s), Not Including Inflation

Program	Incentive Expenditures ($000s)					Non-Incentive Expenditures ($000s)					Total Expenditures ($000s)				
	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total
Prescriptive	1,987	2,370	2,628	2,901	9,885	500	500	500	500	2,000	2,487	2,870	3,128	3,401	11,885
Performance	3,125	6,475	9,838	12,020	31,458	100	100	100	100	400	3,225	6,575	9,938	12,120	31,858
Performance New Construction	-	-	800	1,600	2,400	150	150	150	150	600	150	150	950	1,750	3,000
RAP	369	369	369	369	1,476	400	400	400	400	1,600	769	769	769	769	3,076
Labour	-	-	-	-	-	1,346	1,656	1,967	1,967	6,935	1,346	1,656	1,967	1,967	6,935
Non-Program Specific Expenditures	-	-	-	-	-	750	750	750	750	3,000	750	750	750	750	3,000
Total	**5,481**	**9,214**	**13,634**	**16,890**	**45,219**	**3,246**	**3,556**	**3,867**	**3,867**	**14,535**	**8,726**	**12,770**	**17,501**	**20,756**	**59,753**

Exhibit 8 – Commercial Gas Savings and Cost-Effectiveness by Program

Program	Yearly Incremental Gas Savings (GJ)					NPV of Gas Savings ($000s)					UCT
	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total	
Prescriptive	49,563	54,351	59,584	61,391	224,888	25,468	27,570	29,874	30,761	113,673	9.6
Performance	30,016	69,564	112,086	141,898	353,564	7,389	22,417	39,979	51,304	121,089	3.8
Performance New Construction	-	-	2,074	4,608	6,682	-	-	1,140	2,533	3,673	1.2
RAP	14,407	14,407	12,183	14,243	55,240	7,414	7,414	5,795	7,348	27,970	9.1
Total	**93,986**	**138,321**	**185,927**	**222,140**	**640,373**	**40,270**	**57,401**	**76,788**	**91,947**	**266,405**	**4.5**

5 Industrial Program Area

In this DSM Plan, the Industrial Program Area consists of two programs:

- Prescriptive Program
- Performance Program

The **Prescriptive Program** includes fixed incentives for the purchase and installation of specific qualifying industrial measures. The Prescriptive Program provides rebates from energy efficient measures where the savings are well understood - and their installation is not typically part of a larger, more complex upgrade. Examples of such measures include air curtains, steam traps, and pipe insulation measures. Program delivery includes various adaptations of the archetype to suit 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 are adapted to suit the requirements of different target markets, and for the purpose of customer engagement some rebates are grouped in ways that are logical for a particular target market.

The **Performance Program** provides incentives to encourage customers to identify, assess and implement measures that use energy for process-related activities. The program is administered jointly with FBC, providing customers with a one-stop program in the FBC/FEI shared service territory and FEI only service areas to evaluate and implement industrial energy efficiency projects. FEI staff provide customer outreach and engagement for the Performance Program.

The Performance Program offers co-funding for plant-wide audits, feasibility studies, implementation, and Strategic Energy Management (SEM) incentives. The plant-wide audit offer in the Performance Program provides incentives for customers to engage a qualified energy consultant to perform a high-level, whole facility audit to identify opportunities to use gas and electricity more efficiently within an industrial facility. The feasibility study offer in the Performance Program provides incentives to study specific processes or systems within an industrial facility to use gas and electricity more efficiently. DSM incentives are available to encourage the implementation of cost-effective energy efficiency measures. The SEM offer is a comprehensive offering for large and medium industrial customers which provides them with energy modeling, energy efficiency coaching and strategic planning support to achieve both operational savings and to encourage larger capital upgrades. The SEM offer is administered in collaboration with BC Hydro as the electric utility outside of FortisBC's shared service territory and with FBC within FortisBC's shared service territory.

Two separate SEM tracks are as follows:

- Individual Support (Large Customers): FEI continues 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 continues to 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.

5.1 Key Changes in New Plan

Compared with the previous DSM Plan, the 2024-2027 DSM Plan has the following key updates in the Industrial Program Area:

- The Industrial SEM offer is now placed under the Industrial Performance Program to create consistency between the Commercial and Industrial Program Areas. This change further streamlines the Industrial Program Area, as the SEM offer is a performance-based offer in nature and acts as a funnel for capital projects that are typically incented under the Performance Program.
- Building on the success of the collaboration with BC Hydro on the SEM front to add more customers to the program in creating new cohorts.
- Increase in participation within prescriptive measures, such as steam trap replacements, as well as pipe and tank insulation to further opportunities in the Industrial Program Area to provide more incentive and achieve more savings.

5.2 Program Budget and Savings

Exhibit 9 shows the annual incentive, non-incentive, and total expenditures for the Industrial Program Area by program. Exhibit 10 shows the gas savings and cost-effectiveness for each industrial program.

Exhibit 9 – Industrial Program Area Expenditures by Program ($000s), Not Including Inflation

Program	Incentive Expenditures ($000s)					Non-Incentive Expenditures ($000s)					Total Expenditures ($000s)				
	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total
Prescriptive	1,188	1,617	2,078	2,639	7,522	320	320	320	320	1,280	1,508	1,937	2,398	2,959	8,802
Performance	5,328	5,328	5,735	5,785	22,175	80	80	80	80	320	5,408	5,408	5,815	5,865	22,495
Labour	-	-	-	-	-	470	470	470	470	1,880	470	470	470	470	1,880
Non-Program Specific Expenditures	-	-	-	-	-	200	200	200	200	800	200	200	200	200	800
Total ($000s)	**6,515**	**6,945**	**7,813**	**8,424**	**29,697**	**1,070**	**1,070**	**1,070**	**1,070**	**4,280**	**7,585**	**8,015**	**8,883**	**9,494**	**33,977**

Exhibit 10 – Industrial Gas Savings and Cost-Effectiveness by Program

Program	Yearly Incremental Gas Savings (GJ)					NPV of Gas Savings ($000s)					UCT
	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total	
Prescriptive	75,973	104,990	135,899	179,425	496,286	27,931	38,616	49,691	65,718	181,956	20.7
Performance	289,560	289,560	337,560	337,560	1,254,240	46,889	46,889	48,593	48,593	190,964	8.5
Total ($000s)	**365,533**	**394,550**	**473,459**	**516,985**	**1,750,526**	**74,821**	**85,505**	**98,284**	**114,310**	**372,920**	**11.0**

6 Low Income Program Area

This program area focuses on creating energy savings opportunities for low income customers - both through programs that low income customers can apply to and through programs that serve charities, non-profit housing providers and co-ops, which in turn benefit FEI's low income customers.

This program area also contributes to meeting the "adequacy" component of the DSM Regulation Section 3, whereby a public utility's 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".[15] The program area is also subject to cost effectiveness requirements in Section 4 of the DSM Regulation as a class A measure[16].

Furthermore, one of FEI's 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."[17] FEI maintains its commitment to this principle by offering both no-cost and rebate programs to low income customers, along with offers that assist charities and non-profit housing providers pursuing energy efficiency and conservation.

In this DSM Plan, the Low Income Program Area consists of four programs:

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

The **Self Install Program** is a program whereby low income participants receive Energy Savings Kits (ESK) or re-engagement kits which include energy saving measures along with an installation instruction booklet and directions to access online "how to" videos. The Self Install Program is a partnership program with FBC and BC Hydro.

The **Direct Install Program** is a program whereby low income participants receive an in-home visit from a program contractor to assess their home's energy efficiency, install basic measures (e.g., high-efficiency showerheads, faucet aerators, etc.) and provide customized energy efficiency coaching. Additionally, some participants qualify to receive more robust measures such as draft-proofing, ventilation, and insulation. Partners in the Direct Install Program include FBC and BC Hydro.

The **Prescriptive Program** provides rebates, implementation support, funding for energy studies, and training for non-profit housing providers. Prescriptive rebates are available for residential and commercial

[15] As per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 3(1)(a)(i) and (ii), amended June 27, 2023

[16] As per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 4(4), amended June 27, 2023

[17] Energy Efficiency and Conservation Programs Application, page 47, May 28, 2008

measures such as thermostats, insulation, ventilation, gas heat pumps, hybrid systems, and water heaters.

The **Support Program** provides funding for training and educational opportunities to enhance energy efficiency retrofit skills for people who experience barriers to employment. Further, it provides support for charities and non-profit housing providers pursuing high-performance new construction projects.

6.1 Key Changes in New Plan

Compared with the previous DSM Plan, the 2024-2027 DSM Plan has the following key updates in the Low Income Program Area:

- Additional funding has been allocated to the Self Install Program with the intention of enhancing the program by providing customers with more choice in the products they receive and offering additional support and education.
- Proposed expenditures for the Direct Install Program are reduced with the removal of gas furnace replacements. The program will continue to support low income customers by offering a full service experience focused on reducing water and space heating energy consumption, as well as making homes more comfortable and safer.
- The Prescriptive Program reflects several changes including the removal of conventional high-efficiency gas equipment incentives, except for water heating incentives for Part 9 buildings. The program focuses on building envelope, equipment optimization and controls, gas heat pumps, and hybrid dual-fuel systems.
- Funding for high performance, new construction projects, which was formerly allocated to the Performance Program, has been shifted to the Support Program. Previously, incentive funding was available to support charities and non-profits housing providers pursing these projects. This funding has shifted to non-incentive support funding.

6.2 Program Budget and Savings

Exhibit 11 shows the annual incentive, non-incentive, and total expenditures for the Low Income Program Area by program. Exhibit 12 shows the gas savings for each Low Income Program.

Exhibit 11 – Low Income Program Area Expenditures by Program ($000s), Not Including Inflation

Program	Incentive Expenditures ($000s)					Non-Incentive Expenditures ($000s)					Total Expenditures ($000s)				
	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total
Self Install	518	605	765	790	2,678	135	141	147	153	576	653	746	912	943	3,254
Direct Install	4,200	4,440	5,280	6,480	20,400	800	840	880	920	3,440	5,000	5,280	6,160	7,400	23,840
Prescriptive	1,606	2,476	3,367	4,847	12,295	117	98	83	83	381	1,723	2,574	3,450	4,930	12,676
Support	-	-	-	-	-	165	175	195	215	750	165	175	195	215	750
Labour	-	-	-	-	-	775	820	893	912	3,400	775	820	893	912	3,400
Non-Program Specific Expenditures	-	-	-	-	-	50	50	50	50	200	50	50	50	50	200
Total ($000s)	6,324	7,521	9,412	12,116	35,373	2,042	2,124	2,248	2,333	8,747	8,366	9,645	11,660	14,449	44,120

Exhibit 12 – Low Income Gas Savings by Program

Program	Yearly Incremental Gas Savings (GJ)					NPV of Gas Savings ($000s)				
	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total
Self Install	27,120	27,768	28,416	29,064	112,368	7,942	8,140	8,337	8,535	32,955
Direct Install	14,735	15,577	18,524	22,734	71,570	7,230	7,643	9,089	11,154	35,115
Prescriptive	8,829	13,647	17,639	23,790	63,905	5,066	7,836	10,162	13,672	36,736
Support	-	-	-	-	-	-	-	-	-	-
Total ($000s)	50,684	56,992	64,579	75,588	247,843	20,238	23,619	27,588	33,361	104,807

7 Indigenous Program Area

Working collaboratively with Indigenous communities, the energy efficiency programming focusses on improvements for existing homes and new construction. Program design and eligible measures are based upon non-Indigenous retrofit and new construction program eligibility criteria but with enhanced rebates and modified application processes and marketing approaches. Support is also provided for community outreach and education, energy efficiency construction and building maintenance training and community member capacity building.

This program area also contributes to meeting the “adequacy” component of the DSM Regulation Section 3, whereby a public utility’s DSM portfolio is considered adequate when there is a demand side measure intended specifically to reduce energy consumption in housing or public buildings owned or operated by an Indigenous governing body.[18] The Indigenous Program Area is also subject to cost effectiveness requirements in Section 4 of the DSM Regulation as a class A measure[19].

In this DSM Plan, the Indigenous Program Area consists of five programs:

- Direct Install Program
- Prescriptive Program
- Performance Program
- Conservation Education and Outreach Program
- Community Energy Specialist

The **Direct Install Program** is modelled after the Low Income direct install offer with application process modifications. The program offers participants to receive an in-home visit from a program contractor to assess their home’s energy efficiency, install basic measures (e.g., high efficiency showerheads, faucet aerators, etc.) and provide customized energy efficiency coaching. Additionally, some participants qualify to receive more robust measures such as draft-proofing, ventilation, and insulation.

The **Prescriptive Program** has enhanced value rebates to support building envelope and space and water heating improvements. This includes ventilation and health and safety rebates to help facilitate energy efficiency upgrades. The program is structured to support community housing departments in residential and commercial applications.

The **Performance Program** includes both new and existing buildings in residential and commercial sectors. For existing buildings, support is provided to identify, assess, and implement building energy-efficiency projects for existing buildings, and provide a commercial Strategic Energy Management programming offer. The new building offer is based on Step Code program design and includes the Integrated Design Process, enhanced rebates, and energy evaluator support.

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[18] As per BC *Utilities Commission Act,* Demand-Side Measures Regulation (BC Reg. 326/2008) Section 3(1)(g)(i) and (ii), as amended June 27, 2023

[19] As per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 4(4), as amended June 27, 2023

The **Conservation Education and Outreach Program** provides funding support for community energy planning, community engagement and outreach, and educational support for energy efficiency construction training.

The **Community Energy Specialist** provides funding support for a dedicated employee and other resources to help communities to facilitate efficiency improvements in buildings, support policy development and ultimately, reduce emissions and improve energy efficiency.

7.1 Key Changes in New Plan

The Indigenous Program Area is a proposed new program area in response to the amended DSM Regulation.[20] FortisBC has previously offered programs for Indigenous customers within the existing Residential, Commercial and Low Income Program Areas. Compared with the previous DSM Plan, the 2024-2027 DSM Plan has the following key updates to offers for Indigenous customers:

- Removal of incentives for conventional high-efficiency gas space heating equipment except in Climate Zone 6 or above.
- Removal of incentives for conventional high-efficiency gas space heating and water heating equipment in Part 3 multi-unit residential, commercial, and other institutional buildings.
- New rebates and support for dual fuel heating systems.
- New support for offering a Strategic Energy Management offer for Indigenous communities to develop a systematic, long-term approach to reduce energy costs and greenhouse gas emissions.

7.2 Program Budget and Savings

Exhibit 13 shows the annual incentive, non-incentive, and total expenditures for the Indigenous Program Area by program. Exhibit 14 shows the gas savings for each Indigenous program.

[20] As per *BC Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 3(1)(g)(i) and (ii), as amended June 27, 2023

Exhibit 13 – Indigenous Program Area Expenditures by Program ($000s), Not Including Inflation

Program	Incentive Expenditures ($000s)					Non-Incentive Expenditures ($000s)					Total Expenditures ($000s)				
	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total
Direct Install	72	72	86	101	331	5	5	5	5	20	77	77	91	106	351
Prescriptive	1,092	2,069	2,927	3,601	9,688	50	50	50	50	200	1,142	2,119	2,977	3,651	9,888
Performance	581	1,032	1,322	1,552	4,487	50	50	50	50	200	631	1,082	1,372	1,602	4,687
Conservation Education and Outreach	-	-	-	-	-	20	20	20	20	80	20	20	20	20	80
Community Energy Specialist	480	550	600	650	2,280	10	10	10	10	40	490	560	610	660	2,320
Labour	-	-	-	-	-	335	350	359	350	1,393	335	350	359	350	1,393
Non-Program Specific Expenditures	-	-	-	-	-	10	10	10	10	40	10	10	10	10	40
Total ($000s)	2,225	3,723	4,935	5,903	16,786	480	495	504	495	1,973	2,704	4,218	5,439	6,398	18,759

Exhibit 14 – Indigenous Gas Savings by Program

Program	Yearly Incremental Gas Savings (GJ)					NPV of Gas Savings ($000s)				
	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total
Direct Install	202	202	253	278	935	99	99	124	136	459
Prescriptive	5,545	10,892	15,498	16,911	48,846	17,957	6,960	10,260	10,895	46,072
Performance	10,328	11,143	11,671	12,037	45,179	2,320	3,055	3,530	3,861	12,767
Conservation Education and Outreach	-	-	-	-	-	-	-	-	-	-
Community Energy Specialist	-	-	-	-	-	-	-	-	-	-
Total ($000s)	16,076	22,237	27,421	29,225	94,959	20,377	10,114	13,914	14,892	59,297

8 Conservation Education and Outreach

The Conservation Education and Outreach (CEO) initiatives provide education about conserving energy and non-program specific outreach communications and engagement. This Program Area fosters a culture of conservation within the province by providing education to a broad range of customers and stakeholders, including hard-to-reach residential and commercial customers, and students. The goal of these programs is to inform customers on how to conserve energy (behaviour change) and to learn about incentive programs. The costs of CEO activities are included on the portfolio level and have an impact on the overall portfolio cost-effectiveness.

The CEO initiatives are designed to meet the DSM Regulation Section 3 adequacy requirements[21] and subject to cost effectiveness requirements in Section 4 of the DSM Regulation as class A measures.[22] The CEO initiatives also support specified public awareness programs,[23] while being subject to cost effectiveness requirements in Section 4 of the DSM Regulation.[24]

For the 2024-2027 DSM Plan, the suite of Conservation Education and Outreach customer offerings are organized into the following programs:

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

The **Customer Engagement Tool** program provides energy reports and other tools that provide energy consumption analysis to residential customers, increasing customer's awareness of energy efficiency and conservation while fostering conservation behaviours. These initiatives are in partnership with FBC and include an online portal where customers can access targeted energy conservation content and build awareness of FEI's other DSM offers. Savings are reported in FEI's annual DSM reports to the British Columbia Utilities Commission. Future enhancements to the Customer Engagement Tool may include a personalized multichannel tool that encourages behaviour change, program uptake, and allows FortisBC to have the ability to garner deeper insights into customers end-uses for additional program marketing through virtual energy audits and home assessments, personalized home energy reports and online portal, and a digital education portal.

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[21] As per *BC Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 3(1)(c) and (d), as amended June 27, 2023

[22] As per *BC Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 4(4), as amended June 27, 2023

[23] As per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 1 "public awareness program", as amended June 27, 2023

[24] As per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 4(5), as amended June 27, 2023

The **Residential Education Program** provides information to residential customers and the public on gas conservation and energy literacy through direct engagement, online tools, and general public marketing/advertising campaigns. Promotional undertakings include a multimedia rebate awareness and education campaign, engagement activities, educational seminars, and participation in home shows and community events. This includes outreach to low income and multilingual customers. Ongoing partnerships with Canadian Home Builders Associations and local sports organizations expand outreach opportunities.

The program includes the cost of producing materials for events and prizes for audience engagement, such as draft proofing kits, used at events that reach residential customers.

The **Commercial Education Program** provides ongoing communication and education about energy conservation measures as well as behavioural change educational programming that help commercial customers reduce their organization's energy consumption. Commercial Education includes small to large businesses in a variety of sub sectors such as retail, offices, multi-family residences, schools, hospitals, hospitality services and municipal/institutions.

Promotional activities include face-to-face engagement, print and online marketing, and participation in industry association meetings and tradeshows. FEI plans to continue the Efficiency in Action Awards, which recognizes commercial customers and community organizations for their innovation and leadership in energy efficiency and the gas savings achieved. These initiatives also guide and support energy specialists (or an energy manager) in their respective organizations or communities.

The **School Education Program** includes the LiveIt Earth series, a kindergarten to grade 8 curriculum-connected resource and the assembly style presentation, Energy Champions, which is currently delivered in collaboration with the BC Lions. Additional programs for grades 9 – 12 are also being evaluated.

FEI enjoys ongoing partnerships with post-secondary institutions and is supporting additional energy efficiency training for academic and trades training initiatives. This includes in-class programs, on-campus education campaigns, and education campaigns delivered by energy specialists (or an energy manager).

This program responds to meeting the adequacy requirements[25] of the DSM 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.

8.1 Key Changes in New Plan

Compared with the previous DSM Plan, the 2024-2027 DSM Plan has the following key updates:

- The Home Energy Report and online portal enhancements are planned to enhance the current customer engagement tool to potentially expand to a personalized multichannel tool that encourages behaviour change, program uptake, and allows FortisBC to have the ability to garner deeper insights into customers end-uses for additional program marketing. Potential programs may include:

[25] As per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 3(1)(d), as amended June 27, 2023

- A virtual home energy assessment platform in which FortisBC homeowners have the potential to interact with an online tool which will help customers find and potentially guide them through deeper energy retrofits.
- An online marketplace and education tools which help customers select equipment through efficiency ratings, price comparison and total cost of ownership including any incentives.

8.2 Program Budget

Exhibit 15 shows the annual incentive, non-incentive, and total expenditures for the Conservation Education and Outreach program by activity. Exhibit 16 shows the gas savings for each Conservation Education and Outreach activity.

Exhibit 15 – CEO Program Area Expenditures by Program ($000s), Not Including Inflation

Program	Incentive Expenditures ($000s)					Non-Incentive Expenditures ($000s)					Total Expenditures ($000s)				
	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total
Customer Engagement Tool	-	-	-	-	-	5,510	4,660	4,860	4,960	19,990	5,510	4,660	4,860	4,960	19,990
Residential Education Program	-	-	-	-	-	3,660	3,580	3,620	3,660	14,520	3,660	3,580	3,620	3,660	14,520
Commercial Education Program	-	-	-	-	-	1,600	1,655	1,705	1,705	6,665	1,600	1,655	1,705	1,705	6,665
School Education Program	-	-	-	-	-	1,086	1,136	1,091	1,091	4,404	1,086	1,136	1,091	1,091	4,404
Labour						2,746	3,060	3,124	3,189	12,119	2,746	3,060	3,124	3,189	12,119
Non-Program Specific Expenditures	-	-	-	-	-	50	50	50	50	200	50	50	50	50	200
Total ($000s)	-	-	-	-	-	**14,652**	**14,141**	**14,450**	**14,655**	**57,898**	**14,652**	**14,141**	**14,450**	**14,655**	**57,898**

Exhibit 16 – CEO Gas Savings by Program

Program	Yearly Incremental Gas Savings (GJ)					NPV of Gas Savings ($000s)				
	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total
Customer Engagement Tool	20,000	30,000	30,000	30,000	110,000	3,466	5,200	5,200	5,200	19,066
Residential Education Program	-	-	-	-	-	-	-	-	-	-
Commercial Education Program	-	-	-	-	-	-	-	-	-	-
School Education Program	-	-	-	-	-	-	-	-	-	-
Total ($000s)	20,000	30,000	30,000	30,000	110,000	3,466	5,200	5,200	5,200	19,066

9 Innovative Technologies

The Innovative Technologies 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 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. 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 in the DSM Plan may be included only if sufficient data to claim those savings is available. When results become available via evaluation activities, any energy savings will be reported in DSM Annual Reports.

In this DSM Plan, the Innovative Technologies Program Area[26] consists of three core activity areas:

- Technology Screening
- Pilot Projects
- Deep Retrofits

The **Technology Screening** activity area incorporates the assessment of new energy efficient technologies. Activities include conducting prefeasibility studies, small demonstrations, or lab tests to 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 Section 1.[27]

Candidate technologies that do not pass the DSM screen are 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.

The Technology Screening activity also incorporates the administration of the Gas Technology Demonstration Program. This program is offered to FEI Energy Specialists to conduct technology studies, demonstrations, and evaluation activities with funding support. Results of these activities are used to inform future DSM programs.

The **Pilot Projects** activity area is designed to gather actual field performance data of a technology in a customer's home or business to verify customer acceptance, installation challenges, costs, and energy

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[27] As per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 1 "technology innovation program", as amended June 27, 2023

savings. This activity is supported by a third-party measurement and verification consultant who follows International Performance Measurement and Verification Protocols. The development and implementation of a typical pilot project for technologies that pass Technology Screening takes approximately one to three years, depending on the complexities of the pilot design, program controls and participation requirements. Results from pilot projects help support the feasibility of developing future DSM programs.

The **Deep Retrofits** activities aim to both assess and evaluate energy efficiency technologies, a system of technologies, and or building designs that can reduce GHG emissions by 50% or greater in both residential and commercial buildings. Activities include conducting house-as-a-system technology research to focus on understanding barriers and identifying innovative solutions to support industry and market transformation, executing small and large demonstrations, and partnering with industry stakeholders to educate the market. Results of these activities will be used to inform energy savings and costing numbers, identify customer adoption barriers, and establish recommendations to support future DSM program offerings.

9.1 Program Budget

Exhibit 17 shows the annual incentive, non-incentive, and total expenditures for the Innovative Technologies area by activity.

Exhibit 17 – Innovative Technologies Program Area Expenditures by Activity ($000s), Not Including Inflation

Program	Incentive Expenditures ($000s)					Non-Incentive Expenditures ($000s)					Total Expenditures ($000s)				
	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total
Technology Screening	300	300	300	300	1,200	500	500	500	500	2,000	800	800	800	800	3,200
Pilots	5,350	5,950	5,850	6,600	23,750	250	250	260	285	1,045	5,600	6,200	6,110	6,885	24,795
Deep Energy Retrofits	25,620	10,163	4,063	5,938	45,783	813	994	1,469	1,519	4,794	26,433	11,156	5,531	7,456	50,576
Labour	-	-	-	-	-	1,709	1,907	1,906	1,907	7,429	1,709	1,907	1,906	1,907	7,429
Non-Program Specific Expenses	-	-	-	-	-	575	525	545	545	2,190	575	525	545	545	2,190
Total ($000s)	**31,270**	**16,413**	**10,213**	**12,838**	**70,733**	**3,847**	**4,175**	**4,680**	**4,755**	**17,458**	**35,117**	**20,588**	**14,893**	**17,593**	88,190

9.2 Planned Activities

The following table provides a brief description of some the technologies that are planned to be evaluated over the DSM Plan period.

Exhibit 18 – Potential Technologies Evaluated for 2024-2027

#	Technology	Description
1	Gas Heat Pumps	Gas heat pumps are used for space heating, water heating, ventilation, and cooling for commercial and residential sectors. Technology manufacturers are developing three types of gas heat pump technologies: engine-driven vapor compression, sorption (absorption/adsorption), and thermal compression. Each type uses different refrigerants and pressurization methods to essentially move heat from an external heat source to a heat sink (indoors) using gas resulting in system efficiencies greater than 100%.
2	Hybrid Heating	A dual fuel hybrid heating system consists of a gas and electric heating system that is sequentially operated to meet heating needs to reduce costs and GHG emissions for building owners. Using hybrid heating systems claims to reduce the number of hours that electric heat pumps are required to operate at lower efficiencies during colder days, leading to reduced electric peak demand. The system also supports annual system efficiencies greater than 100% and resulting in less GHG emissions.
4	Gas Demand Response	Digital demand response technologies that can offer pathways to support events to reduce system capacity restraints with customers and reduce energy consumption and related GHG emissions.
5	Deep Retrofits	A deep energy retrofit or 'deep retrofit' of a home or building is a retrofit in which the envelope and energy systems are improved such that there is a reduction in overall energy consumption and GHG performance by at least 50% or more. Considering home as a system and improving the thermal performance of the envelope will reduce the heat demand and therefore creates better opportunity to downsize the required energy system. Across FEI's service territory, there is a significant base of buildings that are at least 25 years old and built before the adoption of the National Energy Code for buildings. The Conservation Potential Review study (CPR)[28], conducted by Posterity Group (an energy consultancy company) estimates an eligible market of 274 thousand dwellings and an annual energy savings potential of 890,000 GJ per year through leveraging comprehensive deep retrofit improvements.

[28] 2021 Conservation Potential review, 12 July 2021, Posterity Group

6	Prefabricated Panelized Solutions	Prefabricated panelized solution is a methodology to reduce the construction time by integrating several thermal performance improvement measures together into a prefabricated wall or roof panel. These panels are fabricated in advance in a controlled environment inside a factory. These prefabricated panels will be attached to the existing building envelope onsite and in a short period of time.
7	Artificial Intelligence-based Energy Performance Evaluation	Artificial Intelligence based energy performance evaluation combines publicly available information with machine learning and provides home energy performance evaluation with current average of 80% accuracy. Leveraging this technology can improve scalability of deep retrofits while driving the cost down.
8	Building Mapping Solutions	Most older existing buildings do not have current architectural and mechanical plans. This can be a barrier for energy performance evaluation and deep retrofit implementation. Building mapping solutions provides dimensional and visual information for existing buildings and facilitates documenting the post retrofit condition.
9	Non-Intrusive Air Sealing Technologies	Improving airtightness is a deep retrofit measure that can provide significant impact on energy use reduction for a reasonable cost. Most often the destruction associated with improving the airtightness through conventional methods lowers the adoptability of this measure and non-intrusive Air Sealing technologies can remove such a barrier and improve market acceptance.
10	Thermal Bridging	Eliminating thermal bridging in existing buildings is one of the deep retrofit measures to improve thermal performance of the envelope. The improvement level depends on the archetype, construction assembly and current condition of the building.
11	Embodied Carbon	Embodied Carbon is a relatively newer consideration for lowering energy use and its associated GHG emissions in new and existing buildings. FortisBC will explore whether implementing a deep retrofit enhances the life of an existing building as well as the prevention of embodied carbon attached to its demolition.
12	Fault Detection and Diagnostics (FDD)	FDD supports buildings with identifying maintenance and design issues. The technology helps enhance operation sequencing and increasing awareness of building operators. This awareness can help optimize systems resulting in reduced consumption.
13	Automated Analytics	Advanced building automated analytics in conjunction with energy management information systems (EMIS) is used to increase the implementation of energy conservation measures.

10 Enabling Activities

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. 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. They are instead included on the portfolio level and reflected in the overall portfolio cost-effectiveness.

For the 2024-2027 DSM Plan, Enabling Activities are organized into the following:

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

The **Trade Ally Network (TAN)** includes the expenditures related to maintaining FEI's program partners that help promote FEI's DSM programs and energy efficiency messaging. FEI relies on trade allies, such as contractors, manufacturers, distributors, and Point of Sale Partners, to provide the qualifying products and quality installations of energy efficiency measures. FEI recognizes that other industry representatives, such as Energy Advisors, general contractors and renovators will play a key role in advancing whole home performance retrofits and influencing energy efficient upgrades in residential homes. As such, incremental funding to support these industry representatives is planned. This program also supports funding energy efficiency training, a specified demand-side measure outlined in Section 1 of the DSM Regulation,[29] and incremental funding to support additional measures and whole home performance retrofits is planned. Through the TAN, FEI provides sponsorships for training and support for several initiatives for the trades and trade organizations.[30]

The **Codes and Standards** budget finances FEI's support for codes and standards policy development and research, through in-kind and financial co-funding arrangements.

In the residential sector, FEI will continue to provide support for energy compliance and testing of new homes through the provision of incentives for energy advisor services as required by the BC Energy Step Code. Incentives encourage builders to work with an energy advisor to validate the energy performance of their home through energy modelling, on-site airtightness testing, completion of the Step Code compliance reports and receipt of an EnerGuide label. Additional support will be provided to encourage

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[29] As per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 1 "class A measure" (c), as amended June 27, 2023

[30] HPSC (Home Performance Stakeholder Council), TECA (Thermal Environmental Comfort Association), MCABC (Mechanical Contractors Association of BC), etc.

early design activities such as mechanical design, building envelope design and integrated design process. These activities minimize time and risk when building to the upper tiers of the BC Energy Step Code.

The Codes and 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 "class A demand-side measures" in Section 1 of the DSM Regulation and supports implementation and adoption of such measures and aims to educate and provide training to the industry.[31]

FEI also works with and supports several international, national, and provincial entities, such as:

- Canadian Standards Association
- Natural Resources Canada
- National Research Council Canada
- BC Ministry of Energy, Mines, and Low Carbon Innovation
- BC Building Safety & Standards Branch
- American Society of Heating, Refrigerating and Air-Conditioning Engineers
- Municipalities across BC

FEI will continue activity in this area to support development and advancement of provincial and federal energy efficiency building codes and appliance standards. In compliance with Section 3 of the DSM Regulation Section 3,[32] 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 regulatory body and/or government to assist with the compliance or development of energy conservation standards or the efficient use of energy. The relevant financial investment planned to meet the 1% adequacy requirement will be $6.2 million in 2024-2027. Included in the 1% planned adequacy funding are resources dedicated to standards making bodies which are advancing new testing and evaluation standards of gas fired equipment. Activities such as providing guidance and technical support for gas related energy efficiency initiatives are included to support the provincial government. On a federal level, planned funding is included to support the development of national building codes.

The **Reporting Tool & Customer Application Portal** includes expenditures related to the Demand-Side Management Tracking System. This system manages DSM rebates from the application stage through to payment, including application review, approval, payment file exports, reporting, and customer communications. The budget consists of licensing and hosting fees and the labour required to operate and maintain the system and related customer portal.

The **Conservation Potential Review** (CPR) is 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

[31] As per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 1 "class A measure" (g)(i), as amended June 27, 2023

[32] As per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 3(1)(e)(i), as amended June 27, 2023

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.

The **Customer Research** budget includes ongoing research to track the impact of C&EM communications, communications testing, digital user experience testing, and customer segmentation research.

The **Commercial Energy Specialist Program** funds Energy Specialist, Energy Analyst and Thermal Energy Manager positions in large commercial organizations. Funding ranges from $50,000 up to $80,000 per year based on position and an annual contract. A funded position's key priority is to identify and implement opportunities for their organization to participate in FEI's C&EM programs, while also identifying and implementing nonprogram specific opportunities to use gas more efficiently.

The estimated costs are based on an average of 33 annual participants over the 2024 – 2027 DSM Plan including all positions. This program is funded as an enabling activity but claims gas savings for those projects completed by a funded position 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[33] and subject to Section 4.[34]

The **Community Energy Specialist Program** funds Senior Energy Specialist positions in municipalities, regional districts and Indigenous communities and organizations for up to $100,000 per year based on an annual contract. In the FEI service territory, C&EM contributes up to 60% of this funding amount, with the remaining portion 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. Costs include an assumption of increasing to 28 positions by 2027. FEI considers this to be an energy management program[35] and subject to Section 4.[36]

10.1 Budget Overview

Exhibit 19 shows the annual incentive, non-incentive, and total expenditures for the Enabling Activities broken down by initiative.

[33] As per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 1 "class A measure" (e), as amended June 27, 2023

[34] As per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 4(4), as amended June 27, 2023

[35] As per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 1 "class A measure" (e), as amended June 27, 2023

[36] As per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 4 (4), as amended June 27, 2023

Exhibit 19 – Enabling Activities Expenditures by Activity ($000s), Not Including Inflation

Program	Incentive Expenditures ($000s)					Non-Incentive Expenditures ($000s)					Total Expenditures ($000s)				
	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total
Trade Ally Network	-	-	-	-	-	1,770	1,735	1,770	1,730	7,005	1,770	1,735	1,770	1,730	7,005
Codes & Standards	3,361	1,359	311	405	5,435	1,138	1,138	1,138	1,138	4,554	4,499	2,498	1,449	1,543	9,989
Reporting Tool & Customer Application Portal	-	-	-	-	-	892	1,209	911	921	3,932	892	1,209	911	921	3,932
Conservation Potential Review	-	-	-	-	-	100	260	360	-	720	100	260	360	-	720
Customer Research	-	-	-	-	-	150	100	100	100	450	150	100	100	100	450
Commercial Energy Specialist Program	2,600	2,600	2,500	2,500	10,200	250	250	275	275	1,050	2,850	2,850	2,775	2,775	11,250
Community Energy Specialist Program	2,600	1,000	1,100	1,100	5,800	30	35	40	45	150	2,630	1,035	1,140	1,145	5,950
Labour	-	-	-	-	-	2,151	2,411	2,471	2,411	9,446	2,151	2,411	2,471	2,411	9,446
Total ($000s)	8,561	4,959	3,911	4,005	21,435	6,482	7,139	7,065	6,621	27,306	15,042	12,098	10,976	10,626	48,742

11 Portfolio Level Activities

Portfolio-level activities are required to properly plan, implement, and evaluate the proposed DSM programs and support efforts to meet the energy savings targets. For the 2024-2027 DSM Plan, Portfolio Level Activities are organized into the following:

Evaluation studies are conducted to determine if FEI's DSM program objectives are being met and savings are being realized. Evaluation of energy efficiency programs provides internal and external accountability by reducing uncertainty in the estimates of energy and demand savings. Evaluation activities and studies are done in collaboration with various stakeholders including FBC, government and other utilities. The cumulative total for evaluation expenditures is $11.3 million. This represents 2% of this DSM Plan's total expenditures.

Portfolio Level Activities are those activities for which the costs cannot be assigned to individual DSM programs. These activities are distinct from Enabling Activities. These distinct Portfolio Level Activities include expenditure 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[37] activities. Portfolio Level Activities also reflects staff efforts to complete the forecasting and reporting of DSM activities and DSM studies which are completed on an ongoing basis to support the overall planning of DSM programs. These studies can include the residential and commercial end use surveys and avoided cost studies.

Exhibit 20 shows the annual expenditures for FEI's portfolio activities.

Exhibit 20 – Annual Portfolio DSM Expenditures by Activity ($000s), Not Including Inflation

Program	Total Expenditures ($000s)				
	2024	2025	2026	2027	Total
Evaluation	2,831	2,978	2,694	2,807	11,311
Portfolio-Level Activities	2,450	2,450	2,450	2,450	9,800
Total ($000s)	**5,281**	**5,428**	**5,144**	**5,257**	**21,111**

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

12 Legacy Expenditures

This section includes legacy expenditures[38] enabled under Section 5 of the DSM Regulation and is made up of less-than-100% efficient gas space and water heating measures (i.e. conventional high-efficiency gas equipment).

The expenditure includes expenditures for conventional high-efficiency gas equipment which were formally under the respective program areas in the 2023 DSM Plan, now included here within the Legacy Expenditures section. These incentives are a continuation of committed incentives under the previous DSM Plan period which are expected to be completed or paid within the 2024 – 2027 DSM Plan period. This Legacy Expenditures section is subject to the prior cost effectiveness guidelines of the DSM Regulation[39] which used the blended Total Resource Cost (TRC) test and modified TRC as the primary cost test. The expenditure, estimated savings, and results are listed below.

The legacy incentives from the **Residential** program area include conventional furnaces, boilers, EnerChoice fireplaces, condensing tankless and storage tank water heaters, combination systems and step code measures from the Home Renovation and New Home programs.

The legacy incentives from the **Commercial** program area include condensing volume boilers, condensing tankless water heaters, furnaces, condensing unit heaters, condensing make up air units, capital upgrades, and whole building step code and non step code measures from the Prescriptive, Performance (Existing Buildings) and Performance (New Construction) programs.

The legacy incentives from the **Low Income** program area include residential furnaces and boilers, commercial condensing volume boilers, condensing tankless water heaters, furnaces, and non-profit measures from the Prescriptive program, and the Energy Conservation Assistance Program from the Direct Install Program.

The legacy incentives from the **Indigenous** program area include furnaces, boilers, EnerChoice fireplaces, step code measures, residential condensing storage tank water heaters, and commercial non-profit measures, condensing tankless and storage tank water heaters, from the Prescriptive program. While the Indigenous program area is a new distinct area beginning in 2024, these offers were previously committed to under existing programs. It is split out here for consistency.

12.1 Program Budget and Savings

Exhibit 21 shows the annual incentive, non-incentive, and total expenditures for the Legacy Program Area. Exhibit 22 shows the gas savings for the Legacy Program Area.

[38] As per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 5, as amended June 27, 2023

[39] This is determined from committed legacy expenditures as per BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 5(2), as amended June 27, 2023, resulting in cost effectiveness testing under the BC *Utilities Commission Act*, Demand-Side Measures Regulation (BC Reg. 326/2008) Section 3, as amended March 24, 2017.

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Exhibit 21 – Legacy Program Area Expenditures ($000s), Not Including Inflation

Program	Incentive Expenditures ($000s)					Non-Incentive Expenditures ($000s)					Total Expenditures ($000s)				
	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total
Legacy Incentives	34,693	16,033	8,204	5,142	64,072	-	-	-	-	-	34,693	16,033	8,204	5,142	64,072
Labour	-	-	-	-	-	1,507	902	180	125	2,714	1,507	902	180	125	2,714
Total ($000s)	**34,693**	**16,033**	**8,204**	**5,142**	**64,072**	**1,507**	**902**	**180**	**125**	**2,714**	**36,200**	**16,934**	**8,384**	**5,267**	**66,785**

Exhibit 22 – Legacy Gas Savings and Cost-Effectiveness

Program	Yearly Incremental Gas Savings (GJ)					NPV of Gas Savings ($000s)					Blended TRC
	2024	2025	2026	2027	Total	2024	2025	2026	2027	Total	
Legacy Incentives	147,185	57,878	31,361	21,340	257,765	91,704	34,477	16,590	11,155	153,926	1.5
Total ($000s)	**147,185**	**57,878**	**31,361**	**21,340**	**257,765**	**91,704**	**34,477**	**16,590**	**11,155**	**153,926**	**1.5**

13 Summary

The information presented in this DSM Plan provides:

- A comprehensive suite of programs for each of the previously approved DSM activities.
- 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. This remaining opportunity reflects, in part, how the continued technology cost and performance improvements have increased the availability of energy-efficiency options.

Overall, the portfolio of programs contained in the DSM Plan provide a UCT value of 2.1, and all the Residential, Commercial, Industrial, Low Income, and Indigenous Program Areas result in passing UCT values. The Legacy Expenditures provide a passing Blended TRC of 1.5.

Appendix B

ADDITIONAL COST EFFECTIVENESS RESULTS AND MEASURE DETAILS REPORT

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GROUP

FortisBC Energy Inc. (FEI)
2024-2027 DSM Expenditures Plan Report

Appendix B: Additional Cost Effectiveness Results, Measure Details and Sources

Date: July 12th, 2023

Posterity Group
135 Laurier Ave. West – Suite 408
Ottawa, ON, K1P 5J2

Appendix B Additional Cost Effectiveness Results and Measure Details

Contents

Portfolio and Program Area Cost Effectiveness Results

Exhibit 1 – Additional DSM Portfolio Cost Effectiveness

	Total
TRC	1.4
PCT	0.9
RIM	0.7

Exhibit 2 – Portfolio Cost Effectiveness by Program Area

Program Area	TRC	MTRC	PCT	RIM
Residential	1.0	-	0.8	0.7
Commercial	3.6	-	1.6	0.8
Industrial	5.7	-	1.4	0.9
Legacy Expenditures	0.5	1.5	1.1	0.1

Residential Home Renovation Program

Exhibit 3 - Residential Home Renovation Program Forecasted Participation by Measure

Measure	2024	2025	2026	2027	Total
Attic Insulation	1,750	2,013	2,314	2,662	8,739
Wall Insulation	268	309	355	408	1,340
Crawlspace and Basement Insulation	287	330	380	437	1,434
Other Insulation	142	164	188	217	711
Drain Water Heat Recovery	200	300	400	500	1,400
Bonus Offers	1,000	300	-	-	1,300
Appliance Maintenance	40,000	40,000	40,000	40,000	160,000
Air Sealing	200	230	265	304	999
Draft Proofing	36,000	37,200	38,400	39,600	151,200
ENERGY STAR Washer ($25)	500	850	1,600	2,485	5,435
ENERGY STAR Dryer	25	50	75	100	250
Showerheads and Aerators	10,050	10,500	10,950	11,400	42,900
High Performance Windows and Doors	9,360	10,296	11,325	12,458	43,439
Dual Fuel Hybrid Systems	2,000	2,400	2,880	3,456	10,736

Measure	2024	2025	2026	2027	Total
High Efficiency Heat Recovery Ventilator	-	250	288	331	868
Whole Home Performance	-	40	45	50	135
HVAC Optimization – Contractor Rebate	3,300	4,000	4,000	4,000	15,300
Whole Home Performance Support	-	32	32	32	96
Space and Water Heating Controls	8,000	9,050	9,810	10,570	37,430
Total	**113,082**	**118,314**	**123,306**	**129,009**	**483,712**

Exhibit 4 - Residential Home Renovation Program Details by Measure[1]

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Attic Insulation	$1,326	$790	-	8.7	-	30	20%	-
Wall Insulation	$2,714	$1,273	-	20.6	-	30	20%	-
Crawlspace and Basement Insulation	$838	$897	-	5.3	-	30	20%	-

[1] Note all values are for planning purposes, values may change due to additional program design, evaluation and participant feedback

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Other Insulation	$1,167	$649	-	6.6	-	30	20%	-
Drain Water Heat Recovery	$738	$250	-	4.3	-	25	3%	-
Bonus Offers	$0	$306	-	-	-	1	-	-
Appliance Maintenance	$245	$35	-	1.3	-	1	-	-
Air Sealing	$2,183	$500	-	16.4	-	15	-	-
Draft Proofing	$6	$3	-	0.1	-	6	20%	-
ENERGY STAR Washer ($25)	$77	$50	-	1.0	69	14	20%	-
ENERGY STAR Dryer	$50	$100	-	0.7	-	12	-	-
Showerheads and Aerators	$21	$8	-	1.9	288	10	-	-
High Performance Windows and Doors	$475	$100	-	0.3	-	18	34%	-
Dual Fuel Hybrid Systems	$17,000	$10,200	$300	20.0	-	17	-	-

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Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
High Efficiency Heat Recovery Ventilator	$1,600	$1,600	$50	10.3	-	14	-	-
Whole Home Performance	$17,728	$15,552	-	32.8	-	30	-	-
HVAC Optimization – Contractor Rebate	$859	$130	-	1.0	-	18	-	-
Whole Home Performance Support	-	$7,000	-	-	-	-	-	-
Space and Water Heating Controls	$248	$123	-	2.6	186	13	23%	-
Weighted Average Per Participant	**$602**	**$296**	**$7**	**1.6**	**41**	**8**	**12%**	**-**

Residential New Home Program

Exhibit 5 - Residential New Home Program Forecasted Participation by Measure

Measure	2024	2025	2026	2027	Total
Drain Water Heat Recovery	15	15	15	15	60
Communicating Thermostat	700	350	150	225	1,425
ENERGY STAR Dryers	35	20	5	-	60
STEP 4 (Detached Home) – Dual Fuel Hybrid System	150	190	250	315	905
STEP 4 (Row Home) – Dual Fuel Hybrid System	25	30	45	55	155
STEP 5 (Detached Home) – Dual Fuel Hybrid System	8	10	15	20	53
STEP 5 (Row Home) – Dual Fuel Hybrid System	2	4	6	10	22
Total	935	619	486	640	2,680

Exhibit 6 - Residential New Home Program Details by Measure

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Drain Water Heat Recovery	$580	$250	-	3.4	-	30	5%	-
Communicating Thermostat	$250	$100	-	2.6	200	12	25%	-
ENERGY STAR Dryers	$50	$100	-	0.7	-	14	-	-
STEP 4 (Detached Home) – **Dual Fuel Hybrid System**	$40,050	$15,000	-	51.0	-6,319	30	10%	-
STEP 4 (Row Home) – **Dual Fuel Hybrid System**	$32,220	$15,000	-	37.7	-6,076	30	10%	-
STEP 5 (Detached Home) – **Dual Fuel Hybrid System**	$63,000	$20,000	-	51.8	-5,386	30	10%	-
STEP 5 (Row Home) – **Dual Fuel Hybrid System**	$47,340	$20,000	-	38.2	-5,093	30	10%	-
Weighted Average Per Participant	**$17,169**	**$6,554**	**-**	**22.2**	**-2,527**	**19**	**19%**	**-**

Commercial Prescriptive Program

Exhibit 7 – Commercial Prescriptive Program Forecasted Participation by Measure

Measure	2024	2025	2026	2027	Total
Condensing Boiler Plant Optimization	15	15	15	15	60
Domestic Hot Water System Optimization	10	10	10	10	40
Food Services Efficiency Measures	20	20	22	22	84
Low Flow Spray Valves	5	5	5	5	20
Vortex Deaerators	5	5	5	5	20
Air Curtains	7	7	7	7	28
Pipe and Tank Insulation	5	10	10	10	35
Steam Boiler Plant Optimization	3	3	3	3	12
Dual Fuel Hybrid RTUs	5	7	10	10	32
Dual Fuel Hybrid Hydronic Systems	3	4	5	5	16
Gas Heat Pumps	5	7	7	10	29
Connected Thermostats	10	10	10	10	40
Hydronic Additives	7	7	7	7	28
Total	**100**	**110**	**116**	**119**	**444**

Exhibit 8 – Commercial Prescriptive Program Details by Measure[2]

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Condensing Boiler Plant Optimization	$30,000	$15,000	$200	240	-	20	-	-
Domestic Hot Water System Optimization	$30,000	$15,000	$200	60	-	20	-	-
Food Services Efficiency Measures	$42,286	$25,714	$1,786	1,386	9,541	16	16%	-
Low Flow Spray Valves	$150	$120	-	19	-	12	20%	-
Vortex Deaerators	$35,000	$10,000	-	396	22,500	18	-	-
Air Curtains	$6,500	$5,000	-	529	2,537	15	18%	-
Pipe and Tank Insulation	$15,000	$10,000	-	120	-	11	18%	-
Steam Boiler Plant Optimization	$30,000	$20,000	-	1,444	-	20	18%	-

[2] Note all values are for planning purposes, values may change due to additional program design, evaluation and participant feedback

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Hybrid Dual Fuel RTUs	$75,000	$50,000	$500	600	-	13	20%	-
Hybrid Dual Fuel Hydronic Systems	$75,000	$50,000	$500	2,664		13	20%	
Gas Heat Pumps	$100,000	$90,000	$1,000	602	-	15	-	-
Connected Thermostats	$200	$100	-	5	-	15	20%	-
Hydronic Additives	$3,500	$2,000	-	186	-	5	18%	-
Weighted Average Per Participant	**$33,622**	**$21,762**	**$502**	**591**	2,979	**15**	**12%**	**-**

Commercial Performance Program (Existing Buildings)

Exhibit 9 – Commercial Performance Program (Existing Buildings) Forecasted Participation by Measure

Measure	2024	2025	2026	2027	Total
Studies	32	40	40	40	152
Capital Upgrades	2	8	15	20	44
Recommissioning	20	25	25	25	95
Commercial Energy Assessments	20	30	35	40	125
Commercial Strategic Energy Management (SEM)	5	10	15	20	50
Total	**79**	**113**	**130**	**145**	**466**

Exhibit 10 – Commercial Performance Program (Existing Buildings) Details by Measure[3]

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Studies	$50,000	$37,500	-	-	-	2	4%	-
Capital Upgrades	$500,000	$400,000	-	4,488	15,500	15	4%	-
Recommissioning	$33,500	$20,000	-	600	-	6	4%	-
Commercial Energy Assessments	$50,000	$37,500	-	187	4,750	2	35%	-
Commercial Strategic Energy Management (SEM)	$35,000	$35,000	-	2,400	125,000	5	20%	-
Weighted Average Per Participant	**$87,117**	**$67,571**	**-**	**850**	16,150	5	**15%**	**-**

[3] Note all values are for planning purposes, values may change due to additional program design, evaluation and participant feedback

Commercial Performance Program (New Construction)

Exhibit 11 – Commercial Performance Program (New Construction) Forecasted Participation by Measure

Measure	2024	2025	2026	2027	Total
Step Code – Whole Building	-	-	1	2	3
Non-Step Code – Whole Building	-	-	1	2	3
Total	**-**	**-**	**2**	**4**	**6**

Exhibit 12 – Commercial Performance Program (New Construction) Details by Measure[4]

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Step Code – Whole Building	$600,000	$400,000	-	1,160	240,000	17	4%	-
Non-Step Code – Whole Building	$600,000	$400,000	-	1,160	240,000	17	4%	-
Weighted Average Per Participant	**$600,000**	**$400,000**	**-**	**1,160**	240,000	**17**	**4%**	**-**

[4] Note all values are for planning purposes, values may change due to additional program design, evaluation and participant feedback

Commercial Rental Apartment Efficiency Program (RAP)

Exhibit 13 – Commercial Rental Apartment Efficiency Program (RAP) Forecasted Participation by Measure

Measure	2024	2025	2026	2027	Total
Energy Assessments	30	30	30	30	120
Implementation Support	5	5	5	5	20
Recirculation Controls	5	5	5	5	20
Pipe Insulation	500	500	500	500	2,000
Door/Window Seal	500	500	500	500	2,000
Showerheads and Aerators	3,000	3,000	3,000	3,000	12,000
Total	**4,040**	**4,040**	**4,040**	**4,040**	**16,160**

Exhibit 14 – Commercial Rental Apartment Efficiency Program (RAP) Details by Measure[5]

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Energy Assessments	$5,000	$5,000	-	156	4,750	2	-	-
Implementation Support	$5,500	$5,500	-	-	-	1	-	-
Recirculation Controls	$4,200	$4,200	-	50	1,305	15	-	-
Pipe Insulation	$23	$23	-	1	-	11	-	-
Door/Window Seal	$210	$210	-	0.6	-	11	-	-
Showerheads and Aerators	$17	$18	-	3	8	25	-	-
Weighted Average Per Participant	**$91**	**$91**	**-**	3.4	43	**21**	**-**	**-**

[5] Note all values are for planning purposes, values may change due to additional program design, evaluation and participant feedback

Industrial Prescriptive Program

Exhibit 15 – Industrial Prescriptive Program Forecasted Participation by Measure

Measure	2024	2025	2026	2027	Total
Process Boiler (Hot Water and Steam)	12	12	12	12	**48**
Air Curtains	5	5	5	5	**20**
Direct Contact Water Heater	2	2	2	2	**8**
Steam Traps Survey	7	7	15	15	**44**
Steam Traps Replacement	7	7	15	15	**44**
1” Insulation 0.5-1” HW Pipe	3	5	7	10	**25**
1” Insulation ≥ 1” HW Pipe	3	5	7	10	**25**
1” Insulation 0.5-1” LPS Pipe	3	5	7	10	**25**
1” Insulation ≥ 1” LPS Pipe	3	5	7	10	**25**
1” Insulation 0.5-1” HPS Pipe	3	5	7	10	**25**
1” Insulation ≥ 1” HPS Pipe	3	5	7	10	**25**
Tank Insulation 1” Low Temp	3	5	7	10	**25**
Tank Insulation 1” High Temp	3	5	7	10	**25**
Tank Insulation 2” High Temp	3	5	7	10	**25**

Measure	2024	2025	2026	2027	Total
Thermal Curtains	10	10	10	10	40
Single Stage Infrared Heater	3	3	3	3	12
Two Stage Infrared Heater	7	7	7	7	28
Condensing Infrared Heater	10	10	10	10	40
Total	**90**	**108**	**142**	**169**	**509**

Exhibit 16 – Industrial Prescriptive Program Details by Measure[6]

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Process Boiler (Hot Water and Steam)	$22,748	$31,431	$200	228	-	20	18%	-
Air Curtains	$11,720	$4,350	$200	274	6,188	15	18%	-
Direct Contact Water Heater	$4,200	$5,873	$200	47	-	20	18%	-
Steam Traps Survey	$1,500	$1,638	$200	-	-	-	18%	-
Steam Traps Replacement	$10,432	$8,736	$200	289	-	6	18%	-
1” Insulation 0.5-1” HW Pipe	$8,150	$7,133	$200	67	-	11	18%	-
1” Insulation ≥ 1” HW Pipe	$8,150	$7,133	$200	131	-	11	18%	-
1” Insulation 0.5-1” LPS Pipe	$8,150	$7,133	$200	151	-	11	18%	-
1” Insulation ≥ 1” LPS Pipe	$8,150	$7,133	$200	294	-	11	18%	-

[6] Note all values are for planning purposes, values may change due to additional program design, evaluation and participant feedback

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
1” Insulation 0.5-1” HPS Pipe	$8,150	$7,133	$200	263	-	11	18%	-
1” Insulation ≥ 1” HPS Pipe	$10,188	$7,133	$200	510	-	11	18%	-
Tank Insulation 1” Low Temp	$134,968	$35,324	$200	3,633	-	11	18%	-
Tank Insulation 1” High Temp	$134,968	$35,324	$200	6,431	-	11	18%	-
Tank Insulation 2” High Temp	$189,536	$70,648	$200	6,216	-	11	18%	-
Thermal Curtains	$507,000	$10,875	$200	3,550	-	10	27%	-
Single Stage Infrared Heater	$9,084	$1,740	$200	75	-	17	18%	-
Two Stage Infrared Heater	$9,084	$2,393	$200	75	-	17	18%	-
Condensing Infrared Heater	$10,000	$4,894	$200	100	-	18	18%	-
Weighted Average Per Participant	**$70,115**	**$14,578**	**$200**	**1,220**	**243**	**11**	**18%**	**-**

Industrial Performance Program

Exhibit 17 – Industrial Performance Program Forecasted Participation by Measure

Measure	2024	2025	2026	2027	Total
Technology Implementation	15	15	15	15	60
Feasibility Study	18	18	18	18	72
Plant Wide Audit	10	10	10	10	40
SEM – Individual, Large Customer	15	15	20	20	70
SEM – Cohort, Medium Customers	30	30	35	35	130
Total	**88**	**88**	**98**	**98**	**372**

Exhibit 18 – Industrial Performance Program Details by Measure[7]

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Technology Implementation	$250,000	$200,000	-	8,000	-	10	-	-
Feasibility Study	$50,000	$37,500	-	-	-	10	-	-
Plant Wide Audit	$15,000	$10,000	-	156	-	10	-	-
SEM – Individual, Large Customer	$40,000	$46,800	-	10,000	-	1	20%	-
SEM – Cohort, Medium Customers	$25,000	$29,221	-	2,000	-	1	20%	-
Weighted Average Per Participant	**$67,876**	**$59,610**	**-**	**3,888**	**-**	**5**	**10%**	**-**

[7] Note all values are for planning purposes, values may change due to additional program design, evaluation and participant feedback

Low Income Self Install Program

Exhibit 19 – Low Income Self Install Forecasted Participation by Measure

Measure	2024	2025	2026	2027	Total
Energy Savings Kit (ESK)	12,000	12,300	12,600	12,900	49,800
Re-Engagement Kit	4,000	4,000	4,000	4,000	16,000
Total	**16,000**	**16,300**	**16,600**	**16,900**	**65,800**

Exhibit 20 – Low Income Self Install Program Details by Measure[8]

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Energy Savings Kit (ESK)	$48	$48	-	2.2	-	9	-	-
Re-Engagement Kit	$17	$17	-	0.3	-	1	-	-
Weighted Average Per Participant	**$40**	**$40**	**-**	**1.7**	**-**	**7**	**-**	**-**

[8] Note all values are for planning purposes, values may change due to additional program design, evaluation and participant feedback

Low Income Direct Install Program

Exhibit 21 – Low Income Direct Install Program Forecasted Participation by Measure

Measure	2024	2025	2026	2027	Total
Energy Conservation Assistance Program (ECAP)	3,500	3,700	4,000	4,500	15,700
Total	**3,500**	**3,700**	**4,000**	**4,500**	**15,700**

Exhibit 22 – Low Income Direct Install Program Details by Measure[9]

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Energy Conservation Assistance Program (ECAP)	$1,299	$1,299	-	4.6	-	15	-	-
Weighted Average Per Participant	**$1,299**	**$1,299**	**-**	**4.6**	**-**	**15**	**-**	**-**

[9] Note all values are for planning purposes, values may change due to additional program design, evaluation and participant feedback

Low Income Prescriptive Program

Exhibit 23 – Low Income Prescriptive Program Forecasted Participation by Measure

Measure	2024	2025	2026	2027	Total
Residential – Communicating Thermostat	120	100	100	100	420
Residential – Condensing Tankless Water Heater	130	100	120	150	500
Residential – Condensing Storage Tank Water Heater	15	15	15	15	60
Residential – Bonus Offers	65	45	45	45	200
Residential – Attic Insulation	25	75	125	175	400
Residential – Wall Insulation	5	20	35	50	110
Residential – Ventilation	20	30	40	50	140
Residential – Crawlspace and Basement Insulation	20	25	45	65	155
Residential – Other Insulation	5	15	25	35	80
Residential – Appliance Maintenance	50	75	150	200	475
Commercial – Non-Profit Bundled Measures	40	45	55	65	205
Commercial – Gas Heat Pumps	2	3	3	5	13
Residential – High Performance Windows and Doors	25	50	75	100	250
Residential – HVAC Optimization (Contractor Rebate)	30	40	50	60	180

Measure	2024	2025	2026	2027	Total
Residential – Dual Fuel Hybrid Systems	-	25	50	100	175
Commercial – Condensing Boiler Heating Plant Optimization	10	15	15	17	57
Commercial – Domestic Water Heater System Optimization	10	15	15	17	57
Commercial – Dual Fuel Hybrid Systems	5	10	15	20	50
Commercial – Connected Thermostats	10	10	10	10	40
Total	587	713	988	1,279	3,567

Exhibit 24 – Low Income Prescriptive Program Details by Measure[10]

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Residential – Communicating Thermostat	$250	$200	-	3	-	12	-	-
Residential – Condensing Tankless Water Heater	$3,300	$3,000	$50	11	-	20	-	-
Residential – Condensing Storage Tank Water Heater	$1,800	$3,000	$50	10	-	13	-	-
Residential – Bonus Offers	-	$350	-	-	-	-	-	-
Residential – Attic Insulation	$1,326	$1,200	-	9	-	30	-	-
Residential – Wall Insulation	$2,714	$2,000	-	21	-	30	-	-

[10] Note all values are for planning purposes, values may change due to additional program design, evaluation and participant feedback

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Residential – Ventilation	-	$1,600	-	-	-	-	-	-
Residential – Crawlspace and Basement Insulation	$838	$2,000	-	5	-	30	-	-
Residential – Other Insulation	$1,167	$1,200	-	7	-	30	-	-
Residential – Appliance Maintenance	-	$150	-	-	-	-	-	-
Commercial – Non-Profit Bundled Measures	$12,133	$6,541	-	23	-	20	-	-
Commercial – Gas Heat Pumps	$100,000	$90,000	$1,000	502	-	15	-	-
Residential – High Performance Windows and Doors	$475	$250	-	-	-	18	-	-

POSTERITY GROUP

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Residential – HVAC Optimization (Contractor Rebate)	$859	$150	-	1	-	18	-	-
Residential – Dual Fuel Hybrid Systems	$8,000	$12,000	$300	20	-	17	-	-
Commercial – Condensing Boiler Heating Plant Optimization	$9,642	$15,000	$200	200	-	20	-	-
Commercial – Domestic Water Heater System Optimization	$1,853	$15,000	$200	50	-	20	-	-
Commercial – Dual Fuel Hybrid Systems	$50,000	$50,000	$500	500	-	13	20%	-
Commercial – Connected Thermostats	$159	$200	-	4	-	15	20%	-
Weighted Average Per Participant	**$3,234**	**$3,407**	**$40**	19	-	**16**	**0.5%**	-

Indigenous Direct Install Program

Exhibit 25 – Indigenous Direct Install Program Forecasted Participation by Measure

Measure	2024	2025	2026	2027	Total
Energy Conservation Assistance Program (ECAP)	60	60	60	60	240
Total	**60**	**60**	**60**	**60**	**240**

Exhibit 26 – Indigenous Direct Install Program Details by Measure[11]

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Energy Conservation Assistance Program (ECAP)	$1,380	$1,380	-	3.9	-	15	-	-
Weighted Average Per Participant	**$1,380**	**$1,380**	**-**	**3.9**	**-**	**15**	**-**	**-**

[11] Note all values are for planning purposes, values may change due to additional program design, evaluation and participant feedback

Indigenous Prescriptive Program

Exhibit 27 – Indigenous Prescriptive Program Forecasted Participation by Measure

Measure	2024	2025	2026	2027	Total
Residential – Communicating Thermostat	50	50	50	50	200
Residential – Condensing Tankless Water Heater	40	50	60	60	210
Residential – Two Upgrade Bonus	100	150	150	150	550
Residential – Attic Insulation	70	100	150	150	470
Residential – Wall Insulation	20	30	40	40	130
Residential – Ventilation	60	100	100	140	400
Residential – Crawlspace and Basement Insulation	20	30	40	40	130
Residential – Other Insulation	20	30	40	40	130
Residential – Appliance Maintenance	100	150	200	200	650
Commercial – Gas Heat Pumps	1	2	2	2	7
Energy Evaluations	100	150	150	150	550
Health & Safety	30	50	80	80	240
Residential – High Performance Windows and Doors	320	400	500	500	1,720
Residential – Quality Installation (Contractor Rebate)	20	40	40	40	140

Measure	2024	2025	2026	2027	Total
Deep Retrofit Lite / Whole Home Performance (20-40% Reduction)	10	30	50	50	140
Residential – Gas Heat Pumps	-	4	10	20	34
Residential – Dual Fuel Hybrid Systems	20	40	50	80	190
Commercial – Condensing Boiler Heating Plant Optimization	5	10	20	20	55
Commercial – Domestic Water Heater System Optimization	5	20	30	30	85
Commercial – Dual Fuel Hybrid Systems	2	4	4	5	15
Commercial – Connected Thermostats	5	10	10	10	35
Total	**998**	**1,450**	**1,776**	**1,857**	**6,081**

Exhibit 28 – Indigenous Prescriptive Program Details by Measure[12]

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Residential – Communicating Thermostat	$250	$200	-	2.6	-	12	-	-
Residential – Condensing Tankless Water Heater	$3,300	$3,000	$50	11.4	-	20	-	-
Residential – Two Upgrade Bonus	-	$300	-	-	-	-	-	-
Residential – Attic Insulation	$1,326	$1,800	-	8.7	-	30	-	-
Residential – Wall Insulation	$2,714	$2,000	-	20.6	-	30	-	-
Residential – Ventilation	-	$1,200	-	-	-	-	-	-

[12] Note all values are for planning purposes, values may change due to additional program design, evaluation and participant feedback

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Residential – Crawlspace and Basement Insulation	$838	$2,000	-	5.3	-	30	-	-
Residential – Other Insulation	$1,167	$1,500	-	6.6	-	30	-	-
Residential – Appliance Maintenance	-	$250	-	-	-	-	-	-
Commercial – Gas Heat Pumps	$86,000	$30,000	$1,000	502	-	15	-	-
Energy Evaluations	$500	$500	-	-	-	-	-	-
Health & Safety	-	$1,500	-	-	-	-	-	-
Residential – High Performance Windows and Doors	$475	$200	-	0.3	-	18	-	-
Residential – Quality Installation (Contractor Rebate)	-	$300	$100	1.0	-	18	-	-
Deep Retrofit Lite / Whole Home	$17,728	$12,000	-	43.2	-	30	-	-

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Performance (20-40% Reduction)								
Residential – Gas Heat Pumps	$30,000	$30,000	$100	31.3	-	18	-	-
Residential – Dual Fuel Hybrid Systems	$8,000	$10,000	$300	20.0	-	12	-	-
Commercial – Condensing Boiler Heating Plant Optimization	$9,642	$6,500	$200	198.2	-	20	-	-
Commercial – Domestic Water Heater System Optimization	$1,853	$1,200	$200	46.6	-	20	-	-
Commercial – Dual Fuel Hybrid Systems	$50,000	$15,000	$500	500	-	13	-	-
Commercial – Connected Thermostats	$159	$200	-	4.0	-	15	-	-
Weighted Average Per Participant	**$1,667**	**$1,572**	**$21**	8.0	-	**12**	**-**	**-**

Indigenous Performance Program

Exhibit 29 – Indigenous Performance Program Forecasted Participation by Measure

Measure	2024	2025	2026	2027	Total
Bundled Residential New Home Measures	20	30	40	40	130
Commercial – Non-Profit New Construction Bonus (Part 3/9)	1	1	1	1	4
Residential – Non-Profit New Construction Bonus (Part 9)	-	1	2	2	5
Commercial SEM	5	5	5	5	20
STEP 4 (Detached Home) – Dual Fuel Hybrid Systems	7	13	17	19	56
STEP 4 (Row Home) – Dual Fuel Hybrid Systems	12	18	23	25	78
STEP 5 (Detached Home) – Dual Fuel Hybrid Systems	-	5	8	8	21
STEP 5 (Row Home) – Dual Fuel Hybrid Systems	-	3	4	10	17
Total	45	76	100	110	331

Exhibit 30 – Indigenous Performance Program Details by Measure[13]

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Bundled Residential New Home Measures	-	$800	-	-	-	30	-	-
Commercial – Non-Profit New Construction Bonus (Part 3/9)	-	$10,000	-	-	-	-	-	-
Residential – Non-Profit New Construction Bonus (Part 9)	-	$2,500	-	-	-	-	-	-
Commercial SEM	$35,000	$35,000	-	2,400	125,000	5	20%	-
STEP 4 (Detached Home) – Dual Fuel Hybrid Systems	$40,050	$20,000	-	51.0	-6,319	30	10%	-

[13] Note all values are for planning purposes, values may change due to additional program design, evaluation and participant feedback

STEP 4 (Row Home) – Dual Fuel Hybrid Systems	$32,220	$20,000	-	37.7	-6,076	30	10%	-
STEP 5 (Detached Home) – Dual Fuel Hybrid Systems	$63,000	$25,000	-	51.8	-5,386	30	10%	-
STEP 5 (Row Home) – Dual Fuel Hybrid Systems	$47,340	$25,000	-	38.2	-5,093	30	10%	-
Weighted Average Per Participant	**$22,912**	**$13,554**	**-**	168	4,449	**28**	**6%**	**-**

Legacy Expenditures – Residential

Exhibit 31 – Legacy Residential Forecasted Participation by Measure

Measure	2024	2025	2026	2027	Total
Furnace (Home Renovation)	2,400	-	-	-	**2,400**
Boiler (Home Renovation)	60	-	-	-	**60**
EnerChoice Fireplace (Home Renovation)	600	-	-	-	**600**
Condensing Storage Tank Water Heater (Home Renovation)	6	-	-	-	**6**
Condensing Tankless Water Heater (Home Renovation)	573	-	-	-	**573**
Combination System (Home Renovation)	200	-	-	-	**200**
STEP 2 – Single Family Dwelling (New Home)	400	140	10	-	**550**
STEP 2 – Townhome/Row Home (New Home)	300	100	5	-	**405**
STEP 3 – Single Family Dwelling (New Home)	1,200	420	20	-	**1,640**
STEP 3 – Townhome/Row Home (New Home)	550	190	10	-	**750**
STEP 4 – Single Family Dwelling (New Home)	300	100	5	-	**405**
STEP 4 – Townhome/Row Home (New Home)	150	50	3	-	**203**
STEP 5 – Single Family Dwelling (New Home)	20	10	1	-	**31**

Measure	2024	2025	2026	2027	Total
STEP 5 – Townhome/Row Home (New Home)	5	2	-	-	**7**
Condensing Storage Tank Water Heater (New Home)	5	5	-	-	**10**
Condensing Tankless Water Heater (New Home)	1,000	300	15	-	**1,315**
EnerChoice Fireplace (New Home)	1,100	350	20	-	**1,470**
Combination System (New Home)	600	150	10	-	**760**
Total	**9,469**	**1,817**	**98**	**-**	**11,383**

Exhibit 32 – Legacy Residential Details by Measure

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Furnace (Home Renovation)	$1,900	$840	$40	5.4	-	18	-	-
Boiler (Home Renovation)	$3,200	$1,000	$40	5.3	-	18	-	-
EnerChoice Fireplace (Home Renovation)	$132	$300	$50	7.4	-	15	39%	-
Condensing Storage Tank Water Heater (Home Renovation)	$1,800	$1,000	$50	10.1	-	13	21%	-
Condensing Tankless Water Heater (Home Renovation)	$3,300	$1,000	$50	11.4	-	20	21%	-
Combination System (Home Renovation)	$3,091	$1,200	$40	6.2	-	20	32%	-
STEP 2 – Single Family Dwelling (New Home)	$2,632	$3,000	-	6.2	-1	30	22%	-

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
STEP 2 – Townhome/Row Home (New Home)	$5,204	$3,000	-	9.5	61	30	23%	-
STEP 3 – Single Family Dwelling (New Home)	$4,955	$4,000	-	11.1	18	30	12%	-
STEP 3 – Townhome/Row Home (New Home)	$6,928	$4,000	-	12.9	-71	30	12%	-
STEP 4 – Single Family Dwelling (New Home)	$9,342	$6,000	-	21.0	43	30	10%	-
STEP 4 – Townhome/Row Home (New Home)	$7,761	$6,000	-	16.6	-89	30	10%	-
STEP 5 – Single Family Dwelling (New Home)	$17,000	$10,000	-	42.4	-	30	10%	-
STEP 5 – Townhome/Row Home (New Home)	$12,750	$10,000	-	31.8	-	30	10%	-

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Condensing Storage Tank Water Heater (New Home)	$1,590	$1,000	-	10.1	-	13	21%	-
Condensing Tankless Water Heater (New Home)	$1,790	$1,000	-	11.4	-	20	21%	-
EnerChoice Fireplace (New Home)	$132	$500	-	5.0	-	15	39%	-
Combination System (New Home)	$3,091	$1,200	-	6.2	-	18	32%	-
Weighted Average Per Participant	**$3,083**	**$1,976**	**$14**	**8.9**	**-**	**22**	**18%**	**-**

Legacy Expenditures – Commercial

Exhibit 33 – Legacy Commercial Forecasted Participation by Measure

Measure	2024	2025	2026	2027	Total
Condensing Volume Boiler (Prescriptive)	15	-	-	-	**15**
Condensing Tankless Water Heater (Prescriptive)	10	-	-	-	**10**
Furnace Replacement – Std. and Mid. (Prescriptive)	7	-	-	-	**7**
Condensing Unit Heaters (Prescriptive)	5	-	-	-	**5**
Condensing Make Up Air Unit (Prescriptive)	5	-	-	-	**5**
Studies (Retrofit)	8	-	-	-	**8**
Capital Upgrades (Retrofit)	14	8	5	3	**29**
Step Code – Whole Building (New Construction)	10	10	7	5	**32**
Non Step Code – Whole Building (New Construction)	10	10	7	5	**32**
Total	**84**	**28**	**19**	**12**	**143**

Exhibit 34 – Legacy Commercial Details by Measure

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Condensing Volume Boiler (Prescriptive)	$22,500	$4,000	$200	222	-	15	18%	-
Condensing Tankless Water Heater (Prescriptive)	$5,500	$950	$200	138	-	17	38%	-
Furnace Replacement – Std. and Mid. (Prescriptive)	$2,000	$800	$200	8	-	18	-	-
Condensing Unit Heaters (Prescriptive)	$1,600	$900	$200	151	-	15	-	-
Condensing Make Up Air Unit (Prescriptive)	$4,500	$3,000	$200	132	1,600	18	5%	-
Studies (Retrofit)	$50,000	$37,500	-	-	-	2	4%	-
Capital Upgrades (Retrofit)	$500,000	$400,000	-	3,117	15,500	15	4%	-
Step Code – Whole Building (New Construction)	$600,000	$400,000	-	1,040	240,000	17	4%	-

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Non Step Code – Whole Building (New Construction)	$600,000	$400,000	-	1,040	240,000	17	4%	-
Weighted Average Per Participant	**$375,233**	**$262,755**	**$59**	**1,148**	**109,769**	**15**	**10%**	**-**

Legacy Expenditures – Low Income

Exhibit 35 – Legacy Low Income Forecasted Participation by Measure

Measure	2024	2025	2026	2027	Total
Residential – Furnace (Prescriptive)	340	-	-	-	340
Residential – Boiler (Prescriptive)	40	-	-	-	40
Commercial – Condensing Volume Boiler (Prescriptive)	25	-	-	-	25
Commercial – Condensing Tankless Water Heater (Prescriptive)	25	-	-	-	25
Commercial – Furnace (Prescriptive)	30	-	-	-	30
Commercial – Non-Profit Bundled Measures (Prescriptive)	35	-	-	-	35
Energy Conservation Assistance Program (ECAP) (Direct Install)	180	-	-	-	180
Total	675	-	-	-	675

Exhibit 36 – Legacy Low Income Details by Measure

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Residential – Furnace (Prescriptive)	$1,900	$2,304	$100	4.3	-	18	-	-
Residential – Boiler (Prescriptive)	$3,200	$2,000	$100	5.8	-	18	-	-
Commercial – Condensing Volume Boiler (Prescriptive)	$15,922	$14,799	-	317.0	-	20	-	-
Commercial – Condensing Tankless Water Heater (Prescriptive)	$1,816	$2,500	-	27.0	-	17	-	-
Commercial – Furnace (Prescriptive)	$1,990	$2,480	-	6.9	-	18	-	-
Commercial – Non-Profit Bundled Measures (Prescriptive)	$12,133	$5,000	-	95.0	-	20	-	-

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Energy Conservation Assistance Program (ECAP) (Direct Install)	$7,900	$7,900	-	4.3	-	15	-	-
Weighted Average Per Participant	**$4,628**	**$4,396**	**$56**	**21.6**	**-**	**17**	**-**	**-**

Legacy Expenditures – Indigenous

Exhibit 37 – Legacy Indigenous Forecasted Participation by Measure

Measure	2024	2025	2026	2027	Total
Furnace (Prescriptive)	40	20	20	10	**90**
Boiler (Prescriptive)	2	1	-	-	**3**
EnerChoice Fireplace (Prescriptive)	5	10	10	10	**35**
Commercial – Non-Profit Bundled Measures (Prescriptive)	10	20	20	20	**70**
Commercial – Condensing Tankless Water Heater (Prescriptive)	2	4	4	4	**14**
STEP 2 – Single Family Dwelling (Performance)	3	-	-	-	**3**
STEP 2 – Townhome/Row Home (Performance)	2	-	-	-	**2**
STEP 3 – Single Family Dwelling (Performance)	5	-	-	-	**5**
STEP 3 – Townhome/Row Home (Performance)	5	-	-	-	**5**
STEP 4 – Single Family Dwelling (Performance)	3	-	-	-	**3**
STEP 4 – Townhome/Row Home (Performance)	4	-	-	-	**4**
Total	**81**	**55**	**54**	**44**	**234**

Exhibit 38 – Legacy Indigenous Details by Measure

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
Furnace (Prescriptive)	$1,900.00	$3,000	$100	4.3	-	18	-	-
Boiler (Prescriptive)	$3,200.00	$2,000	$100	5.8	-	18	-	-
EnerChoice Fireplace (Prescriptive)	$132.00	$300	-	7.4	-	15	-	-
Commercial – Non-Profit Bundled Measures (Prescriptive)	$12,133.00	$5,900	-	21.2	-	20	-	-
Commercial – Condensing Tankless Water Heater (Prescriptive)	$1,816.00	$2,500	-	27.0	-	17	-	-
STEP 2 – Single Family Dwelling (Performance)	$2,632	$4,000	-	9.5	-	30	22%	-
STEP 2 – Townhome/Row Home (Performance)	$5,204	$4,000	-	11.1	-	30	23%	-

Measure	Incremental Cost ($)	Incentive ($)	Contractor Incentive ($)	Annual Gas Savings (GJ)	Annual Elec. Savings (kWh)	Measure Lifetime (Years)	Free Rider Rate (%)	Spillover Rate (%)
STEP 3 – Single Family Dwelling (Performance)	$4,955	$5,000	-	12.9	-	30	12%	-
STEP 3 – Townhome/Row Home (Performance)	$6.928	$5,000	-	21.0	-	30	12%	-
STEP 4 – Single Family Dwelling (Performance)	$9,342	$8,000	-	16.6	-	30	10%	-
STEP 4 – Townhome/Row Home (Performance)	$7,761	$8,000	-	42.4	-	30	10%	-
Weighted Average Per Participant	**$5,114**	**$3,677**	**$40**	**12.7**	-	**21**	**3%**	**-**

Appendix B-1: Sources for Measure Assumptions

Residential Energy Efficiency Program Area

Space and Water Heating Controls – Connected Thermostat	
Gas Savings per Participant	APEX Analytics LLC and Demand Side Analytics, FortisBC Smart Learning Thermostat Pilot - Evaluation Final, April 29, 2019, page 51 ICF Marbek: Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, DRAFT ICF Consultants, July 2014, page 122
Electricity Savings per Participant	
Incremental Cost	2021 FEI CPR
Measure Life	
Free Rider Rate	APEX Analytics LLC and Demand Side Analytics, FortisBC Smart Learning Thermostat Pilot - Evaluation Final, April 29, 2019
Spillover Rate	N/A

Space and Water Heating Controls – Fireplace timers	
Gas Savings per Participant	2021 CPR, FortisBC Prefeasibility study in progress
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

Space and Water Heating Controls – Connected water heater controls	
Gas Savings per Participant	2021 CPR, FortisBC
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

HVAC Optimization	
Gas Savings per Participant	N/A - under development with program partners
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

Dual Fuel Hybrid Systems	
Gas Savings per Participant	Hybrid System Prefeasibility Study, ICF, 2022 Pilot program in progress
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

Heat Recovery Ventilator	
Gas Savings per Participant	2021 CPR, FortisBC Prefeasibility study in progress
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

Attic Insulation	
Gas Savings per Participant	Dunsky Energy Consulting analysis, 2021, 2018, 2015 – 2016, and 2013
Electricity Savings per Participant	N/A
Incremental Cost	Dunsky Energy Consulting analysis update, 2018.
Measure Life	
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, 2021, 2018, 2015 – 2016, and 2013
Electricity Savings per Participant	N/A
Incremental Cost	Dunsky Energy Consulting analysis update, 2018.
Measure Life	
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, 2021, 2018, 2015 – 2016, and 2013
Electricity Savings per Participant	N/A
Incremental Cost	Dunsky Energy Consulting analysis update, 2018.
Measure Life	
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, 2021, 2018, 2015 – 2016, and 2013
Electricity Savings per Participant	N/A
Incremental Cost	Dunsky Energy Consulting analysis update, 2018.
Measure Life	
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

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

<table>
<tr><th colspan="2">Bonus Offers (Two Upgrade Bonus)</th></tr>
<tr><td>Gas Savings per Participant</td><td rowspan="6">N/A - under development with program partners</td></tr>
<tr><td>Electricity Savings per Participant</td></tr>
<tr><td>Incremental Cost</td></tr>
<tr><td>Measure Life</td></tr>
<tr><td>Free Rider Rate</td></tr>
<tr><td>Spillover Rate</td></tr>
</table>

<table>
<tr><th colspan="2">Appliance Maintenance</th></tr>
<tr><td>Gas Savings per Participant</td><td>2021 FEI CPR</td></tr>
<tr><td>Electricity Savings per Participant</td><td>N/A</td></tr>
<tr><td>Incremental Cost</td><td rowspan="2">2021 FEI CPR</td></tr>
<tr><td>Measure Life</td></tr>
<tr><td>Free Rider Rate</td><td rowspan="2">N/A</td></tr>
<tr><td>Spillover Rate</td></tr>
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<table>
<tr><th colspan="2">Air Sealing – Contractor Incentive</th></tr>
<tr><td>Gas Savings per Participant</td><td rowspan="6">2021 FEI CPR</td></tr>
<tr><td>Electricity Savings per Participant</td></tr>
<tr><td>Incremental Cost</td></tr>
<tr><td>Measure Life</td></tr>
<tr><td>Free Rider Rate</td></tr>
<tr><td>Spillover Rate</td></tr>
</table>

<table>
<tr><th colspan="2">Draft Proofing</th></tr>
<tr><td>Gas Savings per Participant</td><td>Dunsky Energy Consulting analysis, 2013
Innes Hood Oct 2010</td></tr>
<tr><td>Electricity Savings per Participant</td><td>N/A</td></tr>
<tr><td>Incremental Cost</td><td>N/A</td></tr>
<tr><td>Measure Life</td><td>Dunsky Energy Consulting analysis, 2013</td></tr>
<tr><td>Free Rider Rate</td><td>Review of Low Income Net-to-Gross, Dunsky Energy Consulting analysis, 2013</td></tr>
<tr><td>Spillover Rate</td><td>N/A</td></tr>
</table>

ENERGY STAR Washer ($25)	
Gas Savings per Participant	Residential Retail Programs Evaluation, Evergreen Economics, 2021 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	Residential Retail Programs Evaluation, Evergreen Economics, 2021 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	
Free Rider Rate	
Spillover Rate	N/A

Showerheads and Aerators	
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

Bonus Offers (Home Energy Improvement Bonus)	
Gas Savings per Participant	N/A - under development with program partners
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

High Performance Windows and Doors	
Gas Savings per Participant	2021 FEI CPR CleanBC Windows and Doors Replacement Rebate – Better Homes BC
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	N/A

Hybrid STEP Code Measures	
Gas Savings per Participant	Preliminary Consulting Analysis, RDH Consultants – Understanding the BC Energy Step Code, 2017-2018 Preliminary Consulting Analysis, RDH Consultants, 2017-18 Preliminary Engineering Calculations (for Hybrid Heating), FEI
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	N/A

Commercial Energy Efficiency Program Area

Condensing Boiler Heating Plant Optimization	
Gas Savings per Participant	Condensing Boilers for Existing Buildings – Prism Engineering Documentation of FortisBC Commercial Boiler Program (EBP) Data, 2018 Minnesota Department of Commerce – Division of Energy Resources – Commercial Condensing Boiler Optimization (December 2016) FortisBC 2010 CPR
Electricity Savings per Participant	N/A
Incremental Cost	Documentation of FortisBC Commercial Boiler Program (EBP) Data, 2018
Measure Life	Documentation of FortisBC Commercial Boiler Program (EBP) Data, 2018 ICF Measure Lifetime analysis
Free Rider Rate	FortisBC 2010 CPR
Spillover Rate	N/A

Domestic Water Heater System Optimization	
Gas Savings per Participant	Condensing Boilers for Existing Buildings – Prism Engineering Documentation of FortisBC Commercial Boiler Program (EBP) Data, 2018 Minnesota Department of Commerce – Division of Energy Resources – Commercial Condensing Boiler Optimization (December 2016) FortisBC 2010 CPR
Electricity Savings per Participant	N/A
Incremental Cost	Documentation of FortisBC Commercial Boiler Program (EBP) Data, 2018
Measure Life	Documentation of FortisBC Commercial Boiler Program (EBP) Data, 2018 ICF Measure Lifetime analysis
Free Rider Rate	FortisBC 2010 CPR
Spillover Rate	N/A

Food Services Efficiency Measures	
Gas Savings per Participant	Commercial Food Service Incentive Program Evaluation, Final Report, Fish and River Consultants, February 2018 Ontario Energy Board: EB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge
Electricity Savings per Participant	N/A
Incremental Cost	Program Cost Data Review, FEI, 2017 and Vendor costing survey 2017 & 2018 Ontario Energy Board: EB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge
Measure Life	Review of TRMs from other jurisdictions, FEI, 2017 including KEMA Measure Life Study Ontario Energy Board: EB-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 Ontario Energy Board: EB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge
Spillover Rate	N/A

Low Flow Spray Valves	
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

HVAC Controls – Kitchen DCV	
Gas Savings per Participant	Review of actual custom program data 2013-2017, FEI, January 2018
Electricity Savings per Participant	
Incremental Cost	
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

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

Air Curtains	
Gas Savings per Participant	IPP Measures Documentation - Phase I & Phase II, 2018 Posterity Group Industrial Measures Analysis (2017) Enbridge Gas Distribution (2016), Updated DSM Measures and the Technical Resource Manual (TRM), EB-2016-0246, Exhibit B.
Electricity Savings per Participant	IPP Measures Documentation - Phase I, 2018 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 Posterity Group Industrial Measures Analysis (2017) Enbridge Gas Distribution (2016), Updated DSM Measures and the Technical Resource Manual (TRM), EB-2016-0246, Exhibit B.
Incremental Cost	IPP Measures Documentation - Phase I, 2018 Illinois Energy Efficiency Stakeholder Advisory Group (2017), Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 6.0, Volume 2 Posterity Group Industrial Measures Analysis (2017) Enbridge Gas Distribution (2016), Updated DSM Measures and the Technical Resource Manual (TRM), EB-2016-0246, Exhibit B.
Measure Life	Enbridge Gas Distribution (2016), Updated DSM Measures and the Technical Resource Manual (TRM), EB-2016-0246, Exhibit B. Filed: 2016-12-21. page 21
Free Rider Rate	FRR- 18% - Internal document IPP Measures Documentation - Phase I, 2018
Spillover Rate	

Pipe and Tank Insulation	
Gas Savings per Participant	IPP Measures Documentation - Phase I & Phase II, 2018 Pipe Insulation Source Documentation - from Kalie McGratten 11/21/2018 Posterity Group Industrial Measures Analysis (2017) Pacific Gas &Electric Company (2014), Work Paper PGECORPRO103 Tank Insulation, Revision 5. Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110812A, Revision 3.
Electricity Savings per Participant	IPP Measures Documentation - Phase I, 2018
Incremental Cost	IPP Measures Documentation - Phase I & Phase II, 2018 McMaster-Carr Website (2018) Posterity Group Industrial Measures Analysis (2017) Pacific Gas &Electric Company (2014), Work Paper PGECORPRO103 Tank Insulation, Revision 5. Southern California Gas Company (2014). Pipe Insulation (Non-Space Conditioning) Workpaper SCGWP 110812A, Revision 3.
Measure Life	IPP Measures Documentation - Phase I & Phase II, 2018 Enbridge Gas Distribution (2016), Updated DSM Measures and the Technical Resource Manual (TRM), EB-2016-0246, Exhibit B. Filed: 2016-12-21. page 21 Pacific Gas &Electric Company (2014), Work Paper PGECORPRO103 Tank Insulation, Revision 5.
Free Rider Rate	FRR- 18% - Internal document, IPP Measures Documentation - Phase I & Phase II, 2018
Spillover Rate	

Steam Boiler Plant Optimization	
Gas Savings per Participant	CLEAResult, Steam Boiler Measure Study Report, Rev.1, February 28, 2019
Electricity Savings per Participant	
Incremental Cost	Cannepp and Raven Supply Workshop CLEAResult, Steam Boiler Measure Study Report, Rev.1, February 28, 2019
Measure Life	CLEAResult, Steam Boiler Measure Study Report, Rev.1, February 28, 2019
Free Rider Rate	FRR- 18% - Internal document
Spillover Rate	Habart & Associates -Efficient Boiler Program Impact Evaluation (June 12, 2003), Page 3

Hybrid Dual Fuel Systems (RTU and Hydronic)	
Gas Savings per Participant	FEI and FBC 2021 CPR
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

Gas Heat Pump	
Gas Savings per Participant	Posterity Group Measure Library (commercial gas heat pump) Based on findings from FEI pilot projects
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	N/A

Connected Thermostats	
Gas Savings per Participant	APEX Analytics LLC and Demand Side Analytics, FortisBC Smart Learning Thermostat Pilot - Evaluation Final, April 29, 2019, page 51 ICF Marbek: Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, DRAFT ICF Consultants, July 2014, page 122
Electricity Savings per Participant	ICF Marbek: Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, DRAFT ICF Consultants, July 2014, page 123
Incremental Cost	
Measure Life	ECAP Measure Characterization_rev3_FINAL_Dunsky, Dec. 5/19.
Free Rider Rate	Review of Low Income Net-to-Gross, APEX Analytics LLC and Demand Side Analytics, FortisBC Smart Learning Thermostat Pilot - Evaluation Final, April 29,2 019, page 45 ICF Marbek: Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, DRAFT ICF Consultants, July 2014, page 63
Spillover Rate	

Hydronic Additives	
Gas Savings per Participant	Based on data from FortisBC Pilot project, 2020
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

Studies - Retrofit	
Gas Savings per Participant	N/A - no savings attributed to study
Electricity Savings per Participant	
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	
Incremental Cost	
Measure Life	
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 & 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	
Incremental Cost	
Measure Life	
Free Rider Rate	
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, September 2017
Electricity Savings per Participant	Review of Actual Program Data for 2014 – 2017, FEI, September 2017
Incremental Cost	
Measure Life	
Free Rider Rate	Energy Assessment Program Evaluations, 2008 and 2010 Friuch Consulting
Spillover Rate	N/A

STEP Code – Whole Building	
Gas Savings per Participant	Preliminary program design work, Dunsky Energy Consulting, February 2018
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	N/A

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

RAP – Energy Assessments (Common Area)	
Gas Savings per Participant	2020 Commercial Energy Assessment - Business Case, by Jermin Hsieh, July 14, 2020 – FINAL Commercial Energy Assessments: 2019 Actuals TrakSmart/SAP Adj File Commercial RAP Energy Assessments: The costs are based on the actual costs invoiced from the Vendor. 2018 Actuals TrakSmart/SAP Adj File Terasen Gas EAP Review 2010 Energy Assessment Program Evaluations, 2008
Electricity Savings per Participant	N/A
Incremental Cost	Review of actual program data 2014-2017
Measure Life	
Free Rider Rate	Commercial Energy Assessment Program Evaluation, Friuch Consulting Energy Assessment Program Evaluations, 2008
Spillover Rate	N/A

RAP – Implementation Support Partial (Common Area)	
Gas Savings per Participant	N/A
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

RAP – Implementation Support Full (Common Area)	
Gas Savings per Participant	N/A
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

RAP – Recirculation Controls (Common Area)	
Gas Savings per Participant	Based on FortisBC Pilot project data, 2016
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

1.5GPM Showerheads (Gas) (Unit)	
Gas Savings per Participant	ECAP Measure Characterization_rev3_FINAL_Dunsky, Dec. 5/19 Terasen Gas TRC model RES, 3/4/2013, reviewed by FEI in February, 2017 (Resi) RAP Business Case, Source is Dunsky Consulting, 20150713, Page 34 Low Flow Numbers for ECAP & ESK v1
Electricity Savings per Participant	N/A
Incremental Cost	Based on actuals
Measure Life	Dunsky Energy Consulting analysis, 2019 Terasen Gas TRC model RES, 3/4/2013, reviewed by FEI in February, 2017 RAP Business Case, Source is Dunsky Consulting, 20150713, Page 34 2012 BC Hydro Persistence Standard
Free Rider Rate	RAP Business Case, Source is Dunsky Consulting, 20150713, page 34 Dunsky Consulting analysis, 2013
Spillover Rate	N/A

1.5GPM Handheld Showerhead (Gas) (Unit)	
Gas Savings per Participant	Dunsky Energy Consulting analysis, 2019 Terasen Gas TRC model RES, 3/4/2013, reviewed by FEI in February 2017 RAP Business Case, Source is Dunsky Consulting, 20150713, Page 34 Low Flow Numbers for ECAP & ESK v1
Electricity Savings per Participant	N/A
Incremental Cost	Based on actuals
Measure Life	Dunsky Energy Consulting analysis, 2019 RAP Business Case, Source is Dunsky Consulting, 20150713, Page 34 Terasen Gas TRC model RES, 3/4/2013, reviewed by FEI in February 2017 2012 BC Hydro Persistence Standard
Free Rider Rate	RAP Business Case, Source is Dunsky Consulting, 20150713, page 34 Dunsky Consulting analysis, 2013
Spillover Rate	N/A

1.5GPM Bathroom Aerators (Gas) (Unit)	
Gas Savings per Participant	Dunsky Energy Consulting analysis, 2019 Terasen Gas TRC model RES, 3/4/2013, reviewed by FEI in February 2017 RAP Business Case, Source is Dunsky Consulting, 20150713, Page 34 Low Flow Numbers for ECAP & ESK v1
Electricity Savings per Participant	N/A
Incremental Cost	Based on actuals
Measure Life	Dunsky Energy Consulting analysis, 2019 RAP Business Case, Source is Dunsky Consulting, 20150713, Page 34 Terasen Gas TRC model RES, 3/4/2013, reviewed by FEI in February 2017 2012 BC Hydro Persistence Standard
Free Rider Rate	RAP Business Case, Source is Dunsky Consulting, 20150713, page 34 Dunsky Consulting analysis, 2013
Spillover Rate	N/A

1.5GPM Kitchen Aerators (Gas) (Unit)	
Gas Savings per Participant	Dunsky Energy Consulting analysis, 2019 Terasen Gas TRC model RES, 3/4/2013, reviewed by FEI in February 2017 RAP Business Case, Source is Dunsky Consulting, 20150713, Page 34 Low Flow Numbers for ECAP & ESK v1
Electricity Savings per Participant	N/A
Incremental Cost	Based on actuals
Measure Life	Dunsky Energy Consulting analysis, 2019 RAP Business Case, Source is Dunsky Consulting, 20150713, Page 34 Terasen Gas TRC model RES, 3/4/2013, reviewed by FEI in February 2017 2012 BC Hydro Persistence Standard
Free Rider Rate	RAP Business Case, Source is Dunsky Consulting, 20150713, page 34 Dunsky Consulting analysis, 2013
Spillover Rate	N/A

Industrial Energy Efficiency Program Area

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	
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

<table>
<tr><th colspan="2">Direct Contact Water Heater</th></tr>
<tr><td>Gas Savings per Participant</td><td>Posterity Group (2017), Analysis of: Pacific Gas &Electric Company (2016), Work Paper PGECORPRO106 Direct Contact Water Heater, Revision 4.</td></tr>
<tr><td>Electricity Savings per Participant</td><td>N/A</td></tr>
<tr><td>Incremental Cost</td><td>Posterity Group (2017), Analysis of: Pacific Gas &Electric Company (2016), Work Paper PGECORPRO106 Direct Contact Water Heater, Revision 4.</td></tr>
<tr><td>Measure Life</td><td>Michigan Public Service Commission (2017), 2017 Michigan Energy Measures Database.</td></tr>
<tr><td>Free Rider Rate</td><td>Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018).</td></tr>
<tr><td>Spillover Rate</td><td>N/A</td></tr>
</table>

<table>
<tr><th colspan="2">Steam Traps Survey</th></tr>
<tr><td>Gas Savings per Participant</td><td rowspan="2">N/A</td></tr>
<tr><td>Electricity Savings per Participant</td></tr>
<tr><td>Incremental Cost</td><td>CLEAResult (2016), Market Characterization of Stream Trap Maintenance Practices.</td></tr>
<tr><td>Measure Life</td><td>N/A</td></tr>
<tr><td>Free Rider Rate</td><td>Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018).</td></tr>
<tr><td>Spillover Rate</td><td>N/A</td></tr>
</table>

<table>
<tr><th colspan="2">Steam Traps Replacement</th></tr>
<tr><td>Gas Savings per Participant</td><td>CLEAResult (2016), Market Characterization of Stream Trap Maintenance Practices</td></tr>
<tr><td>Electricity Savings per Participant</td><td>N/A</td></tr>
<tr><td>Incremental Cost</td><td rowspan="2">CLEAResult (2016), Market Characterization of Stream Trap Maintenance Practices</td></tr>
<tr><td>Measure Life</td></tr>
<tr><td>Free Rider Rate</td><td>Preliminary determination based on Commercial Prescriptive Program (to be formalized in 2018)</td></tr>
<tr><td>Spillover Rate</td><td>N/A</td></tr>
</table>

Pipe and Tank Insulation	
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

Thermal Curtains	
Gas Savings per Participant	Business Case of Greenhouse Thermal Curtains Prescriptive Measure-Conservation & Energy Management, July 2018, Page 3 Posterity Group Industrial Measures Analysis (2017)
Electricity Savings per Participant	N/A
Incremental Cost	Business Case of Greenhouse Thermal Curtains Prescriptive Measure-Conservation & Energy Management, July 2018, Page 3 IOP FS Results MCS Review
Measure Life	Business Case of Greenhouse Thermal Curtains Prescriptive Measure-Conservation & Energy Management, July 2018, Page 3 Greenhouse Measures Energy Trust of Oregon PG&E-Work Paper Focus on Energy Wisconsin 2015
Free Rider Rate	Business Case of Greenhouse Thermal Curtains Prescriptive Measure-Conservation & Energy Management, July 2018, Page 3 PG&E Agricultural and Food Processing: Greenhouse Heat Curtain and Infrared Film Measures
Spillover Rate	Business Case of Greenhouse Thermal Curtains Prescriptive Measure-Conservation & Energy Management, July 2018, Page 3

Infrared Heater	
Gas Savings per Participant	Posterity Group Industrial Measures Analysis (2017)
Electricity Savings per Participant	N/A
Incremental Cost	Posterity Group Industrial Measures Analysis (2017)
Measure Life	
Free Rider Rate	FRR- 18% - Internal document IPP Measures Documentation - Phase I, 2018
Spillover Rate	

Technology Implementation	
Gas Savings per Participant	FEI (2017), Analysis of 2015-2017 program participants
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
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	
Incremental Cost	FEI (2017), Analysis of 2016-2017 study participants
Measure Life	N/A
Free Rider Rate	
Spillover Rate	

Plant Wide Audit	
Gas Savings per Participant	N/A
Electricity Savings per Participant	
Incremental Cost	FEI (2017), Analysis of 2016-2017 study participants
Measure Life	N/A
Free Rider Rate	
Spillover Rate	

Individual, Large Customer	
Gas Savings per Participant	Preliminary engineering estimate
Electricity Savings per Participant	N/A
Incremental Cost	Estimate based on BC Hydro program planning
Measure Life	
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

Cohort, Medium Customers	
Gas Savings per Participant	Preliminary engineering estimate
Electricity Savings per Participant	N/A
Incremental Cost	Estimate based on BC Hydro program planning
Measure Life	Estimate based on BC Hydro program planning
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

Residential – Connected Thermostat	
Gas Savings per Participant	APEX Analytics LLC and Demand Side Analytics, FortisBC Smart Learning Thermostat Pilot - Evaluation Final, April 29, 2019, page 51 ICF Marbek: Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, DRAFT ICF Consultants, July 2014, page 122
Electricity Savings per Participant	APEX Analytics LLC and Demand Side Analytics, FortisBC Smart Learning Thermostat Pilot - Evaluation Final, April 29, 2019, page 51 ICF Marbek: Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, DRAFT ICF Consultants, July 2014, page 122
Incremental Cost	2021 FEI CPR
Measure Life	2021 FEI CPR
Free Rider Rate	APEX Analytics LLC and Demand Side Analytics, FortisBC Smart Learning Thermostat Pilot - Evaluation Final, April 29, 2019
Spillover Rate	N/A

Residential – Hybrid (Dual Fuel) Systems	
Gas Savings per Participant	Hybrid System Prefeasibility Study, ICF, 2022 Pilot program in progress
Electricity Savings per Participant	Hybrid System Prefeasibility Study, ICF, 2022 Pilot program in progress
Incremental Cost	Hybrid System Prefeasibility Study, ICF, 2022 Pilot program in progress
Measure Life	Hybrid System Prefeasibility Study, ICF, 2022 Pilot program in progress
Free Rider Rate	Hybrid System Prefeasibility Study, ICF, 2022 Pilot program in progress
Spillover Rate	Hybrid System Prefeasibility Study, ICF, 2022 Pilot program in progress

Residential – HVAC Optimization	
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

Commercial – Condensing Boiler Heating Plant Optimization	
Gas Savings per Participant	Condensing Boilers for Existing Buildings – Prism Engineering Documentation of FortisBC Commercial Boiler Program (EBP) Data, 2018 Minnesota Department of Commerce – Division of Energy Resources – Commercial Condensing Boiler Optimization (December 2016) FortisBC 2010 CPR
Electricity Savings per Participant	N/A
Incremental Cost	Documentation of FortisBC Commercial Boiler Program (EBP) Data, 2018
Measure Life	Documentation of FortisBC Commercial Boiler Program (EBP) Data, 2018 ICF Measure Lifetime analysis
Free Rider Rate	FortisBC 2010 CPR
Spillover Rate	N/A

Commercial – Domestic Water Heater System Optimization	
Gas Savings per Participant	Condensing Boilers for Existing Buildings – Prism Engineering Documentation of FortisBC Commercial Boiler Program (EBP) Data, 2018 Minnesota Department of Commerce – Division of Energy Resources – Commercial Condensing Boiler Optimization (December 2016) FortisBC 2010 CPR
Electricity Savings per Participant	N/A
Incremental Cost	Documentation of FortisBC Commercial Boiler Program (EBP) Data, 2018
Measure Life	Documentation of FortisBC Commercial Boiler Program (EBP) Data, 2018 ICF Measure Lifetime analysis
Free Rider Rate	FortisBC 2010 CPR
Spillover Rate	N/A

Commercial – Hybrid Dual Fuel Systems (RTU and Hydronic)	
Gas Savings per Participant	FEI and FBC 2021 CPR
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

<table>
<tr><th colspan="2">Commercial – Connected Thermostats</th></tr>
<tr><td>Gas Savings per Participant</td><td>APEX Analytics LLC and Demand Side Analytics, FortisBC Smart Learning Thermostat Pilot - Evaluation Final, April 29, 2019, page 51
ICF Marbek: Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, DRAFT ICF Consultants, July 2014, page 122</td></tr>
<tr><td>Electricity Savings per Participant</td><td rowspan="2">ICF Marbek: Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, DRAFT ICF Consultants, July 2014, page 123</td></tr>
<tr><td>Incremental Cost</td></tr>
<tr><td>Measure Life</td><td>ECAP Measure Characterization_rev3_FINAL_Dunsky, Dec. 5/19.</td></tr>
<tr><td>Free Rider Rate</td><td rowspan="2">Review of Low Income Net-to-Gross, APEX Analytics LLC and Demand Side Analytics, FortisBC Smart Learning Thermostat Pilot - Evaluation Final, April 29,2 019, page 45
ICF Marbek: Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, DRAFT ICF Consultants, July 2014, page 63</td></tr>
<tr><td>Spillover Rate</td></tr>
</table>

<table>
<tr><th colspan="2">New Construction Project Support</th></tr>
<tr><td>Gas Savings per Participant</td><td rowspan="6">N/A - under development with program partners</td></tr>
<tr><td>Electricity Savings per Participant</td></tr>
<tr><td>Incremental Cost</td></tr>
<tr><td>Measure Life</td></tr>
<tr><td>Free Rider Rate</td></tr>
<tr><td>Spillover Rate</td></tr>
</table>

<table>
<tr><th colspan="2">Energy Savings Kit (ESK)</th></tr>
<tr><td>Gas Savings per Participant</td><td>ECAP Measure Characterization_rev3_FINAL_Dunsky, Dec. 5/19
Discounted Savings Based on BC Hydro Evaluation of Installation Rates & 2013 Tech Review (SFD) & (MURB)</td></tr>
<tr><td>Electricity Savings per Participant</td><td>ECAP Measure Characterization_rev3_FINAL_Dunsky, Dec. 5/19</td></tr>
<tr><td>Incremental Cost</td><td>Average based on the full cost of the gas measures included in the ESK</td></tr>
<tr><td>Measure Life</td><td>ECAP Measure Characterization_rev3_FINAL_Dunsky, Dec. 5/19
Average based on the individual gas measures included in the Energy Saving Kit, 2017</td></tr>
<tr><td>Free Rider Rate</td><td>Review of Low Income Net-to-Gross
Esource: Low-income, Income Assisted Customers or Charitable Programs Oct. 30, 2017; BC Hydro, Oct. 30, 2017</td></tr>
<tr><td>Spillover Rate</td><td>Low Income Spillover, 2019</td></tr>
</table>

Re-engagement Kit	
Gas Savings per Participant	Based on 2019-2020 annual report data
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

Energy Conservation Assistance Program (ECAP)	
Gas Savings per Participant	ECAP Measure Characterization_rev3_FINAL_Dunsky, Dec. 5/19 Dunsky Energy Consultants analysis, 2019 Based on analysis of 2017-2020 actuals
Electricity Savings per Participant	Dunsky Energy Consultants analysis, 2019
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	Dunsky Energy Consultants analysis, 2019 Average based on the individual gas measures installed
Free Rider Rate	Review of Low Income Net-to-Gross Esource: Low-income, Income Assisted Customers or Charitable Programs Oct. 30, 2017; BC Hydro, Oct. 30, 2017
Spillover Rate	Review of Low Income Spillover, 2019

Water Heater Condensing Tankless	
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 Measures And Assumptions for Demand Side Management 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

Water Heater Condensing Storage Tank	
Gas Savings per Participant	Energy Savings Assumptions Review (of multiple energy savings data sources), FEI, November 2014, revisited February 2018 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

Bonus Offers (Two Upgrade Bonus)	
Gas Savings per Participant	N/A - under development with program partners
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

Attic Insulation	
Gas Savings per Participant	Dunsky Energy Consulting analysis, 2021, 2018, 2016-2016 and 2013.
Electricity Savings per Participant	N/A
Incremental Cost	Dunsky Energy Consulting analysis update, 2018.
Measure Life	
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, 2021, 2018, 2016-2016 and 2013.
Electricity Savings per Participant	N/A
Incremental Cost	Dunsky Energy Consulting analysis update, 2018
Measure Life	
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

Ventilation	
Gas Savings per Participant	(HRR) HERO Measure Savings-Dunsky Energy Consulting analysis, Apr 4, 2018 Dunsky Consulting, 2013-2016
Electricity Savings per Participant	N/A
Incremental Cost	HERO Measure Savings-Dunsky Energy Consulting analysis
Measure Life	
Free Rider Rate	Review of actual 2017 data 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	
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	
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

Appliance Maintenance	
Gas Savings per Participant	2021 FEI CPR
Electricity Savings per Participant	N/A
Incremental Cost	2021 FEI CPR
Measure Life	N/A
Free Rider Rate	
Spillover Rate	

Commercial – Non-Profit Bundled Measures	
Gas Savings per Participant	Review of actual program measure implementation, FEI (2020-2023)
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

Commercial – Gas Heat Pump	
Gas Savings per Participant	Posterity Group Measure Library (commercial gas heat pump)
Electricity Savings per Participant	Based on findings from FEI pilot projects
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	N/A

High Performance Windows and Doors	
Gas Savings per Participant	2021 FEI CPR CleanBC Windows and Doors Replacement Rebate – Better Homes BC
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	N/A

Hybrid STEP Code Measures	
Gas Savings per Participant	Preliminary Consulting Analysis, RDH Consultants – Understanding the BC Energy Step Code, 2017-2018 Preliminary Consulting Analysis, RDH Consultants, 2017-18
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	Estimation based on market assessment, FEI, February 2018 New Home Program Analysis, ISE Consulting Group, 2014 and program experience
Spillover Rate	N/A

Bundled Residential New Home Measures	
Gas Savings per Participant	Review of actual program measure implementation, FEI
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

Residential Energy Efficiency Works (REnEW)	
Gas Savings per Participant	N/A
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	Review of Low Income Net-to-Gross Esource: Low-income, Income Assisted Customers or Charitable Programs Oct. 30, 2017; BC Hydro, Oct. 30, 2017
Spillover Rate	Review of Low Income Spillover, 2019

Indigenous Energy Efficiency Program Area

Residential – Connected Thermostat	
Gas Savings per Participant	APEX Analytics LLC and Demand Side Analytics, FortisBC Smart Learning Thermostat Pilot - Evaluation Final, April 29, 2019, page 51 ICF Marbek: Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, DRAFT ICF Consultants, July 2014, page 122
Electricity Savings per Participant	
Incremental Cost	2021 FEI CPR
Measure Life	
Free Rider Rate	APEX Analytics LLC and Demand Side Analytics, FortisBC Smart Learning Thermostat Pilot - Evaluation Final, April 29, 2019
Spillover Rate	N/A

Residential – Condensing Tankless Water Heater	
Gas Savings per Participant	Energy Savings Assumptions Review (of multiple energy savings data sources), FEI, November 2014, revisited February 2018 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 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

Residential – Bonus Offers (Two Upgrade Bonus)	
Gas Savings per Participant	N/A - under development with program partners
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

Residential – Wall Insulation	
Gas Savings per Participant	Dunsky Energy Consulting analysis, 2021, 2018, 2015 – 2016, and 2013
Electricity Savings per Participant	N/A
Incremental Cost	Dunsky Energy Consulting analysis update, 2018.
Measure Life	
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

Residential – Attic Insulation	
Gas Savings per Participant	Dunsky Energy Consulting analysis, 2021, 2018, 2015 – 2016, and 2013
Electricity Savings per Participant	N/A
Incremental Cost	Dunsky Energy Consulting analysis update, 2018.
Measure Life	
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

Residential – Crawlspace and Basement Insulation	
Gas Savings per Participant	Dunsky Energy Consulting analysis, 2021, 2018, 2015 – 2016, and 2013
Electricity Savings per Participant	N/A
Incremental Cost	Dunsky Energy Consulting analysis update, 2018.
Measure Life	
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

Residential – Other Insulation	
Gas Savings per Participant	Dunsky Energy Consulting analysis, 2021, 2018, 2015 – 2016, and 2013
Electricity Savings per Participant	N/A
Incremental Cost	Dunsky Energy Consulting analysis update, 2018.
Measure Life	
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

Residential – Appliance Maintenance	
Gas Savings per Participant	2021 FEI CPR
Electricity Savings per Participant	N/A
Incremental Cost	2021 FEI CPR
Measure Life	
Free Rider Rate	N/A
Spillover Rate	

Commercial – Gas Heat Pump	
Gas Savings per Participant	Posterity Group Measure Library (commercial gas heat pump) Based on findings from FEI pilot projects
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	N/A

Residential – High Performance Windows and Doors	
Gas Savings per Participant	2021 FEI CPR CleanBC Windows and Doors Replacement Rebate – Better Homes BC
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	N/A

Residential – Hybrid (Dual Fuel) Systems	
Gas Savings per Participant	Hybrid System Prefeasibility Study, ICF, 2022 Pilot program in progress
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

Commercial – Condensing Boiler Heating Plant Optimization	
Gas Savings per Participant	Condensing Boilers for Existing Buildings – Prism Engineering Documentation of FortisBC Commercial Boiler Program (EBP) Data, 2018 Minnesota Department of Commerce – Division of Energy Resources – Commercial Condensing Boiler Optimization (December 2016) FortisBC 2010 CPR
Electricity Savings per Participant	N/A
Incremental Cost	Documentation of FortisBC Commercial Boiler Program (EBP) Data, 2018
Measure Life	Documentation of FortisBC Commercial Boiler Program (EBP) Data, 2018 ICF Measure Lifetime analysis
Free Rider Rate	FortisBC 2010 CPR
Spillover Rate	N/A

Commercial – Domestic Water Heater System Optimization	
Gas Savings per Participant	Condensing Boilers for Existing Buildings – Prism Engineering Documentation of FortisBC Commercial Boiler Program (EBP) Data, 2018 Minnesota Department of Commerce – Division of Energy Resources – Commercial Condensing Boiler Optimization (December 2016) FortisBC 2010 CPR
Electricity Savings per Participant	N/A
Incremental Cost	Documentation of FortisBC Commercial Boiler Program (EBP) Data, 2018
Measure Life	Documentation of FortisBC Commercial Boiler Program (EBP) Data, 2018 ICF Measure Lifetime analysis
Free Rider Rate	FortisBC 2010 CPR
Spillover Rate	N/A

<table>
<tr><th colspan="2">Commercial – Hybrid Dual Fuel Systems (RTU and Hydronic)</th></tr>
<tr><td>Gas Savings per Participant</td><td rowspan="6">FEI and FBC 2021 CPR</td></tr>
<tr><td>Electricity Savings per Participant</td></tr>
<tr><td>Incremental Cost</td></tr>
<tr><td>Measure Life</td></tr>
<tr><td>Free Rider Rate</td></tr>
<tr><td>Spillover Rate</td></tr>
</table>

<table>
<tr><th colspan="2">Commercial – Connected Thermostats</th></tr>
<tr><td>Gas Savings per Participant</td><td>APEX Analytics LLC and Demand Side Analytics, FortisBC Smart Learning Thermostat Pilot - Evaluation Final, April 29, 2019, page 51
ICF Marbek: Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, DRAFT ICF Consultants, July 2014, page 122</td></tr>
<tr><td>Electricity Savings per Participant</td><td rowspan="2">ICF Marbek: Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, DRAFT ICF Consultants, July 2014, page 123</td></tr>
<tr><td>Incremental Cost</td></tr>
<tr><td>Measure Life</td><td>ECAP Measure Characterization_rev3_FINAL_Dunsky, Dec. 5/19.</td></tr>
<tr><td>Free Rider Rate</td><td rowspan="2">Review of Low Income Net-to-Gross, APEX Analytics LLC and Demand Side Analytics, FortisBC Smart Learning Thermostat Pilot - Evaluation Final, April 29,2 019, page 45
ICF Marbek: Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, DRAFT ICF Consultants, July 2014, page 63</td></tr>
<tr><td>Spillover Rate</td></tr>
</table>

<table>
<tr><th colspan="2">Bundled Residential New Home Measures</th></tr>
<tr><td>Gas Savings per Participant</td><td rowspan="6">Review of actual program measure implementation, FEI</td></tr>
<tr><td>Electricity Savings per Participant</td></tr>
<tr><td>Incremental Cost</td></tr>
<tr><td>Measure Life</td></tr>
<tr><td>Free Rider Rate</td></tr>
<tr><td>Spillover Rate</td></tr>
</table>

<table>
<tr><th colspan="2">Hybrid STEP Code Measures</th></tr>
<tr><td>Gas Savings per Participant</td><td rowspan="5">Preliminary Consulting Analysis, RDH Consultants – Understanding the BC Energy Step Code, 2017-2018
Preliminary Consulting Analysis, RDH Consultants, 2017-18
Preliminary Engineering Calculations (for Hybrid Heating), FEI</td></tr>
<tr><td>Electricity Savings per Participant</td></tr>
<tr><td>Incremental Cost</td></tr>
<tr><td>Measure Life</td></tr>
<tr><td>Free Rider Rate</td></tr>
<tr><td>Spillover Rate</td><td>N/A</td></tr>
</table>

Legacy Expenditures Energy Efficiency Program Area

Residential

Furnace	
Gas Savings per Participant	Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018
Electricity Savings per Participant	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
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

EnerChoice Fireplace	
Gas Savings per Participant	AFER Study, Apartment Fireplace Efficiency Retrofit (AFER) Project, Building Energy Solutions, April 2017 Fireplace Impact Evaluation, Sampson Research, 2015 2010 Conservation Potential Review, ICF Marbek, 2010
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

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
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	

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 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

Condensing Tankless Water Heater	
Gas Savings per Participant	Energy Savings Assumptions Review (of multiple energy savings data sources), FEI, November 2014, revisited February 2018 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 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

STEP Code Measures	
Gas Savings per Participant	Preliminary Consulting Analysis, RDH Consultants – Understanding the BC Energy Step Code, 2017-2018 Preliminary Consulting Analysis, RDH Consultants, 2017-18
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	New Home Program Analysis, ISE Consulting Group, 2014 and program experience Estimation based on market assessment, FEI, February 2018
Spillover Rate	N/A

Commercial

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

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	
Incremental Cost	Ontario Energy Board: OEB-2015-0344 New and Updated DSM Measures - Joint Submission from Union Gas Ltd. and Enbridge
Measure Life	
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	
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

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

Studies – Retrofit (Legacy)	
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 (Legacy)	
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, February 2018
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

STEP Code – Whole Building (Legacy)	
Gas Savings per Participant	Preliminary program design work, Dunsky Energy Consulting, Feb 2018
Electricity Savings per Participant	Preliminary program design work, Dunsky Energy Consulting, Feb 2018
Incremental Cost	Preliminary program design work, Dunsky Energy Consulting, Feb 2018
Measure Life	Preliminary program design work, Dunsky Energy Consulting, Feb 2018
Free Rider Rate	Preliminary program design work, Dunsky Energy Consulting, Feb 2018
Spillover Rate	N/A

Non-STEP Code – Whole Building (Legacy)	
Gas Savings per Participant	Preliminary program design work, Dunsky Energy Consulting, February 2018
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	Review of Technical Reference Manuals from other jurisdictions and other relevant publications, FEI, January 2010.
Spillover Rate	N/A

RAP – Condensing Boilers (Common Area)	
Gas Savings per Participant	Based on 2018-2019 analysis of actuals Update of Energy Savings Analysis from FortisBC Efficient Boiler Program – Final Report 2013, Prism Engineering.
Electricity Savings per Participant	N/A
Incremental Cost	Based on 2018-2019 analysis of actuals
Measure Life	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 12, 2003, page 51
Spillover Rate	

RAP – Water Heaters (Common Area)	
Gas Savings per Participant	Based on analysis of 2018-2019 actuals Efficient Commercial Water Heater Evaluation – Final Report, Prism Engineering, February 2017
Electricity Savings per Participant	N/A
Incremental Cost	Based on analysis of 2018-2019 actuals
Measure Life	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

Low Income

Energy Conservation Assistance Program (ECAP) - Legacy	
Gas Savings per Participant	Dunsky Energy Consultants analysis, 2019 Based on analysis of 2017-2020 actuals
Electricity Savings per Participant	Dunsky Energy Consultants analysis, 2019
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	Dunsky Energy Consultants analysis, 2019 Average based on the individual gas measures installed
Free Rider Rate	Review of Low Income Net-to-Gross Esource: Low-income, Income Assisted Customers or Charitable Programs Oct. 30, 2017; BC Hydro, Oct. 30, 2017
Spillover Rate	Review of Low Income Spillover, 2019

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 (94% or Higher AFUE)	
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
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

Connected Thermostat	
Gas Savings per Participant	APEX Analytics LLC and Demand Side Analytics, FortisBC Smart Learning Thermostat Pilot - Evaluation Final, April 29, 2019, page 51 ICF Marbek: Inventory and Energy Savings Estimates for Residential Self-programmable Thermostats, DRAFT ICF Consultants, July 2014, page 122
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	N/A

Commercial – Water Heater Condensing Tankless	
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 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

Commercial – Non-Profit Bundled Measures (Legacy)	
Gas Savings per Participant	Review of actual program measure implementation, FEI
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

Commercial – 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
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

Commercial – 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

STEP Code Measures (Legacy)	
Gas Savings per Participant	Preliminary Consulting Analysis, RDH Consultants – Understanding the BC Energy Step Code, 2017-2018 Preliminary Consulting Analysis, RDH Consultants, 2017-18
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	New Home Program Analysis, ISE Consulting Group, 2014 and program experience Estimation based on market assessment, FEI, February 2018
Spillover Rate	N/A

Indigenous

Furnace	
Gas Savings per Participant	Documentation of FortisBC Furnace and Boiler Early Replacement Program, FEI, February 2018
Electricity Savings per Participant	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
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
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

Commercial – Non-Profit Bundled Measures (Legacy)	
Gas Savings per Participant	Review of actual program measure implementation, FEI
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	
Spillover Rate	

Commercial – 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

Residential – 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 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

EnerChoice Fireplace	
Gas Savings per Participant	AFER Study, Apartment Fireplace Efficiency Retrofit (AFER) Project, Building Energy Solutions, April 2017 Fireplace Impact Evaluation, Sampson Research, 2015 2010 Conservation Potential Review, ICF Marbek, 2010
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

STEP Code Measures	
Gas Savings per Participant	Preliminary Consulting Analysis, RDH Consultants – Understanding the BC Energy Step Code, 2017-2018 Preliminary Consulting Analysis, RDH Consultants, 2017-18
Electricity Savings per Participant	
Incremental Cost	
Measure Life	
Free Rider Rate	New Home Program Analysis, ISE Consulting Group, 2014 and program experience Estimation based on market assessment, FEI, February 2018
Spillover Rate	N/A

Appendix C

DRAFT ORDER

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British Columbia
Utilities Commission

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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 Acceptance of 2024-2027 Demand Side Management Expenditures Plan

BEFORE:
[Panel Chair]
Commissioner
Commissioner

on Date

ORDER

WHEREAS:

A. On July 12, 2023, FEI filed an application for British Columbia Utilities Commission (BCUC) acceptance of its 2024-2027 Demand Side Management (DSM) Expenditures Plan (DSM Plan);

B. FEI seeks acceptance, pursuant to section 44.2 of the *Utilities Commission Act* (UCA) of total DSM expenditures of $626.703 million for 2024 through 2027;

C. FEI seeks the following additional approvals:

1. continuation of its existing funding transfer rules;

2. proposed changes to its funding carryover rules;

3. continuation of its existing variance allowance rule on total portfolio expenditures in the final year of the DSM Plan; and

4. continuation of the amount included its rate base DSM deferral account on a forecast basis of $60 million; and

D. The BCUC has reviewed FEI's DSM Plan and requested approvals for DSM expenditures for 2024-2027 and concludes that the requested expenditure schedules should be accepted.

NOW THEREFORE, pursuant to section 44.2(a) of the UCA, the BCUC orders as follows:

1. The FEI DSM expenditure schedule, as outlined in Table 1-1 of the Application setting out expenditures of $626.703 million for 2024 through 2027, is accepted.

2. FEI's funding transfer rules for the DSM expenditure schedule are approved.

3. FEI's funding carryover rules for the DSM expenditure schedule are approved.

4. FEI is approved to exceed total accepted expenditures by no more than 5% without prior approval from the BCUC for the final year of the 2024-2027 DSM Expenditure Schedule.

5. FEI is approved to include $60 million in its rate base DSM deferral account on a forecast basis, effective for 2024-2027.

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

CONSERVATION POTENTIAL REVIEW

POSTERITY GROUP

2021 Conservation Potential Review

Final Report

Date: 12 July 2021

Tanja Percival
Project Specialist, Innovative Technologies & Projects
Conservation & Energy Management
FortisBC
16705 Fraser Highway, Surrey BC V4N 0E8

Posterity Group
43 Eccles St, 2nd Floor – Unit 2
Ottawa, ON K1R 6S3

Contents

POSTERITY GROUP

List of Exhibits

Executive Summary

Background and Objectives

The 2021 Conservation Potential Review (CPR) is the review of energy efficiency opportunities available among FortisBC's residential, commercial, and industrial natural gas customers.

The CPR will support two of FortisBC Energy Inc's (FEI) major regulatory filings in 2022: the long-term gas resource plan (LTGRP) and the Demand Side Management (DSM) plan. For this CPR, Posterity Group reviewed estimated technical, economic, and market potential natural gas savings in FEI's service territory over a 20-year period. The CPR is an important guiding document for ongoing conservation and energy management program development and support at FortisBC.

FEI has also retained Posterity Group to produce the load forecast of natural gas demand of FEI's customers to support the 2022 LTGRP filing. The base year and reference case forecast developed by Posterity Group is common to both the LTGRP and CPR. As a result of the integrated nature of the two projects, the LTGRP project is frequently referenced in this document.

Findings Summary

- This study has found significant cost-effective and market achievable natural gas savings throughout the study period 2020-2040, and in all sectors and segments.

  Across all sectors, and using the MTRC screen, medium market potential savings are estimated at approximately 8 PJ, or 4% of reference consumption in 2025, rising to 24 PJ, or 10% of reference consumption in 2040.

  This estimated 24 PJ savings by 2040 includes potential savings from Residential, Industrial, and Commercial sectors of 9.9 PJ, 8.6 PJ, and 5.8 PJ respectively.

- In the ***residential sector***, only a small number of measures are cost-effective based on the TRC test, most being low-cost retrofit measures. Measures that pass the MTRC screen only become more important in the residential sector as the study period progresses.
  - The opportunities for equipment replacement measures, especially space heating measures, are much smaller relative to previous studies. This is primarily due to increasingly higher federal and provincial minimum energy performance standards (MEPS) for furnaces, which have caused DSM opportunities to become increasingly scarce.
  - In terms of percentage of reference case consumption forecast, more residential opportunities are available in the domestic hot water end use than the space heating end use throughout the study period. In absolute terms, savings potential for DHW measures (4 PJ by 2040 in the medium market potential scenario, MTRC screen) approaches that of space heating measures (5 PJ by 2040 in the medium market potential scenario, MTRC screen).

* *Commercial sector* savings show the most variance between the high and medium market potential scenarios. Using the MTRC screen, by 2040 the difference in potential between the medium and high market scenarios is 11.6 PJ.

  Gas heat pumps (GHPs) and efficient new construction are major contributing factors to this difference. These measures have high technical and economic potential, but future uptake is uncertain. For example, in the medium scenario, GHPs are modeled as an innovative technology with low forecasted growth. In the high scenario, they are modeled as an innovative technology with high forecasted growth, especially in the second half of the study period (2030-2040).
* The *industrial sector* is estimated to have the largest cost-effective savings potential on the TRC economic screen relative to other sectors. However, industrial customers require shorter payback periods relative to commercial and residential customers. Achieving savings from industrial measures that are cost-effective but have longer customer payback periods may be challenging and/or more expensive due to higher incentives and program costs.

Scope

Timing: The base year for this study is the 2019 calendar year, where the reference case forecast is from 2020 to 2040 with results calculated for each intervening year.

Regions: This study divides the FortisBC gas regions in British Columbia into six: City of Vancouver, Lower Mainland (excluding Vancouver), Vancouver Island, Northern BC, Southern Interior, and Whistler.

Sectors: The study addresses three sectors: residential, commercial, and industrial. The LTGRP also includes transportation in its scope. EX 1 shows the breakdown of each sector (except transportation), which are organized into segments.

EX 1 – CPR Segments

Residential	Commercial	Industrial
• Single Family Detached/Duplexes • Single Family Attached/Row • Mobile/Other Residential	• Apartments – Medium • Apartments – Large Food Retail • Hospital • Hotel – Medium • Hotel – Large • Non-Food Retail – Medium • Non-Food Retail – Large • Nursing Home • Office – Medium • Office – Large • Other Commercial • Restaurant • School – Medium • School – Large • University/College • Warehouse	• Agriculture (includes greenhouses[1]) • Chemical • District energy providers • Fabricated Metal • Food & Beverage • Other Manufacturing (includes transportation[2] and other industrial) • Mining • Non-metallic Mineral (includes cement) • Pulp & Paper – Kraft • Pulp & Paper – TMP • Utilities • Wood Products

End uses vary and are described in more detail in Section 2 of this report. The residential sector is also broken down into vintages that define the time periods when the dwellings were constructed.

Approach

The CPR model was developed using Posterity Group's Navigator™ Energy and Emissions Simulation Suite. Data was collected from various sources for the analysis and inputted to the model.

The CPR followed these key steps to perform the analysis:

1. **Determine the current (Base Year) customer base and their energy consumption.**
   a. Collect and review data on the building stock in FortisBC's service territory, including end use surveys and previous CPRs.
   b. Develop energy use models of each building or facility type (segments) and model energy consumption by end use.

1 Cannabis included in agriculture segment since there is not enough data at FEI to create a cannabis-specific forecast.
2 In the 2015 CPR, 'transportation' pertained to facilities that supported the transportation sector.

c. Collect and review actual base year (2019) energy use and billing data of FortisBC's customers.
d. Use the billing data to calibrate the base year energy consumption in each sector's energy model.

2. Develop reference case energy consumption forecast.
    a. Collect and review data on all factors that will affect energy use trends over the study period (2020 to 2040 in this study's case).
        i. This includes analyzing and modelling natural improvements in building energy use intensities (e.g. from natural replacement of furnaces with new, higher efficiency ones at replacement time).
        ii. Other factors are existing building demolition / renovation trends, rate of new building stock construction, baseline energy efficiency of new buildings and equipment, and known changes to policies and codes and standards that will impact the energy use of buildings.
    b. Use this data to develop an energy consumption forecast model for each sector.
    c. Calibrate the reference case based on FortisBC's own account forecasts and industrial survey information at the region and rate class level.
3. Characterize energy conservation measures.
    a. Select a set of energy conservation measures for each sector. Measures range from mature, widely known measures that are currently part of FortisBC's program portfolio (e.g. commercial condensing boilers) to innovative or enabling technologies (e.g. smart residential water heater controllers). Behavioural measures are also considered (e.g. thermostat setback).
    b. For each measure, review and collect data on energy savings, costs, useful life, and the baseline equipment or technology that it should be compared with (if applicable).
    c. Use the data to characterize the technology's energy savings potential, cost-effectiveness, and financial attractiveness.
    d. Use the data as inputs to the energy model for each sector.
4. Estimate technical savings potential.
    a. For each measure, determine its technical applicability (i.e. how many buildings or facilities can this measure be applied to, considering only technical barriers).
    b. Determine the measures' current market penetration (i.e. how many buildings or facilities have already installed a measure).
    c. Estimate the measures' reference adoption – their natural rate of uptake in the absence of incentives or utility program intervention.

d. Input all data into the energy model for each sector and develop a hypothetical estimate of the technically feasible energy savings potential within FortisBC's service territory.[3]

5. **Estimate economic savings potential.**

    a. Screen each measure for cost-effectiveness from FortisBC's perspective by determining whether the benefit to cost ratio of each measure is 1.0 or above (pass) or if it is below 1.0 (fail) for two cost effectiveness tests: TRC and MTRC.
    b. Update the technical potential model with only the TRC-passing measures, removing measures that are not cost-effective.
    c. Estimate the economic savings potential of all cost-effective measures applied to all technically feasible buildings in the customer base.[4]
    d. Repeat steps 5b and 5c using the MTRC screen. This study presents findings from two economic (and subsequent market potential) models: One with TRC as the economic screen and one with MTRC.

6. **Estimate market savings potential.**

    a. Based on existing research, develop sets of "generic" adoption curves based on customer payback acceptance and typical market diffusion patterns.[5]
    b. Apply these generic curves to each measure in the economic potential model to develop "simplified market potential" estimates at the measure level.
    c. This data is input into the TRC economic potential model to develop a simplified market potential.
    d. Develop a more realistic market potential for each measure by soliciting feedback from FortisBC and its external stakeholders on the simplified market potential.[6]
    e. Revise the simplified market potential model based on this feedback to develop a realistic market potential scenario (referred to in this study as "medium market potential").
    f. Perform sensitivity analysis by varying incentive levels to model "low" and "high" market potential scenarios.
    g. Repeat steps 6c to 6f using the MTRC economic potential model to estimate low, medium, and high market potential scenarios using the MTRC economic screen.

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3 See Exhibit 2 for an overview of the constraints considered in the technical potential scenario, and the difference between different potential scenarios.
4 See Exhibit 2 for an overview of the constraints considered in an economic potential scenario.
5 Generic adoption curves primarily consider two things: the current market penetration of the measure, and its simple payback. Based on these factors, the curves are applied to each measure to estimate generic participation rates as a percentage of economic potential.
6 This process includes selecting representative, high-impact measures and adjusting their generic participation rates using historical program data, local market knowledge, and industry insights/feedback, then extrapolating these calibrated participation rates to other similar measures within each sector.

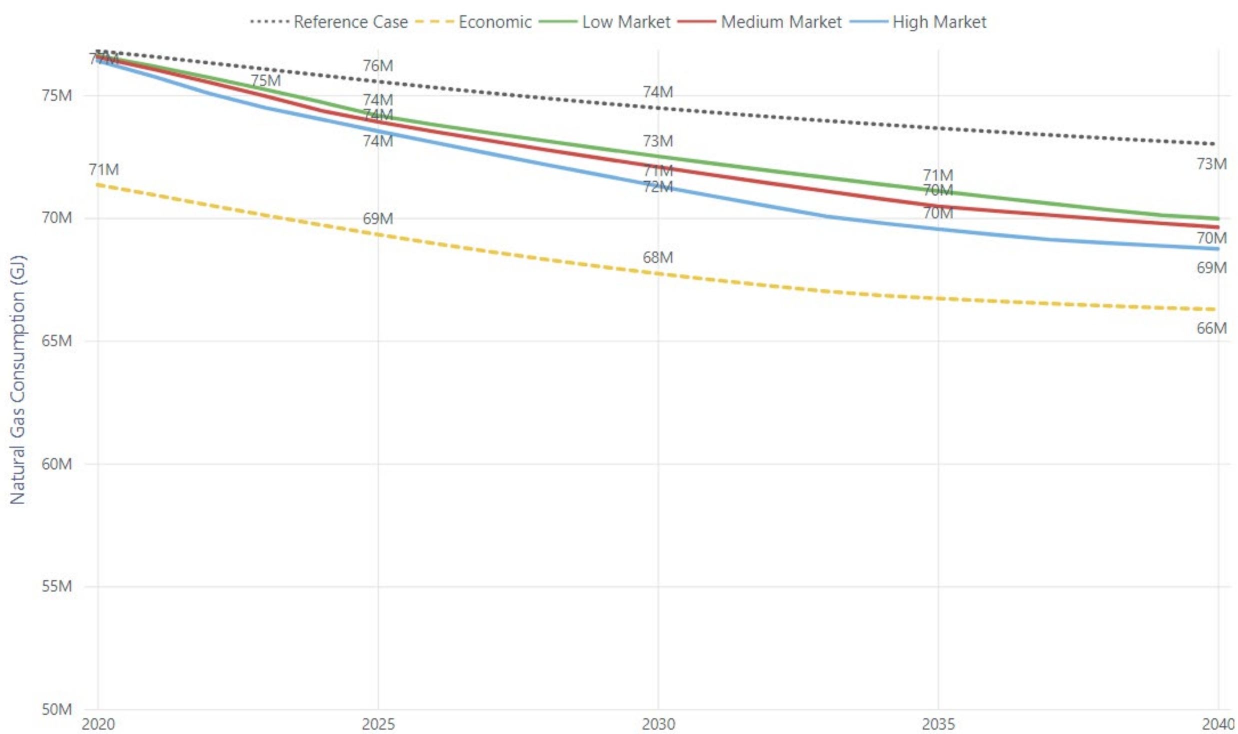
7. **Estimate other energy and non-energy benefits of the potential energy savings.**
    a. Greenhouse gas emissions savings.
    b. Impact of energy conservation measure investments and energy bill savings on provincial employment.

Results and Findings

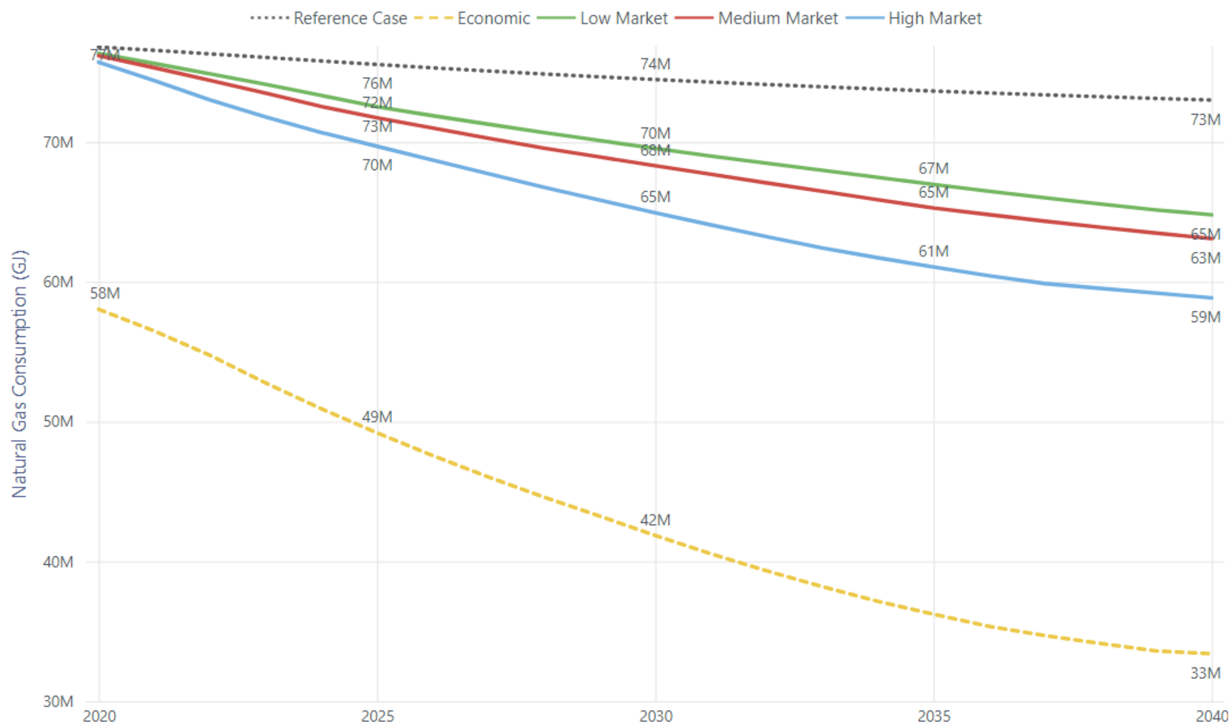
Residential

EX 2 (TRC) and EX 3 (MTRC) show the forecasted gas consumption under the three market potential scenarios for the commercial sector. The reference consumption is forecasted to drop to 73 PJ in 2040 from 77 PJ today. The residential low, medium, and high market TRC potential consumption levels are estimated to be 70 PJ, 69.6 PJ, and 69 PJ by 2040. For MTRC, the potential consumption levels are estimated to be 65 PJ, 63 PJ, and 59 PJ, respectively.

EX 2 – Market Potential Consumption (GJ) Forecasts – Residential, TRC



EX 3 – Market Potential Consumption (GJ) Forecasts – Residential, MTRC



EX 4 (TRC) and EX 5 (MTRC) show the incentive and non-incentive spending required to achieve the medium and high market potential. Medium and high market incentives are 50% and 100% of measures' incremental costs, respectively. The tables show the total and incremental savings from the new measures installed every year.

EX 4 – Medium and High Market Incentive Costs and Natural Gas Savings – Residential, TRC

Year	Medium Market Incentive Cost	Medium Market Non-Incentive Cost	Medium Market Total Costs	Medium Market Potential Savings (GJ)	Medium Incremental Savings (Year-over-Year, GJ)	High Market Incentive Cost	High Market Non-Incentive Cost	High Market Total Costs	High Market Potential Savings (GJ)	High Incremental Savings (Year-over-Year, GJ)
2020	$3.5M	$0.5M	$4.0M	255K	255K	$12.6M	$1.9M	$14.5M	397K	397K
2021	$3.6M	$0.5M	$4.2M	513K	258K	$13.0M	$2.0M	$15.0M	801K	405K
2022	$4.0M	$0.6M	$4.6M	793K	280K	$14.6M	$2.2M	$16.8M	1,251K	450K
2023	$4.5M	$0.7M	$5.2M	1,100K	307K	$10.9M	$1.6M	$12.6M	1,576K	325K
2024	$5.1M	$0.8M	$5.9M	1,442K	342K	$8.1M	$1.2M	$9.3M	1,794K	219K
2025	$3.0M	$0.4M	$3.4M	1,642K	199K	$8.3M	$1.2M	$9.5M	2,016K	221K
2026	$2.4M	$0.4M	$2.8M	1,792K	151K	$8.4M	$1.3M	$9.7M	2,240K	225K
2027	$2.5M	$0.4M	$2.8M	1,943K	151K	$8.6M	$1.3M	$9.9M	2,468K	228K
2028	$2.5M	$0.4M	$2.9M	2,095K	152K	$8.8M	$1.3M	$10.1M	2,700K	232K
2029	$2.6M	$0.4M	$3.0M	2,248K	153K	$9.0M	$1.3M	$10.3M	2,935K	236K
2030	$2.6M	$0.4M	$3.0M	2,401K	154K	$9.2M	$1.4M	$10.6M	3,175K	240K
2031	$2.7M	$0.4M	$3.1M	2,556K	155K	$9.1M	$1.4M	$10.5M	3,414K	239K
2032	$2.7M	$0.4M	$3.2M	2,712K	156K	$9.1M	$1.4M	$10.5M	3,653K	239K
2033	$2.8M	$0.4M	$3.2M	2,870K	157K	$9.1M	$1.4M	$10.5M	3,893K	239K
2034	$2.9M	$0.4M	$3.3M	3,029K	159K	$8.0M	$1.2M	$9.2M	4,015K	123K
2035	$2.9M	$0.4M	$3.4M	3,178K	149K	$8.0M	$1.2M	$9.2M	4,107K	92K
2036	$2.5M	$0.4M	$2.9M	3,222K	43K	$7.8M	$1.2M	$9.0M	4,196K	89K
2037	$2.5M	$0.4M	$2.9M	3,265K	43K	$6.7M	$1.0M	$7.7M	4,265K	69K
2038	$2.4M	$0.4M	$2.8M	3,307K	42K	$4.3M	$0.6M	$4.9M	4,264K	-1K
2039	$2.4M	$0.4M	$2.7M	3,347K	41K	$4.3M	$0.6M	$4.9M	4,265K	1K
2040	$2.3M	$0.4M	$2.7M	3,388K	40K	$4.4M	$0.7M	$5.1M	4,268K	4K

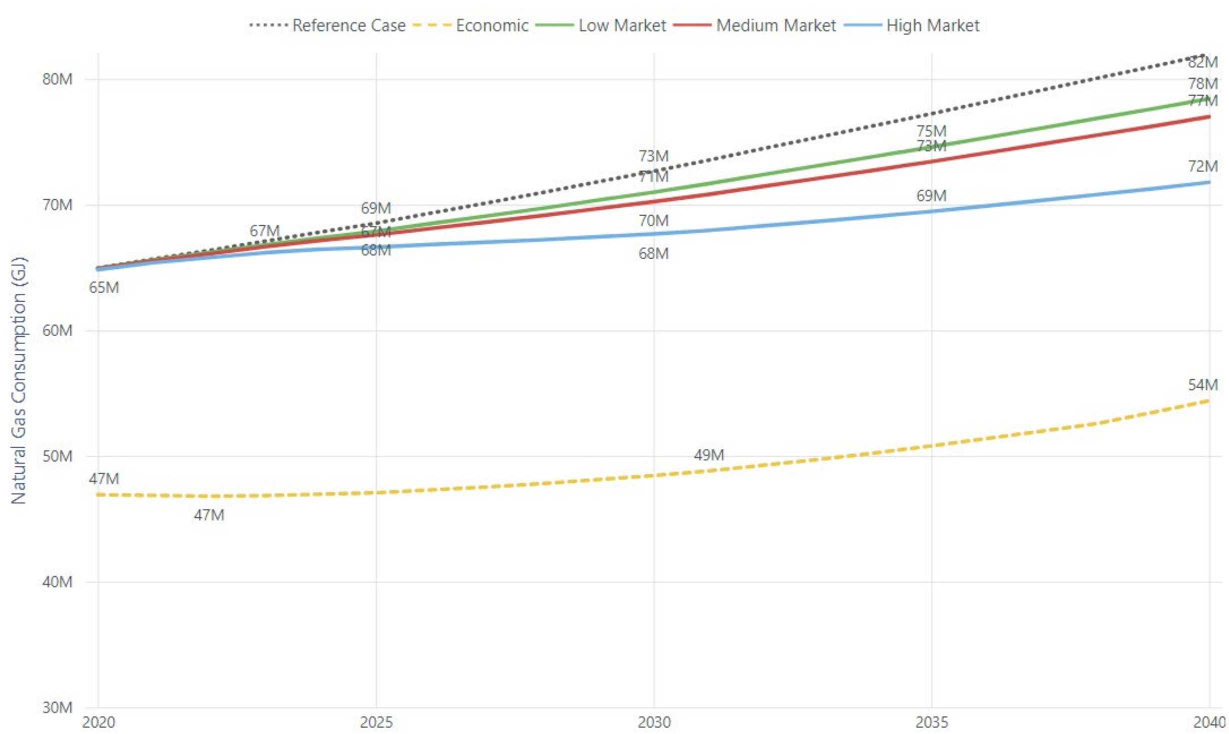
EX 5 – Medium and High Market Incentive Costs and Natural Gas Savings – Residential, MTRC

Year	Medium Market Incentive Cost	Medium Market Non-Incentive Cost	Medium Market Total Costs	Medium Market Potential Savings (GJ)	Medium Incremental Savings (Year-over-Year, GJ)	High Market Incentive Cost	High Market Non-Incentive Cost	High Market Total Costs	High Market Potential Savings (GJ)	High Incremental Savings (Year-over-Year, GJ)
2020	$41.2M	$6.2M	$47.4M	622K	622K	$152.3M	$22.8M	$175.1M	1,080K	1,080K
2021	$42.2M	$6.3M	$48.5M	1,250K	628K	$155.5M	$23.3M	$178.9M	2,170K	1,089K
2022	$43.1M	$6.5M	$49.6M	1,897K	647K	$159.7M	$24.0M	$183.6M	3,300K	1,130K
2023	$44.0M	$6.6M	$50.6M	2,556K	659K	$156.9M	$23.5M	$180.4M	4,267K	967K
2024	$45.2M	$6.8M	$51.9M	3,262K	706K	$148.8M	$22.3M	$171.1M	5,117K	850K
2025	$43.1M	$6.5M	$49.6M	3,810K	548K	$132.1M	$19.8M	$151.9M	5,855K	738K
2026	$43.3M	$6.5M	$49.8M	4,310K	500K	$135.8M	$20.4M	$156.2M	6,601K	746K
2027	$44.0M	$6.6M	$50.6M	4,811K	501K	$140.0M	$21.0M	$160.9M	7,355K	754K
2028	$44.5M	$6.7M	$51.2M	5,310K	499K	$142.9M	$21.4M	$164.3M	8,112K	757K
2029	$36.9M	$5.5M	$42.4M	5,735K	424K	$130.6M	$19.6M	$150.2M	8,822K	710K
2030	$38.0M	$5.7M	$43.7M	6,164K	429K	$130.4M	$19.6M	$150.0M	9,529K	706K
2031	$39.0M	$5.9M	$44.9M	6,598K	434K	$128.0M	$19.2M	$147.2M	10,214K	685K
2032	$40.2M	$6.0M	$46.2M	7,036K	438K	$125.9M	$18.9M	$144.8M	10,879K	665K
2033	$41.4M	$6.2M	$47.6M	7,479K	443K	$124.4M	$18.7M	$143.0M	11,527K	648K
2034	$42.7M	$6.4M	$49.1M	7,926K	448K	$121.6M	$18.2M	$139.9M	12,077K	550K
2035	$44.0M	$6.6M	$50.6M	8,370K	443K	$119.1M	$17.9M	$137.0M	12,589K	511K
2036	$41.9M	$6.3M	$48.2M	8,707K	337K	$116.2M	$17.4M	$133.6M	13,076K	487K
2037	$41.4M	$6.2M	$47.6M	9,038K	331K	$109.0M	$16.4M	$125.4M	13,502K	426K
2038	$39.5M	$5.9M	$45.4M	9,345K	307K	$89.6M	$13.4M	$103.0M	13,710K	207K
2039	$37.7M	$5.7M	$43.3M	9,633K	289K	$89.6M	$13.4M	$103.1M	13,923K	213K
2040	$36.9M	$5.5M	$42.4M	9,910K	276K	$91.9M	$13.8M	$105.7M	14,153K	230K

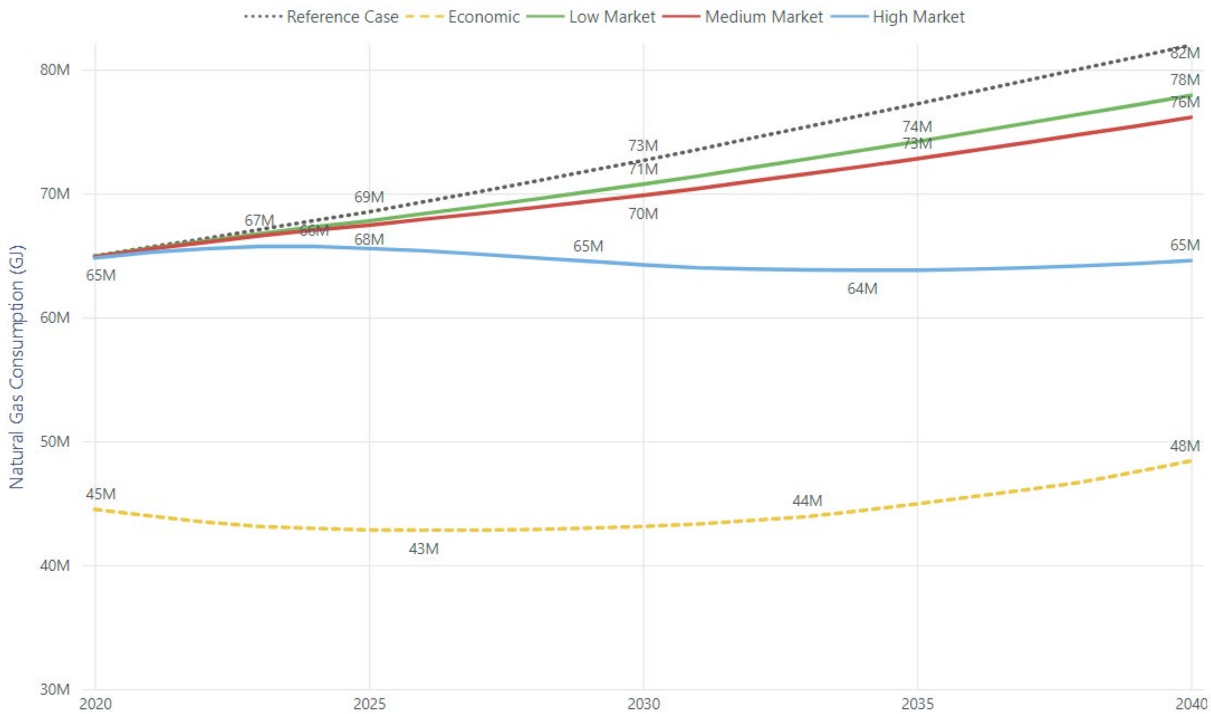
Commercial

EX 6 (TRC) and EX 7 (MTRC) show the forecasted gas consumption under the three market potential scenarios for the commercial sector. The commercial low, medium, and high market TRC potential consumption levels are estimated to be 78 PJ, 77 PJ, and 72 PJ by 2040, while reference consumption is forecasted to reach 82 PJ. The commercial low, medium, and high market MTRC potential consumption levels are estimated to be 78 PJ, 76 PJ, and 65 PJ by 2040, while reference consumption is forecasted to reach 82 PJ.

EX 6 – Commercial Market Potential Consumption (GJ) Forecasts – Commercial, TRC



EX 7 – Commercial Market Potential Consumption (GJ) Forecasts – Commercial, MTRC



The incentive and non-incentive spending in the MTRC scenario required to achieve the medium and high market potential are shown in EX 8 and EX 9. Medium and high market incentives are assumed to be 50% and 100% of measures' incremental costs, respectively. The tables show the total and incremental savings from the new measures installed every year.

EX 8 – Medium and High Market Incentive Costs and Natural Gas Savings – Commercial, TRC

Year	Medium Market Incentive Cost	Medium Market Non-Incentive Cost	Medium Market Total Costs	Medium Market Potential Savings (GJ)	Medium Incremental Savings (Year-over-Year, GJ)	High Market Incentive Cost	High Market Non-Incentive Cost	High Market Total Costs	High Market Potential Savings (GJ)	High Incremental Savings (Year-over-Year, GJ)
2020	$1.0M	$0.1M	$1.1M	57K	57K	$5.9M	$0.9M	$6.8M	124K	124K
2021	$1.6M	$0.2M	$1.9M	142K	85K	$9.9M	$1.5M	$11.4M	306K	183K
2022	$2.6M	$0.4M	$3.0M	267K	125K	$15.7M	$2.4M	$18.0M	563K	256K
2023	$3.9M	$0.6M	$4.5M	441K	174K	$24.1M	$3.6M	$27.7M	914K	352K
2024	$5.4M	$0.8M	$6.2M	667K	226K	$34.1M	$5.1M	$39.2M	1,370K	456K
2025	$6.8M	$1.0M	$7.8M	934K	267K	$43.9M	$6.6M	$50.5M	1,912K	542K
2026	$8.1M	$1.2M	$9.3M	1,223K	289K	$53.2M	$8.0M	$61.2M	2,501K	589K
2027	$8.9M	$1.3M	$10.2M	1,526K	302K	$59.1M	$8.9M	$68.0M	3,124K	623K
2028	$9.5M	$1.4M	$10.9M	1,830K	304K	$63.7M	$9.6M	$73.2M	3,757K	633K
2029	$9.7M	$1.5M	$11.2M	2,132K	302K	$65.4M	$9.8M	$75.2M	4,384K	627K
2030	$9.9M	$1.5M	$11.4M	2,430K	298K	$66.3M	$9.9M	$76.3M	4,999K	615K
2031	$9.9M	$1.5M	$11.4M	2,723K	293K	$67.0M	$10.0M	$77.0M	5,597K	599K
2032	$10.1M	$1.5M	$11.7M	3,009K	286K	$67.7M	$10.2M	$77.9M	6,170K	572K
2033	$9.7M	$1.5M	$11.2M	3,285K	276K	$64.9M	$9.7M	$74.6M	6,712K	542K
2034	$9.9M	$1.5M	$11.4M	3,555K	270K	$65.9M	$9.9M	$75.8M	7,249K	537K
2035	$9.6M	$1.4M	$11.1M	3,810K	255K	$64.6M	$9.7M	$74.2M	7,773K	524K
2036	$9.5M	$1.4M	$11.0M	4,058K	248K	$63.5M	$9.5M	$73.0M	8,283K	510K
2037	$9.5M	$1.4M	$11.0M	4,298K	240K	$64.0M	$9.6M	$73.6M	8,782K	498K
2038	$9.5M	$1.4M	$10.9M	4,534K	237K	$62.0M	$9.3M	$71.2M	9,269K	488K
2039	$9.1M	$1.4M	$10.5M	4,760K	226K	$58.1M	$8.7M	$66.8M	9,735K	466K
2040	$9.2M	$1.4M	$10.6M	4,981K	221K	$59.2M	$8.9M	$68.0M	10,197K	462K

EX 9 – Medium and High Market Incentive Costs and Natural Gas Savings – Commercial, MTRC

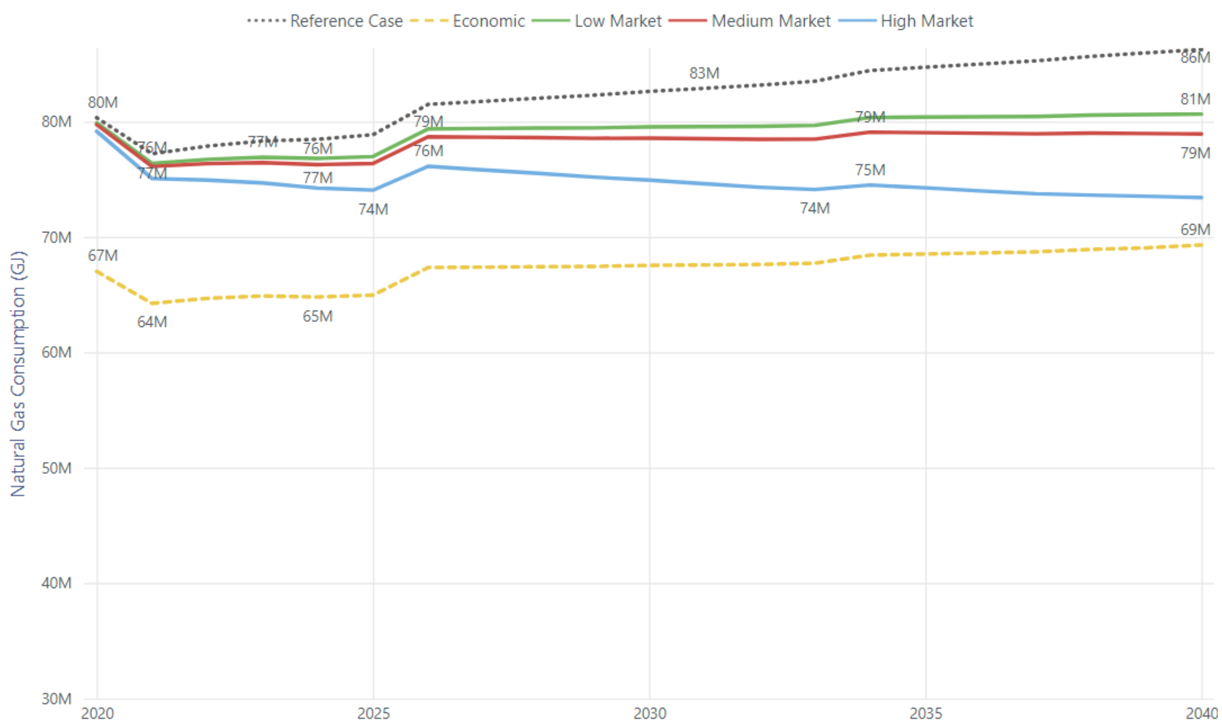
Year	Medium Market Incentive Cost	Medium Market Non-Incentive Cost	Medium Market Total Costs	Medium Market Potential Savings (GJ)	Medium Incremental Savings (Year-over-Year, GJ)	High Market Incentive Cost	High Market Non-Incentive Cost	High Market Total Costs	High Market Potential Savings (GJ)	High Incremental Savings (Year-over-Year, GJ)
2020	$1.2M	$0.2M	$1.4M	62K	62K	$10.8M	$1.6M	$12.4M	160K	160K
2021	$2.1M	$0.3M	$2.4M	159K	97K	$20.1M	$3.0M	$23.1M	422K	262K
2022	$3.4M	$0.5M	$3.9M	303K	144K	$32.7M	$4.9M	$37.6M	810K	388K
2023	$5.1M	$0.8M	$5.8M	505K	201K	$49.6M	$7.4M	$57.1M	1,359K	549K
2024	$6.9M	$1.0M	$7.9M	767K	262K	$70.0M	$10.5M	$80.5M	2,083K	724K
2025	$8.6M	$1.3M	$9.9M	1,075K	309K	$89.6M	$13.4M	$103.1M	2,961K	879K
2026	$10.3M	$1.5M	$11.8M	1,412K	336K	$109.6M	$16.4M	$126.0M	3,954K	993K
2027	$11.3M	$1.7M	$13.0M	1,762K	351K	$122.4M	$18.4M	$140.7M	5,027K	1,072K
2028	$12.1M	$1.8M	$13.9M	2,115K	352K	$132.5M	$19.9M	$152.3M	6,143K	1,116K
2029	$12.4M	$1.9M	$14.2M	2,465K	350K	$137.1M	$20.6M	$157.6M	7,280K	1,137K
2030	$12.6M	$1.9M	$14.5M	2,811K	345K	$140.6M	$21.1M	$161.6M	8,419K	1,139K
2031	$12.7M	$1.9M	$14.6M	3,151K	340K	$140.9M	$21.1M	$162.0M	9,541K	1,122K
2032	$12.9M	$1.9M	$14.9M	3,485K	335K	$142.3M	$21.3M	$163.7M	10,589K	1,049K
2033	$12.5M	$1.9M	$14.4M	3,810K	325K	$135.8M	$20.4M	$156.2M	11,557K	968K
2034	$12.6M	$1.9M	$14.5M	4,130K	319K	$135.8M	$20.4M	$156.1M	12,504K	946K
2035	$12.3M	$1.8M	$14.2M	4,431K	302K	$133.0M	$19.9M	$152.9M	13,422K	918K
2036	$12.3M	$1.8M	$14.1M	4,726K	295K	$131.3M	$19.7M	$151.0M	14,292K	870K
2037	$12.2M	$1.8M	$14.1M	5,014K	288K	$129.9M	$19.5M	$149.4M	15,127K	836K
2038	$12.2M	$1.8M	$14.0M	5,297K	283K	$124.3M	$18.6M	$143.0M	15,918K	790K
2039	$11.9M	$1.8M	$13.7M	5,568K	271K	$118.5M	$17.8M	$136.3M	16,673K	755K
2040	$12.0M	$1.8M	$13.8M	5,833K	266K	$116.1M	$17.4M	$133.5M	17,391K	718K

Industrial

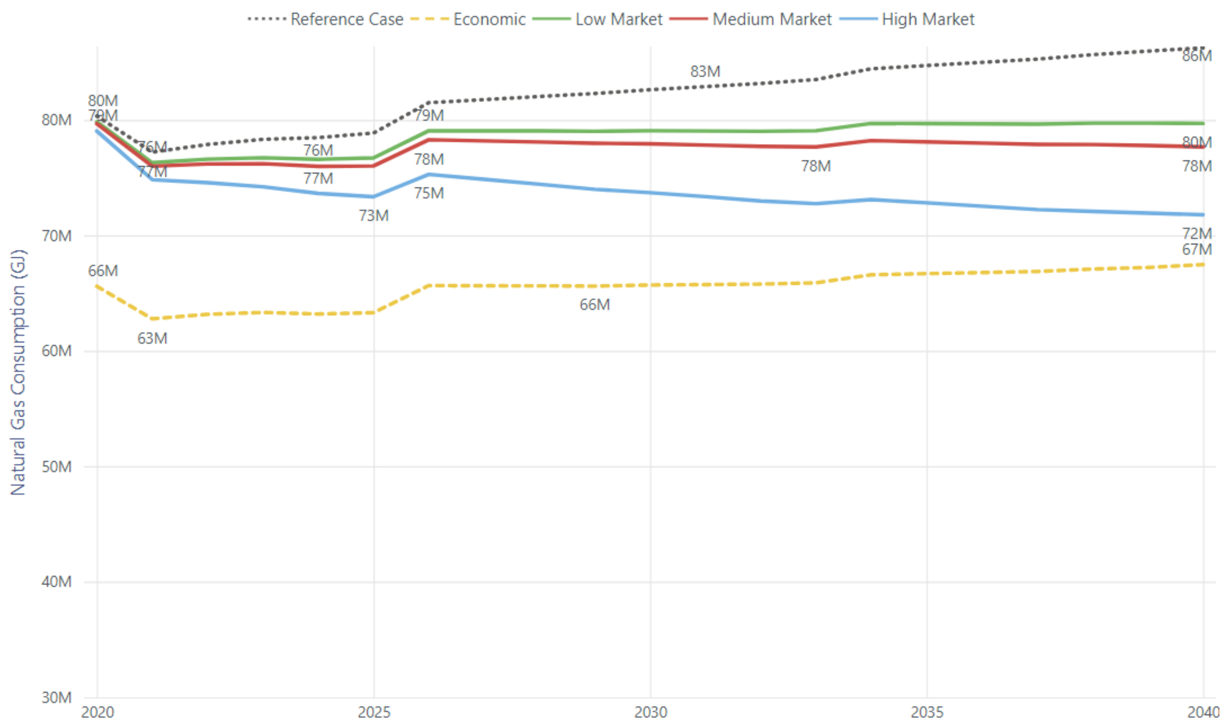
The market potential consumption results are shown in EX 10 and EX 11. The results for the TRC and MTRC screens appear quite similar because of the 39 measures included in the assessment, 34 pass the TRC and 38 pass the MTRC.

The industrial low, medium, and high market TRC potential consumption levels are estimated to be 81 PJ, 79 PJ, and 73 PJ by 2040, while reference consumption is forecasted to reach 86 PJ. The industrial low, medium, and high market MTRC potential consumption levels are estimated to be 80 PJ, 78 PJ, and 72 PJ, by 2040.

EX 10 – Market Potential Consumption (GJ) Forecasts – Industrial, TRC



EX 11 – Market Potential Consumption (GJ) Forecasts – Industrial, MTRC



EX 12 (TRC) and EX 13 (MTRC) show the incentive and non-incentive spending required to achieve the medium and high market potential. Medium and high market incentives are assumed to be 50% and 100% of measures' incremental costs, respectively. The tables show the total and incremental savings from the new measures installed every year.

EX 12 – Medium and High Market Incentive Costs and Natural Gas Savings – Industrial, TRC

Year	Medium Market Incentive Cost	Medium Market Non-Incentive Cost	Medium Market Total Costs	Medium Market Potential Savings (GJ)	Medium Incremental Savings (Year-over-Year, GJ)	High Market Incentive Cost	High Market Non-Incentive Cost	High Market Total Costs	High Market Potential Savings (GJ)	High Incremental Savings (Year-over-Year, GJ)
2020	$3.3M	$0.5M	$3.8M	600K	600K	$13.0M	$2.0M	$15.0M	1,178K	1,178K
2021	$3.3M	$0.5M	$3.8M	1,099K	499K	$12.9M	$1.9M	$14.8M	2,144K	966K
2022	$3.2M	$0.5M	$3.7M	1,518K	419K	$12.7M	$1.9M	$14.6M	2,949K	805K
2023	$3.1M	$0.5M	$3.5M	1,874K	356K	$12.1M	$1.8M	$13.9M	3,631K	681K
2024	$3.0M	$0.4M	$3.4M	2,196K	323K	$11.5M	$1.7M	$13.2M	4,234K	603K
2025	$2.9M	$0.4M	$3.3M	2,501K	305K	$11.3M	$1.7M	$13.0M	4,805K	572K
2026	$2.9M	$0.4M	$3.4M	2,804K	303K	$11.4M	$1.7M	$13.1M	5,373K	568K
2027	$3.0M	$0.5M	$3.5M	3,109K	305K	$11.6M	$1.7M	$13.4M	5,944K	571K
2028	$3.1M	$0.5M	$3.6M	3,419K	310K	$12.0M	$1.8M	$13.8M	6,520K	577K
2029	$3.2M	$0.5M	$3.7M	3,733K	315K	$12.5M	$1.9M	$14.4M	7,103K	583K
2030	$3.4M	$0.5M	$3.9M	4,051K	317K	$13.0M	$2.0M	$15.0M	7,689K	585K
2031	$3.5M	$0.5M	$4.0M	4,371K	320K	$13.4M	$2.0M	$15.4M	8,276K	587K
2032	$3.5M	$0.5M	$4.0M	4,694K	323K	$13.2M	$2.0M	$15.2M	8,848K	572K
2033	$3.5M	$0.5M	$4.0M	5,018K	324K	$12.7M	$1.9M	$14.6M	9,386K	538K
2034	$3.5M	$0.5M	$4.0M	5,343K	325K	$12.6M	$1.9M	$14.4M	9,924K	538K
2035	$3.5M	$0.5M	$4.0M	5,667K	324K	$12.4M	$1.9M	$14.3M	10,458K	534K
2036	$3.5M	$0.5M	$4.0M	5,994K	327K	$12.4M	$1.9M	$14.2M	10,990K	532K
2037	$3.5M	$0.5M	$4.0M	6,323K	329K	$12.4M	$1.9M	$14.2M	11,518K	528K
2038	$3.6M	$0.5M	$4.1M	6,653K	331K	$12.0M	$1.8M	$13.8M	12,020K	502K
2039	$3.6M	$0.5M	$4.1M	6,986K	333K	$9.1M	$1.4M	$10.5M	12,434K	414K
2040	$3.7M	$0.6M	$4.2M	7,323K	337K	$8.8M	$1.3M	$10.1M	12,833K	399K

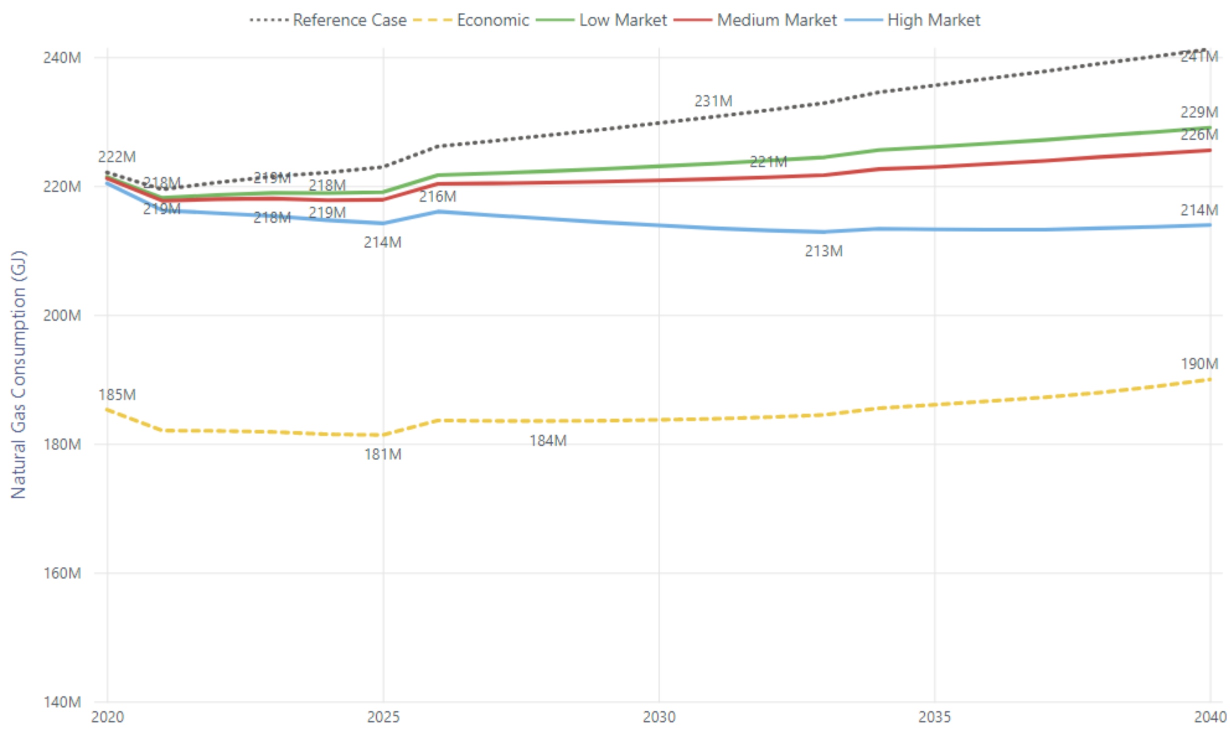
EX 13 – Medium and High Market Incentive Costs and Natural Gas Savings – Industrial, MTRC

Year	Medium Market Incentive Cost	Medium Market Non-Incentive Cost	Medium Market Total Costs	Medium Market Potential Savings (GJ)	Medium Incremental Savings (Year-over-Year, GJ)	High Market Incentive Cost	High Market Non-Incentive Cost	High Market Total Costs	High Market Potential Savings (GJ)	High Incremental Savings (Year-over-Year, GJ)
2020	$8.8M	$1.3M	$10.2M	658K	658K	$35.2M	$5.3M	$40.5M	1,298K	1,298K
2021	$8.8M	$1.3M	$10.1M	1,215K	557K	$35.0M	$5.3M	$40.3M	2,384K	1,086K
2022	$8.8M	$1.3M	$10.1M	1,692K	477K	$34.9M	$5.2M	$40.1M	3,309K	925K
2023	$8.6M	$1.3M	$9.9M	2,105K	414K	$34.3M	$5.1M	$39.4M	4,110K	801K
2024	$8.5M	$1.3M	$9.8M	2,486K	381K	$33.7M	$5.1M	$38.8M	4,833K	723K
2025	$8.5M	$1.3M	$9.7M	2,848K	362K	$33.5M	$5.0M	$38.6M	5,524K	691K
2026	$8.5M	$1.3M	$9.7M	3,209K	361K	$33.6M	$5.0M	$38.7M	6,211K	687K
2027	$8.6M	$1.3M	$9.8M	3,572K	363K	$33.9M	$5.1M	$39.0M	6,901K	690K
2028	$8.7M	$1.3M	$10.0M	3,940K	367K	$34.3M	$5.1M	$39.4M	7,597K	696K
2029	$8.8M	$1.3M	$10.1M	4,313K	373K	$34.8M	$5.2M	$40.0M	8,299K	703K
2030	$8.9M	$1.3M	$10.3M	4,688K	376K	$15.2M	$2.3M	$17.5M	8,914K	615K
2031	$9.1M	$1.4M	$10.4M	5,067K	379K	$15.7M	$2.3M	$18.0M	9,532K	618K
2032	$9.1M	$1.4M	$10.5M	5,451K	383K	$25.7M	$3.9M	$29.5M	10,182K	649K
2033	$9.1M	$1.4M	$10.5M	5,835K	384K	$15.2M	$2.3M	$17.5M	10,753K	571K
2034	$9.1M	$1.4M	$10.5M	6,221K	386K	$15.1M	$2.3M	$17.4M	11,326K	572K
2035	$9.1M	$1.4M	$10.5M	6,607K	386K	$15.1M	$2.3M	$17.3M	11,895K	569K
2036	$9.2M	$1.4M	$10.5M	6,997K	389K	$15.1M	$2.3M	$17.4M	12,464K	569K
2037	$9.2M	$1.4M	$10.6M	7,389K	392K	$15.2M	$2.3M	$17.5M	13,030K	566K
2038	$9.3M	$1.4M	$10.7M	7,783K	394K	$14.9M	$2.2M	$17.1M	13,572K	542K
2039	$9.4M	$1.4M	$10.8M	8,180K	397K	$12.1M	$1.8M	$13.9M	14,026K	454K
2040	$9.5M	$1.4M	$10.9M	8,582K	402K	$11.9M	$1.8M	$13.7M	14,467K	441K

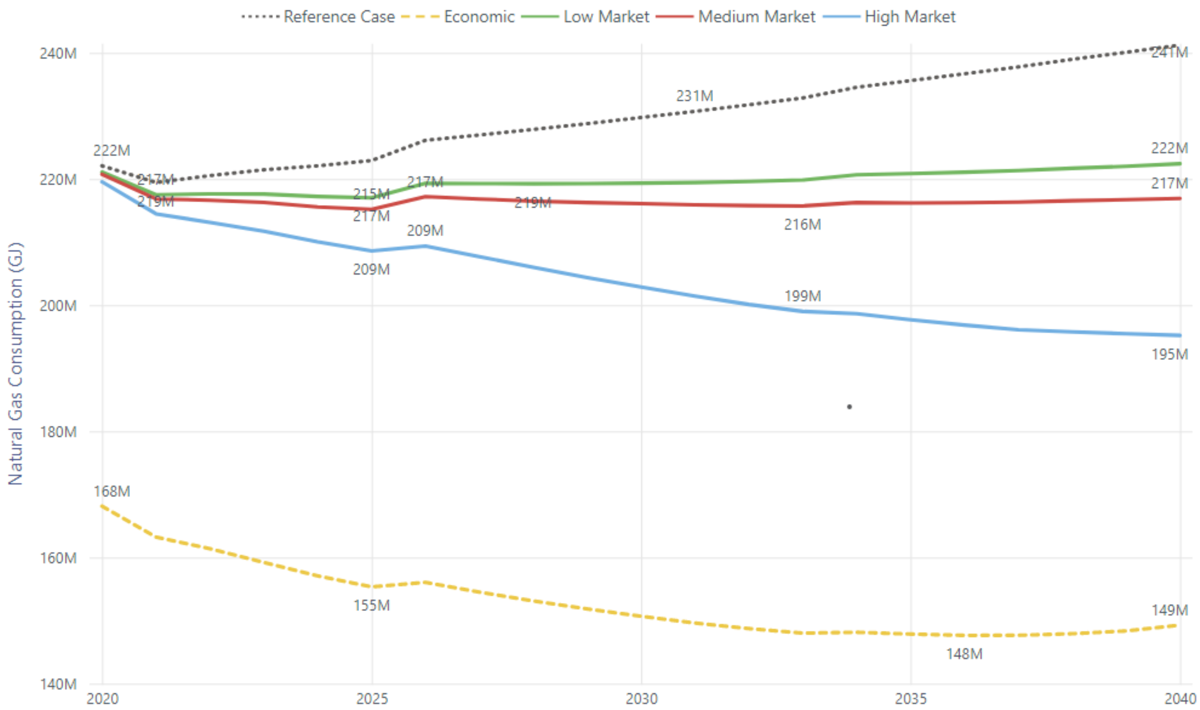
Portfolio

EX 14 (TRC) and EX 15 (MTRC) show the forecasted total natural gas consumption under the three market potential scenarios. The reference consumption is forecasted to increase to 241 PJ in 2040 from 222 PJ today. The total low, medium, and high market TRC potential consumption levels are estimated to be 229 PJ, 226 PJ, and 214 PJ. The low, medium, and high market MTRC potential consumption levels are estimated to be 222 PJ, 217 PJ, and 195 PJ.

EX 14 – Market Potential Consumption (GJ) Forecasts – All Sectors, TRC



EX 15 – Market Potential Consumption (GJ) Forecasts – All Sectors, MTRC

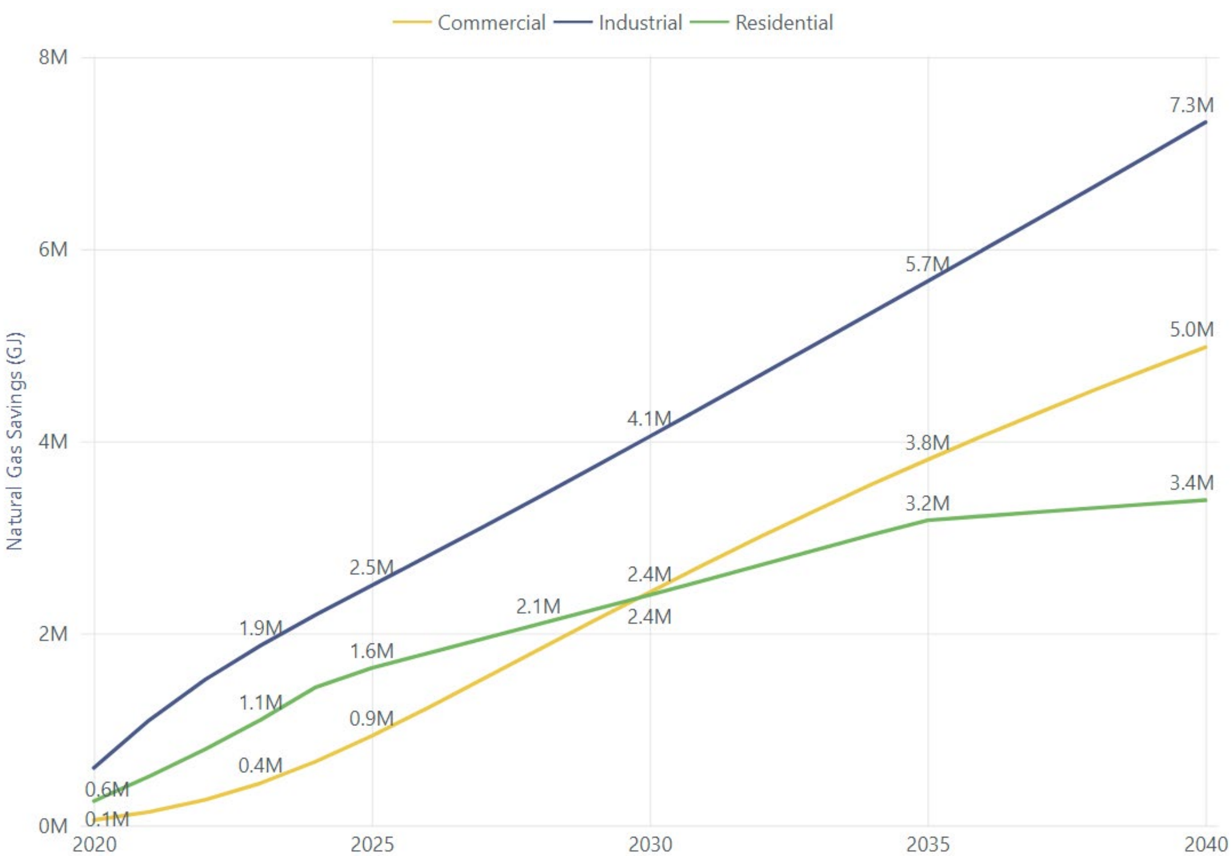


The medium market potential savings from the commercial, industrial, residential sectors are plotted together in EX 16 (TRC) and EX 17 (MTRC).

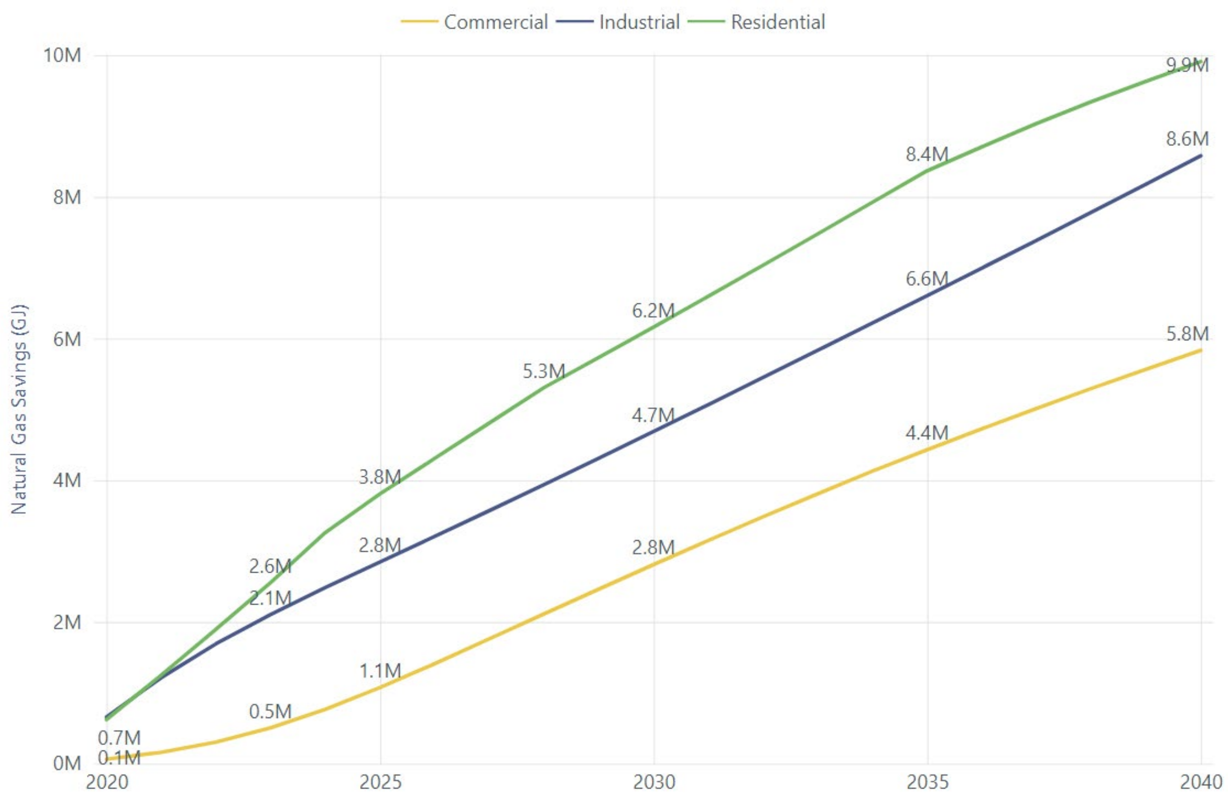
By 2025, the TRC medium market scenario for the industrial sector is expected to have the most savings potential, followed by residential and then commercial sectors. By 2030, the commercial sector overtakes residential. This is because there are only 14 residential measures that pass the TRC, and almost all of them are retrofit measures that can be implemented early in the study period. By 2040, potential savings from industrial, commercial, and residential sectors are estimated to be 7.3 PJ, 5.0 PJ, and 3.4 PJ.

Under the MTRC medium market scenario, the residential sector is estimated to have the most savings potential for the entire study period, followed by the industrial and then commercial. By 2040, potential savings from residential, industrial, and commercial sectors are estimated to be 9.9 PJ, 8.6 PJ, and 5.8 PJ.

EX 16 – Medium Market Potential Savings (GJ) – All Sectors, TRC



EX 17 – Medium Market Potential Savings (GJ) – All Sectors, MTRC



EX 18 (TRC) and EX 19 (MTRC) show the incentive and non-incentive spending required to achieve the medium and high market potential. Medium and high market incentives are assumed to be 50% and 100% of measures' incremental costs, respectively. The tables show the total and incremental savings from the new measures installed every year.

EX 18 – Medium and High Market Incentive Costs and Natural Gas Savings – All Sectors, TRC

Year	Medium Market Incentive Cost	Medium Market Non-Incentive Cost	Medium Market Total Costs	Medium Market Potential Savings (GJ)	Medium Incremental Savings (Year-over-Year, GJ)	High Market Incentive Cost	High Market Non-Incentive Cost	High Market Total Costs	High Market Potential Savings (GJ)	High Incremental Savings (Year-over-Year, GJ)
2020	$7.8M	$1.2M	$8.9M	912K	912K	$31.5M	$4.7M	$36.3M	1,698K	1,698K
2021	$8.5M	$1.3M	$9.8M	1,754K	842K	$35.8M	$5.4M	$41.2M	3,252K	1,554K
2022	$9.9M	$1.5M	$11.3M	2,578K	824K	$42.9M	$6.4M	$49.4M	4,763K	1,511K
2023	$11.5M	$1.7M	$13.2M	3,415K	837K	$47.0M	$7.1M	$54.1M	6,120K	1,357K
2024	$13.5M	$2.0M	$15.5M	4,306K	891K	$53.7M	$8.1M	$61.8M	7,398K	1,278K
2025	$12.6M	$1.9M	$14.5M	5,077K	771K	$63.5M	$9.5M	$73.0M	8,733K	1,334K
2026	$13.5M	$2.0M	$15.5M	5,819K	743K	$73.0M	$11.0M	$84.0M	10,114K	1,382K
2027	$14.4M	$2.2M	$16.5M	6,578K	759K	$79.3M	$11.9M	$91.2M	11,536K	1,421K
2028	$15.1M	$2.3M	$17.4M	7,344K	766K	$84.5M	$12.7M	$97.1M	12,976K	1,441K
2029	$15.5M	$2.3M	$17.9M	8,114K	770K	$86.9M	$13.0M	$99.9M	14,422K	1,446K
2030	$15.9M	$2.4M	$18.3M	8,882K	769K	$88.5M	$13.3M	$101.8M	15,863K	1,440K
2031	$16.1M	$2.4M	$18.5M	9,650K	767K	$89.5M	$13.4M	$102.9M	17,288K	1,425K
2032	$16.4M	$2.5M	$18.9M	10,415K	766K	$90.1M	$13.5M	$103.6M	18,671K	1,384K
2033	$16.1M	$2.4M	$18.5M	11,172K	757K	$86.7M	$13.0M	$99.7M	19,991K	1,320K
2034	$16.2M	$2.4M	$18.7M	11,926K	754K	$86.5M	$13.0M	$99.5M	21,189K	1,198K
2035	$16.0M	$2.4M	$18.4M	12,655K	729K	$85.0M	$12.7M	$97.7M	22,338K	1,149K
2036	$15.5M	$2.3M	$17.8M	13,273K	618K	$83.7M	$12.5M	$96.2M	23,469K	1,131K
2037	$15.5M	$2.3M	$17.9M	13,885K	612K	$83.0M	$12.5M	$95.5M	24,565K	1,095K
2038	$15.4M	$2.3M	$17.8M	14,494K	609K	$78.2M	$11.7M	$90.0M	25,554K	989K
2039	$15.1M	$2.3M	$17.4M	15,094K	599K	$71.6M	$10.7M	$82.3M	26,434K	880K
2040	$15.2M	$2.3M	$17.5M	15,692K	598K	$72.4M	$10.9M	$83.3M	27,299K	865K

EX 19 – Medium and High Market Incentive Costs and Natural Gas Savings – All Sectors, MTRC

Year	Medium Market Incentive Cost	Medium Market Non-Incentive Cost	Medium Market Total Costs	Medium Market Potential Savings (GJ)	Medium Incremental Savings (Year-over-Year, GJ)	High Market Incentive Cost	High Market Non-Incentive Cost	High Market Total Costs	High Market Potential Savings (GJ)	High Incremental Savings (Year-over-Year, GJ)
2020	$51.3M	$7.7M	$59.0M	1,343K	1,343K	$198.3M	$29.8M	$228.1M	2,538K	2,538K
2021	$53.1M	$8.0M	$61.1M	2,625K	1,282K	$210.7M	$31.6M	$242.3M	4,975K	2,437K
2022	$55.3M	$8.3M	$63.6M	3,892K	1,267K	$227.2M	$34.1M	$261.3M	7,418K	2,443K
2023	$57.7M	$8.7M	$66.3M	5,166K	1,274K	$240.8M	$36.1M	$276.9M	9,736K	2,317K
2024	$60.6M	$9.1M	$69.7M	6,514K	1,349K	$252.5M	$37.9M	$290.3M	12,032K	2,296K
2025	$60.2M	$9.0M	$69.2M	7,734K	1,219K	$255.2M	$38.3M	$293.5M	14,340K	2,308K
2026	$62.1M	$9.3M	$71.4M	8,931K	1,197K	$279.0M	$41.9M	$320.9M	16,766K	2,426K
2027	$63.9M	$9.6M	$73.5M	10,146K	1,215K	$296.2M	$44.4M	$340.6M	19,282K	2,516K
2028	$65.3M	$9.8M	$75.1M	11,365K	1,219K	$309.6M	$46.4M	$356.1M	21,852K	2,569K
2029	$58.0M	$8.7M	$66.7M	12,512K	1,147K	$302.5M	$45.4M	$347.8M	24,402K	2,550K
2030	$59.5M	$8.9M	$68.5M	13,663K	1,151K	$286.2M	$42.9M	$329.1M	26,862K	2,461K
2031	$60.8M	$9.1M	$69.9M	14,816K	1,153K	$284.5M	$42.7M	$327.2M	29,287K	2,424K
2032	$62.2M	$9.3M	$71.6M	15,972K	1,156K	$293.9M	$44.1M	$338.0M	31,650K	2,363K
2033	$63.0M	$9.5M	$72.5M	17,124K	1,152K	$275.4M	$41.3M	$316.7M	33,838K	2,188K
2034	$64.4M	$9.7M	$74.1M	18,277K	1,153K	$272.5M	$40.9M	$313.4M	35,907K	2,069K
2035	$65.4M	$9.8M	$75.3M	19,408K	1,131K	$267.1M	$40.1M	$307.2M	37,905K	1,999K
2036	$63.3M	$9.5M	$72.8M	20,430K	1,022K	$262.6M	$39.4M	$302.0M	39,832K	1,927K
2037	$62.9M	$9.4M	$72.3M	21,440K	1,011K	$254.1M	$38.1M	$292.2M	41,660K	1,828K
2038	$61.0M	$9.1M	$70.1M	22,425K	984K	$228.8M	$34.3M	$263.1M	43,199K	1,539K
2039	$58.9M	$8.8M	$67.7M	23,381K	957K	$220.3M	$33.0M	$253.3M	44,622K	1,423K
2040	$58.3M	$8.8M	$67.1M	24,325K	944K	$219.8M	$33.0M	$252.8M	46,010K	1,388K

1 Introduction

1.1 Background and Study Goals

The 2021 Conservation Potential Review (CPR) is the review of energy efficiency opportunities available among FortisBC's residential, commercial, and industrial natural gas customers.

The CPR will support two of FortisBC Energy Inc's (FEI) major regulatory filings in 2022: the long-term gas resource plan (LTGRP) and the Demand Side Management (DSM) plan. For this CPR, Posterity Group (PG) reviewed estimated technical, economic, and market potential natural gas savings in FEI's service territory over a 20-year period. The CPR is an important guiding document for ongoing conservation and energy management program development and support at FortisBC.

FEI has also retained Posterity Group to produce the load forecast of natural gas demand of FEI's customers to support the 2022 LTGRP filing. The base year and reference case forecast developed by Posterity Group is common to both the LTGRP and CPR. As a result of the integrated nature of the two projects, the LTGRP project is frequently referenced in this document.

1.2 Report Organization and Results Presentation

This Report

The 2021 CPR has been prepared as **a single report that contains results for three sectors: residential, commercial, and industrial.** The report has been structured as follows:

Section 1 provides an overview of the CPR scope and definitions of key terms and acronyms.

Section 2 presents the overall steps taken and approach followed to complete this CPR. This section is applicable to all three sectors.

Section 3 presents the **residential** sector results. These include findings on base year and reference case energy forecasts, measure analysis, technical potential, economic potential, and market potential.

Section 4 presents the **commercial** sector results, following the same format as Section 4.

Section 5 presents the **industrial** sector results, following the same format as Section 4.

Section 6 presents aggregate portfolio-level results covering all three sectors. These include market potential, greenhouse gas emissions impacts, and employment impacts.

Presentation of CPR Potential Results

There are five deliverables included in the CPR report:

- **This report**, which presents the conservation potential results for the residential, commercial, and industrial sectors.
- **Method Appendices Document** that includes all method-related memos that were shared between the study and client team through the course of the project, compiled into a stand-alone document.
- **CPR Data Visualization Tool** that provides a dashboard built using Power BI, with access provided to the FortisBC project team and sector leads. During project execution, this

dashboard was used to facilitate detailed review of draft potential analysis outputs. In its final form, it can be used by FortisBC staff to explore output data for the purposes of DSM planning, program research and program design.

- **Market Potential Model Outputs** that include raw model output that has been organized into Excel workbooks with built-in tables and graphs and provided with this report. There are two workbooks per sector: one using TRC as the economic screen and one with MTRC.
- **Measure Analysis Workbooks** that provide final versions of the workbooks containing measure assumptions for each sector have been shared for reference.

1.3 Caveats and Limitations

Forecasting and modelling are a key part of this CPR study. Both activities require extensive research and more importantly, require assumptions, engineering estimates and the professional judgement of the study team. The study team strove to ensure that these assumptions are in line with the FortisBC team's knowledge of their customer base and are made with the best information available. However, given the nature of forecasting, the results in this report should be considered as estimates.

All potential scenarios in this report are estimated in relation to a "business as usual" reference case scenario. The CPR reference case incorporates FortisBC's account forecast, observed customer consumption trends, and industrial customer demand survey results. By incorporating these sources, the reference case implicitly includes the effects of current policy, but does not adjust for potential future policy changes. Scenarios with specific regulation/policy drivers, including high electrification, are not assessed within the scope of the CPR. High electrification scenarios have been modelled separately, in support of FortisBC's LTGRP.

2 Study Scope

This section defines some common terms used in this study and an overview of what is covered in this CPR.

2.1 Definition of Terms

Accounts – Number of FEI customer accounts. This report refers to 'accounts' rather than customers, as one customer could have multiple accounts.

Benefit/Cost Ratio – Expresses the attractiveness of a measure relative to its costs. A measure with a ratio of 1 or higher has benefits that outweigh its costs. For this study, two measure cost tests were used, both expressed as a Benefit/Cost ratio. These tests, the Total Resource Cost (TRC) test and the Modified Total Resource Cost Test (MTRC), are defined below.

Early Replacement – The act of replacing equipment prior to failure, while it has some remaining useful life. Contrast with "Replace on Burnout (ROB)", below.

End Use, Sub-End Use – The final purpose for which energy is being used. For example, space heating, domestic hot water (DHW), or industrial process heat. In the CPR model, end uses are occasionally further divided into smaller subcategories referred to as Sub-End Uses. For example, Residential DHW is further divided by into shower DHW, washer DHW, dishwasher DHW, and other DHW to facilitate analysis of measures that apply to a specific portion of the und-use energy.

Energy Conservation Measure (ECM, or Measure) – An equipment, technology, or a behavior that results in reduction of energy use in a dwelling, building, or facility.

Fuel Share – Ratio of a specific end use load that is met by a particular fuel. For example, if 90% of single-family dwelling space heating load is met by natural gas equipment, the natural gas fuel share for space heating in single-family dwellings is 90%.

Full Cost Measure – A measure whose benefit/cost ratio is evaluated on the basis of its full cost, as opposed to their incremental cost between the measure and a less-efficient "baseline" alternative. See "Retrofit (RET)" below for further explanation.

Gas-Heated Dwelling, Non-Gas-Heated Dwelling – In the residential sector, a dwelling that primarily uses gas for space heating heat (>50% of the fuel share for space heating) is considered a gas-heated dwelling. A dwelling that has a natural gas space heating fuel share <50% is considered a non-gas-heated dwelling. Gas-heated dwellings may have other fuels serving the space heating end use, but gas comprises at least 50% of the fuel share.

GJ – Gigajoule, or one billion joules. The unit of energy used by FortisBC for billing purposes.

Incremental Cost Measure – A measure whose benefit/cost ratio is evaluated on the basis of its incremental cost relative to a less-efficient alternative. See definition of "Replace on Burnout (ROB)" for further explanation.

Modified Total Resource Cost (MTRC) – A modified version of the TRC test that includes an alternate avoided cost and an adder for non-energy benefits. Per section 4(1.1)(a) of the province's DSM Regulation, the MTRC test incorporates the avoided cost of electricity – BC Hydro's marginal cost of acquiring electricity generated from clean or renewable resources, called the Zero Emission Energy Alternative (ZEEA) - rather than the marginal cost of new gas supply.

Participation or Participation Rate – The rate or percentage of buildings or end users that take part in a utility's program. This is a measurement of customer uptake of a measure and is an input to determine market potential.

Region – In this CPR, FEI's gas service territory is divided into six regions: City of Vancouver, Lower Mainland excluding Vancouver ("Lower Mainland x Vancouver"), Vancouver Island, Northern BC, Southern Interior, and Whistler.

Replace on Burnout (ROB) – One of two primary measure replacement types. Replace-on-burnout measures are typically time, labor, and cost intensive and are applied at the end of the useful life of the underlying equipment. For example, boiler replacements are typically evaluated as replace on burnout. ROB measures are typically evaluated on the basis of their incremental cost relative to a less-efficient, code-compliant alternative. Contrast with "Early Replacement", above and Retrofit (RET) below.

Retrofit (RET) – One of two primary measure replacement types. Retrofit measures are typically less costly measures that can be installed at any time. For example, a communicating thermostat or low-flow showerhead. RET measures are typically evaluated on their full costs. Contrast with "Early Replacement" and "Replace on Burnout (ROB)" above.

R-Value – A measure of a material's resistance to heat flow. In the context of building science, R-value is used to measure the effectiveness of insulation for building envelope components (e.g. attic insulation). The higher the R value, the better the measure's ability to insulate.

Saturation – For most end uses, Saturation is the extent to which an end use is present in a region, and segment. For some specific end uses that are associated with appliances, Saturation is defined as the average number of appliances per Unit.

Sector – Grouping or category of customers or buildings by customer type: residential, commercial, and industrial.

Segment – Grouping or category of buildings (e.g., single-family detached in residential, large offices in commercial). Segments reflect the main purpose of the building and helps to differentiate between energy use intensity or patterns across building types within a sector.

Simple Payback – The duration of time to recover the cost of a project based on cumulative savings, without taking into account the time value of money. In the context of energy conservation measures, savings are accrued based on the value of energy savings. Simple payback is calculated from the perspective of the end user and is presented as a number of years. For example, a measure that costs $600 and results in energy savings valued at $200 annually has a simple payback $600 / $200 = 3 years.

Size Factor – The change in average number of units per account. This is primarily used to reflect the forecast change in production volumes in industry.

Step Code – Compliance path in British Columbia Building Code (BCBC) for achieving energy efficiency in new construction beyond the minimum code requirements.

Stock Average Efficiency – Average efficiency of equipment serving the tertiary load for that end use.

Tertiary Load – The useful energy delivered to an end use. In the context of the CPR, tertiary load is the amount of energy required to be delivered as an end use service, for example, heat delivered by a furnace to a residential dwelling.

Total Resource Cost (TRC) – A metric for evaluating the cost-effectiveness of an energy conservation measure based on both the participants and utility's costs and benefits.

Unit Energy Consumption (UEC) – The amount of energy used by each end use per unit.

Units – The sector-specific unit of analysis: dwellings in the residential sector, square metres in the commercial sector, and production capacity in the industrial sector.

Vintage – A grouping of facilities based on their age.

2.1.1 Acronyms

BAS	Building Automation System
C&EM	Conservation and Energy Management
CCE	Cost of Conserved Energy
CEUS	Commercial End Use Survey
CPR	Conservation Potential Review
DHW	Domestic Hot Water
DIY	Do-It-Yourself
DSM	Demand Side Management
ECM	Energy Conservation Measure
EECAG	Energy Efficiency and Conservation Advisory Group
EUI	Energy Use Intensity
FEI	FortisBC Energy Inc.
GJ	Gigajoule
HE	High Efficiency
HVAC	Heating, Ventilation, and Air Conditioning
LTGRP	Long Term Gas Resource Plan
MUA	Make Up Air
NAICS	North American Industry Classification System
NEW	New Construction
O&M	Operation and Maintenance
PJ	Petajoule, i.e. 1 million gigajoules
RET	Retrofit
REUS	Residential End Use Survey
ROB	Replace-on-burnout
RTU	Remote Terminal Unit
TAC	Technical Advisory Committee
TMP	Thermomechanical Pulping – an industrial Pulp & Paper segment term
TRM	Technical Resource Manual
UEC	Unit Energy Consumption
ZEEA	Zero Emission Energy Alternative

2.2 CPR Coverage

2.2.1 Timing

The base year for the CPR Study is the 2019 calendar year. The reference case forecast is for 2020 to 2040. Results are calculated for each intervening year.

2.2.2 Regions

The CPR divides the FortisBC gas regions in British Columbia (BC) into six:

- City of Vancouver
- Lower Mainland excluding Vancouver ("Lower Mainland x Vancouver")
- Vancouver Island
- Northern BC
- Southern Interior
- Whistler

2.2.3 Sectors, Segments, and End Uses

The 2021 CPR covers three sectors: residential, commercial, and industrial.[7] Each sector is unique and has important differences which are reflected in how inputs and outputs are organized. Please see the supporting Method Appendices Document for details of how the sector model was developed. Exhibit 1 presents the specific way each sector is organized into segments, energy end uses, and building vintages in the CPR model.

A segment is a grouping or category of buildings, such as a single-family Detached dwelling in Residential, or large offices in Commercial, for example. Segments reflect the main purpose of the building and help to differentiate between energy use intensity or patterns across building types within a sector.

7 The LTGRP includes these three sectors as well as transportation.

Exhibit 1 – CPR Segments, End Uses, & Vintages by Sector

	Residential	Commercial	Industrial
Segments	• Single Family Detached/Duplexes • Single Family Attached/Row • Mobile/Other Residential	• Apartments – Medium • Apartments – Large • Food Retail • Hospital • Hotel – Medium • Hotel – Large • Non-Food Retail – Medium • Non-Food Retail – Large • Nursing Home • Office – Medium • Office – Large • Other Commercial • Restaurant • School – Medium • School – Large • University/College • Warehouse	• Agriculture (includes greenhouses[8]) • Chemical • District energy providers • Fabricated Metal • Food & Beverage • Other Manufacturing (includes transportation[9] and other industrial) • Mining • Non-metallic Mineral (includes cement) • Pulp & Paper – Kraft • Pulp & Paper – TMP • Utilities • Wood Products

8 Cannabis included in agriculture segment since there is not enough data at FEI to create a cannabis-specific forecast.
9 In the 2015 CPR, 'transportation' pertained to facilities that supported the transportation sector.

	Residential	Commercial	Industrial

End Uses[10]	• Clothes dryer
	• Cooking
	• Domestic hot water[11]
	  o Dishwasher DHW
	  o Washer DHW
	  o Shower DHW
	  o Other DHW
	• Fireplace
	• Other gas uses (outdoor fireplaces, patio heaters)
	• Pool & spa heaters
	• Space heating
		• Cooking
		• Domestic Hot Water
		• Other[12]
		• Pools, Spas & Hot tubs
		• Space Heating
			• Direct-fired heating
			• Direct Consumption of Gas in Process[13]
			• Heat Treating
			• Kilns
			• On-Site Power Generation[13]
			• Other[12]
			• Ovens
			• Petrochemical Refining and Process Heating
			• Process Boilers
			• Product Drying
			• Space Heating [includes HVAC air heating and HVAC boilers]
			• Water heaters

Vintages[14]	• Pre-1950 • 1950-1975 • 1976-1985 • 1986-1995 • 1996-2005 • 2006-2015 • Post-2015 (Existing) • New	• Existing • New	• Existing • New

10 All-electric end uses, such as clothes washer, lighting or plug loads, are not included in the reported results therefore are excluded from the End Uses row of this table.
11 In some cases, end uses are broken out into sub-end uses to facilitate CPR measure analysis. DHW can be reported at the end use or sub-end use level in the CPR.
12 The ‘other’ end use is a catch all for equipment that account for a small portion of consumption in the sector. In the commercial sector, examples of ‘other’ equipment are patio heaters and laundry dryers.
13 No CPR measures are applied to this end use; included for tracking purposes only.
14 The residential sector segments are divided into vintages that define time periods when residential dwellings were built. ‘New’ residential dwellings do not appear until the first year of the reference case.

3 Study Approach

This section presents the major steps that were taken to complete this CPR. Subsequent sections present the process for completing each CPR step in further detail.

For this study, Posterity Group developed a common base year and reference case model (steps 1 and 2 below) for the CPR and FortisBC's 2022 LTGRP.

3.1 Major CPR Analysis Steps

1. **Determine the current (Base Year) customer base and their energy consumption.**
    a. Collect and review data on the building stock in FortisBC's service territory, including end use surveys and previous CPRs.
    b. Develop energy use models of each building or facility type (segments) and model energy consumption by end use.
    c. Collect and review actual base year (2019) energy use and billing data of FortisBC's customers.
    d. Use the billing data to calibrate the base year energy consumption in each sector's energy model.
2. **Develop reference case energy consumption forecast.**
    a. Collect and review data on all factors that will affect energy use trends over the study period (2020 to 2040 in this study's case).
        i. This includes analyzing and modelling natural improvements in building energy use intensities (e.g. from natural replacement of furnaces with new, higher efficiency ones at replacement time).
        ii. Other factors are existing building demolition / renovation trends, rate of new building stock construction, baseline energy efficiency of new buildings and equipment, and known changes to policies and codes and standards that will impact the energy use of buildings.
    b. Use this data to develop an energy consumption forecast model for each sector.
    c. Calibrate the reference case based on FortisBC's own account forecasts and industrial survey information at the region and rate class level.
3. **Characterize energy conservation measures.**
    a. Select a set of energy conservation measures for each sector. Measures range from mature, widely known measures that are currently part of FortisBC's program portfolio (e.g. commercial condensing boilers) to innovative or enabling technologies (e.g. smart residential water heater controllers). Behavioural measures are also considered (e.g. thermostat setback).
    b. For each measure, review and collect data on energy savings, costs, useful life, and the baseline equipment or technology that it should be compared with (if applicable).
    c. Use the data to characterize the technology's energy savings potential, cost-effectiveness, and financial attractiveness.

d. Use the data as inputs to the energy model for each sector.

4. **Estimate technical savings potential.**

   a. For each measure, determine its technical applicability (i.e. how many buildings or facilities can this measure be applied to, considering only technical barriers).
   b. Determine the measures' current market penetration (i.e. how many buildings or facilities have already installed a measure).
   c. Estimate the measures' reference adoption – their natural rate of uptake in the absence of incentives or utility program intervention.
   d. Input all data into the energy model for each sector and develop a hypothetical estimate of the technically feasible energy savings potential within FortisBC's service territory.[15]

5. **Estimate economic savings potential.**

   a. Screen each measure for cost-effectiveness from FortisBC's perspective by determining whether the benefit to cost ratio of each measure is 1.0 or above (pass) or if it is below 1.0 (fail) for two cost effectiveness tests: TRC and MTRC.
   b. Update the technical potential model with only the TRC-passing measures, removing measures that are not cost-effective.
   c. Estimate the economic savings potential of all cost-effective measures applied to all technically feasible buildings in the customer base.[16]
   d. Repeat steps 5b and 5c using the MTRC screen. This study presents findings from two economic (and subsequent market potential) models: One with TRC as the economic screen and one with MTRC.

6. **Estimate market savings potential.**

   a. Based on existing research, develop sets of "generic" adoption curves based on customer payback acceptance and typical market diffusion patterns.[17]
   b. Apply these generic curves to each measure in the economic potential model to develop "simplified market potential" estimates at the measure level.
   c. This data is input into the TRC economic potential model to develop a simplified market potential.
   d. Develop a more realistic market potential for each measure by soliciting feedback from FortisBC and its external stakeholders on the simplified market potential.[18]

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15 See Exhibit 2 for an overview of the constraints considered in the technical potential scenario, and the difference between different potential scenarios.
16 See Exhibit 2 for an overview of the constraints considered in an economic potential scenario.
17 Generic adoption curves primarily consider two things: the current market penetration of the measure, and its simple payback. Based on these factors, the curves are applied to each measure to estimate generic participation rates as a percentage of economic potential.
18 This process includes selecting representative, high-impact measures and adjusting their generic participation rates using historical program data, local market knowledge, and industry insights/feedback, then extrapolating these calibrated participation rates to other similar measures within each sector.

e. Revise the simplified market potential model based on this feedback to develop a realistic market potential scenario (referred to in this study as "medium market potential").
f. Perform sensitivity analysis by varying incentive levels to model "low" and "high" market potential scenarios.
g. Repeat steps 6c to 6f using the MTRC economic potential model to estimate low, medium, and high market potential scenarios using the MTRC economic screen.

7. **Estimate other energy and non-energy benefits of the potential energy savings.**[19]
    a. Greenhouse gas emissions savings.
    b. Impact of energy conservation measure investments and energy bill savings on provincial employment.

19 Due to uncertainty regarding measure-level impacts on regional and system peak demand, detailed analysis of the system peak impacts from energy efficiency measures has not been undertaken as part of the CPR.

Exhibit 2 – Difference Between Technical, Economic, and Market Potential

Constraints	Description	
Technical applicability	Is the measure compatible with the current systems in place in the building or facility? Are there any technical constraints that will prevent installation in specific buildings or facilities? If not, then the measure's hypothetical energy savings can be included in the technical potential. Example: If this is a furnace-related measure, do I have a forced air heating system in my building?	Technical Potential
Cost-Effectiveness	In addition to the technical constraints above: From the utility's perspective, are the energy savings that result from installing the measure financially attractive? Do they provide a return on investment (i.e., the capital and installation costs) based on the economic screen the utility is required to use? If yes, then the measure's hypothetical energy savings can be included in the economic potential.	Economic Potential
Market-related	In addition to the technical and economic constraints above: Are there any constraints related to the market, logistics, or the target customers? Is the measure readily available in the market? Are customers aware of the measure? Realistically, how many customers will have the willingness or interest to install the measure given its costs and benefits? How would the customers' willingness change if the incentives to install these measures increased?	**Market Potential** *(this study's ultimate objective)*
Utility-related *(out of scope for this study, as this is typically a program design activity)*	In addition to all the constraints above: What are the utility's constraints around encouraging the uptake of this measure? How much budget does the utility have to spend on a program and incentives for a measure? How many resources can a utility allocate to delivering a program realistically?	Program Potential

3.2 Base Year Energy Use Model Development

The CPR model is developed in the following sequence for each sector:

- Base Year (2019): the first year of a forecast period and is based on historical data provided by FEI.
- Reference Case (2020-2040)[20]: forecast of natural gas consumption over a twenty-year (2020-2040) period based on exogenous conditions that follow a "business-as-usual" scenario.

The base year and reference case was modelled for each sector using Posterity Group's Navigator™ Energy and Emissions Simulation Suite. This section provides an overview of the model structure and the process to develop the base year and reference case.

Exhibit 3 defines the six parameters that provide the structure for the model used for the CPR.[21]

Exhibit 3 – 2021 CPR Model Parameters

Parameter	Definition
Accounts[22]	Number of FEI customer accounts.
Units	The basis for how energy consumption is expressed. The unit of analysis is unique to each sector: dwellings in the residential sector, square metres in the commercial sector and production capacity in the industrial sector.
Size Factor	The change in average number of units per account. This is primarily used to reflect the forecast change in production volumes in industry.
Saturation	For most end uses, saturation is the extent to which an end use is present in a region, and segment.[23] For some specific end uses that are associated with appliances, Saturation is defined as the average number of appliances per Unit.
Fuel Share	The percentage of the energy end use that is supplied by each fuel.
Unit Energy Consumption (UEC)	The amount of energy used by each end use per unit.

20 Note that the LTGRP forecast period is 2020-2042. The LTGRP will not be filed until 2022 and requires a twenty-year reference case.
21 Some of the model parameters are adjusted when necessary to reflect a distinct characteristic of a sector. Any adjustments are explained in this document.
22 PG uses 'accounts' instead of customers in this document as one customer could have multiple accounts.
23 A segment is a grouping or category of buildings (e.g., single-family detached in residential, large offices in commercial). Segments reflect the main purpose of the building and helps to differentiate between energy use intensity or patterns across building types within a sector.

Once each parameter of the model is populated with the applicable data, energy consumption is calculated for a specific end use for each region, segment, and vintage each year using the following equation:

$$Consumption = Units * Saturation * Fuel\ Share * Unit\ Energy\ Consumption$$

Exhibit 4 presents the detailed steps that the team took to calibrate the base year energy consumption in the CPR model with FortisBC's actual customer energy use.

Exhibit 4 – Base Year Calibration Steps for All Sectors

Step	Description
1	Compile and analyze available data on FortisBC's existing building stock by segment, including consultation of Residential End Use Survey (REUS), Commercial End Use Survey (CEUS) and relevant third-party data.
2	Develop detailed technical descriptions of the existing building stock at the subsector, end use, and end use equipment level. For each sector, detailed regional and subsector assumptions regarding fuel shares, end use penetrations, equipment saturations and equipment efficiency levels are aggregated in Excel workbooks as inputs into the Navigator™ model under step 4.
3	Compile utility billing data by subsector and region.
4	Create sector model inputs and generate preliminary results.
5	Adjust input assumptions for end uses with greater uncertainty until the results closely match the actual utility billing data.

The results of the base year energy consumption model are presented in Section 4.2 (residential), Section 5.2 (commercial), and Section 6.2 (industrial).

3.3 Reference Case Forecast Development

As explained in Section 3.2 Base Year Energy Use Model Development, the reference case begins with the base year values and forecasts natural gas use based on exogenous conditions that follow a "business-as-usual" scenario. The reference case for the CPR is intended to represent the baseline from which calculation of new potential can be calculated. It considers current energy consumption patterns and known future changes, including expected customer growth, current and known future changes to codes and standards, and natural replacement of equipment at end of life. The reference case does not account for potential changes in fuel share or end use saturations, except those that would occur incidentally because of different rates of new construction for different types of buildings or in the different regions.

The reference case starts with actual 2019 consumption, which includes all DSM activity up to that point. The subsequent years of the reference case incorporate natural conservation, such as the natural turnover of furnaces and other appliances. It does not include conservation from DSM activities carried out after 2019.

Exhibit 5 – Reference Case Development Steps for All Sectors

Step	Description
1	Compile and analyze available data on FortisBC's new building stock by segment and gather forward-looking estimates of demolition rates.
2	Develop detailed technical descriptions of the new building stock at the subsector, end use, and equipment level.
3	Compile data on forecast levels of construction, demolition and natural (non-utility-influenced) efficiency within the existing and new (post 2020) buildings stock.
4	Create sector model inputs and generate gas use forecasts by adding accounts to match forecast construction levels in cooperation with FortisBC Load Forecasting staff.

The results of the reference case energy consumption forecasts are presented in Section 4.3 (residential), Section 5.3 (commercial), and Section 6.3 (industrial).

3.4 Measure Characterization

In this CPR activity, energy conservation measures were selected and analyzed. The team started with developing a list of measures to consider, then finalized this list in collaboration with FortisBC and external stakeholders. For each measure, the team collected and reviewed information on energy savings, costs, useful life, and the baseline equipment or technology that it should be compared with (if applicable). This data was used to characterize the technology's energy savings potential, cost-effectiveness, and financial attractiveness to the utility and the end user.

3.4.1 Development of Measures List

Under this task, the study team reviewed existing energy efficiency measure analysis and program assumptions, assessed gaps and developed a measure list for input by FortisBC staff.

The team started by reviewing the 2015 CPR measure analysis, existing FortisBC Conservation and Energy Management (C&EM) program assumptions, and publicly available resources, especially Technical Resource Manuals (TRMs) from other utilities. Previous measure analysis and prefeasibility studies completed by FortisBC were also reviewed.

Measures range from mature and widely known to innovative or enabling technologies. Several behavioural measures (e.g. thermostat setback) are included as well. The team also developed "mature market" versions of several innovative technologies, such as gas heat pumps. These mature market measures assumed that within two to five years, various measures that are currently at an early stage of market entry would have lower costs, improved energy performance, or both. This approach allowed the study team to include these measures in subsequent analysis at a point after the first forecast year (2020) consistent with best estimates of market entry.

The study team solicited feedback on the measures list from both FortisBC as well as external stakeholders, the CPR Technical Advisory Committee (TAC). Ultimately, more than 180 measures were shortlisted for inclusion in this CPR: 70 in residential, 72 in commercial, and 40 in industrial. For comparison, the 2015 CPR included 97 measures: 45 residential, 36 commercial, and 16 industrial.

3.4.2 Energy Performance and Costs of Selected Measures

Under this task, the study team collected and reviewed information on each selected measure's energy savings, costs, useful life, and other relevant information. The analysis used several types of data sources to gather and establish this information: FortisBC's TRMs, previous FortisBC measure analysis (e.g. 2015 CPR, pre-feasibility studies), TRMs and literature from other jurisdictions, as well as the study team's own technical analysis and building modelling.

Using a typical FortisBC TRM template as guidance, the team developed one Excel-based measure analysis workbook per sector in which all measure data was recorded. The intent of these workbooks was to have each measure's metrics and assumptions easily reviewable, referenceable, and reusable by the FortisBC team. Exhibit 6 shows an example of a measure from the workbook.

Measures were characterized in a way that was consistent with FortisBC's measure TRM templates:

- Type of replacement (Retrofit or Replace on Burnout)
- Cost basis on which the measure should be evaluated – full or incremental
- Energy performance metrics and savings (% against end use and absolute)
- Technical applicability to various segments and / or vintages

- Cost of Conserved Energy (CCE) and simple payback metrics
- Cost-effectiveness on TRC and MTRC scales
- Ability to enter previous program results and customer enrollment (participation) rates, specific regional and segment subtleties

Exhibit 6 – CPR Measure Characterization Workbook Example: Residential Communicating Thermostat

MEASURE SUMMARY						**NOTES**	**DATA SOURCES**
Measure Description	Installation of a communicating (also often referred to as "smart," advanced, wi-fi or connected) thermostat to replace a manually operated or conventional programmable thermostat. Thermostat must be on the ENERGY STAR® list of Smart Thermostats and be able to: - Work as a basic thermostat in absence of connectivity to the service provider. - Give residents some form of feedback about the energy consequences of their settings. - Provide information about HVAC energy use, such as monthly run time. - Provide the ability to set a schedule. - Provide the ability to work with utility programs to prevent brownouts and blackouts, while preserving consumers' ability to override those grid requests.						
Measure Type	Controls						
Baseline Condition Description	The baseline condition is an assumed mix of manual and programmable thermostats.						
Calculation Method Description	Space heating and cooling savings estimated based on review of MN and Mid-Atlantic TRMs assumptions for ENERGY STAR® qualifying communicating thermostats. Also reviewed FortisBC's SLT pilot study results. See general notes and sources section below for additional details.						
Measure Applicability	Applies to existsing homes where a manual or programmable thermostat previously existed.						
APPLICABILITY							
Affected Natural Gas End-Uses	Space Heating					You can select up to 2 end-uses affected by this measure. Leave second one blank if not	
Affected Electricity End-Uses	Space Cooling					You can select up to 2 end-uses affected by this measure. Leave second one blank if not	
Applicable Codes / Standards	n/a						
Meets DSM Definition	Yes						
Meets Tech Innovation Definition	Yes						
Applicable Years	**First:**	2020	**Last:**	2040			
MODEL INPUT ASSUMPTIONS							
Measure Specifications	**Base Case**		**Upgrade Case**		**Notes**		**Data Sources**
Effective Useful Life (years)	12		12		FortisBC's EUL estimate is high compared to other TRMs (e.g., Mid-Atlantic TRM states 7.5 years, MN TRM states 10 years). 12 years is still in a reasonable range, so did not change it.		1, 6, 7
RESULTS (SPECIFIC TO A GIVEN REGION, SEGMENT AND VINTAGE)							
Region	Whistler				Segment Sheet Row #	Change the selections in light blue to see the results specific to a region, segment and vintage.	
Segment	SFD/Duplex				82		
Vintage	Post-2015				Comm T-Stat - Segment		
Costs	**Base Case**	**Upgrade**	**Increme**	**Units**		**Notes**	**Data Sources**
Capital	$ -	$ 250	$ 250	per thermostat		FortisBC's estimate of $250 per connected thermostat seems reasonable compared to costs listed in other TRMs.	1, 6, 7
Installation	$ -	$ -	$ -	per thermostat			
O&M	$ -	$ -	$ -	per thermostat			
Energy Savings (%)	**Space Heating**					**Notes**	**Data Sources**
Natural Gas (%)	6%					Estimating 6% savings based on MN and Mid-Atlantic TRMs.	1,7
	Space Cooling						
Electricity (%)	8%					Estimating 8% savings based on MN and Mid-Atlantic TRMs.	1,7
Energy Use (Absolute)	**Base Case**	**Upgrade**	**Saving**	**Units**			
Natural Gas	51.9	48.8	3.1	GJ /year			
Electricity	515.3	474.1	41.2	kWh /year			
Water	-	-	-	m3 /year			
Financial Metrics					**Units**		
Simple Payback				8.86	years		
NPV of Avoided Utility Costs (TRC)				244.94	$ / yr		
NPV of Avoided Utility Costs (mTRC)				897.46	$ / yr		
Cost of Conserved Energy (CCE)				6.69	$ / GJ		
Cost Effectiveness					**Units**		
Measure TRC				1.0	total		
Measure mTRC				4.1	total		

The final measures and their information can be found in Section 4.4 (residential), Section 5.4 (commercial), and Section 6.4 (industrial).

3.5 Technical Potential Forecast Development

The technical potential forecast includes the installation of all conservation measures that are technically feasible. This exercise is hypothetical in nature and is used to provide the team with a starting point on which to develop the economic and market potential. Refer to Exhibit 2 for an overview of the differences between the potential scenarios.

Technical potential estimates ignore all non-engineering and financial constraints, such as cost-effectiveness and the willingness of end users to adopt measures. This is done to estimate the theoretical maximum amount of energy use that could be captured by energy efficiency measures. In this study, the following assumptions were made:

- Retrofit (RET) measures that are technically feasible are applied immediately (that is, in the first year of CPR study period, 2020).
- Replace on burnout (ROB) measures that are technically feasible are implemented at the rate of failure of the underlying baseline equipment, to better match in-market replacement rates. However, there are ROB measures that have “Early Replacement” versions (e.g. early replacement of a commercial boiler) that are treated the same way as RET measures.
- New construction measures that are technically feasible are implemented immediately as new buildings are added to the stock each year.

Development of the technical potential involved the following steps:

- Select the measures to be included from the Measure Analysis Workbook.
- Determine each measure’s technical applicability (i.e. what portion of buildings can a measure be applied to considering only technical constraints) and current market penetration (i.e. what portion of buildings have already installed a measure).

  This information is gathered from various data sources and literature review, including FortisBC’s Residential End-Use Survey (REUS), Commercial End-Use Survey (CEUS), and industrial datasets. The percentage of technically applicable customers that have already adopted a measure are excluded from the technical potential.
- Estimate reference adoption – the natural rate of adoption of a measure. For example, if 2% of the technically eligible customers are expected to implement a measure each year without any utility intervention, reference adoption is 2%. These customers are excluded from the technical potential.
- Apply measure information to the model. For each measure, the following inputs are required: measure’s description, the baseline equipment it affects, incremental or full costs, energy savings information, the total proportion of accounts or dwellings under different segments and vintages that the measure is applicable to, and the pre-retrofit and post-retrofit energy consumption.
- Determine the order that measures should be applied against the baseline energy end-use, and whether these measures are applied in series (in which case measure impacts

“cascade”) or in parallel (in which case measure impacts are directly additive). This is an important feature of Posterity Group’s modelling software that serves two purposes:

  - It avoids overestimation and double counting of savings in instances where measures are not additive. For example, assume there is a reference-case house that uses 100 GJ of natural gas for the space heating end use. An air sealing measure is applied to this house, and it is expected to save 20% of space heating energy. A communicating thermostat can also be installed – it is expected to save 5% of total remaining space heating natural gas use.
  - If both measures are applied to the same house, the air sealing measure would reduce the overall heating load, reducing the absolute potential savings for the thermostat. In other words, the thermostat saves 5% of 80 GJ (post-air-sealing consumption), not 5% of 100 GJ. Total natural gas savings in this example are 20 GJ + 4 GJ = 24 GJ.
  - It avoids applying two mutually exclusive technologies to the same building. For example, a typical single-family house can be upgraded to a new high-efficiency furnace, or a new high-efficiency boiler, but almost never both. Additionally, there are many upgrade measures that apply to the same end use and baseline equipment. The model’s cascade feature ensures that only one appropriate upgrade measure is applied to an eligible account or building.

- Run the model to calculate technical potential – this includes savings from all retrofit measures that can be immediately applied, savings from replace-on-burnout measure at their natural rate of replacement, and savings from new construction measures.

The results of the technical potential forecasts can be found in Section 4.5 (residential), Section 5.5 (commercial), and Section 6.5 (industrial).

3.6 Economic Potential Forecast Development

Economic potential is the subset of technical potential that is financially cost-effective. Cost-effectiveness is determined by screening each measure with the benefit/cost ratio test required by the utility's regulatory authorities. Economic potential considers the cost of the efficiency measures themselves, ignoring market constraints and programmatic barriers. Using economic screening, measures that have a benefit/cost ratio of greater than 1.0 under either the Total Resource Cost Test (TRC) or modified TRC (MTRC) "pass" the screening test and are included in the economic potential. Measures that score below 1.0 are not considered cost-effective and are excluded from future analysis.

Retrofit (RET) measures are evaluated on the basis of their full costs including capital, labor and maintenance costs. This is because the baseline for a retrofit measure is typically "do-nothing": the customer has the option to not install the measure, in which case they would not incur any costs.

Replace on burnout (ROB) measures are evaluated on the basis of their incremental costs – the cost difference between the high-efficiency measure versus the baseline, less-efficient option. This is because the baseline for a replace on burnout measure is typically "do something" because the underlying base equipment has reached the end of its useful life.

New construction measures were also evaluated based on their incremental costs.

Two economic models were developed for each sector – one with TRC as the economic screen and one with MTRC.

Development of the economic potential scenarios involved:

- Determining how measures should be assessed based on their replacement type: retrofit (immediate replacement at full cost), replace on burnout (end of life replacement at incremental cost), or new construction (immediate installation at incremental cost).
- Running the technical potential model using the TRC economic screen – this produces the subset of measures that are cost-effective in terms of TRC (i.e. they have a TRC benefit/cost ratio 1.0 or higher).
- Rerunning the technical potential model using the MTRC economic screen – this produces the subset of measures that are cost-effective in terms of MTRC (i.e. they have an MTRC benefit/cost ratio of 1.0 or higher).

The results of the economic potential forecasts are presented in Section 4.6 (residential), Section 5.6 (commercial), and Section 6.6 (industrial).

3.7 Market Potential Forecast Development

Market potential refers to the subset of the economic potential that is likely to be realized based on expected customer uptake. To be included in the market potential forecasts, customers must have the knowledge of various measures that are economically attractive to the utility and must have the willingness and means to adopt them.

The Low, Medium, and High market potential scenarios in this CPR estimate how customers' adoption rates would change as the simple customer payback varies based on varying incentive levels.

For this study, the market potential forecast was developed in two phases: first a Simplified Market Potential was developed using standard relationships between measure awareness, customer payback and measure uptake. Next, that simplified model was refined based on input from FortisBC staff, local market experts and other external stakeholders to develop a FortisBC-specific Market Potential.

Development of the market potential involved the following steps:

- Develop Simplified Market Potential.
  - At the measure level, this potential estimate was based on standard curves estimating the relationship between measure awareness, measure payback, and measure uptake consistent with the approach taken in the 2015 CPR.
  - Analysis included the development of a library of payback-acceptance and market diffusion curves, and their application to each measure based on attributes such as capital cost and reference market penetration.
  - These curves were then applied at three incentive levels: 25% 50%, and 100% of incremental cost to develop generic measure participation rates at the three spending levels.
- Market Potential Consultation and Workshops.

  This step consisted of two workshops for each sector:
  - Three sector-specific workshops engaging FortisBC Conservation & Energy Management program personnel, discussing and gathering input on the Simplified Market Potential participation rates based on prior program experience and known barriers and factors promoting uptake.
  - Three subsequent workshops attended by both FortisBC staff and members of Fortis BC's CPR Technical Advisory Committee[24] aimed at gathering external input on the Simplified Market Potential participation rates based on local market knowledge and capacity.

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24 The Technical Advisory Group was made up of various external stakeholders including industry professionals, environmental nongovernmental organization representatives, and municipal/provincial government staff, and industry organization representatives.

- Develop Market Potential.
    - Based on the results of these consultations, updated measure uptake assumptions were developed and re-run through the model. This produced a Market Potential, meant to be the "expected" outcome from DSM programs at a typical incentive level (50% of incremental cost) and a sensitivity analysis at 25% and 100% of incremental cost.
    - The Low, Medium, and High market potential scenarios in this report assume that measure incentive levels will be 25%, 50% and 100% of incremental costs, respectively. For example, assume that a high-efficiency furnace may cost $200 more than a standard furnace, meaning the furnace would have an incremental cost of $200. In the medium scenario, this measure's hypothetical incentive from FortisBC would be $100. The other $100 would be paid by the end user.
    - In all scenarios, the non-incentive program costs are assumed to be 15% of the incentive cost.[25] In the example above, FortisBC's non-incentive spending would be $15. FortisBC's total cost for providing the measure to an end user would be $115.

25 Non-incentive program costs include activities such as program administration, communications, and research & evaluation. These costs have been estimated at 15%, a figure that is consistent with typical industry practice and the assumptions included in the 2017 CPR. Actual non-incentive program costs are dependent on several factors including program design, administrative structure, and evaluation requirements. For the purposes of this analysis, non-incentive spending that is not associated with specific measures or programs (including conservation education and outreach, and portfolio-level enabling activities) are not considered.

4 Residential Sector Results

This section presents the residential sector results and key findings, including:

- Base year (2019) natural gas use
- Reference case consumption forecast (2020-2040)
- Energy conservation measures evaluated in this CPR
- Technical potential savings
- Economic potential savings
- Market potential savings and scenarios

4.1 Residential Segments, End Uses, Vintages

The residential sector is divided into three segments, seven major energy end uses, and eight housing vintages. The residential domestic hot water (DHW) end use is subdivided into four as shown in Exhibit 7.

Exhibit 7 – Residential Sector Segments, End Uses, and Vintages

	Segments (3)	End Uses[26] (7)	Vintages[27] (8)

Residential Sector	• Single Family Detached/Duplexes
	• Single Family Attached/Row
	• Mobile/Other Residential
		• Clothes dryer
		• Cooking
		• Domestic hot water[28]
		  ○ Dishwasher DHW
		  ○ Washer DHW
		  ○ Shower DHW
		  ○ Other DHW
		• Fireplace
		• Other gas uses (outdoor fireplaces, patio heaters)
		• Pool & spa heaters
		• Space heating
			• Pre-1950
			• 1950-1975
			• 1976-1985
			• 1986-1995
			• 1996-2005
			• 2006-2015
			• Post-2015 (Existing)
			• New

26 All-electric end uses, such as clothes washer, lighting or plug loads, are not included in the reported results therefore are excluded from the end uses row of this table.
27 The residential sector has vintages to define time periods when residential dwellings are built. Existence Categories also apply to the residential vintages, as there is conversion of existing dwellings into new homes (i.e., renovations). 'New' residential dwellings do not appear until the first year of the reference case.
28 The DHW end use has been broken out into sub-end uses to facilitate CPR measure analysis. DHW can be reported at the end use or sub-end use level in the CPR.

4.2 Base Year Natural Gas Use

This section profiles the base year (2019) natural gas consumption for the residential sector. The following exhibits summarize how natural gas is used in the residential sector by segment, end use, vintage, and region, respectively.

Natural gas consumption in the residential sector base year is highest:

- In single-family detached (SFD)/duplex segment (~90% of consumption)
- For space heating end use (~62%)
- In the Lower Mainland excluding Vancouver region (~55%)
- In homes built between 1950 and 1975 (26%)

Exhibit 8 – Residential Natural Gas Consumption (GJ) in 2019 by Segment

Segment	Natural Gas Consumption (GJ)	% of Total
SFD/Duplex	69,593,368	90.3%
Attached/Row	5,609,684	7.3%
Mobile/other	1,888,575	2.4%
Total	**77,091,627**	**100.0%**

Exhibit 9 – Residential Natural Gas Consumption (GJ) in 2019 by End Use

Parent End Use	Natural Gas Consumption (GJ)	% of Total
Space Heating	48,159,206	62.5%
Domestic Hot Water (DHW)	13,800,150	17.9%
Fireplace	11,367,123	14.7%
Other Gas Uses	1,779,960	2.3%
Cooking	1,252,716	1.6%
Pool & Spa Heaters	509,960	0.7%
Clothes Dryer	222,511	0.3%
Total	**77,091,627**	**100.0%**

Exhibit 10 – Residential Natural Gas Consumption (GJ) in 2019 by Region[29]

Region	Natural Gas Consumption (GJ)	% of Total
Lower Mainland x Van	42,239,373	54.8%
Southern Interior	14,848,987	19.3%
City of Vancouver	9,339,690	12.1%
Vancouver Island	5,832,901	7.6%
Northern BC	4,564,223	5.9%
Whistler	266,452	0.3%
Total	**77,091,627**	**100.0%**

Exhibit 11 – Residential Natural Gas Consumption (GJ) in 2019 by Vintage [30]

Segment Vintage	Natural Gas Consumption (GJ)	% of Total
1950-1975	19,633,614	26.1%
1986-1995	12,634,000	16.8%
1976-1985	10,907,142	14.5%
1996-2005	10,070,375	13.4%
Pre-1950	9,196,994	12.2%
2006-2015	7,805,930	10.4%
Post-2015	4,954,997	6.6%

29 Recall that the 2019 actuals from FEI were based on FEI's billing system premise city and mapped by PG into the regions included in the study coverage.
30 "Mobile" has been excluded from the vintage results in this report; "mobile/other" appears in the segment results. The sample sizes for mobile dwellings in the REUS were too small to reliably divide the segment into vintages.

4.2.1 Accounts

Base year residential natural gas accounts are presented in Exhibit 12 by segment, region, and vintage. As shown in the table, the largest number of residential accounts in 2019 were:

- SFD / duplex type homes (806k out of 933k total)
- In Lower Mainland x Vancouver region (463k out of 933k total)
- Homes built between 1950 and 1975 (210k out of 933k total)

Exhibit 12 – Number of Residential Dwellings in 2019

Segment	City of Vancouver	Lower Mainland x Van	Northern BC	Southern Interior	Vancouver Island	Whistler	Total
SFD/Duplex	**80,641**	**395,571**	**40,486**	**180,309**	**106,270**	**2,527**	**805,804**
1950-1975	20,353	99,839	10,219	45,509	26,822	639	**203,381**
1986-1995	13,310	65,294	6,683	29,763	17,541	417	**133,008**
1976-1985	11,779	57,782	5,913	26,337	15,523	369	**117,703**
1996-2005	11,132	54,606	5,589	24,890	14,670	349	**111,236**
2006-2015	9,490	46,551	4,764	21,219	12,506	297	**94,827**
Pre-1950	8,780	43,065	4,408	19,630	11,569	275	**87,727**
Post-2015	5,797	28,434	2,910	12,961	7,639	181	**57,922**
Attached/Row	**11,638**	**57,086**	**2,949**	**10,017**	**8,677**	**140**	**90,507**
1986-1995	3,197	15,682	810	2,751	2,384	38	**24,862**
1996-2005	2,736	13,425	694	2,356	2,041	32	**21,284**
Post-2015	1,902	9,329	482	1,637	1,418	23	**14,791**
2006-2015	1,599	7,841	405	1,376	1,191	20	**12,432**
1976-1985	1,236	6,058	313	1,063	921	15	**9,606**
1950-1975	823	4,039	208	709	614	10	**6,403**
Pre-1950	145	712	37	125	108	2	**1,129**
Mobile/other	**2,024**	**9,928**	**8,459**	**12,764**	**2,706**	**179**	**36,060**
All	2,024	9,928	8,459	12,764	2,706	179	**36,060**
Total	**94,303**	**462,585**	**51,894**	**203,090**	**117,653**	**2,846**	**932,371**

4.2.2 Tertiary Load

Tertiary load is the useful energy delivered to an end use, or end use energy requirement: heat delivered by a furnace to a house, for example. This differs from natural gas consumption which is impacted by equipment efficiency: in the furnace example, consumption is equal to the tertiary load divided by seasonal efficiency of the furnace.

4.2.3 Unit Energy Consumption

As explained in Exhibit 3, unit energy consumption (UEC) is the end-use energy per unit (a “unit” in the residential sector is a dwelling). Fuel share is the percentage of the energy end use that is supplied by each fuel.

This section presents UEC by end use for dwellings that have gas as the predominant heating fuel and dwellings that have fuels other than gas as the predominant heating fuel[31] (referred to as “gas-heated” and “non-gas-heated” dwellings for simplicity). Tertiary loads for gas-heated and non-gas-heated dwellings are modelled identically for all end uses, except for space heating. Based on market research, non-gas-heated dwellings in FortisBC’s service territory have been shown to have slightly lower space heating loads, meaning that they are somewhat smaller, better insulated, heated to a lower temperature, or some combination of these three.

This section also presents *stock average efficiency*, the average efficiency of equipment serving the tertiary load for that end use. UEC by end use is calculated by dividing unit tertiary load with stock average efficiency.

Exhibit 13 presents the 2019 modelled values for unit tertiary load, stock average efficiency and UEC values for all end uses (DHW sub-end uses are shown separately in Exhibit 14) for gas-heated and non-gas-heated SFD dwellings in the Lower Mainland excluding Vancouver region.

Exhibit 13 – 2019 Modelled UEC Values by End Use, Gas and Non-Gas-Heated SFD/Duplex Dwellings in the Lower Mainland

	Unit Tertiary Load (GJ/Dwelling/Yr.)	Stock Average Efficiency (%)[32]	UEC
Predominantly Gas-Heated Dwellings			
Clothes Dryer	3.9	86%	4.6
Cooking	2.9	51%	5.7
Fireplace	7.3	50%	14.5
Other Gas Uses	2.3	100%	2.3
Pool & Spa Heaters	23.7	86%	27.7

31 “Predominant heating fuel” represents if a building primarily uses gas for heat (>50% of the fuel share for space heating is from gas) or other fuels (>50% of fuel share for space heating is from fuels other than gas). In this report, we refer to this as ‘gas-heated’ and ‘non-gas-heated’ dwellings to simplify the text. Note that gas-heated dwellings can have other fuels supplying space heating, but gas is at least 50% of the fuel share.
32 Average stock efficiencies are only used to calculate tertiary load and are not used in the measure savings calculations or elsewhere in the modelling.

	Unit Tertiary Load (GJ/Dwelling/Yr.)	Stock Average Efficiency (%)[32]	UEC
Space Heating	59.1	85%	69.4
Domestic Hot Water	12.0	62%	19.5
Predominantly Non-Gas-Heated Dwellings			
Clothes Dryer	3.9	86%	4.6
Cooking	2.9	51%	5.7
Fireplace	7.3	50%	14.5
Other Gas Uses	2.3	100%	2.3
Pool & Spa Heaters	23.7	86%	27.7
Space Heating	55.8	85%	65.5
Domestic Hot Water	12.0	62%	19.5

Exhibit 14 presents the 2019 modelled values for unit tertiary load, stock average efficiency, and UEC values for the DHW sub-end uses. As DHW gas consumption does not vary by the predominant heating fuel in the dwelling, the table does not differentiate by gas versus non-gas-heated dwellings. The values are specific to the SFD/Duplex segment in the Lower Mainland excluding Vancouver ("LML") region.

Exhibit 14 – 2019 Modelled UEC Values for DHW Sub-End Uses, SFD/Duplex Dwellings in the LML

	Unit Tertiary Load (GJ/Dwelling/Yr.)	Stock Average Efficiency (%)	UEC
Other DHW	2.3	62%	3.7
Dishwasher DHW	1.4	62%	2.3
Shower DHW	6.5	62%	10.5
Washer DHW	1.8	62%	2.9

4.2.4 Average Natural Gas Use per Dwelling

The following exhibits present average annual natural gas consumption per account by end use. Included in the exhibits are:

- UEC: the amount of energy used by each end use per unit (the "unit" in the residential sector is typically a dwelling, with some minor exceptions described below).
- Fuel Share: the percentage of the energy end use that is supplied by each fuel (in this case, natural gas).
- Saturation: For most end uses, saturation reflects the extent to which an end use is present in a region, and segment. In the residential sector, cooking, space heating, DHW, and 'other gas uses' have a saturation of 100% as these end uses are assumed to be present in all residential dwellings.

  Three end uses – clothes dryers, fireplaces, and pool & spa heaters – are not present in every residential dwelling. In these cases, saturation is used to show the average number of appliances per dwelling supplying those end uses, and the "unit" referred to in the UEC is one equipment unit: a fireplace for example. In the exhibits below, saturation for these three end uses is not 100%: greater than 100% means that the average residential dwelling has more than one appliance related to that end use (e.g., fireplaces) and less than 100% means that the average residential dwelling has less than one (therefore no) appliances related to that end use (e.g., pool & spa heaters).

Average annual gas consumption per unit is calculated by multiplying these three variables together; therefore, they are included in the exhibits below.

Exhibit 15 presents the modelled average annual gas use per residential dwelling by end use (DHW sub-end uses are presented separately in Exhibit 16) for gas and non-gas-heated dwellings, respectively. Note that these values are specific to the SFD/Duplex segment and the Lower Mainland excluding Vancouver ("LML") region.[33]

Exhibit 15 – 2019 Modelled Average Annual Gas Use Per Dwelling by End Use, Gas and Non-Gas SFD/Duplex Heated Dwellings in the Lower Mainland

	UEC	Fuel Share	Saturation	Average Annual Gas Use (GJ/yr.)
Predominantly Gas-Heated Dwellings				
Clothes Dryer	4.6	6%	104%	0.3
Cooking	5.7	29%	100%	1.6
DHW	19.5	87%	100%	17.0
Fireplace	14.5	95%	110%	15.1
Other Gas Uses	2.3	100%	100%	2.3
Pool & Spa Heaters	27.7	26%	9%	0.7
Space Heating	69.4	93%	99%	63.8
Total Annual Consumption for an Average Residential Customer in LML				**100.8**
Predominantly Non-Gas-Heated Dwellings				
Clothes Dryer	4.6	7%	104%	0.4
Cooking	5.7	35%	100%	2.0
DHW	19.5	58%	99%	11.2
Fireplace	14.5	96%	121%	17.0
Other Gas Uses	2.3	100%	100%	2.3
Pool & Spa Heaters	27.7	10%	9%	0.2
Space Heating	65.5	17%	95%	10.8
Total Annual Consumption for an Average Residential Customer in LML				**43.9**

33 Note that the average annual natural gas use for all residential customers within FortisBC's service territory is approximately 90 GJ per year.

Exhibit 16 presents the modelled average annual gas use per residential dwelling by DHW sub-end use for gas and non-gas-heated dwelling, respectively. Note that these values are specific to the SFD/Duplex segment and the Lower Mainland excluding Vancouver region.

Exhibit 16 – 2019 Modelled Average Annual Gas Use Per SFD/Duplex Dwellings in the LML by DHW Sub-End Uses and Predominant Heating Fuel

	UEC	Gas Fuel Share	Saturation	Average Annual Gas Use (GJ/dwelling/yr.)
Predominantly Gas-Heated Dwellings				
Other DHW	3.7	87%	100%	3.3
Dishwasher DHW	2.3	87%	100%	2.1
Shower DHW	10.5	87%	100%	9.2
Washer DHW	2.9	87%	100%	2.5
Predominantly Non-Gas-Heated Dwellings				
Other DHW	3.7	58%	100%	2.2
Dishwasher DHW	2.3	58%	100%	1.4
Shower DHW	10.5	58%	100%	6.0
Washer DHW	2.9	58%	100%	1.7

4.3 Reference Case Natural Gas Use

This section profiles the reference case forecast (2020-2040) natural gas consumption for the residential sector.

Overall gas consumption is forecasted to decline by approximately 5% by 2040 (as shown in Exhibit 19) compared to 2020 consumption, with an average annual decrease of about 0.25%. While the forecast shows an increase in the number of residential accounts (as seen in Exhibit 18), the growth in accounts is less than the decrease in usage per account, so the net result is that consumption declines.

Exhibit 17 – 2020 vs 2040 Residential Gas Consumption (GJ) by Segment

Segment	2020	2040	Change
SFD/Duplex	69,263K	65,033K	-6%
Attached/Row	5,646K	6,046K	7%
Mobile/other	1,891K	1,927K	2%
Total	**76,801K**	**73,006K**	**-5%**

Exhibit 18 – Number of Residential Accounts, 2019 vs 2040, by Region, Segment, and Vintage

Region	City of Vancouver		Lower Mainland x Van		Northern BC		Southern Interior		Vancouver Island		Whistler		Total	
Segment	**2019**	**2040**	**2019**	**2040**	**2019**	**2040**	**2019**	**2040**	**2019**	**2040**	**2019**	**2040**	**2019**	**2040**
SFD/Duplex	**80,641**	**84,969**	**395,571**	**413,166**	**40,486**	**44,763**	**180,309**	**200,305**	**106,270**	**146,349**	**2,527**	**3,274**	**805,804**	**892,826**
1950-1975	20,353	13,358	99,839	65,502	10,219	6,788	45,509	30,366	26,822	21,015	639	445	**203,381**	**137,474**
1986-1995	13,310	8,736	65,294	42,838	6,683	4,439	29,763	19,859	17,541	13,743	417	290	**133,008**	**89,905**
1976-1985	11,779	7,731	57,782	37,910	5,913	3,927	26,337	17,574	15,523	12,163	369	257	**117,703**	**79,562**
1996-2005	11,132	7,306	54,606	35,826	5,589	3,713	24,890	16,608	14,670	11,494	349	243	**111,236**	**75,190**
2006-2015	9,490	6,229	46,551	30,541	4,764	3,164	21,219	14,159	12,506	9,799	297	207	**94,827**	**64,099**
Pre-1950	8,780	5,762	43,065	28,254	4,408	2,928	19,630	13,099	11,569	9,064	275	192	**87,727**	**59,299**
Post-2015	5,797	35,847	28,434	172,295	2,910	19,804	12,961	88,640	7,639	69,071	181	1,640	**57,922**	**387,297**
Attached/Row	**11,638**	**13,214**	**57,086**	**68,550**	**2,949**	**3,668**	**10,017**	**13,414**	**8,677**	**13,914**	**140**	**464**	**90,507**	**113,224**
1986-1995	3,197	2,098	15,682	10,289	810	538	2,751	1,836	2,384	1,868	38	26	**24,862**	**16,655**
1996-2005	2,736	1,796	13,425	8,807	694	461	2,356	1,573	2,041	1,599	32	23	**21,284**	**14,259**
Post-2015	1,902	6,824	9,329	37,219	482	2,029	1,637	7,822	1,418	8,226	23	383	**14,791**	**62,503**
2006-2015	1,599	1,049	7,841	5,144	405	269	1,376	918	1,191	933	20	14	**12,432**	**8,327**
1976-1985	1,236	811	6,058	3,974	313	208	1,063	709	921	722	15	10	**9,606**	**6,434**
1950-1975	823	541	4,039	2,650	208	138	709	473	614	481	10	7	**6,403**	**4,290**
Pre-1950	145	95	712	467	37	25	125	83	108	85	2	1	**1,129**	**756**
Mobile/other	**2,024**	**2,153**	**9,928**	**10,564**	**8,459**	**9,432**	**12,764**	**14,332**	**2,706**	**3,773**	**179**	**251**	**36,060**	**40,505**
All	2,024	2,153	9,928	10,564	8,459	9,432	12,764	14,332	2,706	3,773	179	251	**36,060**	**40,505**
Total	**94,303**	**100,336**	**462,585**	**492,280**	**51,894**	**57,863**	**203,090**	**228,051**	**117,653**	**164,036**	**2,846**	**3,989**	**932,371**	**1,046,555**

The following exhibits present how natural gas is forecasted to be used from 2020 to 2040 by segment, end use, and region, respectively. (Section 4.3.1 focuses on consumption from existing and new dwellings over the reference case). These exhibits illustrate forecasted trends in consumption over the reference case, including:

- Many consumption patterns evident in the base year are expected to persist throughout the reference case: natural gas is predominately used in the SFD/Duplex segment, in the Lower Mainland excluding Vancouver region, and for space heating throughout the study period.
- In 2020, post-2015 residential dwellings are forecasted to account for approximately 9% of consumption. By 2040, this vintage is projected to use about 38% of consumption.

Exhibit 19 – 2020 vs 2040 Residential Gas Consumption (GJ) by End Use

Parent End Use	2020	2040	Change
Space Heating	47,864K	43,877K	-8%
Domestic Hot Water (DHW)	13,680K	12,445K	-9%
Fireplace	11,407K	11,710K	3%
Other Gas Uses	1,844K	2,728K	48%
Cooking	1,268K	1,453K	15%
Pool & Spa Heaters	514K	556K	8%
Clothes Dryer	224K	238K	6%
Total	**76,801K**	**73,006K**	**-5%**

Exhibit 20 – 2020 vs 2040 Residential Gas Consumption (GJ) by Region

Region	2020	2040	Change
Lower Mainland x Van	41,954K	38,521K	-8%
Southern Interior	14,828K	14,406K	-3%
City of Vancouver	9,275K	8,502K	-8%
Vancouver Island	5,915K	6,830K	15%
Northern BC	4,557K	4,425K	-3%
Whistler	271K	322K	19%
Total	**76,801K**	**73,006K**	**-5%**

4.3.1 Reference Case Natural Gas Use: Existing versus New Residential Dwellings

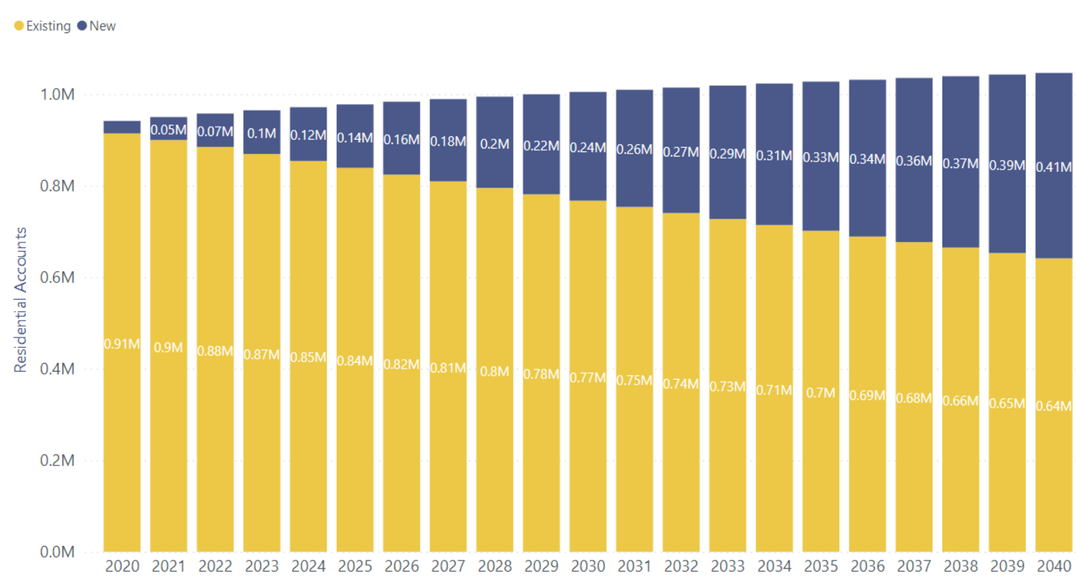
Exhibit 21 illustrates the expected increase in consumption from new residential dwellings over the reference case, from 2% in 2020 to approximately 33% in 2040, compared to existing dwellings.

Exhibit 21 – 2020-2040 Gas Consumption (GJ) by New and Existing and Segment

Existing/New	2020	2040	Change
Existing	**75,137K**	**48,621K**	**-35%**
SFD/Duplex	67,800K	43,427K	-36%
Attached/Row	5,462K	3,456K	-37%
Mobile/other	1,875K	1,737K	-7%
New	**1,664K**	**24,385K**	**1365%**
SFD/Duplex	1,464K	21,605K	1376%
Attached/Row	184K	2,590K	1305%
Mobile/other	16K	190K	1078%
Total	**76,801K**	**73,006K**	**-5%**

Despite the reference case showing a 5% decrease in residential sector gas use from 2020 to 2040, residential accounts are expected to grow by approximately 11% from 2020 to 2040, from 932,000 to 1,047,000. The portion of FEI accounts from new residential dwellings is forecasted to increase over the reference case from 3% in 2020 to almost 40% in 2040, with new construction contributing approximately 400,000 new accounts, and approximately 290,000 existing dwellings being demolished over the reference case period. This represents 30% of the existing dwellings being demolished between 2020 and 2040, a demolition rate of approximately 2% per year. Slightly countering this trend is the inclusion of some conversion customers, which are existing homes to which gas service is extended sometime after their construction. In most regions, conversion customers are a small fraction of new connections.

Exhibit 22 – 2020 vs 2040 Residential Gas Accounts Forecast by Existing and New Vintage



4.4 Measure Assessment

4.4.1 List of Measures

The list of residential measures that were included in this CPR are presented in Exhibit 23. The measures are divided into categories by end use and measure type.

Please see the MS Excel file entitled “Res_Measure Analysis Workbook” for a description of each measure and a full analysis.

Measures were classified in five measure type categories:

- Building Envelope (also referred to as “envelope measures”)
- Equipment
- Controls
- Energy Management (including behavioral measures)
- New Construction – all new construction measures were placed in a separate category

New construction measures are analyzed using a whole-building approach, represented by the Step 3 - Step 5 BC Energy Step Code measures listed below. See Appendix M of the CPR method for the modelling approach used to assess residential Step Code measures.

Exhibit 23 – Residential Sector Conservation and Energy Management Measures

Space Heating – Building Envelope	Water Heating – Equipment
Attic Duct Insulation Attic Insulation Basement or Crawlspace Insulation Comprehensive Air Sealing Comprehensive Draft Proofing Exposed Floor Insulation High Performance Windows and Doors Manufactured Homes Duct Sealing Manufactured Homes Floor Insulation Wall Insulation	Connected Water Heater Controller Drain Water Heat Recovery Faucet Aerator Gas Heat Pump – Domestic Hot Water High-Efficiency Condensing Gas Tankless Water Heater High-Efficiency Condensing Gas Water Heater High-Efficiency Storage Gas Water Heater Low Flow Showerhead Pipe Wrap Solar Water Heating System Thermostatic Restrictor Shower Valve Water Heater Tune-Up
Space Heating – Equipment	**Appliances**
Boiler Early Retirement Boiler Reset Controls Boiler Tune-Up Communicating Thermostat Electric Air Source Heat Pump with Existing Gas Furnace Backup (Dual-Fuel Measure) Electric Air Source Heat Pump with New Gas Furnace Backup (Dual-Fuel Measure) Fireplace Timer Furnace Early Retirement Furnace Tune-Up Gas Heat Pump – Space Heating High Efficiency Boiler High Efficiency Boiler Dual Fuel-Gas Primary High Efficiency Fireplace High Efficiency Furnace High Efficiency Furnace Dual Fuel-Gas Primary High Quality Furnace Installation High-Efficiency Heat Recovery Ventilator HVAC Zoning	Convection Oven ENERGY STAR Dishwasher High Efficiency (ENERGY STAR®) Clothes Washer High Efficiency (ENERGY STAR®) Gas Clothes Dryer High Efficiency Gas Range **Pool & Spa Heaters – Equipment** HE Gas Pool Heater Outdoor Pool Cover Solar Pool Heater **New Construction** New Construction - Step 3 Homes New Construction - Step 4 Homes New Construction - Step 5 Homes
Space Heating & Water Heating - Equipment	**Other**
Combination System - Type 1 and 2 Combination System - Type 1 and 2 Early Retirement Combination System - Type 3 Gas Heat Pump Combination System – Type 1 and 2	Deep Energy Retrofits[34] ENERGY STAR Manufactured Home Home Energy Report

[34] Note that analysis that forms the technical, economic and market potential is based on individual measures rather than on "packages of measures" or program delivery approaches. Measures packaged in comprehensive programs such as FortisBC's Rental Apartment Efficiency program, Social Housing Retrofit Support program and deep energy retrofits were assessed within this analysis individually but not also collectively as a program package.

4.4.2 Results

Exhibit 24 shows measure-level results for the residential sector in order of decreasing cost effectiveness.

Measures were assessed based on their replacement type: **retrofit** (immediate replacement at full cost), **replace on burnout** (end of life replacement at incremental cost), or **new construction** (immediate installation at incremental cost).

The TRC and MTRC are presented at the measure-level and exclude program costs and free ridership.

Key findings of the measure assessment for the residential sector include:

- Of the 65 measures included in the analysis, only 14 pass the TRC screen. Substantially more, 54 measures, pass the MTRC screen.
- The most attractive water heating measures (i.e. measures with the highest TRC) include faucet aerators, pipe wrap and low flow showerheads.
- The most attractive space heating measures are certain building envelope (walls, attic duct, and basement) insulation measures, high-efficiency fireplaces, and communicating thermostats.
- Other building envelope measures, such as attic, floor insulation and air sealing measures do not pass the TRC (i.e. TRC is less than 1.0).
- Gas heat pumps combination systems and the mature market version of DHW gas heat pumps pass the MTRC. Neither pass the TRC.
- Most Step Code new construction measures pass the MTRC but neither pass the TRC.

Exhibit 24 – Residential Sector Results: Sector Averages (Sorted by High to Low MTRC)

#	Measure	Measure Type	Replacement Type	TRC	MTRC
1	Faucet Aerator	Equipment	RET	8.2	42.2
2	Pipe Wrap	Equipment	RET	7.7	38.5
3	Low Flow Showerhead	Equipment	RET	5	25.8
4	Combination System - Type 1 and 2	Equipment	ROB	10	10
5	ENERGY STAR Dishwasher	Equipment	ROB	10	10
6	Fireplace Timer	Equipment	RET	1.8	8.6
7	High Efficiency (ENERGY STAR) Clothes Washer	Equipment	ROB	1.7	8.5
8	Wall Insulation - Cavity (R-3 baseline)	Building Envelope	RET	1.7	7.6
9	High Efficiency (EnerChoice) Gas Fireplace or Vertically Direct Vented Fireplace	Equipment	ROB	1.5	7.4
10	Attic Duct Insulation	Building Envelope	RET	1.4	6.1
11	Communicating Thermostat	Controls	RET	1.2	5.2
12	Basement or Crawlspace Insulation	Building Envelope	RET	1.1	5
13	High Efficiency (ENERGY STAR) Gas Clothes Dryer	Equipment	ROB	1	4.8
14	Attic Insulation (R-12.6 Baseline)	Building Envelope	RET	0.9	4
15	GHP Combination System - Type 1 and 2	Equipment	ROB	0.7	3.6

16	Home Energy Report	Energy Management	RET	1.4	3.2
17	Air Source Heat Pump (Central) - Retrofit Existing Gas Furnace	Equipment	RET	0.6	3.1
18	Outdoor Pool Cover	Equipment	RET	0.6	3.1
19	Air Source Heat Pump (Central) - New Gas Furnace	Equipment	ROB	0.6	2.9
20	Comprehensive Air Sealing	Building Envelope	RET	0.6	2.8
21	Drain Water Heat Recovery	Equipment	RET	0.6	2.7
22	Attic Insulation (R-20 Baseline)	Building Envelope	RET	0.5	2.5
23	HVAC Zoning (HVAC Zone Control)	Equipment	RET	0.6	2.4
24	Exposed Floor Insulation	Building Envelope	RET	0.5	2.1
25	New Construction - Step 4 Homes - Electric DHW	New Construction	NEW	0.9	2.1
26	Wall Insulation - Cavity (R-10 baseline)	Building Envelope	RET	0.4	2.1
27	High Efficiency Furnace	Equipment	ROB	0.4	2
28	New Construction - Step 4 Homes	New Construction	NEW	0.4	2
29	Gas Heat Pump - DHW - Mature Market Costs	Equipment	ROB	0.4	1.9
30	Thermostatic Restrictor Shower Valve	Equipment	RET	0.3	1.8
31	Furnace Early Retirement	Equipment	RET	0.3	1.8
32	High-Efficiency Storage Gas Water Heater	Equipment	ROB	0.3	1.7
33	High-Efficiency Heat Recovery Ventilator	Equipment	RET	0.4	1.6
34	Boiler Reset Controls	Equipment	RET	0.3	1.6
35	Combination System - Type 3	Equipment	ROB	0.3	1.6
36	High-Efficiency (ENERGY STAR) Condensing Gas Tankless Water Heater - Mature Market Costs	Equipment	ROB	0.3	1.6
37	High Quality Furnace Installation - ENERGY STAR Verified	Equipment	ROB	0.3	1.6
38	Wall Insulation - Sheathing (R-7 baseline)	Building Envelope	RET	0.3	1.6
39	New Construction - Step 5 Homes - Mature Market Costs	New Construction	NEW	0.3	1.5
40	New Construction - Step 3 Homes - Electric DHW	New Construction	NEW	0.6	1.4
41	High Efficiency Furnace Dual Fuel-Gas Primary	Equipment	ROB	0.3	1.4
42	Combination System - Type 1 and 2 Early Retirement	Equipment	ROB	0.3	1.4
43	New Construction - Step 5 Homes - Electric DHW	New Construction	NEW	0.6	1.4
44	High Efficiency Boiler	Equipment	ROB	0.3	1.4
45	New Construction - Step 5 Homes	New Construction	NEW	0.3	1.3
46	Comprehensive Draft Proofing	Building Envelope	RET	0.3	1.3
47	New Construction - Step 3 Homes	New Construction	NEW	0.3	1.3
48	Solar Pool Heater	Equipment	RET	0.3	1.2
49	Boiler Early Retirement	Equipment	RET	0.2	1.1
50	Gas Heat Pump - Space Heating	Equipment	ROB	0.2	1.1
51	High Efficiency Boiler Dual Fuel-Gas Primary	Equipment	ROB	0.2	1

52	Manufactured Homes Duct Sealing	Equipment	RET	0.2	1
53	Manufactured Homes Floor Insulation	Equipment	RET	0.2	0.9
54	High Efficiency Gas Range	Equipment	ROB	0.2	0.8
55	Solar Water Heating System	Equipment	RET	0.1	0.7
56	Gas Heat Pump - DHW	Equipment	ROB	0.1	0.7
57	Convection Oven	Equipment	ROB	0.1	0.7
58	High-Efficiency (ENERGY STAR) Condensing Gas Water Heater	Equipment	ROB	0.1	0.5
59	Connected Water Heater Controller	Controls	RET	0.2	0.5
60	Boiler Tune-Up	Equipment	RET	0.1	0.3
61	Furnace Tune-Up	Equipment	RET	0.1	0.3
62	ENERGY STAR Manufactured Home	Equipment	RET	0.1	0.3
63	High Performance Windows and Doors	Building Envelope	ROB	0.1	0.3
64	Water Heater Tune-Up	Energy Management	RET	0	0.2
65	High Efficiency Gas Pool Heater	Equipment	ROB	0	0.2

4.5 Technical Potential

This section provides an overview of the technical potential savings results for the residential sector. Overall results are presented below, followed by measure level results and supply curves for the TRC and MTRC results.

As shown in Exhibit 25, almost half of the residential technical potential (24 PJ) would be available in 2021 and would increase to 43 PJ in 2040. This indicates that a large amount of the potential, approximately 19 PJ, would come from replace on burnout measures over the next two decades. The forecasted natural gas consumption for the residential sector is included for reference.

Exhibit 25 – Residential Technical Potential Savings (GJ)

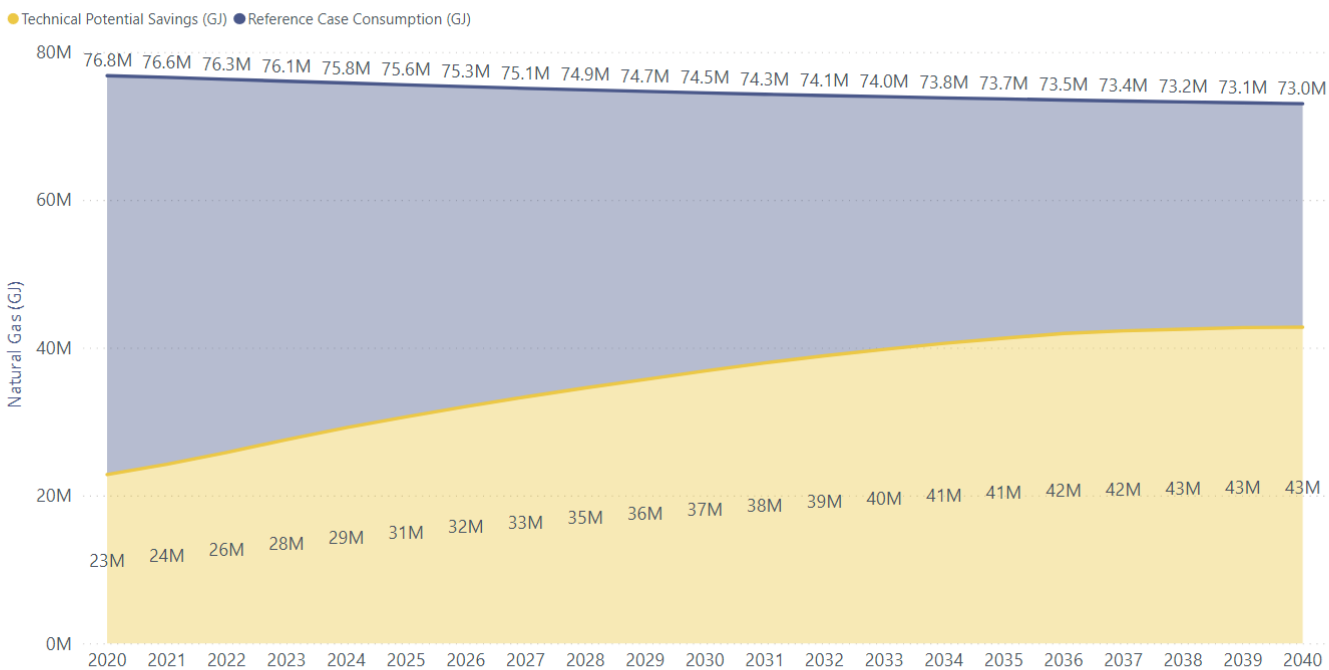
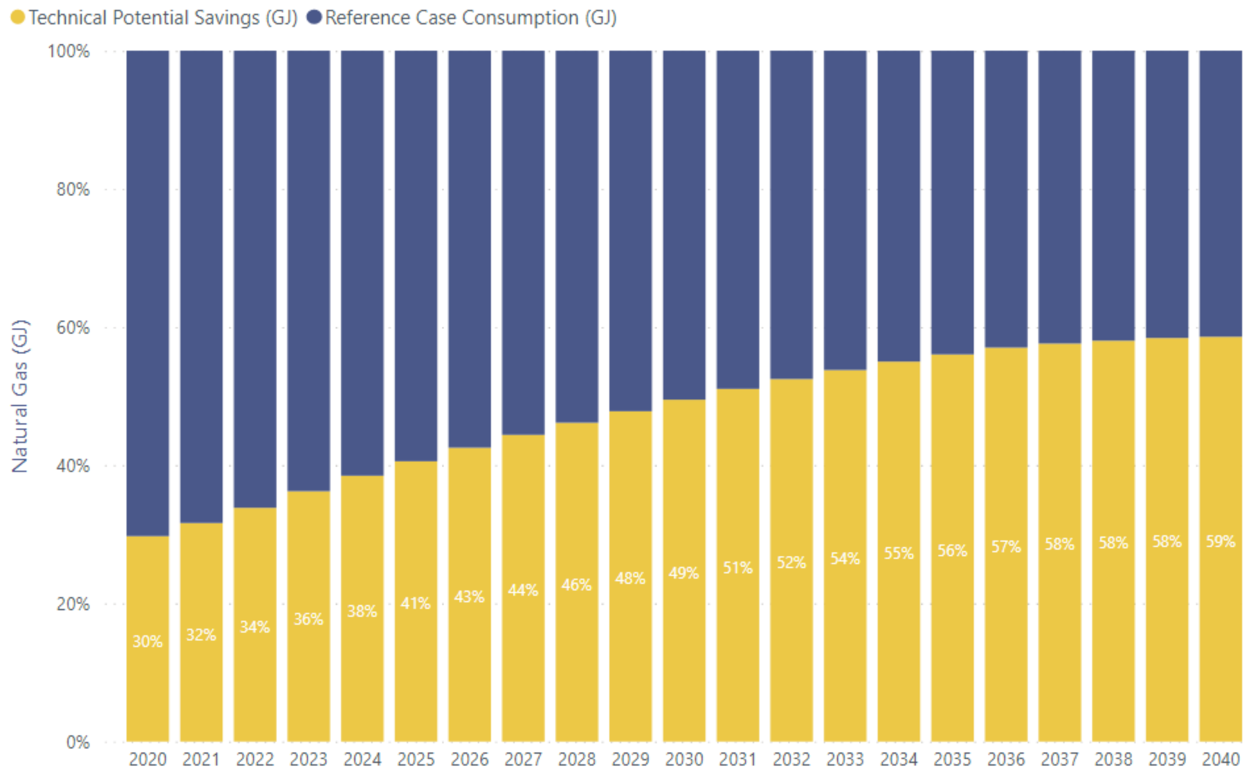


Exhibit 26 – Technical Savings Potential as a Percent of Residential Reference Case Consumption (%)



As shown in Exhibit 26, the technical potential savings is about 32% of residential reference case consumption in 2021 and increases to 59% by 2040, further indicating a that a substantial portion of the potential is expected to come from replace on burnout measures.

The technical potential savings by 2025 broken down by measure (only showing the top 25) are presented in Exhibit 27. The top three measures are all space heating measures (including gas heat pumps), followed by Step 4 new construction.

Exhibit 27 – Technical Potential – Annual Gas Savings from Top 30 Residential Measures in 2025 (GJ)

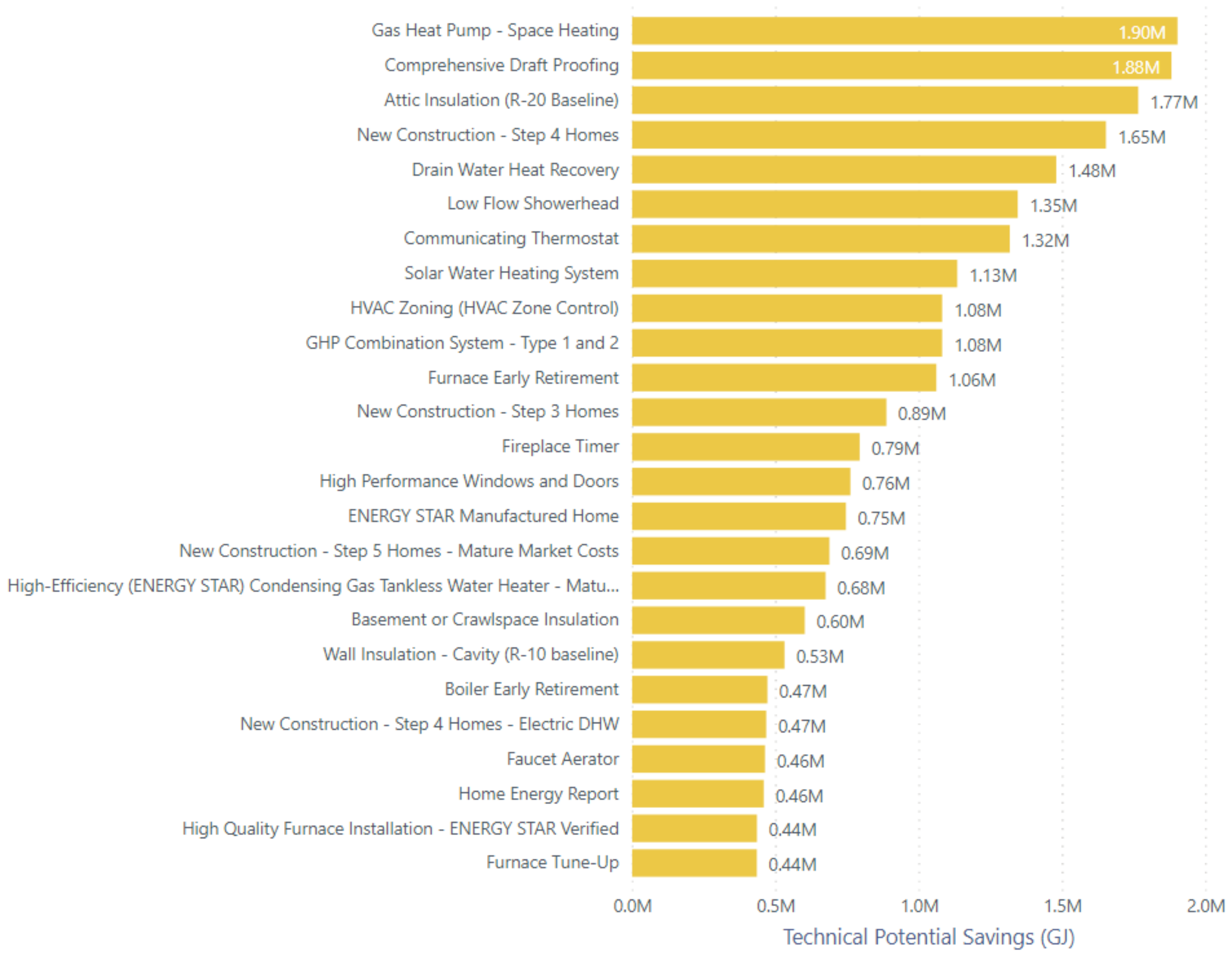


Exhibit 28 shows the cumulative residential sector technical potential savings in 2040 arranged as a supply curve, with measures ordered by decreasing TRC ratio from left to right. The graph shows that roughly 16% (around 7 out of 43 PJ) of the residential sector's technical potential by 2040, comes from measures with a TRC of 1.0 or higher. Approximately 1.5 PJ of savings come from measures with a TRC ratio of greater than 2. These are shown in aggregate.

Exhibit 28 – Residential Sector: Technical Potential Supply Curve – TRC

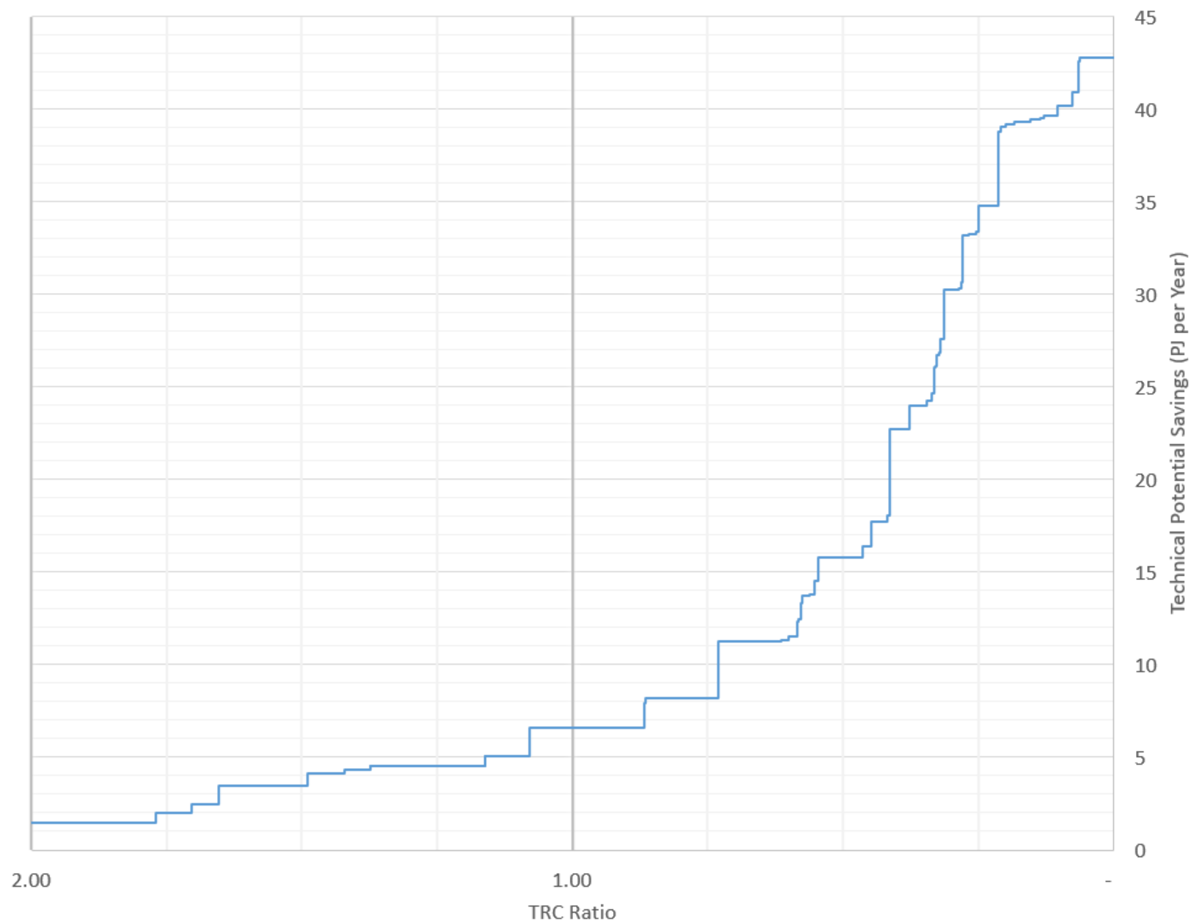
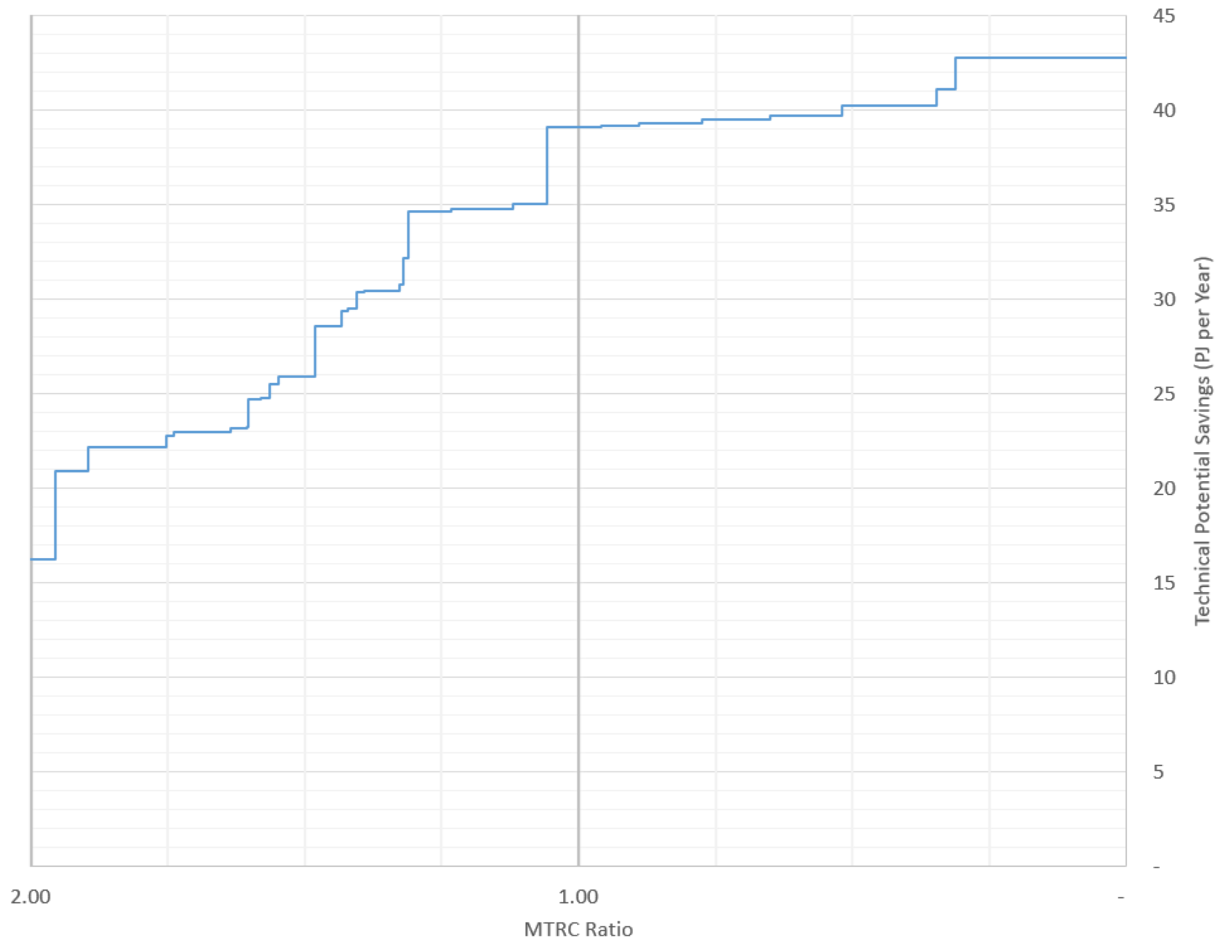


Exhibit 29 shows a similar supply curve, but with measures ordered by decreasing MTRC ratio from left to right. The graph shows that 90% (around 39 out of 43 PJ) of residential sector's technical potential by 2040 comes from cost-effective measures with an MTRC of 1.0 or higher. Approximately 16 PJ of savings come from measures with an MTRC ratio of greater than 2. These are shown in aggregate.

Exhibit 29 – Residential Sector: Technical Potential Supply Curve – MTRC

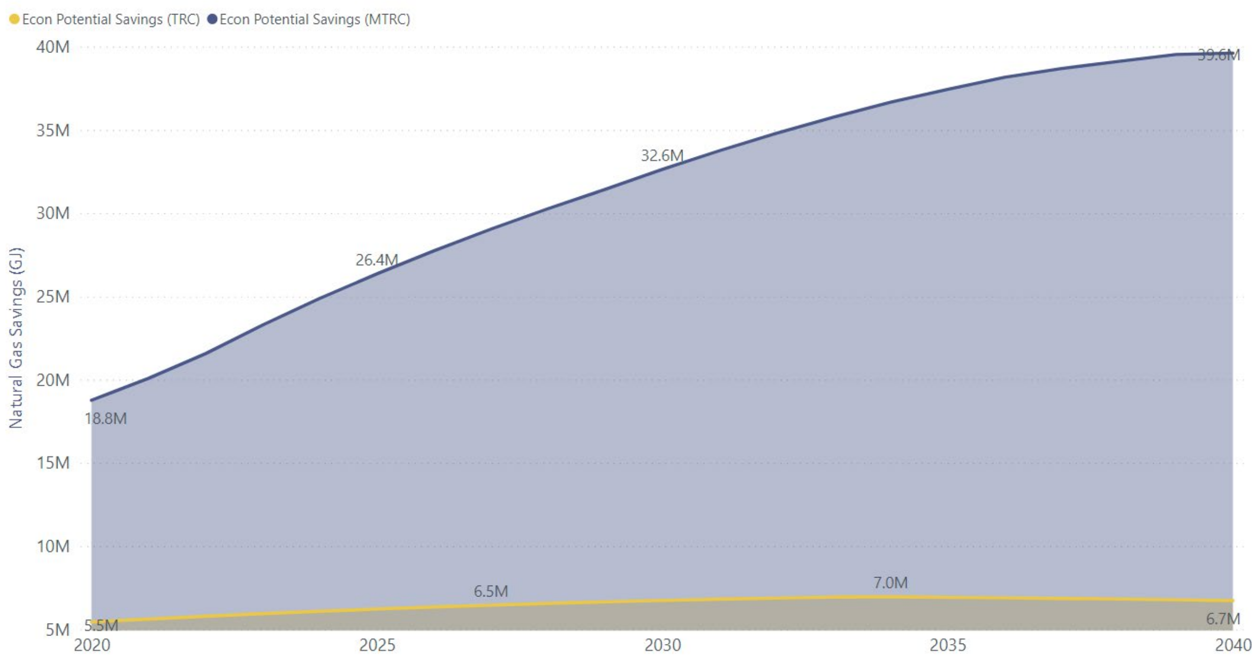


4.6 Economic Potential

This section provides the economic potential savings results for the residential sector from 2020 to 2040. We conducted two economic potential assessments: one using a TRC screen that includes measures with a TRC ratio of 1.0 and above, and one using an MTRC screen that includes measures with an MTRC of 1.0 and above. Outputs of both economic models are presented in this section.

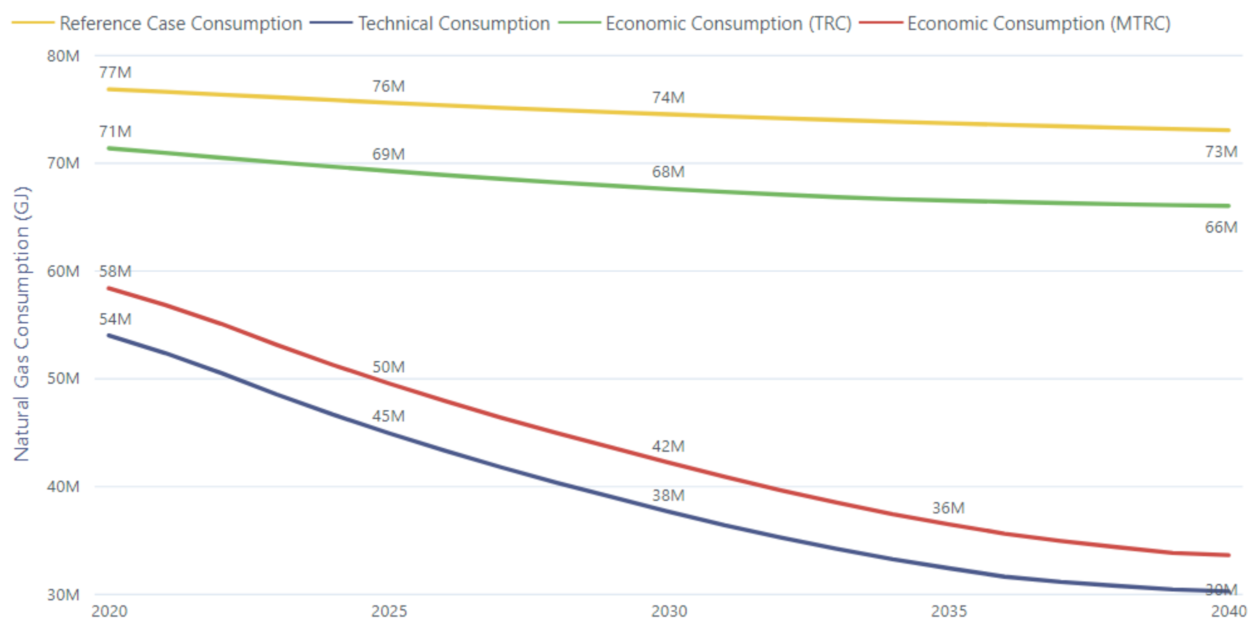
The residential sector economic potential savings with a TRC screen and with an MTRC screen are shown in Exhibit 30. As mentioned earlier, of the 65 measures included in the assessment, only 14 pass the TRC screen whereas 54 measures pass the MTRC screen. Those 40 measures that pass the MTRC but fail the TRC make up the difference between the two economic potential scenarios. This difference in economic potential in 2025 is roughly 20 PJ. In 2025, 24% of the MTRC economic potential comes from measures that pass the TRC as well. By 2040, that ratio is only 17%.

Exhibit 30 – Economic Potential Savings (GJ) – Residential, TRC and MTRC



The forecasted gas consumption under the technical potential, economic potential with a TRC screen, economic potential with an MTRC screen, and reference case scenarios for residential sector are shown in Exhibit 31.

Exhibit 31 – Economic Potential Consumption (GJ) Forecasts – Residential, TRC and MTRC



Results by Region

The TRC and MTRC economic potential savings in 2025 are presented by region in Exhibit 32 and Exhibit 33 respectively. The largest economic potential savings (3 PJ to 14 PJ depending on economic screen) are estimated to occur in the Lower Mainland outside of the City of Vancouver. The percentage of consumption captured by economic potential is uniform across all regions – around 8% under TRC screen and 34% under MTRC.

Exhibit 32 – Economic Potential Savings by Region in 2025 – Residential, TRC

Region	Ref Case Consumption (GJ)	Economic Potential Savings (GJ)	% of Consumption
Lower Mainland x Van	40,757K	3,303K	8%
Southern Interior	14,701K	1,343K	9%
City of Vancouver	9,007K	853K	9%
Vancouver Island	6,280K	421K	7%
Northern BC	4,517K	385K	9%
Whistler	290K	26K	9%
Total	**75,552K**	**6,331K**	**8%**

Exhibit 33 – Economic Potential Savings by Region in 2025 – Residential, MTRC

Region	Ref Case Consumption (GJ)	Economic Potential Savings (GJ)	% of Consumption
Lower Mainland x Van	40,757K	14,230K	35%
Southern Interior	14,701K	4,933K	34%
City of Vancouver	9,007K	3,150K	35%
Vancouver Island	6,280K	2,113K	34%
Northern BC	4,517K	1,522K	34%
Whistler	290K	87K	30%
Total	**75,552K**	**26,034K**	**34%**

Results by Segment and Vintage

The TRC and MTRC economic potential savings in 2025 are presented by segment and vintage in Exhibit 34 and Exhibit 35 respectively. As expected, older single-family dwellings present the most opportunities for economic potential under both economic screens. However, in the MTRC economic potential, the largest percentage of consumption is captured by the post-2015 vintage. This implies a sizeable potential contribution by Step Code new construction measures.

Exhibit 34 – Economic Potential Savings by Segment and Vintage in 2025 – Residential, TRC

Segment	Ref Case Consumption (GJ)	Economic Potential Savings (GJ)	% of Consumption
⊟ **SFD/Duplex**	**67,869K**	**5,854K**	**9%**
1950-1975	16,604K	1,731K	10%
1976-1985	8,892K	895K	10%
Pre-1950	7,885K	857K	11%
1986-1995	9,572K	830K	9%
1996-2005	7,606K	637K	8%
2006-2015	6,144K	509K	8%
Post-2015	11,166K	395K	4%
⊟ **Attached/Row**	**5,783K**	**381K**	**7%**
1986-1995	1,367K	99K	7%
1996-2005	1,115K	84K	8%
Post-2015	1,654K	69K	4%
2006-2015	619K	48K	8%
1976-1985	553K	40K	7%
1950-1975	397K	33K	8%
Pre-1950	77K	8K	10%
⊞ **Mobile/other**	**1,900K**	**97K**	**5%**
Total	**75,552K**	**6,331K**	**8%**

Exhibit 35 – Economic Potential Savings by Segment and Vintage in 2025 – Residential, MTRC

Segment	Ref Case Consumption (GJ)	Economic Potential Savings (GJ)	% of Consumption
⊟ **SFD/Duplex**	**67,869K**	**23,720K**	**35%**
1950-1975	16,604K	5,541K	33%
Post-2015	11,166K	5,048K	45%
1986-1995	9,572K	3,142K	33%
1976-1985	8,892K	2,931K	33%
Pre-1950	7,885K	2,642K	34%
1996-2005	7,606K	2,463K	32%
2006-2015	6,144K	1,954K	32%
⊟ **Attached/Row**	**5,783K**	**1,853K**	**32%**
Post-2015	1,654K	618K	37%
1986-1995	1,367K	418K	31%
1996-2005	1,115K	324K	29%
1976-1985	553K	172K	31%
2006-2015	619K	171K	28%
1950-1975	397K	126K	32%
Pre-1950	77K	24K	32%
⊞ **Mobile/other**	**1,900K**	**462K**	**24%**
Total	**75,552K**	**26,034K**	**34%**

Results by End Use

The TRC and MTRC economic potential savings in 2025 are presented by segment in Exhibit 36 and Exhibit 37 respectively. The largest amounts, in absolute savings, are expected to be captured under the space heating end use (2.7 PJ or 17.5 PJ depending on the economic screen). In terms of the percentage of reference case consumption captured by economic potential, domestic hot water captures the largest share in both economic screens (18% TRC, 51% MTRC). Although small in absolute savings, pool and spa heater end use has an economic potential ratio of 76% savings under the MTRC screen.

Exhibit 36 – Economic Potential Savings by End Use in 2025 – Residential, TRC

Parent End Use	Ref Case Consumption (GJ)	Economic Potential Savings (GJ)	% of Consumption
Space Heating	46,600K	2,710K	6%
Domestic Hot Water (DHW)	13,205K	2,347K	18%
Fireplace	11,549K	1,247K	11%
Clothes Dryer	229K	13K	5%
Cooking	1,328K	11K	1%
Pool & Spa Heaters	528K	5K	1%
Other Gas Uses	2,112K	0K	0%
Total	**75,552K**	**6,331K**	**8%**

Exhibit 37 – Economic Potential Savings by End Use in 2025 – Residential, MTRC

Parent End Use	Ref Case Consumption (GJ)	Economic Potential Savings (GJ)	% of Consumption
Space Heating	46,600K	17,569K	38%
Domestic Hot Water (DHW)	13,205K	6,784K	51%
Fireplace	11,549K	1,248K	11%
Pool & Spa Heaters	528K	403K	76%
Clothes Dryer	229K	19K	8%
Cooking	1,328K	11K	1%
Other Gas Uses	2,112K	0K	0%
Total	**75,552K**	**26,034K**	**34%**

The TRC and MTRC economic potential savings in 2040 are presented by end use in Exhibit 38. The difference is drastic – around 32 PJ. This is due to the large number of measures that pass the MTRC but fail the TRC. The biggest difference between the economic screens stem from measures that affect space heating.

Exhibit 38 – Economic Potential Savings by End Use in 2040 – Residential, TRC and MTRC

Parent End Use	Economic Savings (GJ) - TRC	Economic Savings (GJ) - MTRC	Difference (GJ)
Space Heating	3,382K	27,738K	24,356K
Domestic Hot Water (DHW)	2,009K	10,226K	8,218K
Pool & Spa Heaters	3K	301K	298K
Clothes Dryer	17K	28K	11K
Fireplace	1,312K	1,313K	1K
Cooking	8K	9K	0K
Other Gas Uses	0K	0K	0K
Total	**6,732K**	**39,615K**	**32,883K**

Results by Measure

The TRC economic potential savings by 2025 broken down by measure are shown in Exhibit 39, sorted by decreasing potential. The savings breakdown by end use is shown in Exhibit 40. Space heating savings make up 42% of the economic potential, domestic hot water 38% and fireplace measures 20% of the savings.

Exhibit 39 – Residential Economic Potential (TRC) – Annual Gas Savings from All TRC-Passing Measures in 2025 (GJ)

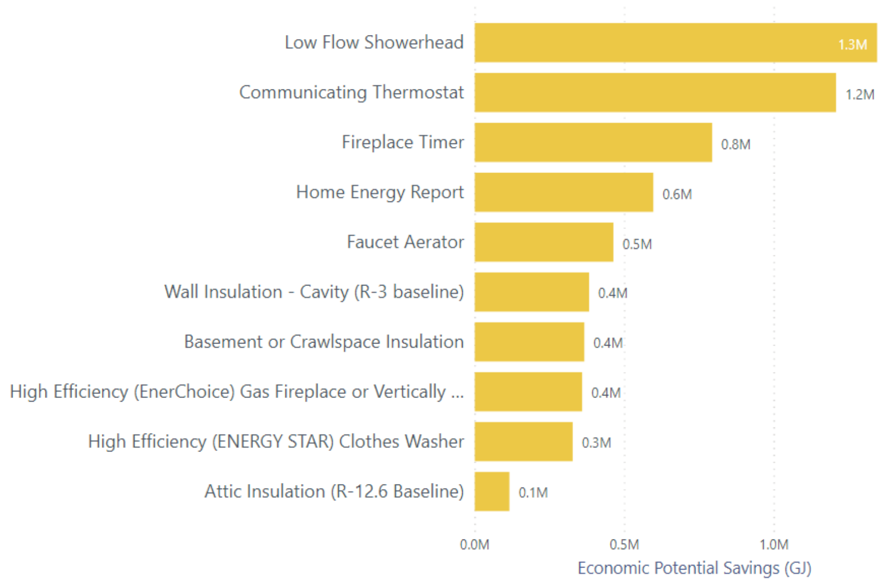
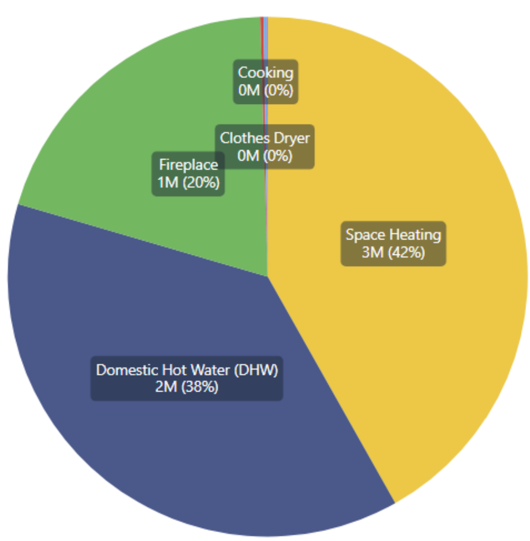


Exhibit 40 – Economic Potential in 2025 (GJ) By End Use – Residential, TRC



The economic potential savings by 2025 broken down by measure (showing only the top 25 measures) are presented in Exhibit 41. The savings breakdown by end use are presented in Exhibit 42. Space heating measures and their savings makes up the majority (68%) of the MTRC economic potential.

Exhibit 41 – Residential Economic Potential (TRC) - Annual Gas Savings from Top 25 MTRC-Passing Measures in 2025 (GJ)

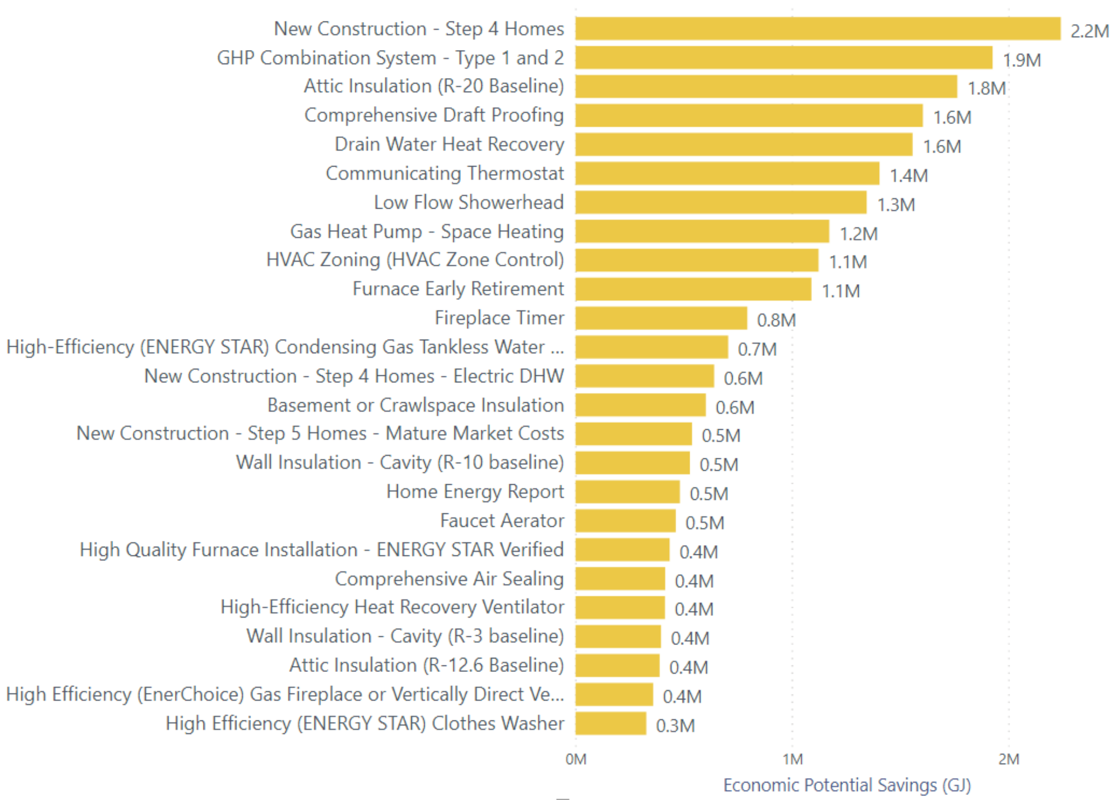
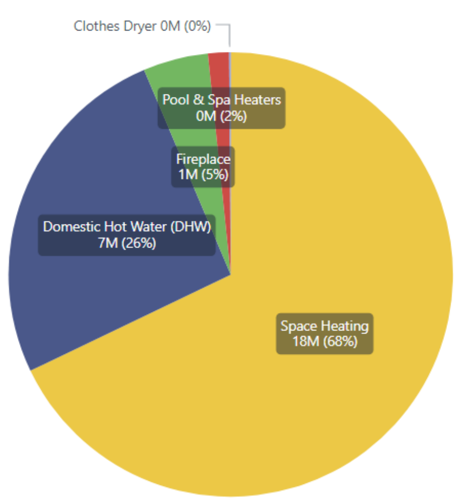


Exhibit 42 – Economic Potential (GJ) in 2025 By End Use – Residential, MTRC



4.7 Market Potential

This section provides an overview of the low, medium, and high market potential results for the residential sector.

Low, medium, and high scenarios assume that measure incentive levels will be 25%, 50% and 100% of incremental costs, respectively. For example, assume that a high-efficiency furnace may cost $200 more than a standard furnace, meaning the furnace would have an incremental cost of $200. In the medium scenario, this measure's hypothetical incentive from FortisBC would be $100. The other $100 would be paid by the end user. In all scenarios, the non-incentive program costs are assumed to be 15% of the incentive cost. In the example above, FortisBC's non-incentive spending would be $15. FortisBC's total cost for providing the measure to an end user would be $115.

The market potential savings results, with a TRC screen and with an MTRC screen, are shown in Exhibit 43 and Exhibit 44, respectively. The medium market potential using the MTRC screen is almost three times the market potential using TRC screen.

By 2040, the residential low, medium, and high market TRC potential savings are estimated to be 3 PJ, 3.4 PJ, and 4.3 PJ, respectively. By 2040, the low, medium, and high market MTRC potential savings are estimated to be 8.2 PJ, 9.9 PJ, and 14.2 PJ, respectively.

Exhibit 43 – Market Potential Savings (GJ) – Residential, TRC

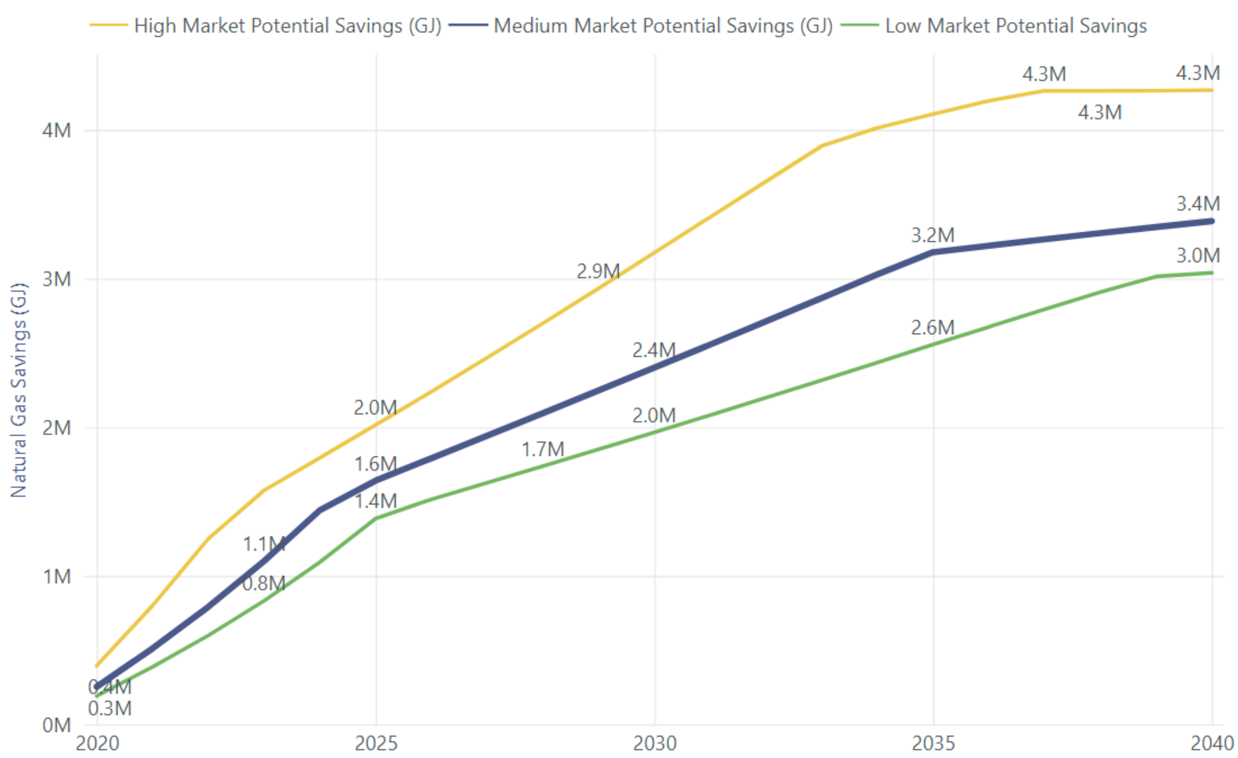
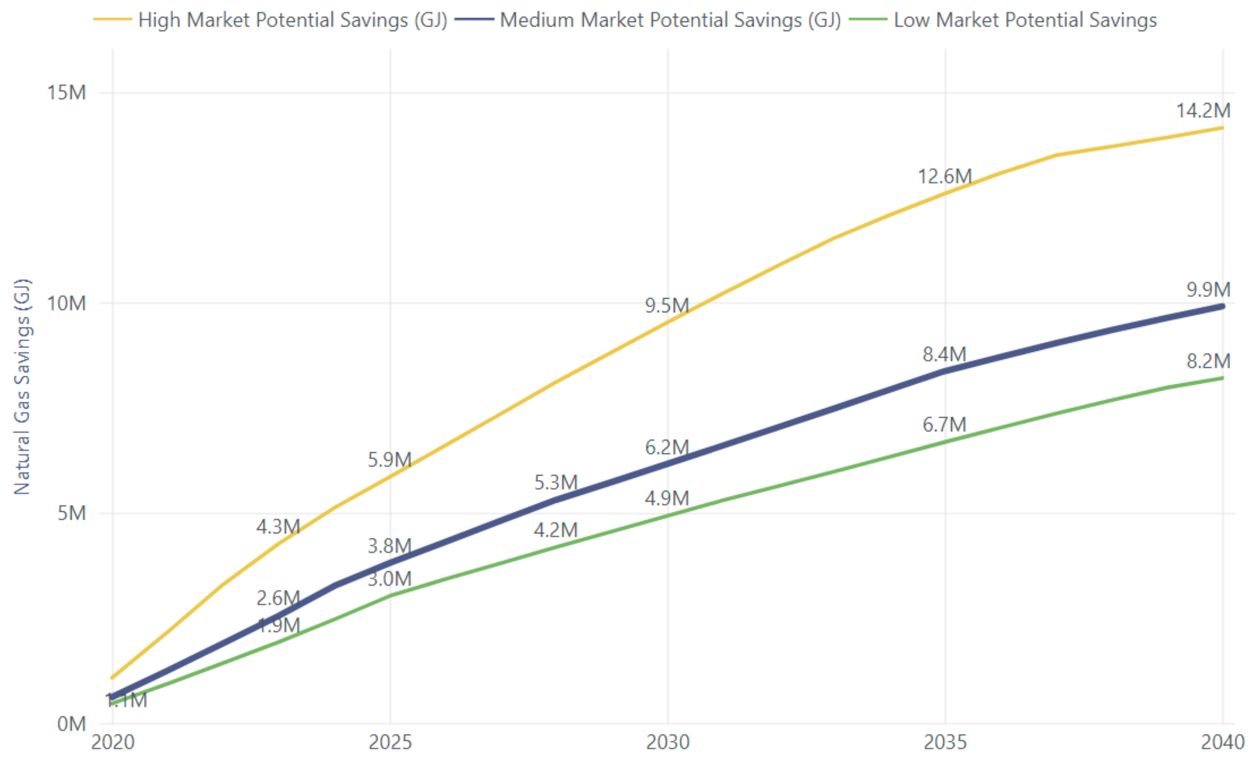


Exhibit 44 – Market Potential Savings (GJ) – Residential, MTRC



The forecasted residential gas consumption under the three market potential scenarios relative to reference case scenario is shown in Exhibit 45 (TRC) and Exhibit 46 (MTRC). The reference consumption is forecasted to drop to 73 PJ, from 77 PJ today. By 2040, the residential low, medium, and high market TRC potential consumption levels are estimated to be 70 PJ, 69.6 PJ, and 69 PJ, respectively. By 2040, the low, medium, and high market MTRC potential consumption levels are estimated to be 65 PJ, 63 PJ, and 59 PJ, respectively.

Exhibit 45 – Market Potential Consumption (GJ) Forecasts – Residential, TRC

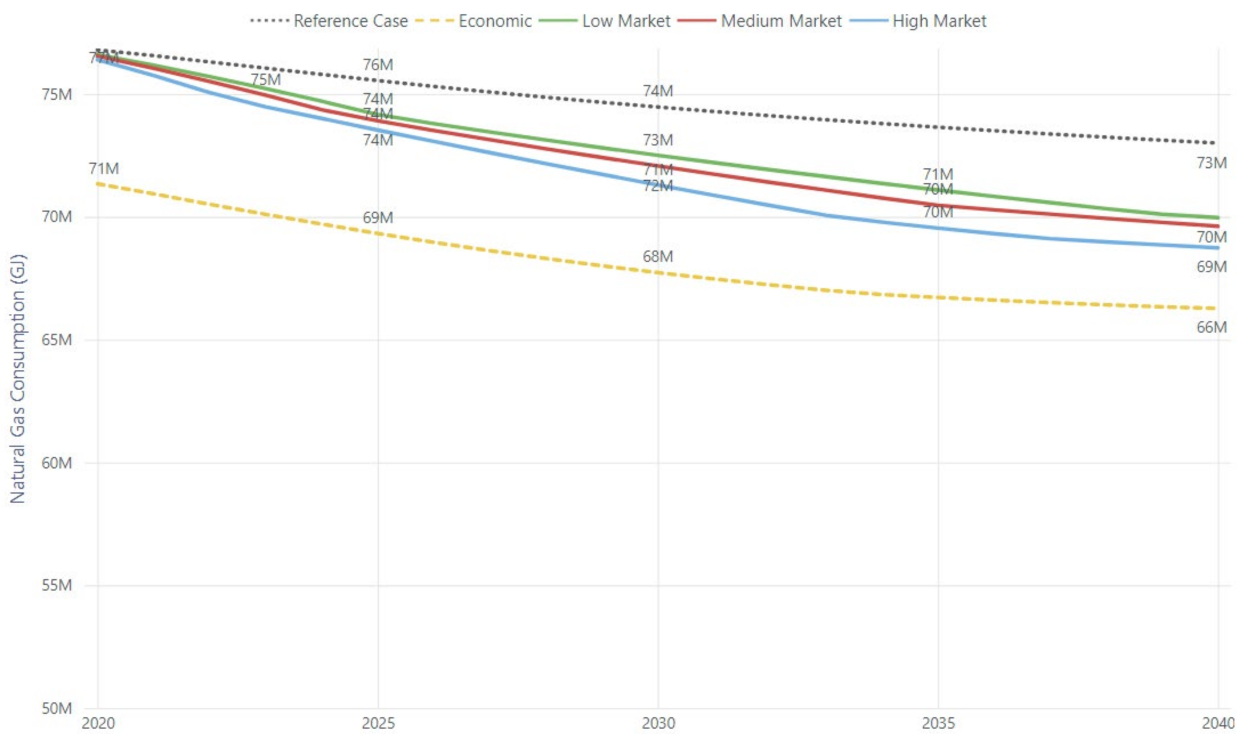
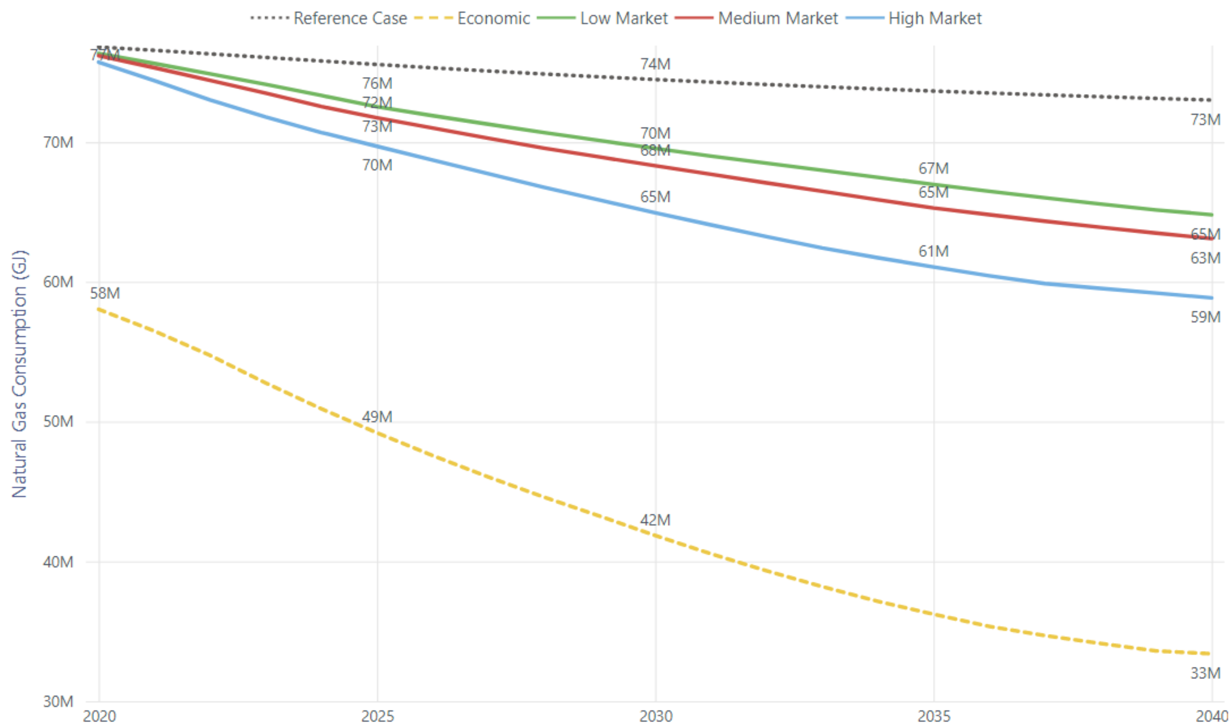


Exhibit 46 – Market Potential Consumption (GJ) Forecasts – Residential, MTRC



The remainder of this section presents detailed results of the medium market potential scenario only. Similarly detailed results of the low and high market potential scenarios can be found on the Power BI dashboard and the Excel workbooks.

Results by Region

The medium market potential savings for 2025 are presented by region in Exhibit 47 and Exhibit 48 using TRC and MTRC screen, respectively. Medium market potential savings in 2025 are estimated to be 2% of reference case consumption in all regions with TRC screen, and 5% with MTRC. The largest portion savings is expected to be in the Lower Mainland x Vancouver region.

Exhibit 47 – Medium Market Potential Savings by Region in 2025 – Residential, TRC

Region	Ref Case Consumption (GJ)	Medium Market Potential Savings (GJ)	% of Consumption
Lower Mainland x Van	40,757K	876K	2%
Southern Interior	14,701K	339K	2%
City of Vancouver	9,007K	202K	2%
Vancouver Island	6,280K	128K	2%
Northern BC	4,517K	92K	2%
Whistler	290K	6K	2%
Total	**75,552K**	**1,642K**	**2%**

Exhibit 48 – Medium Market Potential Savings by Region in 2025 – Residential, MTRC

Region	Ref Case Consumption (GJ)	Medium Market Potential Savings (GJ)	% of Consumption
Lower Mainland x Van	40,757K	2,054K	5%
Southern Interior	14,701K	767K	5%
City of Vancouver	9,007K	451K	5%
Vancouver Island	6,280K	301K	5%
Northern BC	4,517K	225K	5%
Whistler	290K	12K	4%
Total	**75,552K**	**3,810K**	**5%**

Results by Segment and Vintage

The TRC and MTRC economic potential savings in 2025 are presented by segment and vintage in Exhibit 49 and Exhibit 50 respectively. Single-family dwellings present the most market potential under both economic screens.

Exhibit 49 – Medium Market Potential Savings by Segment and Vintage in 2025 – Residential, TRC

Segment	Ref Case Consumption (GJ)	Medium Market Potential Savings (GJ)	% of Consumption
⊟ **SFD/Duplex**	**67,869K**	**1,503K**	**2%**
1950-1975	16,604K	427K	3%
1986-1995	9,572K	233K	2%
1976-1985	8,892K	215K	2%
Pre-1950	7,885K	199K	3%
1996-2005	7,606K	187K	2%
2006-2015	6,144K	152K	2%
Post-2015	11,166K	91K	1%
⊟ **Attached/Row**	**5,783K**	**108K**	**2%**
1986-1995	1,367K	30K	2%
1996-2005	1,115K	25K	2%
Post-2015	1,654K	16K	1%
2006-2015	619K	14K	2%
1976-1985	553K	12K	2%
1950-1975	397K	8K	2%
Pre-1950	77K	2K	2%
⊟ **Mobile/other**	**1,900K**	**31K**	**2%**
All	1,900K	31K	2%
Total	**75,552K**	**1,642K**	**2%**

Exhibit 50 – Medium Market Potential Savings by Segment and Vintage in 2025 – Residential, MTRC

Segment	Ref Case Consumption (GJ)	Medium Market Potential Savings (GJ)	% of Consumption
SFD/Duplex	**67,869K**	**3,472K**	**5%**
1950-1975	16,604K	935K	6%
1986-1995	9,572K	545K	6%
1976-1985	8,892K	505K	6%
Pre-1950	7,885K	438K	6%
1996-2005	7,606K	435K	6%
2006-2015	6,144K	351K	6%
Post-2015	11,166K	264K	2%
Attached/Row	**5,783K**	**262K**	**5%**
1986-1995	1,367K	74K	5%
1996-2005	1,115K	60K	5%
Post-2015	1,654K	41K	3%
2006-2015	619K	31K	5%
1976-1985	553K	30K	5%
1950-1975	397K	21K	5%
Pre-1950	77K	4K	5%
Mobile/other	**1,900K**	**75K**	**4%**
All	1,900K	75K	4%
Total	**75,552K**	**3,810K**	**5%**

Results by End Use

The TRC and MTRC medium market potential savings in 2025 are presented by segment in Exhibit 51 and Exhibit 52 respectively. In the TRC potential, the largest amount of absolute savings in 2025 are expected to be from domestic hot water (DHW) end use. These savings are roughly 6% of the DHW end use reference case consumption in that year. In the MTRC potential, the largest absolute savings in 2025 come from space heating end use, even though these savings amount to only 4% of the end use reference case consumption. When evaluating percentages, DHW has a larger potential (11% of the end use consumption in that year). Although small in absolute savings, pool and spa heater end use has the potential of capturing 17% savings under the MTRC screen.

Exhibit 51 – Medium Market Potential Savings by End Use in 2025 – Residential, TRC

Parent End Use	Ref Case Consumption (GJ)	Medium Market Potential Savings (GJ)	% of Consumption
Domestic Hot Water (DHW)	13,205K	757K	6%
Space Heating	46,600K	621K	1%
Fireplace	11,549K	246K	2%
Cooking	1,328K	11K	1%
Pool & Spa Heaters	528K	4K	1%
Clothes Dryer	229K	2K	1%
Other Gas Uses	2,112K	0K	0%
Total	**75,552K**	**1,642K**	**2%**

Exhibit 52 – Medium Market Potential Savings by End Use in 2025 – Residential, MTRC

Parent End Use	Ref Case Consumption (GJ)	Medium Market Potential Savings (GJ)	% of Consumption
Space Heating	46,600K	1,951K	4%
Domestic Hot Water (DHW)	13,205K	1,503K	11%
Fireplace	11,549K	252K	2%
Pool & Spa Heaters	528K	89K	17%
Cooking	1,328K	11K	1%
Clothes Dryer	229K	4K	2%
Other Gas Uses	2,112K	0K	0%
Total	**75,552K**	**3,810K**	**5%**

The TRC and MTRC medium market potential savings in 2040 are presented by end use in Exhibit 53. MTRC market potential is almost three times the TRC market potential. The biggest difference between the two economic screen scenarios comes from measures that affect space heating.

Exhibit 53 – Medium Market Potential Savings by End Use in 2040 – Residential, TRC and MTRC

Parent End Use	Medium Potential Savings (GJ) - TRC	Medium Potential Savings (GJ) - MTRC	Difference (GJ)
Space Heating	1,154K	5,049K	3,895K
Domestic Hot Water (DHW)	1,596K	3,981K	2,385K
Pool & Spa Heaters	3K	219K	216K
Fireplace	625K	643K	18K
Clothes Dryer	1K	9K	8K
Cooking	8K	9K	0K
Other Gas Uses	0K	0K	0K
Total	**3,388K**	**9,910K**	**6,522K**

Results by Measure

The medium market potential savings in 2025 of the top 15 residential measures are shown in Exhibit 54. The top measures in the TRC medium market potential are shown on the left and top measures in the MTRC scenario are shown on the right. Home energy reports and low flow showerheads top the list in both scenarios. More space heating measures contribute to savings in the MTRC screen, as evident from the measures list and the end use breakdown difference in Exhibit 55. The sixth measure on the MTRC list on the right side of Exhibit 54 is High-Efficiency (ENERGY STAR) condensing Gas Tankless Water Heater.

Exhibit 54 – Medium Market Potential (TRC on Left, MTRC on Right) - Top 14 Residential Measures in 2025 (GJ)

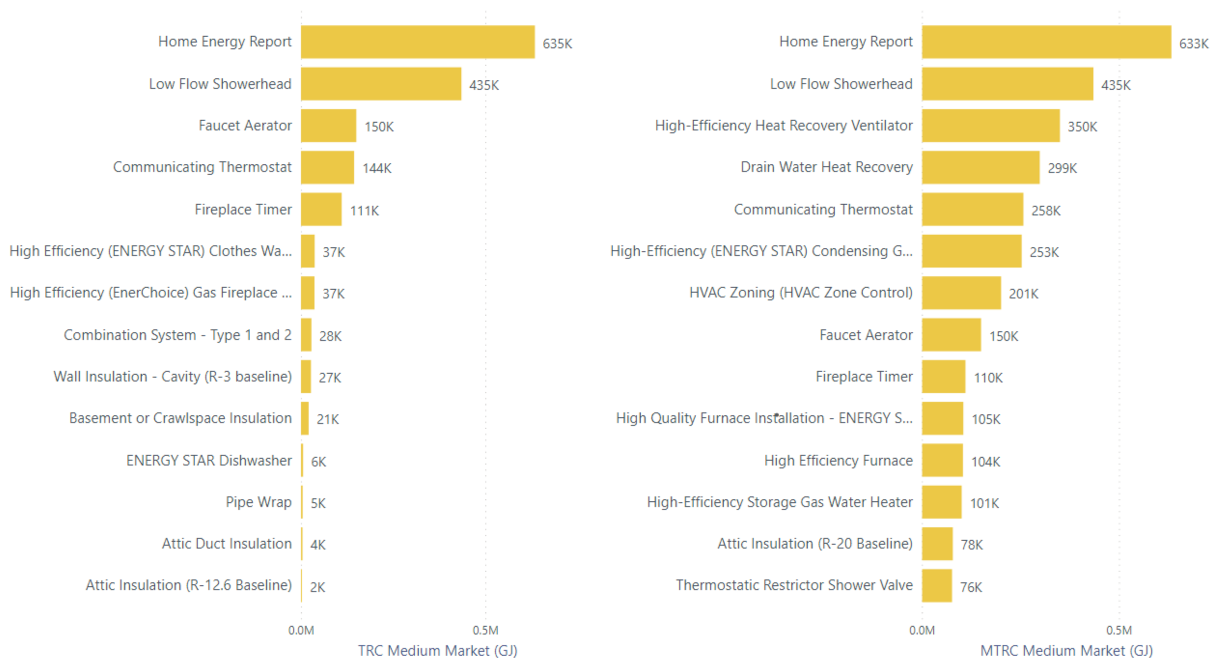
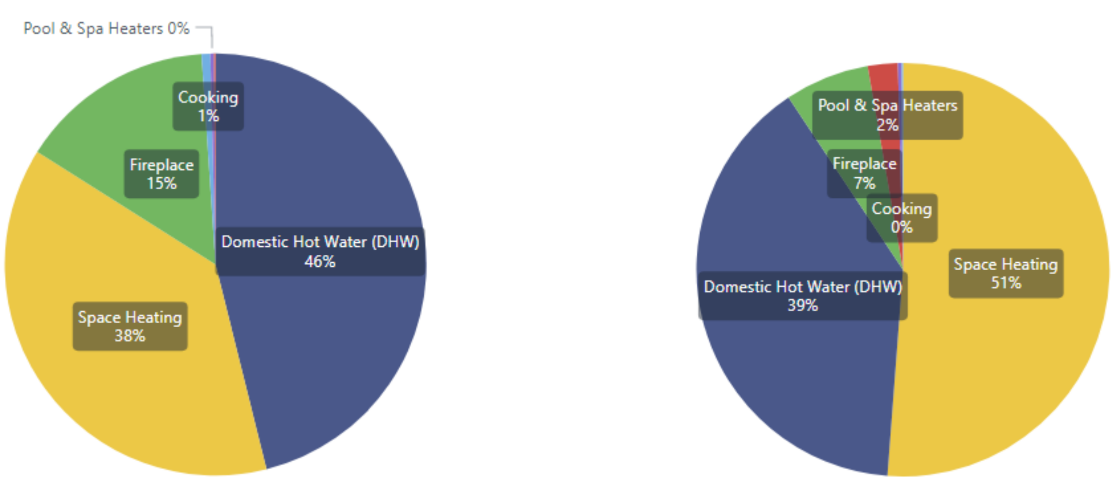


Exhibit 55 – Medium Market Potential (TRC on Left, MTRC on Right) – Savings by End Use in 2025 (%)



4.7.1 Incentive and Non-Incentive Spending

The incentive and non-incentive spending required to achieve the medium and high market potential are shown in Exhibit 56 (TRC) and Exhibit 57 (MTRC). Medium and high market incentives are assumed to be 50% and 100% of measures' incremental costs, respectively. In both medium and high scenarios, non-incentive costs are estimated to be 15% of incentive costs. The tables also show the total as well as incremental (that is, savings from new measures installed in a year) savings every year.

Exhibit 56 – Medium and High Market Incentive Costs and Natural Gas Savings – Residential, TRC

Year	Medium Market Incentive Cost	Medium Market Non-Incentive Cost	Medium Market Total Costs	Medium Market Potential Savings (GJ)	Medium Incremental Savings (Year-over-Year, GJ)	High Market Incentive Cost	High Market Non-Incentive Cost	High Market Total Costs	High Market Potential Savings (GJ)	High Incremental Savings (Year-over-Year, GJ)
2020	$3.5M	$0.5M	$4.0M	255K	255K	$12.6M	$1.9M	$14.5M	397K	397K
2021	$3.6M	$0.5M	$4.2M	513K	258K	$13.0M	$2.0M	$15.0M	801K	405K
2022	$4.0M	$0.6M	$4.6M	793K	280K	$14.6M	$2.2M	$16.8M	1,251K	450K
2023	$4.5M	$0.7M	$5.2M	1,100K	307K	$10.9M	$1.6M	$12.6M	1,576K	325K
2024	$5.1M	$0.8M	$5.9M	1,442K	342K	$8.1M	$1.2M	$9.3M	1,794K	219K
2025	$3.0M	$0.4M	$3.4M	1,642K	199K	$8.3M	$1.2M	$9.5M	2,016K	221K
2026	$2.4M	$0.4M	$2.8M	1,792K	151K	$8.4M	$1.3M	$9.7M	2,240K	225K
2027	$2.5M	$0.4M	$2.8M	1,943K	151K	$8.6M	$1.3M	$9.9M	2,468K	228K
2028	$2.5M	$0.4M	$2.9M	2,095K	152K	$8.8M	$1.3M	$10.1M	2,700K	232K
2029	$2.6M	$0.4M	$3.0M	2,248K	153K	$9.0M	$1.3M	$10.3M	2,935K	236K
2030	$2.6M	$0.4M	$3.0M	2,401K	154K	$9.2M	$1.4M	$10.6M	3,175K	240K
2031	$2.7M	$0.4M	$3.1M	2,556K	155K	$9.1M	$1.4M	$10.5M	3,414K	239K
2032	$2.7M	$0.4M	$3.2M	2,712K	156K	$9.1M	$1.4M	$10.5M	3,653K	239K
2033	$2.8M	$0.4M	$3.2M	2,870K	157K	$9.1M	$1.4M	$10.5M	3,893K	239K
2034	$2.9M	$0.4M	$3.3M	3,029K	159K	$8.0M	$1.2M	$9.2M	4,015K	123K
2035	$2.9M	$0.4M	$3.4M	3,178K	149K	$8.0M	$1.2M	$9.2M	4,107K	92K
2036	$2.5M	$0.4M	$2.9M	3,222K	43K	$7.8M	$1.2M	$9.0M	4,196K	89K
2037	$2.5M	$0.4M	$2.9M	3,265K	43K	$6.7M	$1.0M	$7.7M	4,265K	69K
2038	$2.4M	$0.4M	$2.8M	3,307K	42K	$4.3M	$0.6M	$4.9M	4,264K	-1K
2039	$2.4M	$0.4M	$2.7M	3,347K	41K	$4.3M	$0.6M	$4.9M	4,265K	1K
2040	$2.3M	$0.4M	$2.7M	3,388K	40K	$4.4M	$0.7M	$5.1M	4,268K	4K

Exhibit 57 – Medium and High Market Incentive Costs and Natural Gas Savings – Residential, MTRC

Year	Medium Market Incentive Cost	Medium Market Non-Incentive Cost	Medium Market Total Costs	Medium Market Potential Savings (GJ)	Medium Incremental Savings (Year-over-Year, GJ)	High Market Incentive Cost	High Market Non-Incentive Cost	High Market Total Costs	High Market Potential Savings (GJ)	High Incremental Savings (Year-over-Year, GJ)
2020	$41.2M	$6.2M	$47.4M	622K	622K	$152.3M	$22.8M	$175.1M	1,080K	1,080K
2021	$42.2M	$6.3M	$48.5M	1,250K	628K	$155.5M	$23.3M	$178.9M	2,170K	1,089K
2022	$43.1M	$6.5M	$49.6M	1,897K	647K	$159.7M	$24.0M	$183.6M	3,300K	1,130K
2023	$44.0M	$6.6M	$50.6M	2,556K	659K	$156.9M	$23.5M	$180.4M	4,267K	967K
2024	$45.2M	$6.8M	$51.9M	3,262K	706K	$148.8M	$22.3M	$171.1M	5,117K	850K
2025	$43.1M	$6.5M	$49.6M	3,810K	548K	$132.1M	$19.8M	$151.9M	5,855K	738K
2026	$43.3M	$6.5M	$49.8M	4,310K	500K	$135.8M	$20.4M	$156.2M	6,601K	746K
2027	$44.0M	$6.6M	$50.6M	4,811K	501K	$140.0M	$21.0M	$160.9M	7,355K	754K
2028	$44.5M	$6.7M	$51.2M	5,310K	499K	$142.9M	$21.4M	$164.3M	8,112K	757K
2029	$36.9M	$5.5M	$42.4M	5,735K	424K	$130.6M	$19.6M	$150.2M	8,822K	710K
2030	$38.0M	$5.7M	$43.7M	6,164K	429K	$130.4M	$19.6M	$150.0M	9,529K	706K
2031	$39.0M	$5.9M	$44.9M	6,598K	434K	$128.0M	$19.2M	$147.2M	10,214K	685K
2032	$40.2M	$6.0M	$46.2M	7,036K	438K	$125.9M	$18.9M	$144.8M	10,879K	665K
2033	$41.4M	$6.2M	$47.6M	7,479K	443K	$124.4M	$18.7M	$143.0M	11,527K	648K
2034	$42.7M	$6.4M	$49.1M	7,926K	448K	$121.6M	$18.2M	$139.9M	12,077K	550K
2035	$44.0M	$6.6M	$50.6M	8,370K	443K	$119.1M	$17.9M	$137.0M	12,589K	511K
2036	$41.9M	$6.3M	$48.2M	8,707K	337K	$116.2M	$17.4M	$133.6M	13,076K	487K
2037	$41.4M	$6.2M	$47.6M	9,038K	331K	$109.0M	$16.4M	$125.4M	13,502K	426K
2038	$39.5M	$5.9M	$45.4M	9,345K	307K	$89.6M	$13.4M	$103.0M	13,710K	207K
2039	$37.7M	$5.7M	$43.3M	9,633K	289K	$89.6M	$13.4M	$103.1M	13,923K	213K
2040	$36.9M	$5.5M	$42.4M	9,910K	276K	$91.9M	$13.8M	$105.7M	14,153K	230K

5 Commercial Sector Results

This section presents the commercial sector results and key findings, including:

- Base year (2019) natural gas use
- Reference case consumption forecast (2020 – 2040)
- Energy conservation measures evaluated in this CPR
- Technical potential savings
- Economic potential savings
- Market potential savings and scenarios

5.1 Commercial Segments and End Uses

In this CPR, the commercial sector is divided into 17 segments, five energy end uses, and two vintages.

Exhibit 58 – Definition of Commercial Sector Segments, End Uses, and Vintages

	Segments (17)	End Uses[35] (5)	Vintages (2)
Commercial Sector	• Apartments – Medium • Apartments – Large • Food Retail • Hospital • Hotel – Medium • Hotel – Large • Non-Food Retail – Medium • Non-Food Retail – Large • Nursing Home • Office – Medium • Office – Large • Other Commercial[36] • Restaurant • School – Medium • School – Large • University/College • Warehouse	• Cooking • Domestic Hot Water • Other[37] • Pools, Spas & Hot tubs • Space Heating	• Existing • New

35 All-electric end uses, such as clothes washer, lighting or plug loads, are not included in the reported results therefore are excluded from the End Uses row of this table.
36 The "other" segment includes facilities that do not fit into any of the other segments.
37 The "other" end use is a catch all for equipment that account for a small portion of consumption in the sector. In the commercial sector, examples of 'other' equipment are patio heaters and laundry dryers.

5.2 Base Year Natural Gas Use

This section profiles the base year (2019) natural gas consumption for the commercial sector. Please see Appendix A in the CPR Method Appendices document for how commercial NAICS codes were categorized into segments.

The following exhibits summarize how natural gas is used in the commercial sector by segment[38], end use, and region, respectively.

Natural gas consumption in the commercial sector base year is highest:

- In the apartment (31%), other (19%) and office (11%) segments
- In the space heating (56%) and water heating (31%) end uses
- In the Lower Mainland excluding Vancouver ("Lower Mainland x Vancouver") (48%) and the City of Vancouver (21%) regions

Exhibit 59 – 2019 Commercial Natural Gas Consumption (GJ) by Segment

Segment	Consumption (GJ)	%
Apartment	19,568K	31%
Other	12,201K	19%
Office	7,084K	11%
Restaurant	4,271K	7%
Warehouse	4,231K	7%
Nonfood Retail	3,587K	6%
Hospital	3,067K	5%
Hotel	2,553K	4%
School	2,271K	4%
University/College	1,987K	3%
Nursing Home	1,665K	3%
Food Retail	1,453K	2%
Total	**63,938K**	**100%**

38 Several commercial segments are further segmented by size (large or medium/small) including apartment, hotel, nonfood retail, office and school. The "other" segment includes facilities that do not fit into any of the other segments.

Exhibit 60 – 2019 Commercial Natural Gas Consumption (GJ) by End Use

Parent End Use	Consumption (GJ)	%
Space heating	35,556K	56%
Water heating	19,619K	31%
Food Service	4,800K	8%
Other	3,384K	5%
Pools; Spas & Hot Tubs	579K	1%
Total	**63,938K**	**100%**

Exhibit 61 – 2019 Commercial Natural Gas Consumption (GJ) by Region

Region	Consumption (GJ)	%
Lower Mainland x Van	30,920K	48%
City of Vancouver	13,507K	21%
Southern Interior	9,153K	14%
Vancouver Island	6,881K	11%
Northern BC	2,809K	4%
Whistler	667K	1%
Total	**63,938K**	**100%**

5.2.1 Accounts

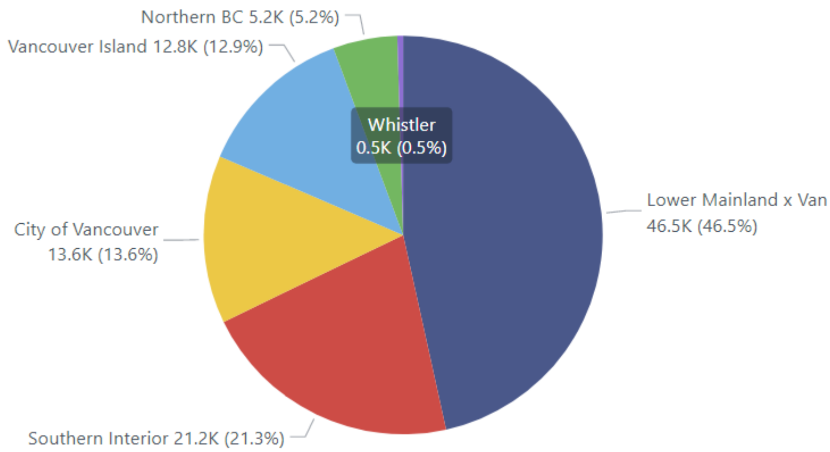
Base year commercial natural gas accounts are presented by segment in Exhibit 62 and by region in Exhibit 63. As shown in these exhibits, in 2019 the greatest number of commercial natural gas accounts were in:

- The other (30%), apartment (27%), office (13%), and nonfood retail (11%) segments
- The Lower Mainland excluding Vancouver region (47% of accounts)

Exhibit 62 – 2019 Commercial Natural Gas Accounts by Segment

Segment	Accounts	%
Other	29,520	30%
Apartment	26,813	27%
Office	13,359	13%
Nonfood Retail	11,211	11%
Restaurant	6,701	7%
Warehouse	4,289	4%
Food Retail	1,857	2%
School	1,713	2%
Hospital	1,640	2%
Hotel	1,534	2%
Nursing Home	660	1%
University/College	524	1%
Total	**99,821**	**100%**

Exhibit 63 – 2019 Commercial Natural Gas Accounts by Region



5.2.2 Tertiary Load

Tertiary load is the useful energy delivered to an end use. In the context of the CPR, tertiary load is the amount of energy required to be delivered as an end use *service*: heat delivered by a boiler to a square meter of office space, for example. This differs from consumption of natural gas which is impacted by the efficiency of the equipment: in the boiler example, consumption is equal to the tertiary load divided by the seasonal efficiency of the boiler.

5.2.3 Unit Energy Consumption

Recall that unit energy consumption (UEC) is the amount of energy used by each end use per unit (a "unit" in the commercial sector is square meter of floor area) and fuel share is the percentage of the energy end use that is supplied by each fuel.

This section presents a sample calculation of UEC for the space heating end use. Along with UEC values is *unit tertiary load*, which is the average tertiary load, by end use, per square meter, and *stock average efficiency*, which is the average efficiency of equipment serving the tertiary load for that end use. These values are included in the table because UEC by end use is calculated by dividing unit tertiary load with stock average efficiency. Values are presented for one segment, region and end use as an example.

Exhibit 64 presents unit tertiary load, stock average efficiency and UEC values for space heating in large offices in the Lower Mainland excluding Vancouver region.

Exhibit 64 – 2019 Space Heating UEC values by End Use, Large Offices in the Lower Mainland

	Unit Tertiary Load ($GJ/m^2.yr.$)	Stock Average Efficiency (%)	UEC ($GJ/m^2.yr.$)
Space heating	0.3	80%	0.3

5.2.4 Average Natural Gas Use per Building

The following exhibit presents average annual natural gas consumption per m^2 for space heating. Included in the exhibit is:

- UEC: the amount of energy used by each end use per unit. The "unit" in commercial sector is square meter of floor area.
- Fuel Share: the percentage of the energy end use that is supplied by each fuel (in this case, natural gas).
- Saturation: reflects the extent to which an end use is present in a region, and segment.

Average annual gas consumption per unit is calculated by multiplying these three variables together; therefore, they are included in the table below. Values are presented for one segment, region and end use as an example.

Exhibit 65 presents average annual gas use for space heating per large office in the Lower Mainland excluding Vancouver ("LML") region.

Exhibit 65 – 2019 Average Annual Space Heating Gas Use Per m^2, Large Offices, LML

	UEC	Fuel Share	Saturation	Average Annual Gas Use ($GJ/m^2.yr.$)
Space heating	0.3	75%	100%	0.25

5.3 Reference Case Natural Gas Use

This section profiles the reference case forecast (2020-2040) natural gas consumption for the commercial sector.

Overall gas consumption in the commercial sector is forecasted to increase over time: consumption in 2040 is expected to be approximately 26% higher than consumption in 2020, with an average annual increase of about 1% from 2020 to 2040. Consumption patterns from 2019 base year are expected to persist throughout the reference case. Natural gas is expected to continue to be used largely in apartments, other and office segments (as shown in Exhibit 66), for space heating (Exhibit 67) and in the Lower Mainland excluding Vancouver region (Exhibit 68).

The forecasted increase in commercial gas consumption can be explained by the following trends:

- There is a forecasted increase in the number of commercial accounts, as seen in Exhibit 69. The growth in accounts is somewhat counterbalanced by a decrease in usage per square meter. However, the decrease in usage per square meter is less than 0.5% per year on average while the increase in floor area due to account growth is more than 1.5% per year. The net result is consumption is forecasted to increase by about 1% per year.
- FortisBC has observed ongoing growth in commercial accounts in recent years with little change in usage per customer. The growth we have estimated is somewhat less than the historical trend, because of our assumed improvement in efficiency. We expect growth in commercial consumption to be further reduced by the future Step Code changes.

Exhibit 66 – 2020 vs 2040 Commercial Gas Consumption Forecast (GJ) by Segment

Segment	2020	2040	Change %
Apartment	19,968K	24,618K	23%
Other	12,440K	15,991K	29%
Office	7,205K	9,086K	26%
Restaurant	4,373K	5,743K	31%
Nonfood Retail	3,634K	4,701K	29%
Warehouse	4,215K	4,639K	10%
Hotel	2,540K	3,628K	43%
Hospital	3,082K	3,437K	12%
School	2,320K	3,319K	43%
Nursing Home	1,713K	2,608K	52%
Food Retail	1,478K	2,194K	48%
University/College	1,986K	2,009K	1%
Total	**64,953K**	**81,973K**	**26%**

Space heating and water heating end uses are expected to grow slower than other end uses, as shown in Exhibit 67. This also implies a slight decline in their ratio to overall building consumption by 2040. This decline is largely driven by:

- Improved new construction practices and more stringent equipment performance standards.
- Natural replacement of space heating and water heating equipment at the end of life. It is assumed that 50% of those replacing such equipment would adopt space heating equipment that was 85% efficient and water heating equipment that was 80% efficient. As a result, the average consumption per square meter for these two end uses was assumed to be declining slightly with time.

Exhibit 67 – 2020 vs 2040 Commercial Gas Consumption Forecast (GJ) by End Use

Parent End Use	2020	2040	Change %
Space heating	36,063K	45,300K	26%
Water heating	19,948K	24,552K	23%
Food Service	4,907K	6,780K	38%
Other	3,448K	4,557K	32%
Pools; Spas & Hot Tubs	587K	784K	34%
Total	**64,953K**	**81,973K**	**26%**

Exhibit 68 – 2020 vs 2040 Commercial Gas Consumption Forecast (GJ) by Region

Region	2020	2040	Change %
Lower Mainland x Van	31,574K	39,777K	26%
City of Vancouver	13,746K	16,815K	22%
Southern Interior	9,274K	13,076K	41%
Vancouver Island	6,877K	7,429K	8%
Northern BC	2,834K	3,975K	40%
Whistler	648K	901K	39%
Total	**64,953K**	**81,973K**	**26%**

Exhibit 69 – 2020 vs 2040 Commercial Gas Accounts Forecast by Segment

Segment	2020	2040	Change %
Other	29,862	37,176	24%
Apartment	27,174	33,437	23%
Office	13,492	16,116	19%
Nonfood Retail	11,320	13,503	19%
Restaurant	6,777	8,329	23%
Warehouse	4,330	5,168	19%
Food Retail	1,880	2,346	25%
School	1,740	2,319	33%
Hotel	1,556	2,010	29%
Hospital	1,656	1,973	19%
Nursing Home	672	971	44%
University/College	529	662	25%
Total	**100,988**	**124,010**	**23%**

5.3.1 Commercial Reference Case Natural Gas Use: Existing versus New Buildings

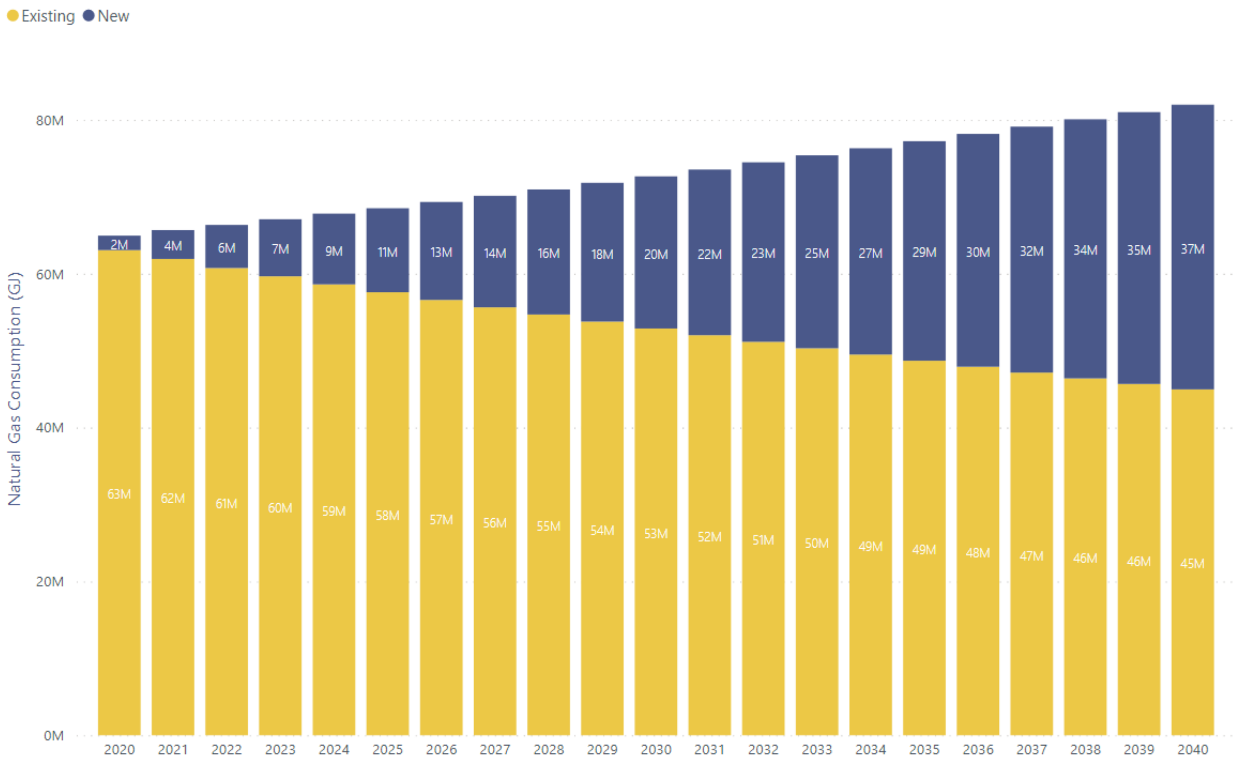
This section compares the consumption in existing versus new commercial facilities in the reference case forecast. Estimated new construction rates are drawn from rate-class level estimates developed by FEI and are applied by segment. Demolition rates are estimated at approximately 2% of floor area per year and held constant across segments. It is assumed that existing commercial buildings that are demolition are replaced by newly constructed buildings. This results in a forecasted commercial gas account increase of 23% by 2040, as shown in Exhibit 70.

In 2020, natural gas consumption from new buildings was roughly two million GJ, or 3% of the total commercial sector consumption. By 2040, new buildings are forecasted to use 37 million GJ (45% of total sector), as shown in Exhibit 71.

Exhibit 70 – 2020 vs 2040 Commercial Gas Accounts Forecast by Existing and New Vintage

Existing/New	2020	2040	Change %
Existing	97,844	65,843	-33%
New	3,144	58,167	1,750%
Total	**100,988**	**124,010**	**23%**

Exhibit 71 – 2020 vs 2040 Commercial Gas Consumption Forecast (GJ) by Existing and New Vintage



5.4 Measure Assessment

5.4.1 List of Measures

The list of commercial measures that were included in this CPR are presented in Exhibit 72. The measures are divided into categories by end use and measure type.

Please see the MS Excel file entitled "Com_Measure Analysis Workbook" for a description of each measure and a full analysis.

Measures were classified in five measure type categories:

- Building Envelope
- Equipment
- Controls
- Energy Management (including behavioral measures)
- New Construction – all new construction measures were placed in a separate category

New construction measures are analyzed using a whole-building approach, represented by the Step 2 - Step 4 BC Energy Step Code measures listed below. See Appendix O of the CPR Appendices document for the modelling approach used to assess these measures.

Exhibit 72 – Commercial Sector Conservation and Energy Management Measures

Appliances – Equipment Demand Control Kitchen Ventilation Efficient Pre-Rinse Spray Valve Efficient Commercial Cooking Equipment ENERGY STAR Dishwasher ENERGY STAR Clothes washer	**New Construction** Step 2 Level-of-Performance Step 3 Level-of-Performance Step 4 Level-of-Performance
Pool & Spa Heaters – Equipment Indoor Pool Cover Outdoor Pool Cover Solar Water Pool Heating	**Space Heating – Equipment** Advanced BAS Advanced Thermostats Air Curtains Condensing Boiler – Early/ROB Condensing MUAs – Early/ROB Condensing Unit Heaters Destratification Fans Dock Door Seals

Space Heating – Envelope

Deep Energy Retrofits[39]
High-Performance Air Sealing
High-Performance Window Upgrade
Low-e Window Film
Panelized Retrofit
Roof Insulation
Wall Insulation

Electric Air-to-Water Heat Pump with Existing Gas Furnace or Boiler Backup (Dual-Fuel Measure)
Electric Air-to-Water Heat Pump with New Gas Furnace or Boiler Backup (Dual-Fuel Measure)
Energy Recovery Ventilators
Gas Boiler/Furnace Tune-Up
Hydronic Additives
Heat Recovery – Waste Heat Chiller
Heat Recovery Ventilator
Infrared Heaters
Residential-Style Condensing Furnace – Early/ROB
Reverse Flow Heat Recovery Ventilator
Strip Curtains
Vertical Direct Vent Fireplaces

Controls

Advanced Remote Terminal Unit (RTU) Controls
Boiler Combustion Controls
Boiler Cycling Controls
Boiler Zoning Controls
DHW Recirculation Controls
Hotel Occupancy Controls
Return Water Temperature Optimization

Space Heating & Water Heating - Equipment

Gas Heat Pumps – Combination Systems

Water Heating - Equipment

Condensing DHW – On-Demand
Condensing DHW – Storage
Condensing DHW Supply Boilers
DHW Tank Insulation
Drain Water Heat Recovery
Faucet Aerators
Low-Flow Showerhead
Pipe Insulation
Solar DHW Preheat
Thermostatic Shower Restriction Valve

Energy Management and Other

Building Energy Report
Comprehensive Recommissioning
Heat Recovery – Health Care Sterilizers
Multi-Unit Gas Submetering
Occupant Behaviour
Refrigeration Waste Heat Recovery
Rink De-Aerator
Solar Air Preheating
Steam to Hot Water Conversion

[39] Note that analysis that forms the technical, economic and market potential is based on individual measures rather than on "packages of measures" or program delivery approaches. Measures packaged in comprehensive programs such as FortisBC's Rental Apartment Efficiency program, Social Housing Retrofit Support program and deep energy retrofits were assessed within this analysis individually but not also collectively as a program package.

5.4.2 Results

Exhibit 73 shows measure-level results for the commercial sector in order of decreasing cost effectiveness. Measures were assessed based on their replacement type: **retrofit** (immediate replacement at full cost), **replace on burnout** (end of life replacement at incremental cost), or **new construction** (immediate installation at incremental cost).

The TRC and MTRC are presented at the measure-level and exclude program costs and free ridership.

Key findings of the measure assessment for the commercial sector include:

- Of the 71 measures included in the assessment, 46 pass the TRC screen and 69 pass the MTRC screen.
- New Construction Step 2 and 3 pass the TRC screen and Step 4 does not.
- Gas heat pumps (Combination type) pass the TRC.
- Aerosol-applied air sealing passes TRC screen, with significant potential for energy savings in existing buildings (especially MURBs).

Exhibit 73 – Commercial Sector Measures with Average TRC and MTRC Results

#	Measure	Measure Type	Replacement Type	TRC	MTRC
1	ESTAR Dishwasher	Equipment	ROB	10	10
2	Boiler Cycling Controls	Equipment	RET	6.9	34.5
3	Steam Trap	Equipment	RET	5.3	28.1
4	DHW Tank Insulation	Equipment	RET	5.5	27.9
5	Efficient Cook Equipment	Equipment	ROB	5	25.1
6	DC Kitchen Vent	Energy Management	RET	4.9	24.6
7	Faucet Aerators	Equipment	RET	4.4	22.3
8	Boiler Zoning Controls	Equipment	RET	6	20.8
9	Occupant Behaviour	Energy Management	RET	3.6	20
10	BoilerFurnace Tune-Up	Equipment	RET	3.6	19.4
11	Efficient Pre-Rinse Spray	Equipment	RET	3.6	19
12	Refrigeration Heat Recovery	Equipment	RET	3.1	15.3
13	Low Flow Showerhead	Equipment	RET	2.8	14.5
14	Dock Door Seal	Equipment	RET	2.9	13.7
15	Lower Boiler Return Temp	Equipment	RET	2.5	11.9
16	Condensing Storage DHW	Equipment	ROB	2.1	10.6
17	Condensing Boiler (Early)	Equipment	RET	2	10.6
18	Direct Vent Fireplace	Equipment	ROB	2.1	10.2
19	Advanced Thermostat	Energy Management	RET	3.8	9.5
20	Air Curtain	Building Envelope	RET	1.9	9.4
21	Strip Curtains	Equipment	RET	1.8	9.4
22	Pipe Insulation	Equipment	RET	1.9	9.3
23	Condensing Boiler (ROB)	Equipment	ROB	1.9	9
24	Air Sealing	Building Envelope	ROB	1.7	7.8

25	Condensing On-Demand DHW	Equipment	ROB	1.6	7.8
26	Business Energy Report	Energy Management	RET	1.8	7
27	Condensing Make Up Air (ROB)	Equipment	ROB	1.4	6.9
28	Condensing Unit Heater	Equipment	RET	1.4	6.9
29	Solar Preheat	Equipment	RET	1.5	6.9
30	Recirculation Demand Control	Controls	RET	1.4	6.6
31	Reverse Flow Energy Recovery Ventilator	Equipment	ROB	1.3	6.5
32	Infrared Heaters	Equipment	RET	1.4	6.3
33	Boiler Combustion Controlss	Equipment	RET	1.2	5.9
34	Passive Drain Water Heat Recovery (DWHR)	Equipment	RET	1.1	5.3
35	Gas Heat Pumps - Combination	Equipment	ROB	1	5.1
36	Condensing Supply Boiler	Equipment	ROB	1.1	5
37	Heating Loop Additive	Equipment	ROB	0.9	5
38	Comprehensive Recommissioning (RCx)	Energy Management	RET	1.4	4.5
39	HRV	Equipment	ROB	0.9	4.3
40	NC Step 2 - Res	New Construction	NEW	1.9	4.3
41	NC Step 2 - Com	New Construction	NEW	2.1	4.3
42	NC Step 2 - Non-Step	New Construction	NEW	2.1	4.2
43	Hotel Controls	Equipment	RET	2	4.1
44	Steam to Hot Water	Energy Management	RET	0.8	3.9
45	Heat Recovery Chiller	Equipment	ROB	0.8	3.9
46	ERV	Equipment	ROB	0.8	3.9
47	NC Step 3 - Non-Step	New Construction	NEW	1.4	3.3
48	ESTAR Clothes Washer	Equipment	ROB	0.7	3.3
49	Window Film	Building Envelope	RET	2.2	3.3
50	NC Step 3 - Res	New Construction	NEW	1.3	3.2
51	NC Step 3 - Com	New Construction	NEW	1.4	3.2
52	Dual-Fuel-Electric Retrofit	Equipment	RET	0.6	3.1
53	Vortex De-Aerators	Equipment	RET	0.6	3
54	Dual-Fuel-Electric ROB	Equipment	RET	0.6	2.9
55	Indoor Pool Cover	Equipment	RET	0.5	2.8
56	Destratification	Equipment	RET	0.6	2.7
57	Advanced Building Automation System (BAS)	Equipment	RET	0.5	2.3
58	Condensing Make Up Air (Early)	Equipment	RET	0.4	2.2
59	RTU Controls	Equipment	RET	1.2	2.2
60	Roof Insulation	Building Envelope	ROB	0.5	2.2
61	Residential Furnace (ROB)	Equipment	ROB	0.4	2.1
62	Window Upgrade	Building Envelope	ROB	0.4	2.1

63	NC Step 4 - Non-Step	New Construction	NEW	0.7	1.7
64	Residential Furnace (Early)	Equipment	RET	0.3	1.7
65	NC Step 4 - Res	New Construction	NEW	0.6	1.6
66	Sterilizer Heat Recovery	Equipment	RET	0.3	1.5
67	Solar Water Pool	Equipment	RET	0.3	1.2
68	Submetering	Equipment	RET	0.2	1.2
69	Thermostat Shower Valve	Equipment	RET	0.2	1
70	Solar DHW Preheat	Energy Management	RET	0.2	0.8
71	Wall Insulation	Building Envelope	ROB	0.2	0.8

5.5 Technical Potential

This section provides an overview of the technical potential savings results for the commercial sector. Overall results are presented below, followed by measure level results and supply curves for the TRC and MTRC results.

As shown in Exhibit 74, the majority of the commercial technical potential (24 PJ) would be available in 2021 and would increase to 35 PJ in 2040. This indicates that a lot of the available potential (around 11 PJ) would come from replace on burnout measures over the next two decades. The forecasted natural gas consumption is included for reference.

Exhibit 74 – Commercial Technical Potential Savings (GJ)

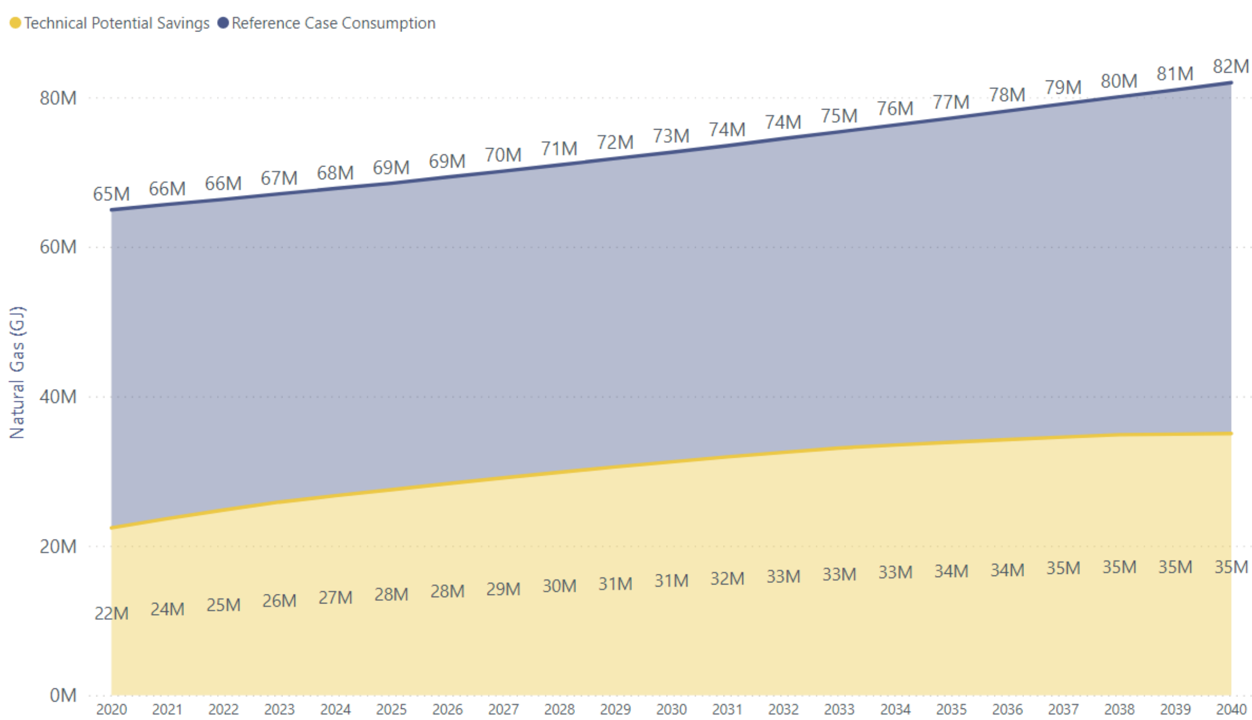
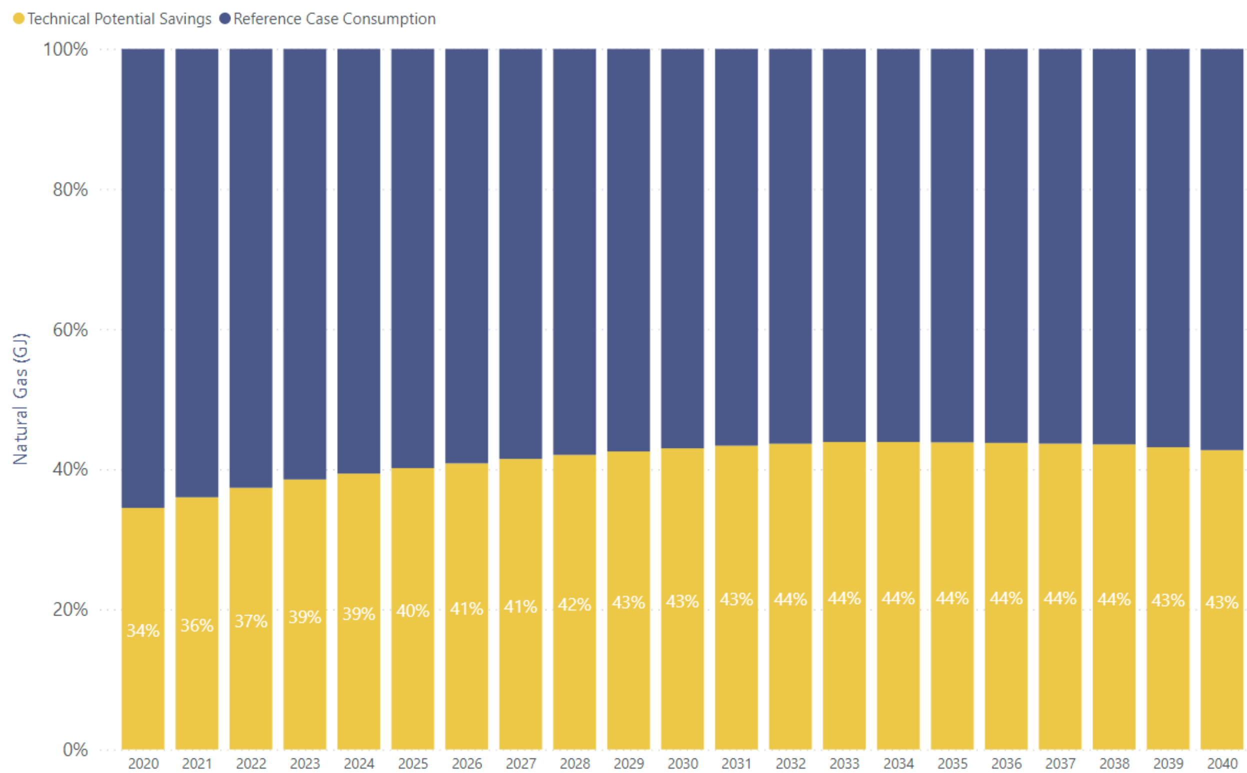


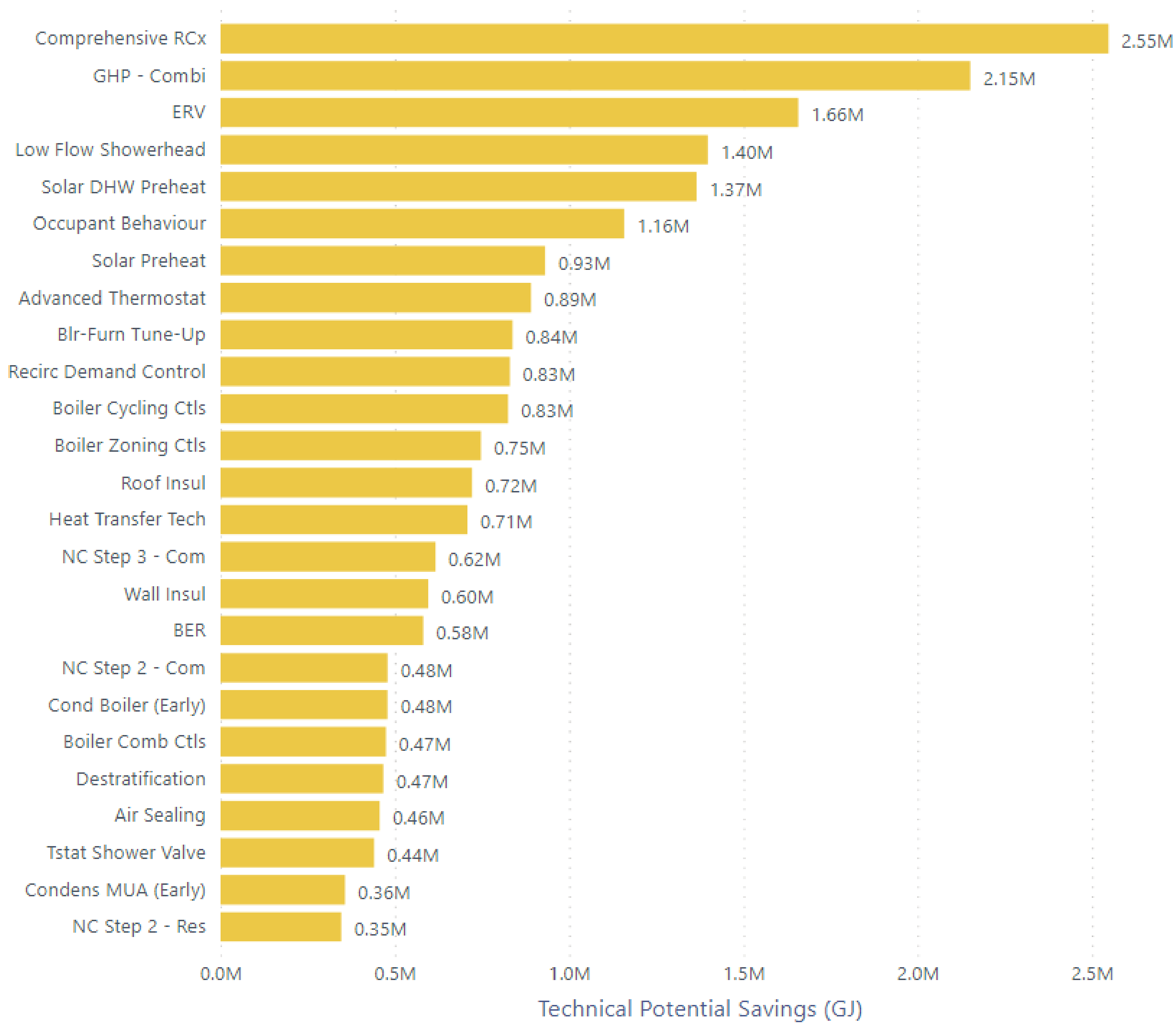
Exhibit 75 – Technical Savings Potential as a Percent of Commercial Reference Case Consumption (%)



As shown in Exhibit 75, the technical potential savings is about 36% of commercial reference case consumption in 2021 and increases to 43% by 2040, further indicating a fairly balance mix of potential from both retrofit and replace on burnout measures.

The technical potential savings in 2025 broken down by measure (only the top 25 measures are shown) are presented in Exhibit 76. From the top 5 measures that are expected to contribute the majority of the technical potential savings, only Solar DHW Preheat does not pass the TRC test. This means that the rest (the top 4) will also be expected to contribute largely to economic potential savings, as described in the following section.

Exhibit 76 – Technical Potential - Top 25 Commercial Measures in 2025 (GJ)

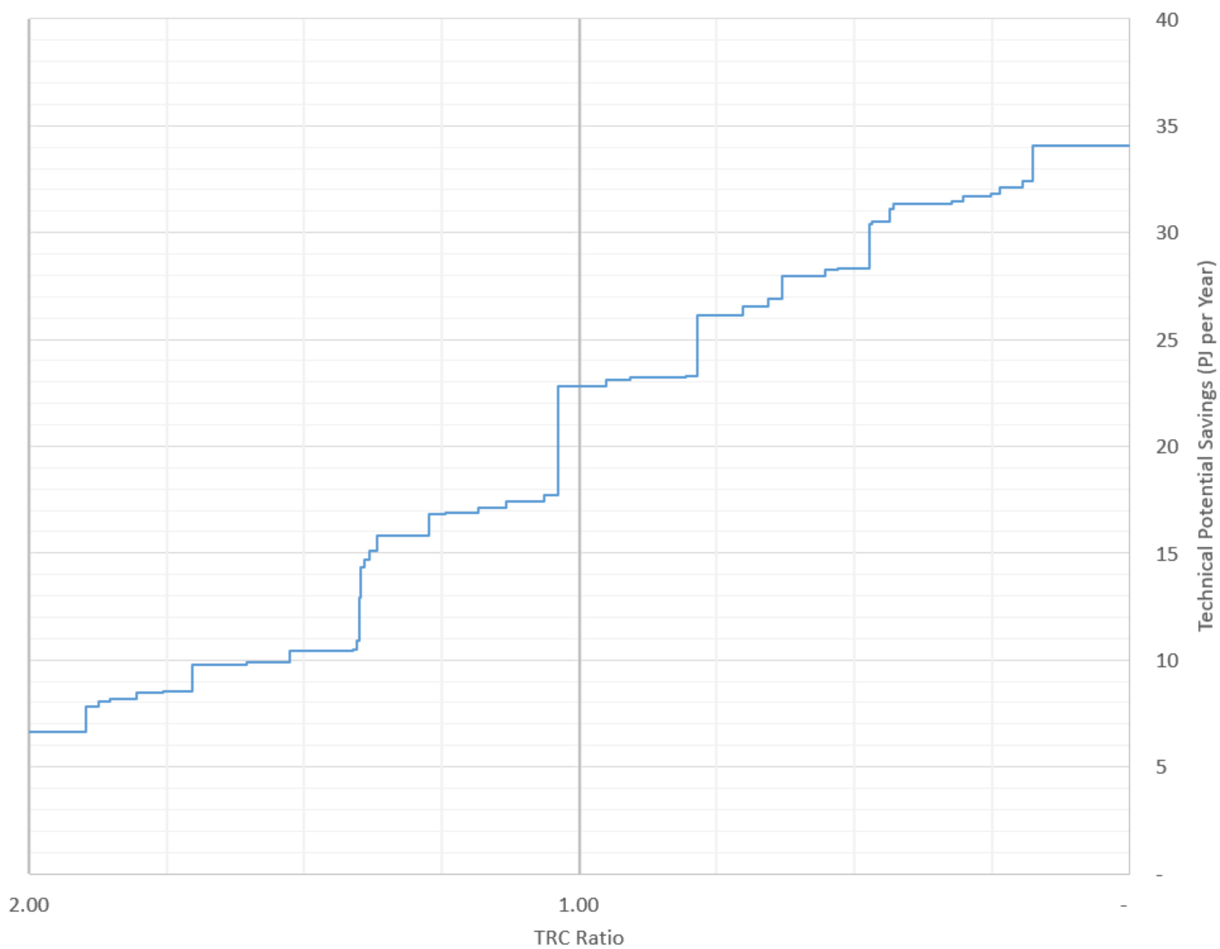


The cumulative commercial sector technical potential savings in 2040 are presented in Exhibit 77 as a supply curve, with measures ordered by decreasing TRC ratio from left to right.

As shown, approximately 68% of the commercial sector technical potential savings (approximately 23 of 34 PJ) comes from measures with a TRC of 1.0 or higher.

Approximately 7 PJ of savings come from measures with a TRC ratio of greater than 7. These are shown in aggregate.

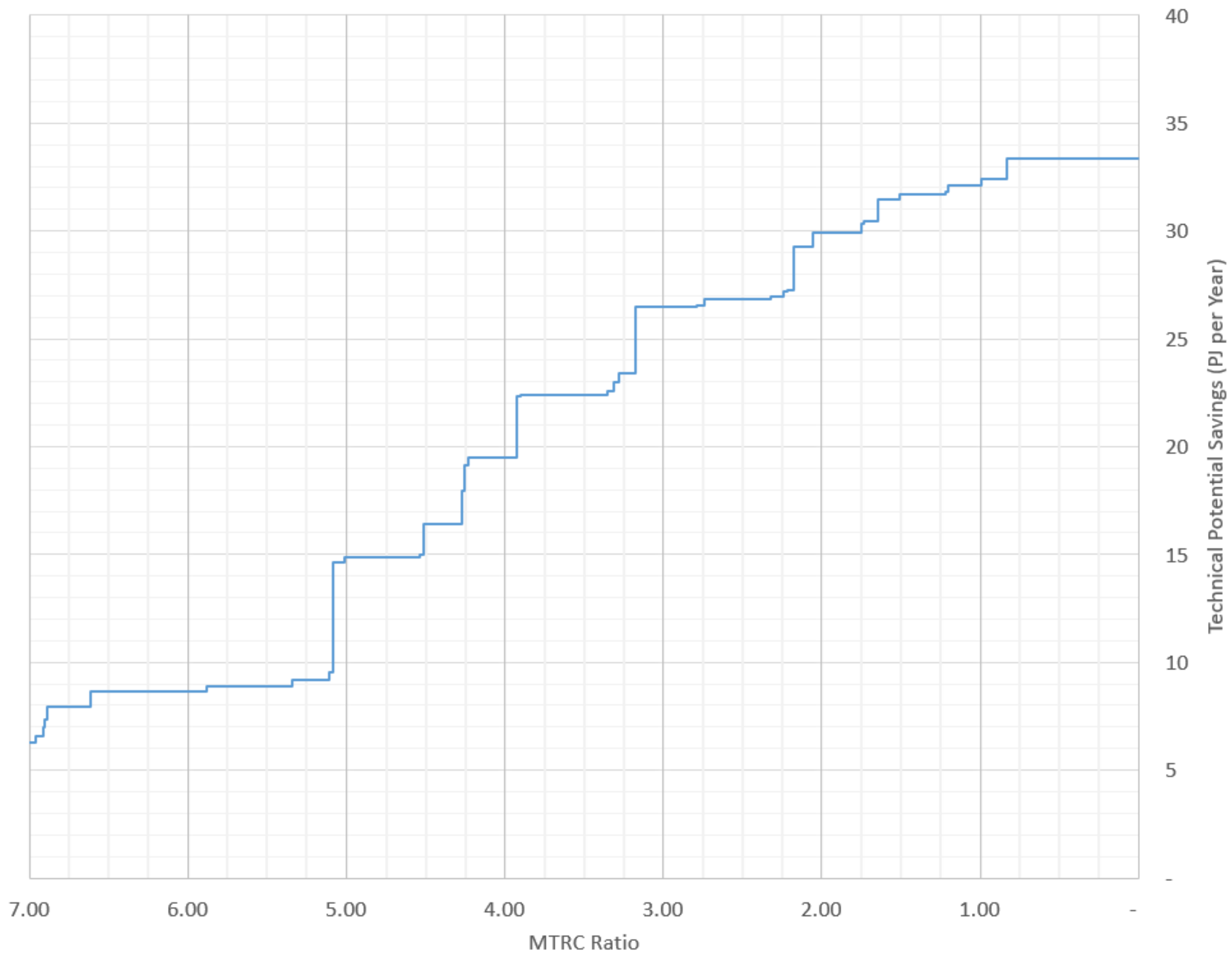
Exhibit 77 – Commercial Sector: Technical Potential Gas Supply Curve in 2040 – TRC Ratio



Similar to Exhibit 77, the cumulative commercial sector technical potential savings in 2040 are presented in Exhibit 78 as a supply curve, with measures ordered by decreasing MTRC ratio from left to right.

As shown, approximately 95% of the commercial sector technical potential savings (approximately 32 of 34 PJ) by 2040, comes from measures with an MTRC of 1.0 or higher. Approximately 6 PJ of savings come from measures with an MTRC ratio of greater than 7. These are shown in aggregate.

Exhibit 78 – Commercial Sector: Technical Potential Supply Curve – MTRC Ratio

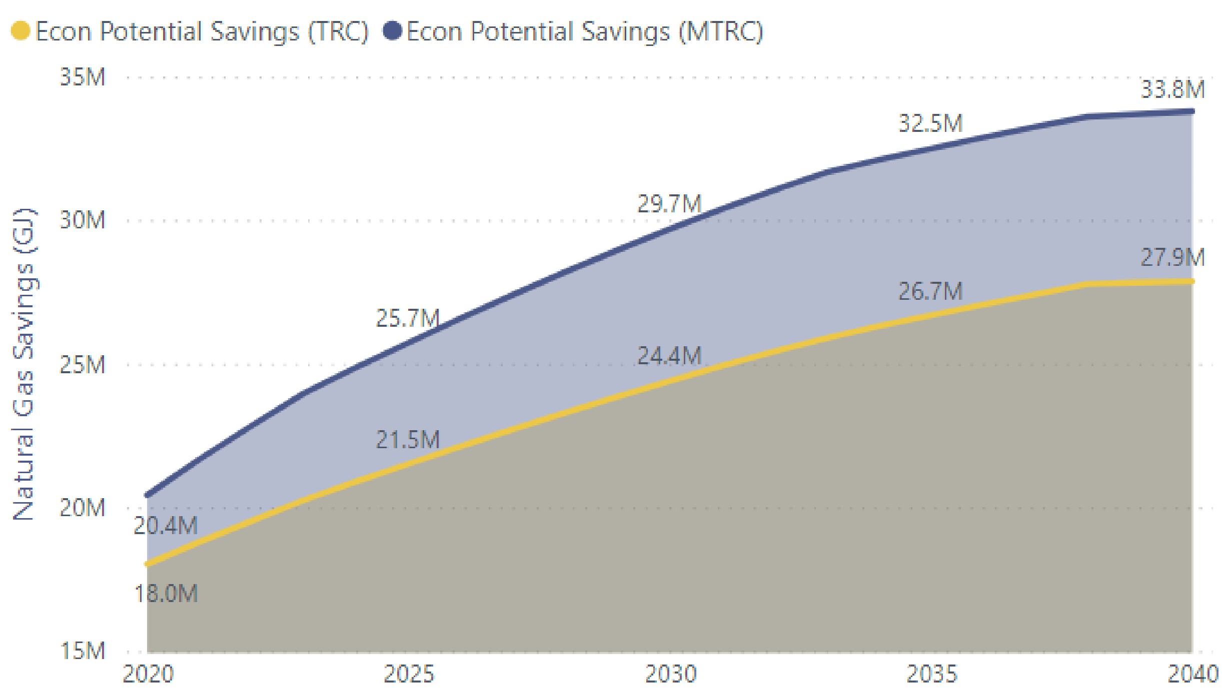


5.6 Economic Potential

This section provides the economic potential savings results for the commercial sector from 2020 to 2040. We conducted two economic potential assessments: one using a TRC Screen that includes measures with a TRC ratio of 1 and above, and one using an MTRC screen that includes measures with an MTRC of 1 and above. Outputs of both economic models are presented in this section.

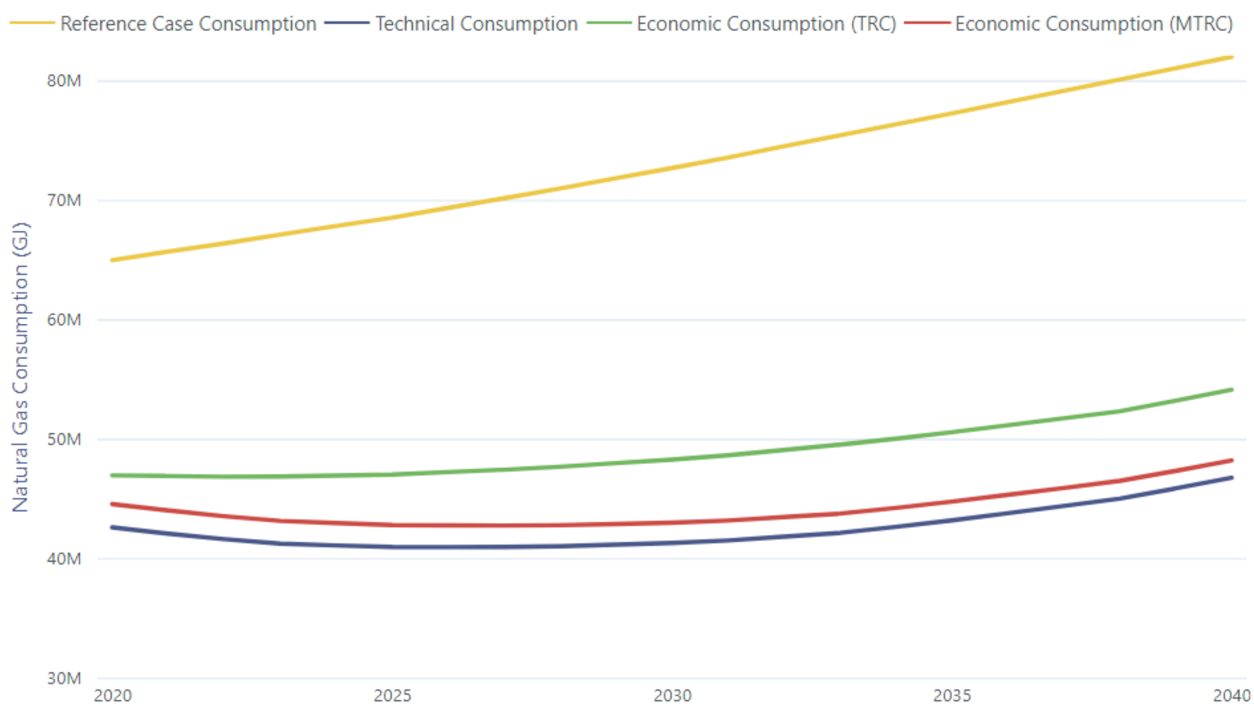
The commercial sector economic potential savings with a TRC screen and with an MTRC screen are shown in Exhibit 79. As mentioned earlier, of the 72 measures included in the assessment, 52 pass the TRC screen and 70 pass the MTRC screen. The 18 measures that that pass the MTRC but fail the TRC make up the difference between the two economic potential scenarios. The difference in economic potential in 2025 is around 4.2 PJ. Another way to look at it that the 84% of the MTRC economic potential comes from measures that pass the TRC as well.

Exhibit 79 – Economic Potential Savings (GJ) – Commercial, TRC and MTRC



The forecasted gas consumption under the technical potential, economic potential with a TRC screen, economic potential with an MTRC screen, and reference case scenarios for the commercial sector are shown in Exhibit 80. The slight uptick at the beginning of the curves is due to the implementation of the retrofit measures. The rest of the curves follow the shape of the reference case curve, as the replace on burnout measures are implemented at equipment end of life.

Exhibit 80 – Economic Potential Consumption (GJ) Forecasts – Commercial, TRC and MTRC



Results by Region

The TRC and MTRC economic potential savings in 2025 are presented by region in Exhibit 81 and Exhibit 82 respectively. The largest economic potential savings (10 PJ to 12.6 PJ depending on economic screen) are estimated to occur in the Lower Mainland outside of the City of Vancouver. Although small in absolute savings, the largest percentage of savings is expected to be captured in northern BC (more than 39% of reference case consumption).

Exhibit 81 – Economic Potential Savings by Region in 2025 – Commercial, TRC

Region	Consumption (GJ)	Economic Potential Savings (GJ)	Economic %
Lower Mainland x Van	33,493K	10,254K	31%
City of Vancouver	14,237K	4,418K	31%
Southern Interior	10,124K	3,322K	33%
Vancouver Island	6,863K	2,146K	31%
Northern BC	3,082K	1,200K	39%
Whistler	713K	171K	24%
Total	**68,513K**	**21,511K**	**31%**

Exhibit 82 – Economic Potential Savings by Region in 2025 – Commercial, MTRC

Region	Consumption (GJ)	Economic Potential Savings (GJ)	Economic %
Lower Mainland x Van	33,493K	12,634K	38%
City of Vancouver	14,237K	5,268K	37%
Southern Interior	10,124K	3,866K	38%
Vancouver Island	6,863K	2,470K	36%
Northern BC	3,082K	1,287K	42%
Whistler	713K	206K	29%
Total	**68,513K**	**25,731K**	**38%**

Results by Segment

The TRC and MTRC economic potential savings in 2025 are presented by segment in Exhibit 83 and Exhibit 84 respectively. The largest amounts of savings are expected to occur in apartments, other, and office segments. In both economic scenarios, the highest percentage of savings are expected to be captured offices, schools, university colleges.

Exhibit 83 – Economic Potential Savings by Segment in 2025 – Commercial, TRC

Segment	Consumption (GJ)	Economic Potential Savings (GJ)	Economic %
Apartment	20,961K	6,496K	31%
Other	13,284K	3,713K	28%
Office	7,633K	3,047K	40%
Warehouse	4,241K	1,361K	32%
Hospital	3,167K	1,198K	38%
Nonfood Retail	3,888K	1,124K	29%
School	2,549K	1,039K	41%
Hotel	2,800K	872K	31%
Restaurant	4,666K	859K	18%
University/College	1,752K	692K	40%
Nursing Home	1,940K	585K	30%
Food Retail	1,633K	525K	32%
Total	**68,513K**	**21,511K**	**31%**

Exhibit 84 – Economic Potential Savings by Segment in 2025 – Commercial, MTRC

Segment	Consumption (GJ)	Economic Potential Savings (GJ)	Economic %
Apartment	20,961K	7,683K	37%
Other	13,284K	4,306K	32%
Office	7,633K	3,710K	49%
Warehouse	4,241K	1,935K	46%
Hospital	3,167K	1,382K	44%
Nonfood Retail	3,888K	1,273K	33%
School	2,549K	1,268K	50%
Hotel	2,800K	1,038K	37%
Restaurant	4,666K	989K	21%
University/College	1,752K	879K	50%
Nursing Home	1,940K	718K	37%
Food Retail	1,633K	551K	34%
Total	**68,513K**	**25,731K**	**38%**

Results by End Use

The TRC and MTRC economic potential savings in 2025 are presented by segment in Exhibit 85 and Exhibit 86 respectively. The largest amounts, in absolute savings, as well as the highest percentage of savings relative to reference case consumption, are expected to be captured under the space heating end use (40% to 49% depending on the economic scenario).

Exhibit 85 – Economic Potential Savings by End Use in 2025 – Commercial, TRC

Parent End Use	Consumption (GJ)	Economic Potential Savings (GJ)	Economic %
Space Heating	37,973K	15,088K	40%
Water heating	20,913K	6,218K	30%
Food Service	5,322K	205K	4%
Other	3,674K	0K	0%
Pools; Spas & Hot Tubs	632K	0K	0%
Total	**68,513K**	**21,511K**	**31%**

Exhibit 86 – Economic Potential Savings by End Use in 2025 – Commercial, MTRC

Parent End Use	Consumption (GJ)	Economic Potential Savings (GJ)	Economic %
Space Heating	37,973K	18,543K	49%
Water heating	20,913K	6,707K	32%
Pools; Spas & Hot Tubs	632K	274K	43%
Food Service	5,322K	205K	4%
Other	3,674K	0K	0%
Total	**68,513K**	**25,731K**	**38%**

The TRC and MTRC economic potential savings in 2040 are presented by end use in Exhibit 87. The difference of almost 6 PJ is mostly a result of more space heating measures being included in the MTRC scenario. A small but interesting change is the pools, spas, and hot tubs end use, which contributed no savings under the TRC scenario, but has 219K GJ of economic potential under the MTRC.

Exhibit 87 – Economic Potential Savings by End Use in 2040 – Commercial, TRC and MTRC

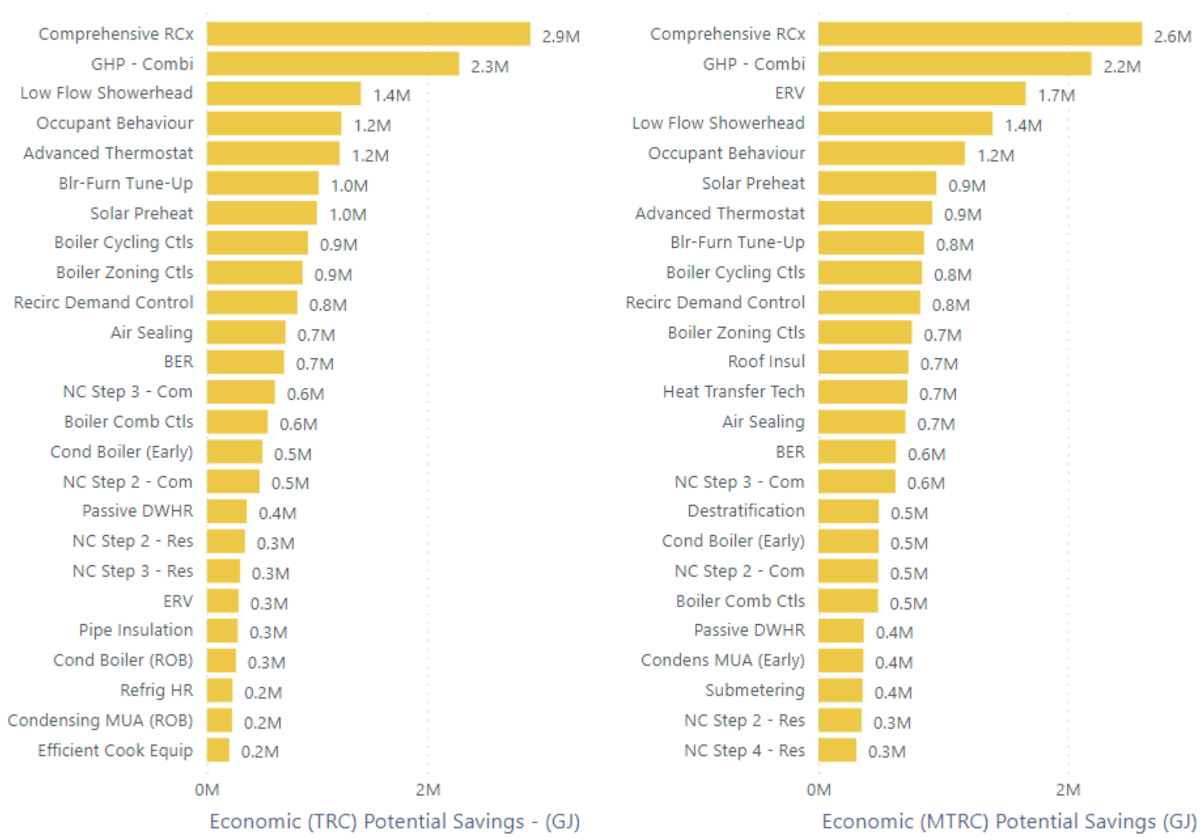
Parent End Use	Economic Savings (GJ) - TRC	Economic Savings (GJ) - MTRC	Difference (GJ)
Space Heating	19,735K	24,646K	4,910K
Water heating	7,822K	8,609K	787K
Food Service	313K	313K	0K
Pools; Spas & Hot Tubs	0K	219K	219K
Other	0K	0K	0K
Total	**27,870K**	**33,786K**	**5,916K**

Results by Measure

The economic potential savings in 2025 broken down by measure (only the top 25 measures are shown) are presented in Exhibit 88. The top measures in the TRC economic potential are shown on the left and on the MTRC scenario is shown on the right. Comprehensive recommissioning and combination gas heat pumps top the list in both scenarios. The MTRC scenario list on the right is almost similar to the top technical potential measures presented in Exhibit 76.

The main differences between the TRC and MTRC list are that the energy recovery ventilators (ERVs) become one of the top measures under MTRC. Other notable additions to the MTRC scenario include heat transfer technologies and roof insulation measures.

Exhibit 88 – Economic Potential (TRC on Left, MTRC on Right) - Top 25 Commercial Measures in 2025 (GJ)



5.7 Market Potential

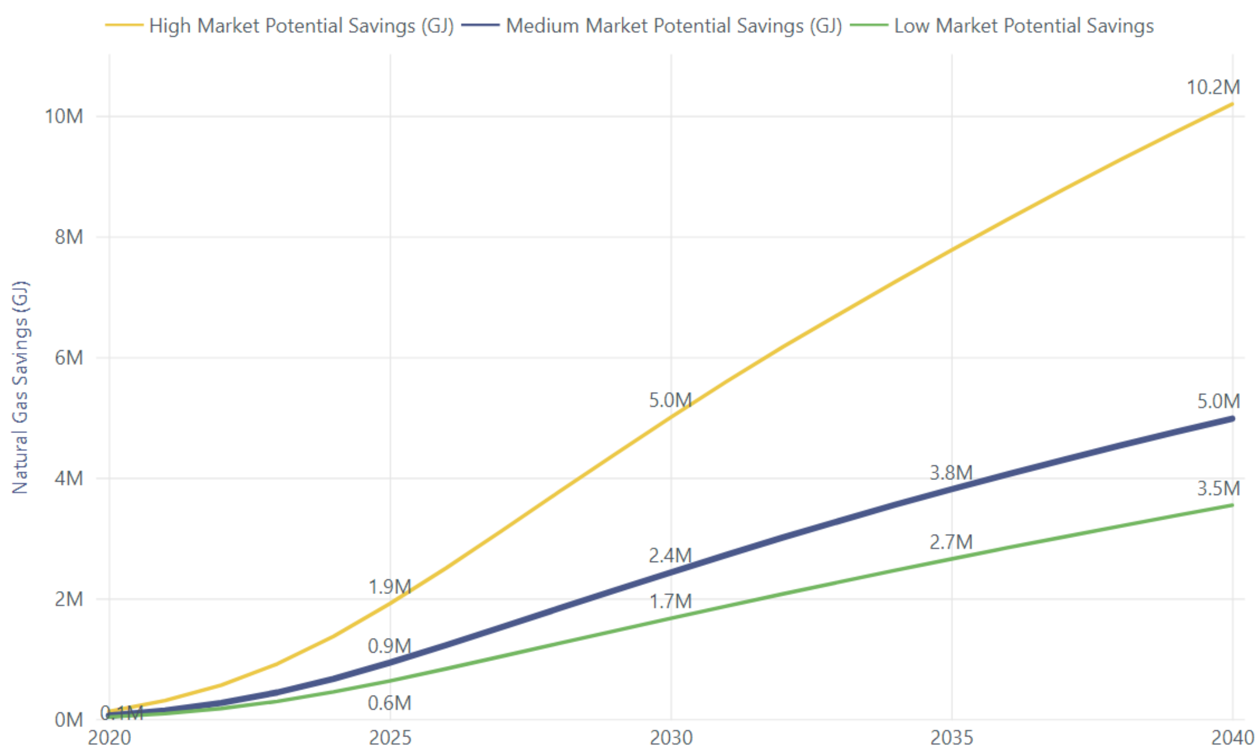
This section provides an overview of the low, medium, and high market potential results for the commercial sector.

Low, medium, and high scenarios assume that measure incentive levels will be 25%, 50% and 100% of incremental costs, respectively. For example, assume that a high-efficiency furnace may cost $200 more than a standard furnace, meaning the furnace would have an incremental cost of $200. In the medium scenario, this measure's hypothetical incentive from FortisBC would be $100. The other $100 would be paid by the end user. In all scenarios, the non-incentive program costs are assumed to be 15% of the incentive cost. In the example above, FortisBC's non-incentive spending would be $15. FortisBC's total cost for providing the measure to an end user would be $115.

The market potential savings results, with a TRC screen and with an MTRC screen, are shown in Exhibit 89 and Exhibit 90, respectively. The medium, or realistic, market potential scenarios under both economic screens are close, as the majority of the measures pass both screens.

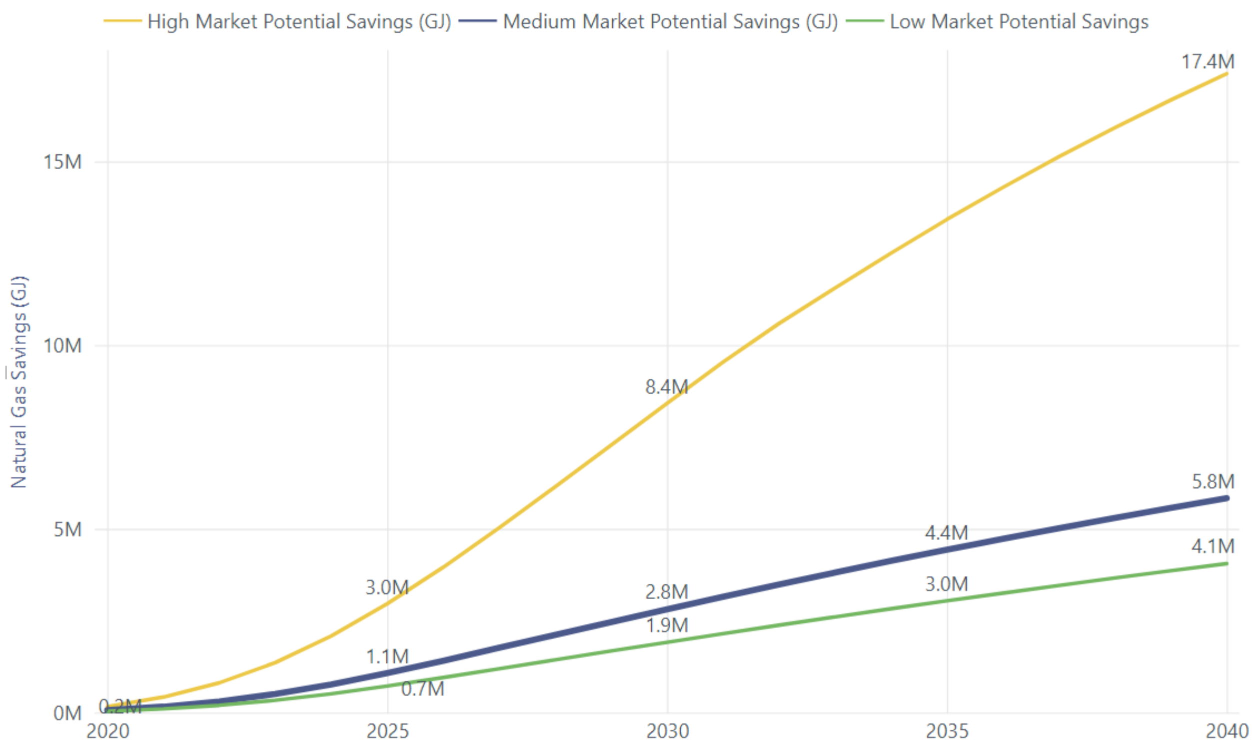
By 2040, the commercial low, medium, and high market TRC potential savings are estimated to be 3.5 PJ, 5 PJ, and 10.2 PJ, respectively.

Exhibit 89 – Market Potential Savings (GJ) – Commercial, TRC



By 2040, the commercial low, medium, and high market MTRC potential savings are estimated to be 4.1 PJ, 5.8 PJ, and 17.4 PJ, respectively.

Exhibit 90 – Market Potential Savings (GJ) – Commercial, MTRC



The high market potential scenario is much higher than the medium market potential in the MTRC scenario. By 2040, the difference in potential between the medium and high market MTRC scenarios is 11.6 PJ. In this case, gas heat pumps (GHPs) are a major factor contributing to the difference:

- For all measures, medium and high scenarios assume that measure incentive levels will be 50% and 100% of incremental costs, respectively.
- In addition to this, gas heat pumps were given different adoption curves in the two scenarios.
- In the medium market scenario, GHPs are modeled as an innovative technology with no current market penetration and low forecasted growth.
- In the high scenario, they are modeled as an innovative technology with no current market penetration, but with high forecasted growth, especially in the second half of the study period (2030-2040).

The difference in MTRC medium and high potential scenarios by 2040, broken down by measure, is shown in Exhibit 91. Only the top 10 measures that contribute to the difference are presented. Gas heat pumps top the list by a sizeable margin, but New Construction Step Code measures and energy recovery ventilators also influence the difference. For comparison, Exhibit 92 shows the difference in TRC medium and high potential scenarios - the absence of gas heat pumps is noticeable here.

Exhibit 91 – Top 10 Commercial Measures Contributing to Difference in Medium and High Market Potential Scenarios (Using MTRC Screen) by 2040

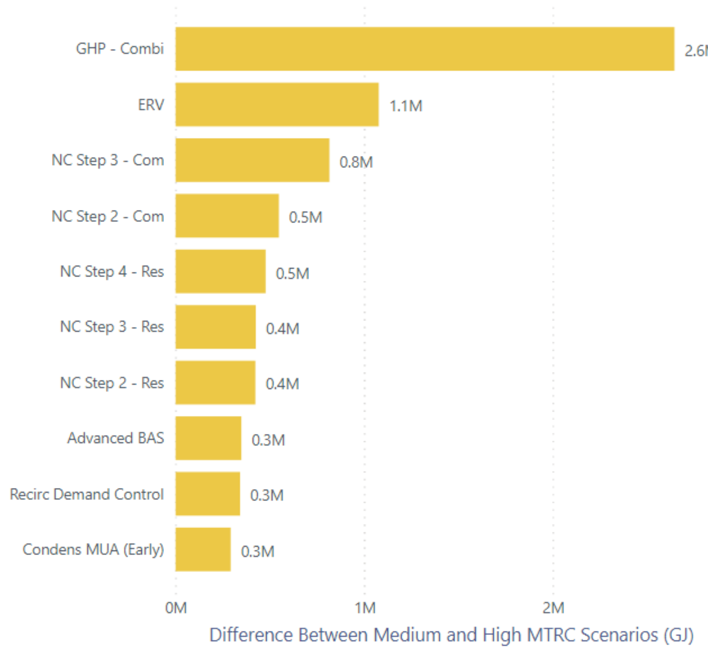
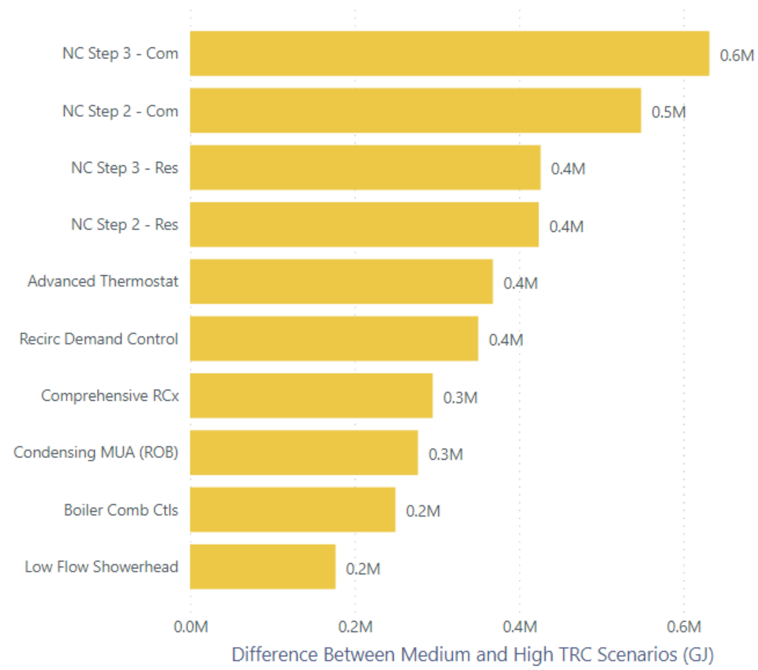


Exhibit 92 – Top 10 Commercial Measures Contributing to Difference in Medium and High Market Potential Scenarios (Using TRC Screen) by 2040



The forecasted gas consumption under the three market potential scenarios relative to reference case scenario for the commercial sector are shown in Exhibit 93 (TRC) and Exhibit 94 (MTRC). By 2040, the commercial low, medium, and high market TRC potential consumption levels are estimated to be 78 PJ, 77 PJ, and 72 PJ, respectively, while reference consumption is forecasted to reach 82 PJ. By 2040, the commercial low, medium, and high market MTRC potential consumption levels are estimated to be 78 PJ, 76 PJ, and 65 PJ, respectively, while reference consumption is forecasted to reach 82 PJ.

Exhibit 93 – Commercial Market Potential Consumption (GJ) Forecasts – Commercial, TRC

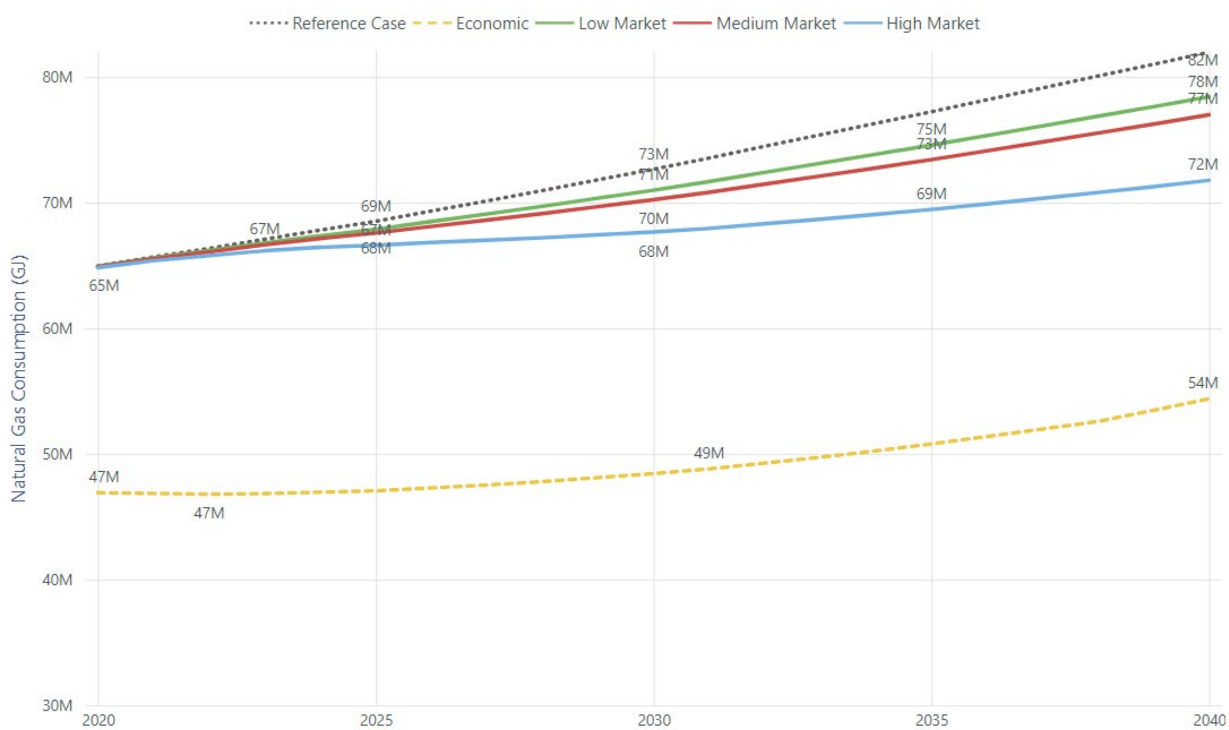
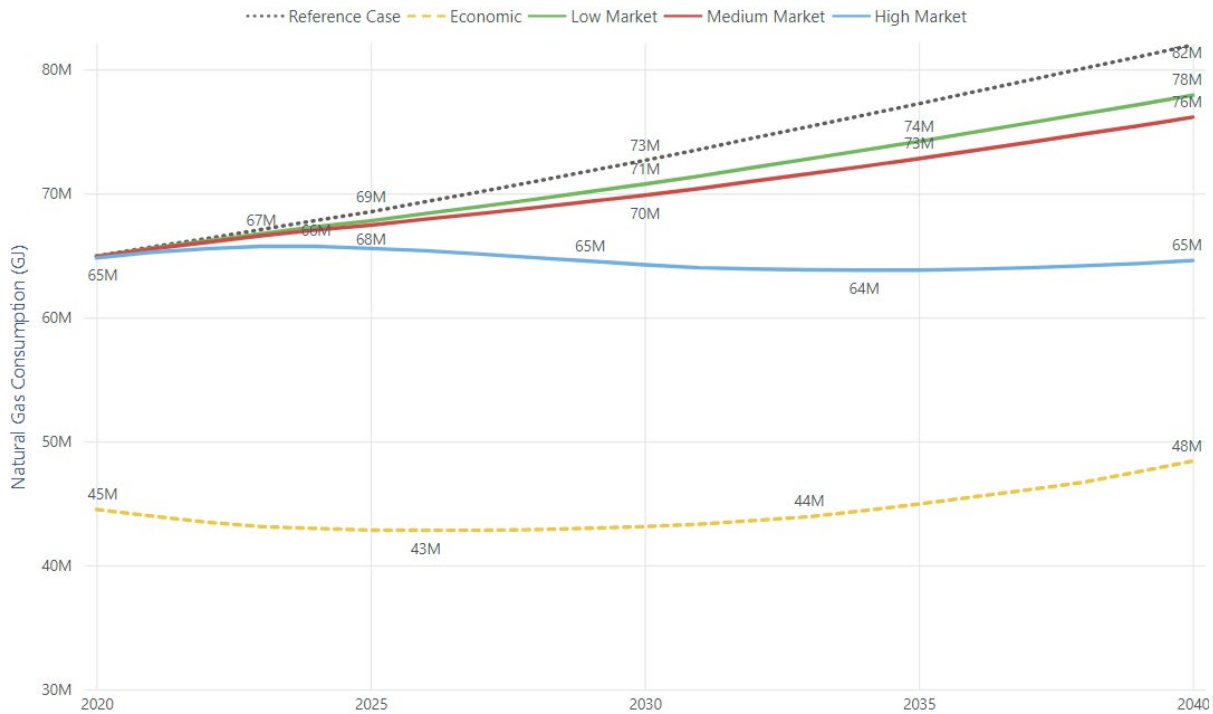


Exhibit 94 – Commercial Market Potential Consumption (GJ) Forecasts – Commercial, MTRC



The remainder of this section presents detailed results of the medium market potential scenario only. Similarly detailed results of the low and high market potential scenarios can be found on the Power BI dashboard and the Excel workbooks.

Results by Region

The medium market potential savings for 2025 are presented by region in Exhibit 95 and Exhibit 96 using TRC and MTRC screen, respectively. Medium market potential savings for 2025 are estimated to be between 1% and 2% of reference case consumption in all regions in both medium market scenarios.

Exhibit 95 – Medium Market Potential Savings by Region in 2025 – Commercial, TRC

Region	Ref Case Consumption (GJ)	Medium Market Potential Savings (GJ)	% of Consumption
Lower Mainland x Van	33,493K	425K	1%
City of Vancouver	14,237K	184K	1%
Southern Interior	10,124K	178K	2%
Vancouver Island	6,863K	103K	2%
Northern BC	3,082K	71K	2%
Whistler	713K	7K	1%
Total	**68,513K**	**969K**	**1%**

Exhibit 96 – Medium Market Potential Savings by Region in 2025 – Commercial, MTRC

Region	Ref Case Consumption (GJ)	Medium Market Potential Savings (GJ)	% of Consumption
Lower Mainland x Van	33,493K	498K	1%
City of Vancouver	14,237K	219K	2%
Southern Interior	10,124K	192K	2%
Vancouver Island	6,863K	113K	2%
Northern BC	3,082K	69K	2%
Whistler	713K	7K	1%
Total	**68,513K**	**1,099K**	**2%**

Results by Segment

The medium market potential savings for 2025 are presented by segment in Exhibit 97 and Exhibit 98 using TRC and MTRC screen, respectively. The largest amounts of medium market potential savings are estimated to occur in apartments, other, and office segments.

Exhibit 97 – Medium Market Potential Savings by Segment in 2025 – Commercial, TRC

Segment	Ref Case Consumption (GJ)	Medium Market Potential Savings (GJ)	% of Consumption
Apartment	20,961K	222K	1%
Other	13,284K	152K	1%
Office	7,633K	137K	2%
Restaurant	4,666K	98K	2%
Warehouse	4,241K	76K	2%
Hospital	3,167K	65K	2%
Nonfood Retail	3,888K	46K	1%
School	2,549K	46K	2%
Food Retail	1,633K	39K	2%
University/College	1,752K	36K	2%
Hotel	2,800K	31K	1%
Nursing Home	1,940K	22K	1%
Total	**68,513K**	**969K**	**1%**

Exhibit 98 – Medium Market Potential Savings by Segment in 2025 – Commercial, MTRC

Segment	Ref Case Consumption (GJ)	Medium Market Potential Savings (GJ)	% of Consumption
Apartment	20,961K	276K	1%
Other	13,284K	166K	1%
Office	7,633K	157K	2%
Restaurant	4,666K	102K	2%
Warehouse	4,241K	86K	2%
Hospital	3,167K	67K	2%
School	2,549K	51K	2%
Nonfood Retail	3,888K	48K	1%
University/College	1,752K	42K	2%
Food Retail	1,633K	40K	2%
Hotel	2,800K	37K	1%
Nursing Home	1,940K	26K	1%
Total	**68,513K**	**1,099K**	**2%**

Results by End Use

The medium market potential savings for 2025 are presented by segment in Exhibit 99 and Exhibit 100 using TRC and MTRC screen, respectively. More than two thirds of the savings come from the space heating end use.

Exhibit 99 – Medium Market Potential Savings by End Use in 2025 – Commercial, TRC

Parent End Use	Ref Case Consumption (GJ)	Medium Market Potential Savings (GJ)	% of Consumption
Space Heating	37,973K	652K	2%
Water heating	20,913K	257K	1%
Food Service	5,322K	60K	1%
Other	3,674K	0K	0%
Pools; Spas & Hot Tubs	632K	0K	0%
Total	**68,513K**	**969K**	**1%**

Exhibit 100 – Medium Market Potential Savings by End Use in 2025 – Commercial, MTRC

Parent End Use	Ref Case Consumption (GJ)	Medium Market Potential Savings (GJ)	% of Consumption
Space Heating	37,973K	776K	2%
Water heating	20,913K	260K	1%
Food Service	5,322K	60K	1%
Pools; Spas & Hot Tubs	632K	3K	0%
Other	3,674K	0K	0%
Total	**68,513K**	**1,099K**	**2%**

The TRC and MTRC medium market potential savings for 2040 are presented by end use in Exhibit 101. The scenarios under both economic screens are close, with a difference of 704 TJ, as the majority of the measures pass both screens.

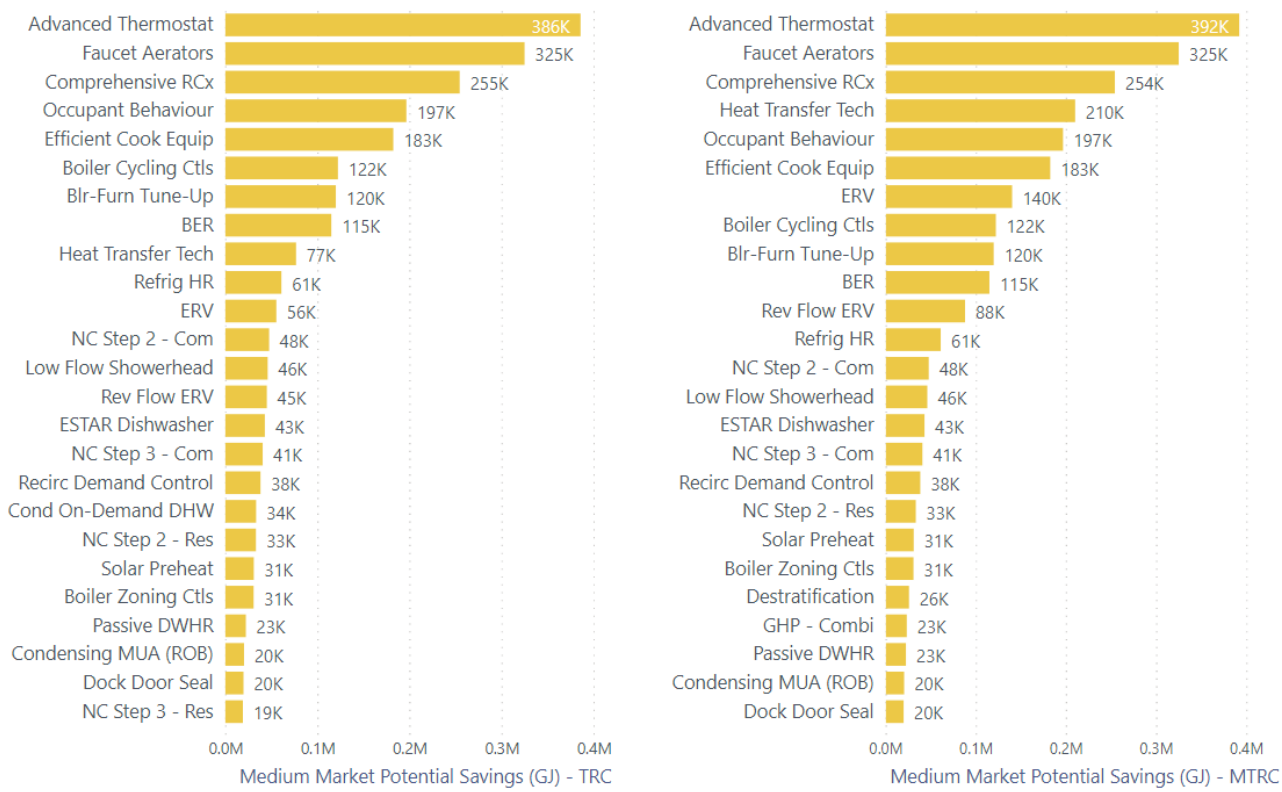
Exhibit 101 – Medium Market Potential Savings by End Use in 2040 – Commercial, TRC and MTRC

Parent End Use	Medium Potential Savings (GJ) - TRC	Medium Potential Savings (GJ) - MTRC	Difference (GJ)
Space Heating	3,702K	4,466K	764K
Water heating	1,072K	1,147K	75K
Pools; Spas & Hot Tubs	0K	13K	13K
Other	0K	0K	0K
Food Service	207K	207K	0K
Total	**4,981K**	**5,833K**	**852K**

Results by Measure

The medium market potential savings by 2025 of the top 25 commercial measures are shown in Exhibit 102, sorted by decreasing potential. The top measures in the TRC medium market potential are shown on the left and the top measures in the MTRC scenario are shown on the right. Advanced thermostats, faucet aerators, and comprehensive recommissioning (RCx) top the list in both scenarios. Occupant behavior measures, efficient cooking equipment, and heat transfer technologies have large potential in both scenarios as well. A major change in this top-measures list when compared with the economic potential list is the relatively small contribution of energy recovery ventilators (ERV) and gas heat pumps (GHP Combi).

Exhibit 102 – Medium Market Potential (TRC on Left, MTRC on Right) - Gas Savings from Top 25 Commercial Measures in 2025 (GJ)



5.7.1 Incentive and Non-Incentive Spending

The incentive and non-incentive spending required to achieve the medium and high market potential are shown in Exhibit 103 (TRC) and Exhibit 104 (MTRC). Medium and high market incentives are assumed to be 50% and 100% of measures' incremental costs, respectively. In both medium and high scenarios, non-incentive costs are estimated to be 15% of incentive costs. The tables also show the total as well as incremental (that is, savings from new measures installed in a year) savings every year.

Exhibit 103 – Medium and High Market Incentive Costs and Natural Gas Savings – Commercial, TRC

Year	Medium Market Incentive Cost	Medium Market Non-Incentive Cost	Medium Market Total Costs	Medium Market Potential Savings (GJ)	Medium Incremental Savings (Year-over-Year, GJ)	High Market Incentive Cost	High Market Non-Incentive Cost	High Market Total Costs	High Market Potential Savings (GJ)	High Incremental Savings (Year-over-Year, GJ)
2020	$1.0M	$0.1M	$1.1M	57K	57K	$5.9M	$0.9M	$6.8M	124K	124K
2021	$1.6M	$0.2M	$1.9M	142K	85K	$9.9M	$1.5M	$11.4M	306K	183K
2022	$2.6M	$0.4M	$3.0M	267K	125K	$15.7M	$2.4M	$18.0M	563K	256K
2023	$3.9M	$0.6M	$4.5M	441K	174K	$24.1M	$3.6M	$27.7M	914K	352K
2024	$5.4M	$0.8M	$6.2M	667K	226K	$34.1M	$5.1M	$39.2M	1,370K	456K
2025	$6.8M	$1.0M	$7.8M	934K	267K	$43.9M	$6.6M	$50.5M	1,912K	542K
2026	$8.1M	$1.2M	$9.3M	1,223K	289K	$53.2M	$8.0M	$61.2M	2,501K	589K
2027	$8.9M	$1.3M	$10.2M	1,526K	302K	$59.1M	$8.9M	$68.0M	3,124K	623K
2028	$9.5M	$1.4M	$10.9M	1,830K	304K	$63.7M	$9.6M	$73.2M	3,757K	633K
2029	$9.7M	$1.5M	$11.2M	2,132K	302K	$65.4M	$9.8M	$75.2M	4,384K	627K
2030	$9.9M	$1.5M	$11.4M	2,430K	298K	$66.3M	$9.9M	$76.3M	4,999K	615K
2031	$9.9M	$1.5M	$11.4M	2,723K	293K	$67.0M	$10.0M	$77.0M	5,597K	599K
2032	$10.1M	$1.5M	$11.7M	3,009K	286K	$67.7M	$10.2M	$77.9M	6,170K	572K
2033	$9.7M	$1.5M	$11.2M	3,285K	276K	$64.9M	$9.7M	$74.6M	6,712K	542K
2034	$9.9M	$1.5M	$11.4M	3,555K	270K	$65.9M	$9.9M	$75.8M	7,249K	537K
2035	$9.6M	$1.4M	$11.1M	3,810K	255K	$64.6M	$9.7M	$74.2M	7,773K	524K
2036	$9.5M	$1.4M	$11.0M	4,058K	248K	$63.5M	$9.5M	$73.0M	8,283K	510K
2037	$9.5M	$1.4M	$11.0M	4,298K	240K	$64.0M	$9.6M	$73.6M	8,782K	498K
2038	$9.5M	$1.4M	$10.9M	4,534K	237K	$62.0M	$9.3M	$71.2M	9,269K	488K
2039	$9.1M	$1.4M	$10.5M	4,760K	226K	$58.1M	$8.7M	$66.8M	9,735K	466K
2040	$9.2M	$1.4M	$10.6M	4,981K	221K	$59.2M	$8.9M	$68.0M	10,197K	462K

Exhibit 104 – Medium and High Market Incentive Costs and Natural Gas Savings – Commercial, MTRC

Year	Medium Market Incentive Cost	Medium Market Non-Incentive Cost	Medium Market Total Costs	Medium Market Potential Savings (GJ)	Medium Incremental Savings (Year-over-Year, GJ)	High Market Incentive Cost	High Market Non-Incentive Cost	High Market Total Costs	High Market Potential Savings (GJ)	High Incremental Savings (Year-over-Year, GJ)
2020	$1.2M	$0.2M	$1.4M	62K	62K	$10.8M	$1.6M	$12.4M	160K	160K
2021	$2.1M	$0.3M	$2.4M	159K	97K	$20.1M	$3.0M	$23.1M	422K	262K
2022	$3.4M	$0.5M	$3.9M	303K	144K	$32.7M	$4.9M	$37.6M	810K	388K
2023	$5.1M	$0.8M	$5.8M	505K	201K	$49.6M	$7.4M	$57.1M	1,359K	549K
2024	$6.9M	$1.0M	$7.9M	767K	262K	$70.0M	$10.5M	$80.5M	2,083K	724K
2025	$8.6M	$1.3M	$9.9M	1,075K	309K	$89.6M	$13.4M	$103.1M	2,961K	879K
2026	$10.3M	$1.5M	$11.8M	1,412K	336K	$109.6M	$16.4M	$126.0M	3,954K	993K
2027	$11.3M	$1.7M	$13.0M	1,762K	351K	$122.4M	$18.4M	$140.7M	5,027K	1,072K
2028	$12.1M	$1.8M	$13.9M	2,115K	352K	$132.5M	$19.9M	$152.3M	6,143K	1,116K
2029	$12.4M	$1.9M	$14.2M	2,465K	350K	$137.1M	$20.6M	$157.6M	7,280K	1,137K
2030	$12.6M	$1.9M	$14.5M	2,811K	345K	$140.6M	$21.1M	$161.6M	8,419K	1,139K
2031	$12.7M	$1.9M	$14.6M	3,151K	340K	$140.9M	$21.1M	$162.0M	9,541K	1,122K
2032	$12.9M	$1.9M	$14.9M	3,485K	335K	$142.3M	$21.3M	$163.7M	10,589K	1,049K
2033	$12.5M	$1.9M	$14.4M	3,810K	325K	$135.8M	$20.4M	$156.2M	11,557K	968K
2034	$12.6M	$1.9M	$14.5M	4,130K	319K	$135.8M	$20.4M	$156.1M	12,504K	946K
2035	$12.3M	$1.8M	$14.2M	4,431K	302K	$133.0M	$19.9M	$152.9M	13,422K	918K
2036	$12.3M	$1.8M	$14.1M	4,726K	295K	$131.3M	$19.7M	$151.0M	14,292K	870K
2037	$12.2M	$1.8M	$14.1M	5,014K	288K	$129.9M	$19.5M	$149.4M	15,127K	836K
2038	$12.2M	$1.8M	$14.0M	5,297K	283K	$124.3M	$18.6M	$143.0M	15,918K	790K
2039	$11.9M	$1.8M	$13.7M	5,568K	271K	$118.5M	$17.8M	$136.3M	16,673K	755K
2040	$12.0M	$1.8M	$13.8M	5,833K	266K	$116.1M	$17.4M	$133.5M	17,391K	718K

6 Industrial Sector Results

This section presents the industrial sector results and key findings, including:

- Base year (2019) natural gas use
- Reference case consumption forecast (2020 – 2040)
- Energy conservation measures evaluated in this CPR
- Technical potential savings
- Economic potential savings
- Market potential savings and scenarios

6.1 Industrial Segments and End Uses

In this CPR, the industrial sector is divided into 12 segments, 12 energy end uses, and two vintages.

	Segments	End Uses	Vintages
Industrial Sector	• Agriculture (includes greenhouses[40]) • Chemical • District energy providers • Fabricated Metal • Food & Beverage • Other Manufacturing (includes transportation[41] and other industrial) • Mining • Non-metallic Mineral (includes cement) • Pulp & Paper – Kraft • Pulp & Paper – TMP • Utilities • Wood Products	• Direct-fired heating • Direct Consumption of Gas in Process[42] • Heat Treating • Kilns • On-Site Power Generation[13] • Other[12] • Ovens • Petrochemical Refining and Process Heating • Process Boilers • Product Drying • Space Heating [includes HVAC air heating and HVAC boilers] • Water heaters	• Existing • New

40 Cannabis has been included in agriculture segment since there is not enough data at FEI to create a cannabis-specific forecast.
41 In the 2015 CPR, 'transportation' pertained to facilities that supported the transportation sector.
42 No CPR measures are applied to this end use; included for accounting purposes only.

6.2 Base Year Natural Gas Use

Base year (2019) industrial natural gas use is presented by segment in Exhibit 105, by end use in Exhibit 106, and by region in Exhibit 107.

Natural gas consumption in the industrial sector base year is highest:

- In the pulp and paper – kraft (31%), agriculture (13%), wood products (12%), and mining (12%) segments
- In the process boilers (36%), product drying (26%), and direct-fired heating (16%) end uses
- In the Lower Mainland excluding the Vancouver (33%), Northern BC (24%), and Southern Interior (26%) regions

Exhibit 105 – 2019 Industrial Natural Gas Consumption (GJ) by Segment[43]

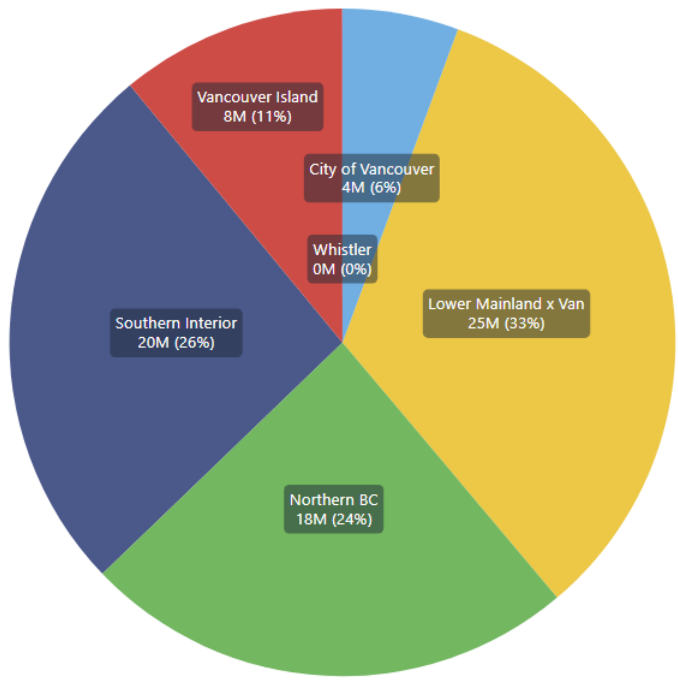
Segment	Natural Gas Consumption (GJ)	%
Pulp & Paper - Kraft	23,480K	31%
Agriculture	9,662K	13%
Wood Products	8,936K	12%
Mining	8,843K	12%
Non-metallic Mineral	4,657K	6%
Food & Beverage	4,548K	6%
Manufacturing	4,291K	6%
Chemical	4,014K	5%
Pulp & Paper - TMP	2,923K	4%
District Energy	2,555K	3%
Utilities	851K	1%
Fabricated Metal	526K	1%
Total	**75,286K**	**100%**

43 Please see Appendix B for how industrial sector NAICS codes were mapped into segments.

Exhibit 106 – 2019 Industrial Natural Gas Consumption (GJ) by End Use

Parent End Use	Natural Gas Consumption (GJ)	%
Process Boilers	27,045K	36%
Product Drying	19,465K	26%
Direct-fired Heating	11,817K	16%
Space Heating	5,737K	8%
Kilns	3,626K	5%
Direct Gas Use	1,553K	2%
Petrochem Refining	1,407K	2%
Other	1,209K	2%
Ovens	1,110K	1%
On-Site Generation	851K	1%
Water Heaters	823K	1%
Heat Treating	644K	1%
Total	**75,286K**	**100%**

Exhibit 107 – 2019 Industrial Natural Gas Consumption (GJ) by Region



6.2.1 Accounts

Base year industrial natural gas accounts are presented by segment in Exhibit 108 and by region in Exhibit 109. As shown in these exhibits, in 2019 the greatest number of industrial natural gas accounts were in:

- The manufacturing (37%), agriculture (21%), and food & beverage (13%) segments
- The Lower Mainland excluding Vancouver region (68%)

Exhibit 108 – 2019 Industrial Accounts by Segment

Segment	Accounts	%
Manufacturing	3,354	37%
Agriculture	1,930	21%
Food & Beverage	1,164	13%
Fabricated Metal	744	8%
Wood Products	701	8%
Chemical	437	5%
Non-metallic Mineral	247	3%
Utilities	201	2%
Mining	125	1%
Pulp & Paper - TMP	76	1%
Pulp & Paper - Kraft	26	0%
District Energy	18	0%
Total	**9,023**	**100%**

Exhibit 109 – 2019 Industrial Accounts by Region

Region	Accounts	%
Lower Mainland x Van	6,138	68%
Southern Interior	1,501	17%
City of Vancouver	680	8%
Northern BC	452	5%
Vancouver Island	247	3%
Whistler	5	0%
Total	**9,023**	**100%**

6.2.2 Tertiary Load

Tertiary load is the useful energy delivered to an end use. In the context of the CPR, tertiary load is the amount energy required to be delivered as an end use *service*: heat delivered by a furnace to a house, for example. This differs from consumption of natural gas which is impacted by the efficiency of the equipment: in the furnace example, consumption is equal to the tertiary load divided by seasonal efficiency of furnaces. Exhibit 110 provides 2019 tertiary load values.

6.2.3 Unit Energy Consumption

As explained in Exhibit 3, unit energy consumption (UEC) is the amount of energy used by each end use per unit. Defining "units" is challenging in the industrial sector. In the residential sector, consumption is typically analyzed per dwelling while in the commercial sector, consumption is analyzed per unit of floor area. In the industrial sector, consumption per unit of production capacity (kg of product, for example) would seem to be a useful approach. Unfortunately, the concept becomes inoperable when many different industries are included in the analysis. Nonetheless, it is desirable to have a way of representing growth in industries that is independent of changes in energy consumption caused by changes in fuel share or equipment efficiency. Therefore, 'units' in the industrial sector is used as a proxy of production capacity of different types of plants. The base year consumption is used as a proxy for the production capacity of different types of plants in each region and rate class.

Along with UEC values is *unit tertiary load*, which is the average tertiary load used by each end use in a dwelling, and *stock average efficiency*, which is the average efficiency of equipment serving the tertiary load for that end use. These values are included in the table because UEC by end use is calculated by dividing unit tertiary load with stock average efficiency.

Unlike the residential or commercial sectors, the end uses in the industrial sector are not common across the segments; rather, some end uses are specific to some segments. For example, the 'on-site generation' end use is only present in the 'utilities' segment. For the purposes of this report, UEC values are shown for one segment and region only, therefore UEC values are included only for the end uses that are present in that segment.

Unit tertiary load, stock average efficiency and UEC values for the pulp & paper – kraft segment in the Northern BC ("NBC") region are presented in Exhibit 110. This combination of segment and region was selected as the example because it A) is a significant consumer of gas, and B) has enough accounts to ensure consumption from one account cannot be determined through the information presented in this report, thereby protecting customer privacy.

Exhibit 110 – 2019 UEC Values by End Use, Pulp & Paper-Kraft Segment in Northern British Columbia

	Unit Tertiary Load (GJ/unit/yr)	Stock Average Efficiency (%)	UEC
Space Heating	0.02	0.62	0.03
Direct-fired Heating	0.38	1.00	0.38
Kilns	0.08	0.79	0.10
Product Drying	0.02	0.88	0.03
Process Boilers	0.34	0.67	0.51

6.2.4 Average Natural Gas Use per Account

Details on natural gas consumption per account by end use are provided in Exhibit 111 for an average Pulp & Paper – Kraft account in the Northern BC region. The following information is included in this exhibit:

- UEC: The amount of energy used by each end use per unit (a "unit" in the industrial sector is based on production capacity. Please see Section 6.2.3 for a discussion of a "unit" in the industrial sector.
- Fuel Share: The percentage of the energy end use that is supplied by each fuel (in this case, natural gas).
- Saturation: The extent to which an end use is present in a region, rate class and segment. In the industrial sector, saturation is either 100% or 0% because end uses are either used in a segment or are not.

Average annual gas consumption per unit would be calculated by multiplying these three variables. Similar to the UEC values presented in Section 6.2.3, only the end uses that are present in the segment and region are included.

Exhibit 111 – 2019 Average Annual Gas Use per Account by End Use, Pulp & Paper - Kraft Account in Northern British Columbia

	UEC	Fuel Share	Saturation	Average Annual Gas Use (GJ/Yr)
Space Heating	0.03	80%	100%	0.03
Direct-fired Heating	0.38	100%	100%	0.38
Kilns	0.10	93%	100%	0.10
Product Drying	0.03	93%	100%	0.02
Process Boilers	0.51	93%	100%	0.47
TOTAL				1.00[44]

44 Recall that "units" in the industrial sector is production capacity. In the base year, by definition, one industrial building unit uses 1 GJ, because base year consumption is the 'unit' for the base year.

6.3 Reference Case Natural Gas Use

This section profiles the reference case forecast (2020-2040) natural gas consumption for the industrial sector. The industrial production forecast, developed by FEI through survey of industrial customers, covers from 2020 to 2025. The first five-year period of the reference case forecast (2020 to 2025) incorporates how individual respondents expect their volume to change, and this five-year trend is extrapolated beyond 2025.

Reference case industrial natural gas consumption is presented by region in Exhibit 112, by segment in Exhibit 113, and by end use in Exhibit 114. These exhibits illustrate the following trends in consumption over the reference case:

- Overall gas consumption is forecasted to increase by approximately 7% between 2020 and 2040, but this increase is not evenly split between the regions, segments, or end uses. Some regions, segments, and end uses are forecasted to experience significant increases, while others are forecasted to remain stable or decrease.
- As shown in Exhibit 112, natural gas use in the Whistler region is forecasted to increase by 98%, while gas use in the Northern BC and Vancouver Island regions will remain relatively flat or decrease (1% decrease and 1% increase, respectively).
- As shown in Exhibit 113, natural gas use in the fabricated metal segment is forecasted increase by 39%, while gas use is forecasted to decrease in the non-metallic mineral and the pulp & paper – kraft segments (6% and 2% decrease, respectively).
- As shown in Exhibit 114, natural gas use in the heat-treating end use is forecasted increase by 28%, while gas use is forecasted to decrease by 4% in the kiln end use.
- Despite the differences in forecasted natural gas use, the same regions, segments and end uses as in the base year are expected to account for the largest shares of natural gas use in the industrial sector.

Exhibit 112 – 2020 vs 2040 Industrial Gas Consumption (GJ) by Region

Region	2020	2040	Change
Lower Mainland x Van	28,463K	31,860K	12%
Southern Interior	19,039K	20,907K	10%
Northern BC	18,892K	18,647K	-1%
Vancouver Island	8,235K	8,308K	1%
City of Vancouver	5,701K	6,511K	14%
Whistler	7K	13K	98%
Total	**80,335K**	**86,246K**	**7%**

Exhibit 113 – 2020 vs 2040 Industrial Gas Consumption (GJ) by Segment

Segment	2020	2040	Change
Pulp & Paper - Kraft	23,871K	23,487K	-2%
Agriculture	11,527K	13,858K	20%
Wood Products	9,960K	10,288K	3%
Mining	8,058K	8,861K	10%
Manufacturing	4,577K	5,418K	18%
Food & Beverage	4,696K	5,247K	12%
Non-metallic Mineral	5,132K	4,819K	-6%
District Energy	4,044K	4,657K	15%
Chemical	3,798K	4,578K	21%
Pulp & Paper - TMP	3,316K	3,341K	1%
Utilities	780K	890K	14%
Fabricated Metal	577K	802K	39%
Total	**80,335K**	**86,246K**	**7%**

Exhibit 114 – 2020 vs 2040 Industrial Gas Consumption (GJ) by End Use

Parent End Use	2020	2040	Change
Process Boilers	30,437K	32,987K	8%
Product Drying	19,680K	20,658K	5%
Direct-fired Heating	12,556K	12,760K	2%
Space Heating	6,179K	7,184K	16%
Kilns	3,864K	3,698K	-4%
Direct Gas Use	1,458K	1,778K	22%
Petrochem Refining	1,311K	1,606K	23%
Other	1,306K	1,548K	19%
Ovens	1,169K	1,250K	7%
Water Heaters	904K	1,004K	11%
On-Site Generation	780K	890K	14%
Heat Treating	691K	883K	28%
Total	**80,335K**	**86,246K**	**7%**

6.4 Measure Assessment

6.4.1 List of Measures

The list of industrial measures is presented in Exhibit 115 by industrial end uses.

Please see the MS Excel file entitled "Ind_Measure Analysis Workbook" for a description of each measure and a full analysis.

Measures were classified in four measure type categories:

- Building Envelope
- Equipment
- Controls
- Energy Management (including behavioral measures)

Exhibit 115 – Industrial Sector Conservation and Energy Management Measures

Process Boiler	Space Heating
Air Compressor Heat Recovery Boiler Right-Sizing Condensing Boiler Direct Contact Hot Water Heater Economizer Heat Recovery Systems Improved Condensate Return Pipe Insulation Process Boiler Load Control Process Boiler O_2 Control Steam to Hot Water Conversion (District Energy) Steam Traps Tank Insulation Venturi Steam Traps	Advanced Thermostat Air Comp Heat Recovery Air Curtains Condensing Make Up Air Units Condensing Unit Heaters Destratification Fans HE Rooftop Unit Controls HE Rooftop Units HVAC Boiler Tune-up HVAC Ventilation Optimization Loading Dock Seals Solar Walls
Other	**Greenhouse**
Combustion Testing Energy Management High-Efficiency Burners High-Efficiency Dryers High-Efficiency Furnaces High-Efficiency Kilns High-Efficiency Ovens Process Control Regenerative Catalytic Oxidizer Veneer Dryers Warm Mix Asphalt	Greenhouse Curtains Greenhouse Envelope Integrated Greenhouse Controls

6.4.2 Results

Exhibit 116 shows measure-level results for the industrial sector in order of decreasing cost effectiveness. Measures were assessed based on their replacement type: **retrofit** (immediate replacement at full cost) or **replace on burnout** (end of life replacement at incremental cost).

The TRC and MTRC are presented at the measure-level and exclude program costs and free ridership.

Some key findings of the measure assessment for the industrial sector include:

- Of the 39 measures included in the assessment, 34 pass the TRC screen and 38 pass the MTRC screen.
- The most attractive equipment replacement measure is boiler right-sizing, with a TRC of 167.7. This measure involves replacing an oversized boiler at equipment end of life, with a smaller, right-sized boiler. The measure TRC is exceptionally high because the incremental measure cost is either negligible or may even be negative in some cases.
- The most attractive energy management measure is process control, which has the potential for significant energy savings at a moderate capital cost.
- The most attractive building envelope measure is the greenhouse envelope measure (#7), which, as shown in Exhibit 115, only applies to the greenhouse end use. The most attractive building envelope measure that applies to the space heating end use is the air curtain measure (#14).
- Several measures that were included on the original list of measures were excluded from the analysis or modified. Please see the file called "Measure List Modifications.xlsx" for a list of changes.

Exhibit 116 – Industrial Sector Measures with Average TRC and MTRC Results

#	Measure	Measure Type	Replacement Type	TRC	MTRC
1	Boiler Right-Sizing[45]	Equipment	ROB	167.7	791.5
2	Process Control	Energy Management	RET	50.4	258.4
3	Furnace RET	Equipment	RET	11.7	56.6
4	Combustion Testing	Energy Management	RET	10.3	54.6
5	Energy Management	Energy Management	RET	10	54.3
6	Tank Insulation	Equipment	RET	10	50.9
7	Greenhouse Envelope	Building Envelope	RET	9.3	47.6
8	Regenerative Catalytic Oxidizer	Energy Management	RET	7.9	39.3

45 For the boiler right-sizing measure the incremental cost is negligible. A cost of $1,000 was used for this measure for the purposes of calculating the payback and TRC, to compare with other measures.

9	Integrated Greenhouse Environmental Controls	Energy Management	RET	6.8	34
10	Replace Steam Traps	Equipment	RET	5.3	28.1
11	Condensing Boiler	Equipment	ROB	5.7	26.9
12	Pipe Insulation	Energy Management	RET	4.8	24
13	High Efficiency Dryers	Equipment	ROB	4.7	22.9
14	Air Curtain	Building Envelope	RET	4.1	20.5
15	Boiler Tune-Up	Energy Management	RET	3.8	20.3
16	Condensing MAU Unit	Equipment	ROB	4.1	19.7
17	High Efficiency Ovens	Equipment	ROB	3.8	18.9
18	High Efficiency Burners	Equipment	RET	3.8	18.9
19	Direct Contact Hot Water Heater	Equipment	ROB	2.9	14
20	Process Boiler Load Control	Controls	RET	2.7	13.7
21	Heat Recovery Systems	Energy Management	RET	2.5	12.4
22	HVAC Ventilation Optimization	Energy Management	RET	2.3	12.4
23	Advanced Veneer Dryer	Equipment	ROB	2.3	11.3
24	Condensing Unit Heaters	Equipment	ROB	2.1	10.5
25	Improved Condensate Return (Retrofit)	Energy Management	RET	2	10
26	Venturi Steam Trap	Equipment	RET	1.8	9.3
27	Air Compressor Heat Recovery (Process Heating)	Equipment	ROB	1.7	8.7
28	Economizer	Equipment	RET	1.7	8.5
29	Advanced Thermostats	Energy Management	RET	2	7.4
30	Greenhouse Curtains	Building Envelope	RET	1.4	7.4
31	Air Compressor Heat Recovery (Space Heating)	Equipment	ROB	1.5	7.2
32	Solar Wall	Energy Management	RET	1.4	6.4
33	HVAC Boiler Tune Up	Energy Management	RET	1.1	6.1
34	Loading Dock Seals	Building Envelope	RET	1.2	5.9
35	High Efficiency Kilns	Equipment	ROB	0.9	4.3
36	High Efficiency RTU Controls	Energy Management	RET	0.9	3.9
37	Destratification Fan	Energy Management	RET	0.7	3.3
38	Steam to Hot Water Conversion (District Energy)	Energy Management	RET	0.5	2.5
39	Warm Mix Asphalt	Energy Management	ROB	0.1	0.5

6.5 Technical Potential

This section provides an overview of the technical potential savings results for the industrial sector. Overall results are presented below, followed by measure level results and supply curves for the TRC and MTRC results.

As shown in Exhibit 117, the majority of the industrial technical potential (15 PJ) would be available in 2021 and would increase slowly until reaching 19 PJ in 2040, indicating most of the available potential would be from retrofit measures as opposed to replace on burnout measures. The forecasted industrial natural gas consumption for the industrial sector is included for reference.

Exhibit 117 – Industrial Technical Potential Savings (GJ)

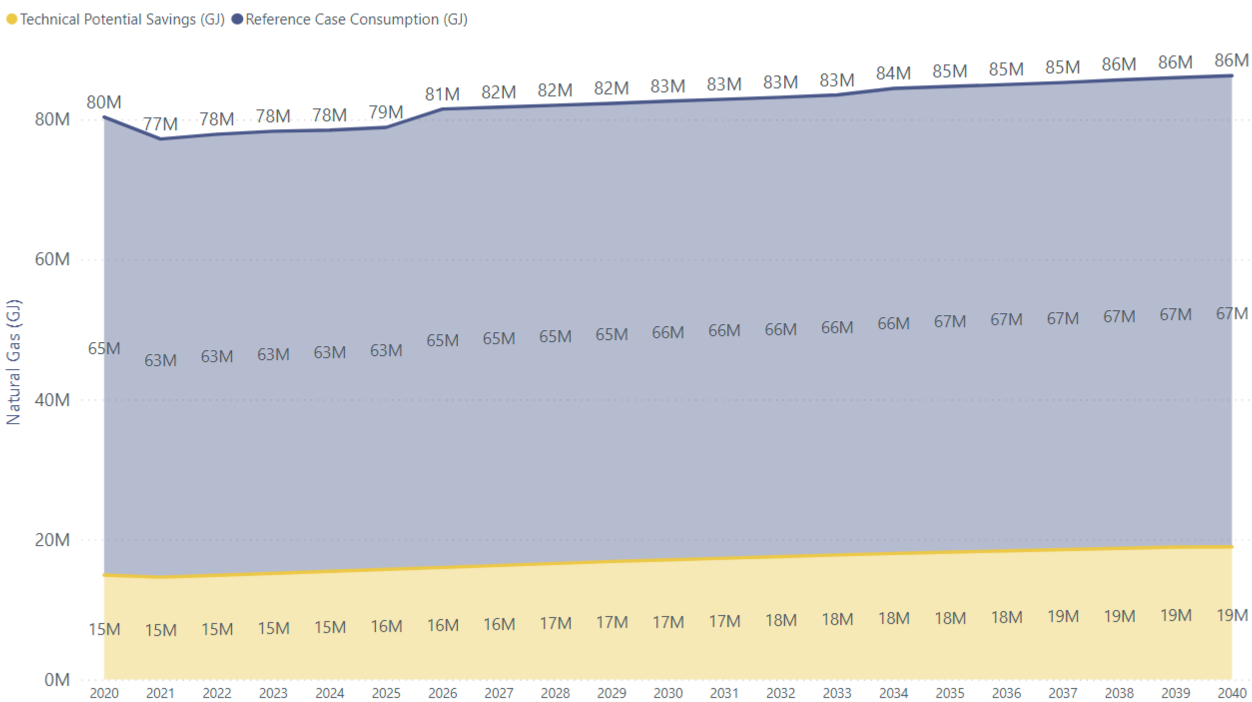
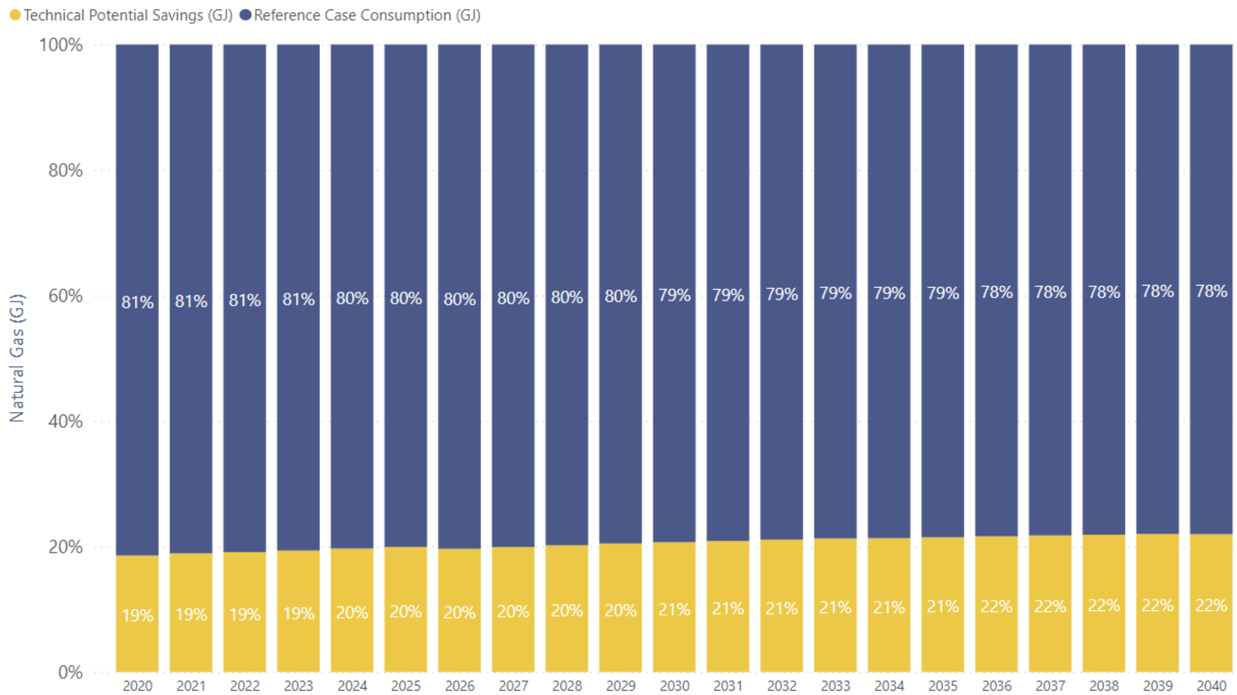


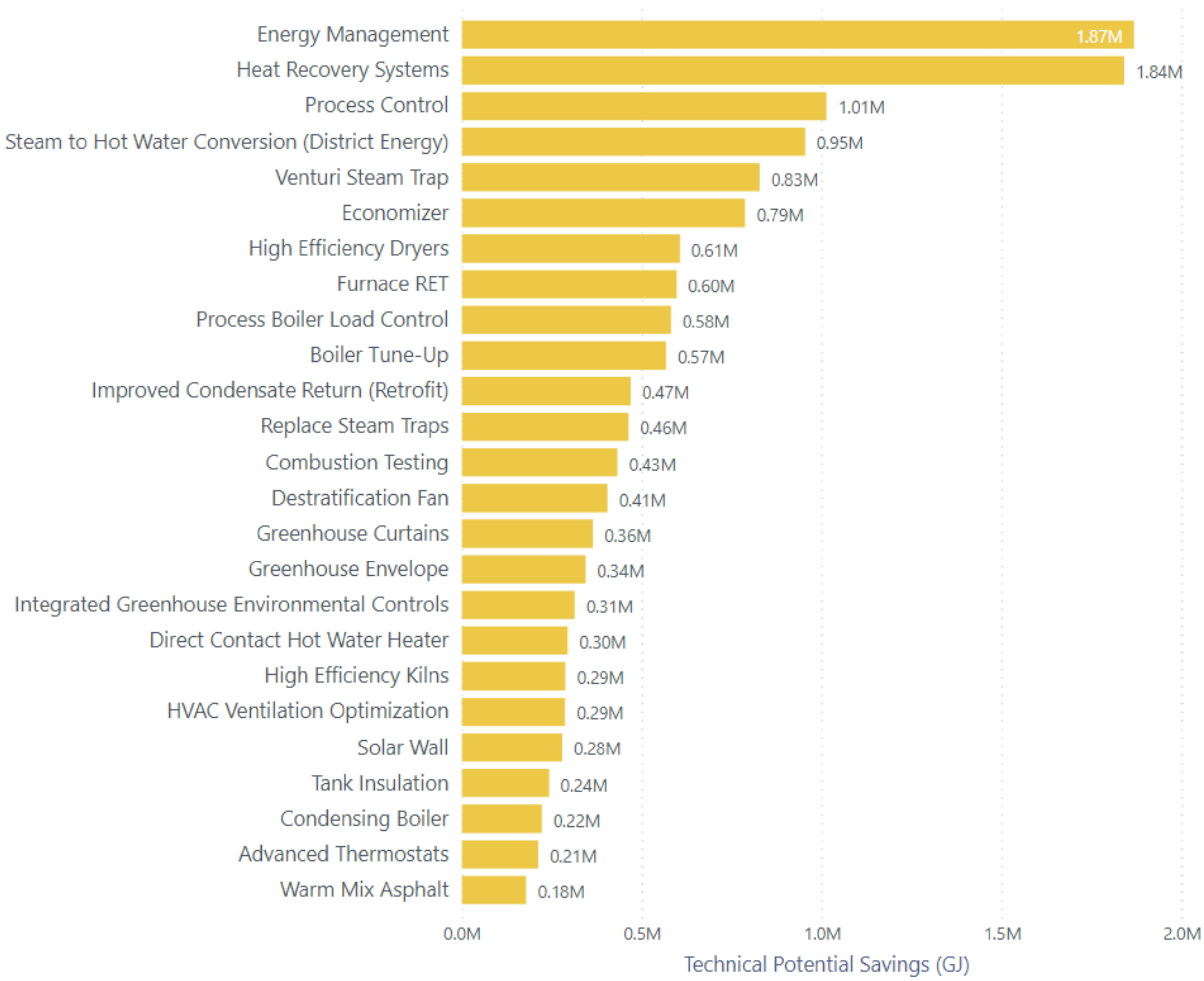
Exhibit 118 – Technical Potential Savings as a Percent of Industrial Reference Case Consumption (%)



As shown in Exhibit 118, the technical potential savings is about 19% of industrial reference case consumption in 2021 and increases to 22% by 2040, further indicating that most of the available potential would be from retrofit measures as opposed to replace on burnout measures.

The technical potential savings in 2025 broken down by measure (only the top 25 measures are shown) are presented in Exhibit 119. The top three measures (energy management, heat recovery systems, and process control) are expected to contribute substantially to technical potential savings (approximately 1.9 PJ, 1.8 PJ, and 1 PJ by 2025). As was shown in Exhibit 116, all three measures pass the TRC test, so they will also be expected to contribute to economic potential savings, as described in the following section. From the five measures that pass the MTRC but fail the TRC, Steam to Hot Water Conversion is the only one that has a large technical potential (#4 on the list below).

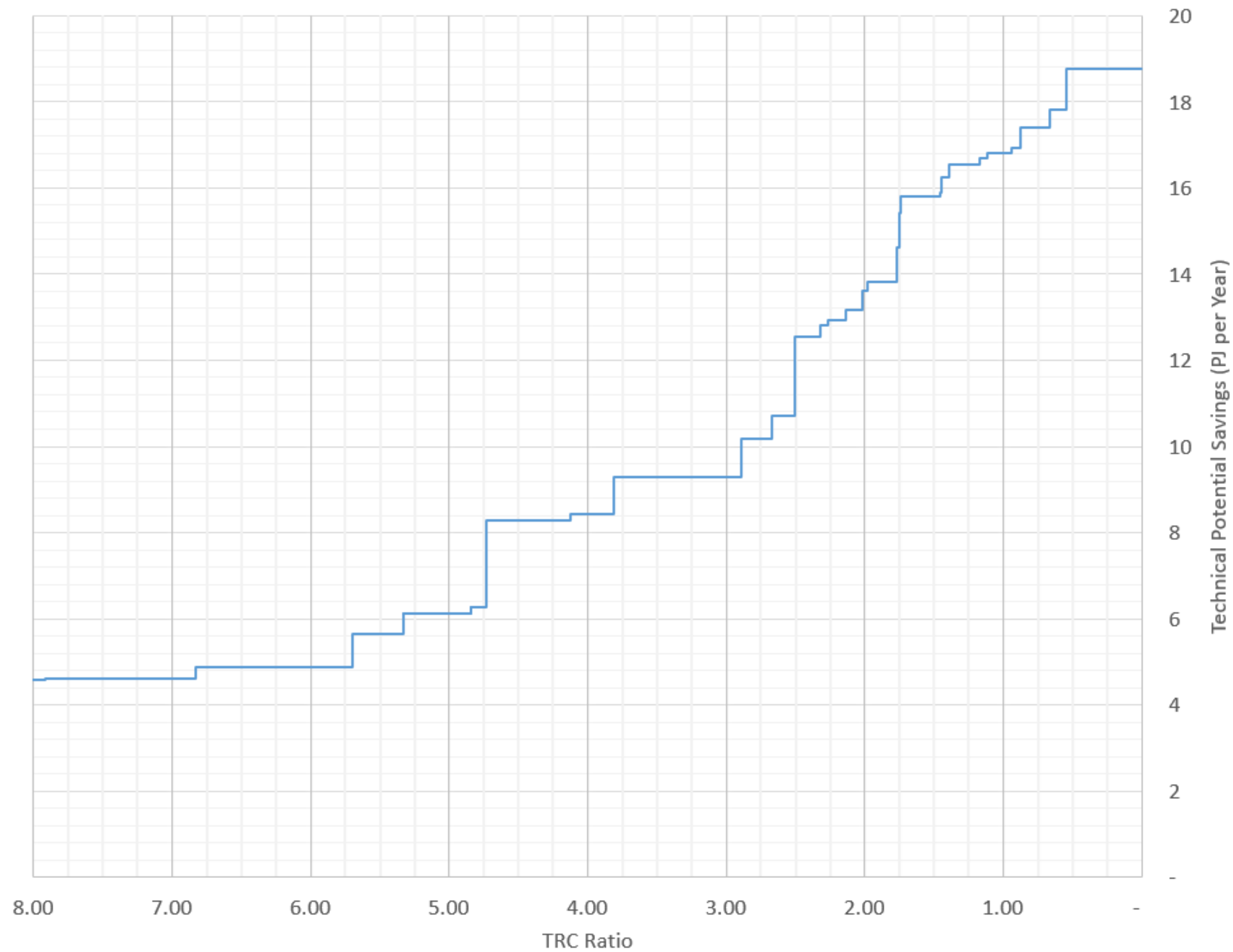
Exhibit 119 – Technical Potential – Top 25 Industrial Measures in 2025 (GJ)



The cumulative industrial sector technical potential savings in 2040 are presented in Exhibit 120 as a supply curve, with measures ordered by decreasing TRC ratio from left to right.

As shown, roughly 90% (17 out of 19 PJ) of the industrial sector technical potential savings by 2040 come from measures with a TRC of 1.0 or higher. Approximately 5 PJ of savings come from measures with a TRC ratio of greater than 8. These are shown in aggregate.

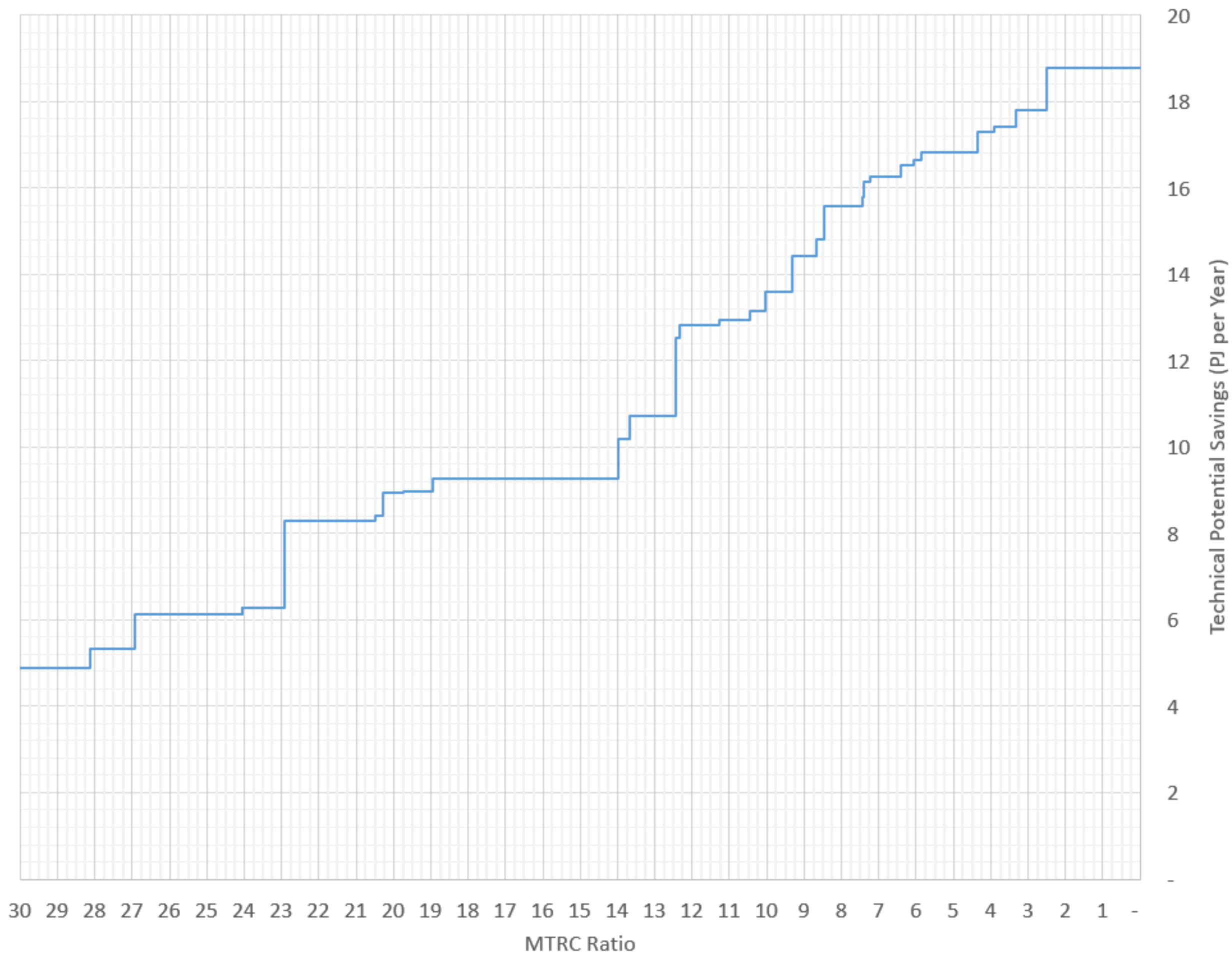
Exhibit 120 – Industrial Sector: Technical Potential Supply Curve, 2040 – TRC



Similar to Exhibit 120, the cumulative Industrial sector technical potential savings in 2040 are presented in Exhibit 121 as a supply curve, with measures ordered by decreasing MTRC ratio from left to right.

As shown, all of the industrial sector technical potential savings (approximately 19 PJ) by 2040, comes from measures with an MTRC of 1.0 or higher. Approximately 5 PJ of savings come from measures with an MTRC ratio of greater than 30. These are shown in aggregate.

Exhibit 121 – Industrial Sector: Technical Potential Supply Curve, 2040 – MTRC

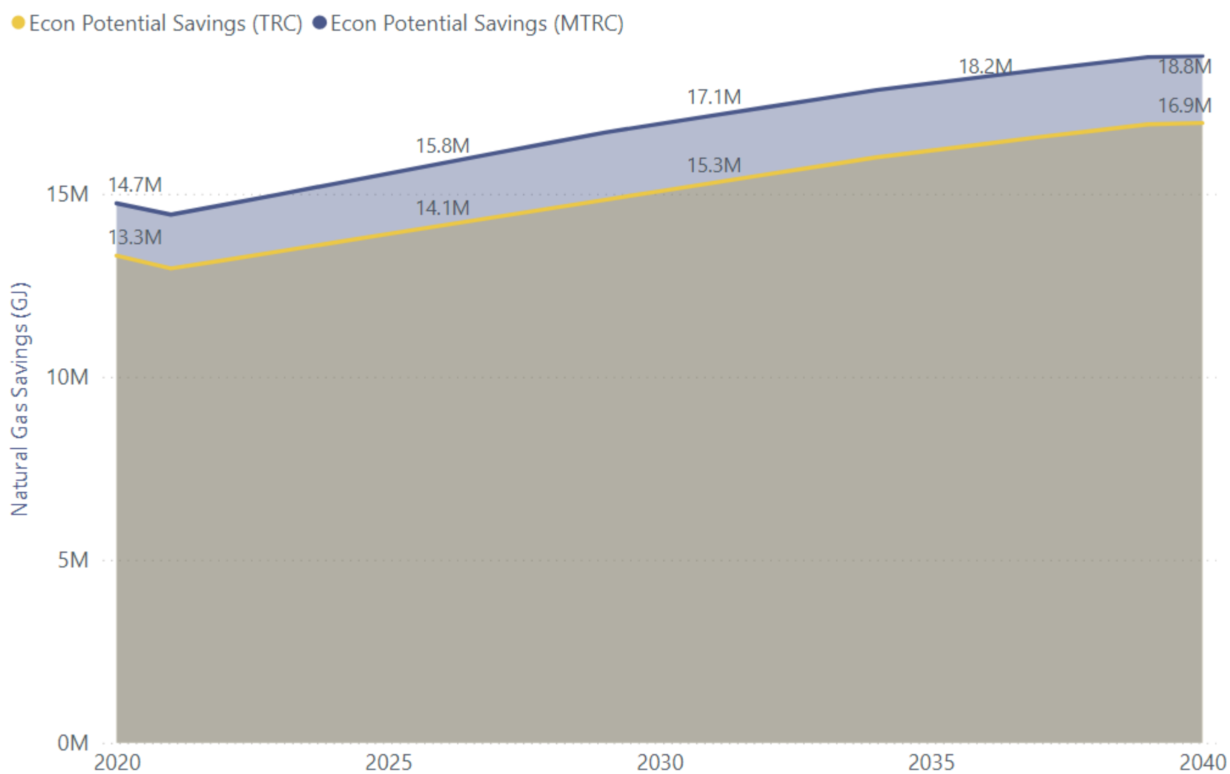


6.6 Economic Potential

This section provides an overview of the economic potential savings results. As was noted in section 6.3.2, 34 of the 39 measures examined have a TRC ratio over 1.0, so the difference between TRC and MTRC economic potential results for the Industrial sector is small.

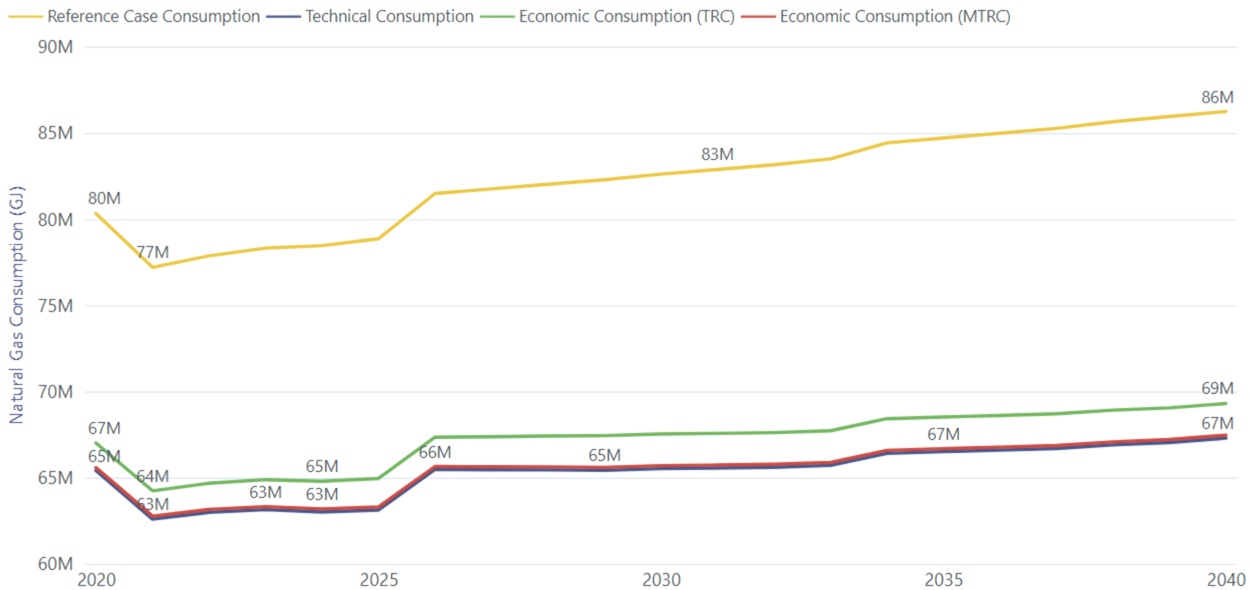
The industrial sector economic potential savings with a TRC screen and with an MTRC screen are shown in Exhibit 122. Although only four measures fail the TRC but pass the MTRC, the economic potential savings with an MTRC screen are roughly 1.7 PJ higher than with the TRC screen in 2025. This is mainly because one of those measures, steam to hot water conversion (district energy), represents the fifth largest technical potential (1 PJ) in 2025, as shown in Exhibit 119. Another way to look at it that the 92% of the MTRC economic potential comes from measures that pass the TRC as well.

Exhibit 122 – Economic Potential Savings (GJ) - Industrial, TRC and MTRC Screen



The forecasted gas consumption under the technical potential, economic potential with a TRC screen, economic potential with an MTRC screen, and reference case scenarios for the industrial sector are shown in Exhibit 123. The rapid decrease in technical and economic potential consumption in 2021 is a result of the implementation of the retrofit measures. The rest of the potential curve follows the shape of the reference case curve, as the replace on burnout measures are implemented at equipment end of life.

Exhibit 123 – Economic Potential Consumption (GJ) Forecasts – Industrial, TRC and MTRC



Results by Region

The economic potential savings in 2025 are presented by region in Exhibit 124 (TRC) and Exhibit 125 (MTRC). The highest level of economic potential savings (21% or 23% depending on the economic screen) is estimated to occur in the Lower Mainland outside of the City of Vancouver.

Exhibit 124 – Economic Potential Savings by Region in 2025 – Industrial, TRC

Region	Ref Case Consumption (GJ)	Economic Potential Savings (GJ)	% of Consumption
Lower Mainland x Van	28,893K	6,029K	21%
Southern Interior	19,995K	2,936K	15%
Northern BC	15,774K	2,793K	18%
Vancouver Island	8,407K	1,669K	20%
City of Vancouver	5,788K	477K	8%
Whistler	7K	0K	1%
Total	**78,864K**	**13,904K**	**18%**

Exhibit 125 – Economic Potential Savings by Region in 2025 – Industrial, MTRC

Region	Ref Case Consumption (GJ)	Economic Potential Savings (GJ)	% of Consumption
Lower Mainland x Van	28,893K	6,576K	23%
Southern Interior	19,995K	3,056K	15%
Northern BC	15,774K	2,887K	18%
Vancouver Island	8,407K	1,698K	20%
City of Vancouver	5,788K	1,339K	23%
Whistler	7K	2K	37%
Total	**78,864K**	**15,558K**	**20%**

Results by Segment

The economic potential savings in 2025 are presented by segment in Exhibit 126 (TRC) and Exhibit 127 (MTRC). The highest percentages of economic potential savings are estimated to occur in the agriculture, food & beverage, and fabricated metals segments. The largest absolute economic potential savings are estimated to occur in the pulp & paper – kraft segment.

Exhibit 126 – Economic Potential Savings by Segment in 2025 – Industrial, TRC

Segment	Ref Case Consumption (GJ)	Economic Potential Savings (GJ)	% of Consumption
Pulp & Paper - Kraft	20,542K	4,153K	20%
Agriculture	11,951K	3,503K	29%
Food & Beverage	4,966K	1,368K	28%
Mining	9,044K	1,121K	12%
Wood Products	10,195K	988K	10%
Manufacturing	4,877K	917K	19%
Pulp & Paper - TMP	3,291K	764K	23%
Non-metallic Mineral	4,856K	563K	12%
Chemical	3,627K	350K	10%
Fabricated Metal	643K	176K	27%
District Energy	4,029K	0K	0%
Utilities	842K	0K	0%
Total	**78,864K**	**13,904K**	**18%**

Exhibit 127 – Economic Potential Savings by Segment in 2025 – Industrial, MTRC

Segment	Ref Case Consumption (GJ)	Economic Potential Savings (GJ)	% of Consumption
Pulp & Paper - Kraft	20,542K	4,300K	21%
Agriculture	11,951K	3,610K	30%
Food & Beverage	4,966K	1,408K	28%
Mining	9,044K	1,137K	13%
Manufacturing	4,877K	1,086K	22%
Wood Products	10,195K	1,008K	10%
District Energy	4,029K	954K	24%
Pulp & Paper - TMP	3,291K	770K	23%
Non-metallic Mineral	4,856K	740K	15%
Chemical	3,627K	359K	10%
Fabricated Metal	643K	185K	29%
Utilities	842K	0K	0%
Total	**78,864K**	**15,558K**	**20%**

Results by End Use

The economic potential savings in 2025 are presented by end use in Exhibit 128 (TRC) and Exhibit 129 (MTRC). The highest percentages of economic potential savings are estimated to occur in the process boilers, space heating, and heat treating end uses.

Approximately two-thirds of the savings are attributable to the largest end uses: process boilers (distributed across all segments except utilities).

Exhibit 128 – Economic Potential Savings by End Use in 2025 – Industrial, TRC

Parent End Use	Ref Case Consumption (GJ)	Economic Potential Savings (GJ)	% of Consumption
Process Boilers	29,383K	8,353K	28%
Product Drying	20,665K	1,951K	9%
Space Heating	6,400K	1,540K	24%
Direct-fired Heating	11,270K	1,348K	12%
Kilns	3,428K	241K	7%
Heat Treating	755K	158K	21%
Ovens	1,204K	155K	13%
Petrochem Refining	1,219K	86K	7%
Other	1,382K	47K	3%
Water Heaters	942K	25K	3%
Direct Gas Use	1,376K	0K	0%
On-Site Generation	842K	0K	0%
Total	**78,864K**	**13,904K**	**18%**

Exhibit 129 – Economic Potential Savings by End Use in 2025 – Industrial, MTRC

Parent End Use	Ref Case Consumption (GJ)	Economic Potential Savings (GJ)	% of Consumption
Process Boilers	29,383K	9,307K	32%
Space Heating	6,400K	1,959K	31%
Product Drying	20,665K	1,951K	9%
Direct-fired Heating	11,270K	1,348K	12%
Kilns	3,428K	521K	15%
Heat Treating	755K	158K	21%
Ovens	1,204K	155K	13%
Petrochem Refining	1,219K	86K	7%
Other	1,382K	47K	3%
Water Heaters	942K	25K	3%
Direct Gas Use	1,376K	0K	0%
On-Site Generation	842K	0K	0%
Total	**78,864K**	**15,558K**	**20%**

The TRC and MTRC economic potential savings for 2040 are presented by end use in Exhibit 130. As only four measures pass the MTRC but not the TRC screen, most savings totals are the same, except for the process boilers end use (954 TJ higher in MTRC), the kilns end use (467 TJ higher in MTRC), and the space heating end use (416 TJ higher in MTRC).

Exhibit 130 – Economic Potential Savings by End Use in 2040 – Industrial, TRC and MTRC

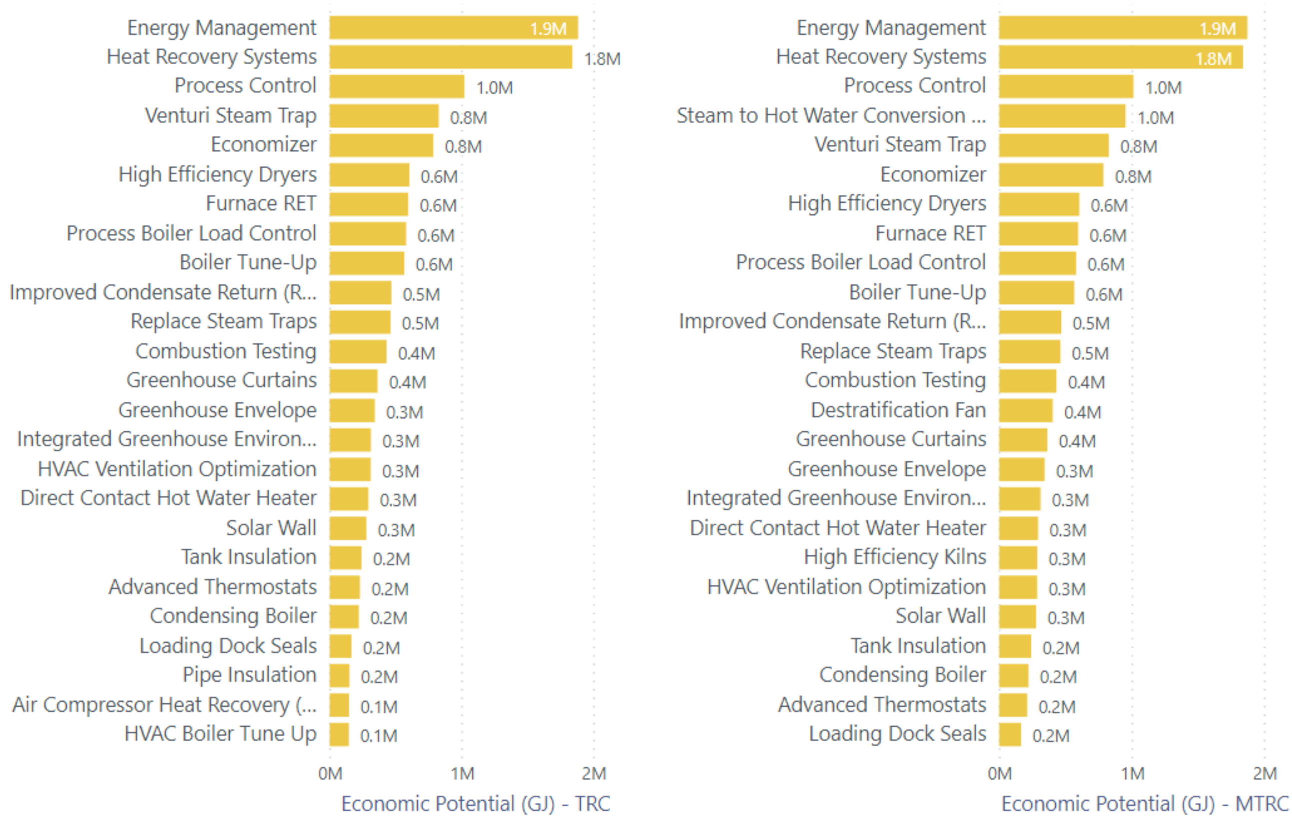
Parent End Use	Economic Savings (GJ) - TRC	Economic Savings (GJ) - MTRC	Difference (GJ)
Process Boilers	9,715K	10,669K	954K
Kilns	241K	708K	467K
Space Heating	1,712K	2,127K	416K
Direct Gas Use	0K	0K	0K
Direct-fired Heating	1,348K	1,348K	0K
Heat Treating	158K	158K	0K
On-Site Generation	0K	0K	0K
Other	47K	47K	0K
Ovens	269K	269K	0K
Petrochem Refining	86K	86K	0K
Product Drying	3,338K	3,338K	0K
Water Heaters	25K	25K	0K
Total	**16,938K**	**18,775K**	**1,836K**

Results by Measure

The economic potential savings in 2025 broken down by measure (only the top 25 measures are shown) are shown in Exhibit 131. The top measures in the TRC economic potential are shown on the left and the top measures in the MTRC scenario are shown on the right. As in the technical potential scenario, the top three measures (energy management, heat recovery systems, and process control) are expected to contribute substantially to economic potential savings (approximately 1.9 PJ, 1.8 PJ, and 1 PJ by 2025).

The main difference between the two lists is the large contribution of steam to hot water conversion (district energy) measure in the MTRC economic potential. Destratification fans and high efficiency kilns are the other two MTRC-only measures that appear on the list on the right.

Exhibit 131 – Economic Potential (TRC on Left, MTRC on Right) - Top 25 Industrial Measures in 2025 (GJ)



6.7 Market Potential

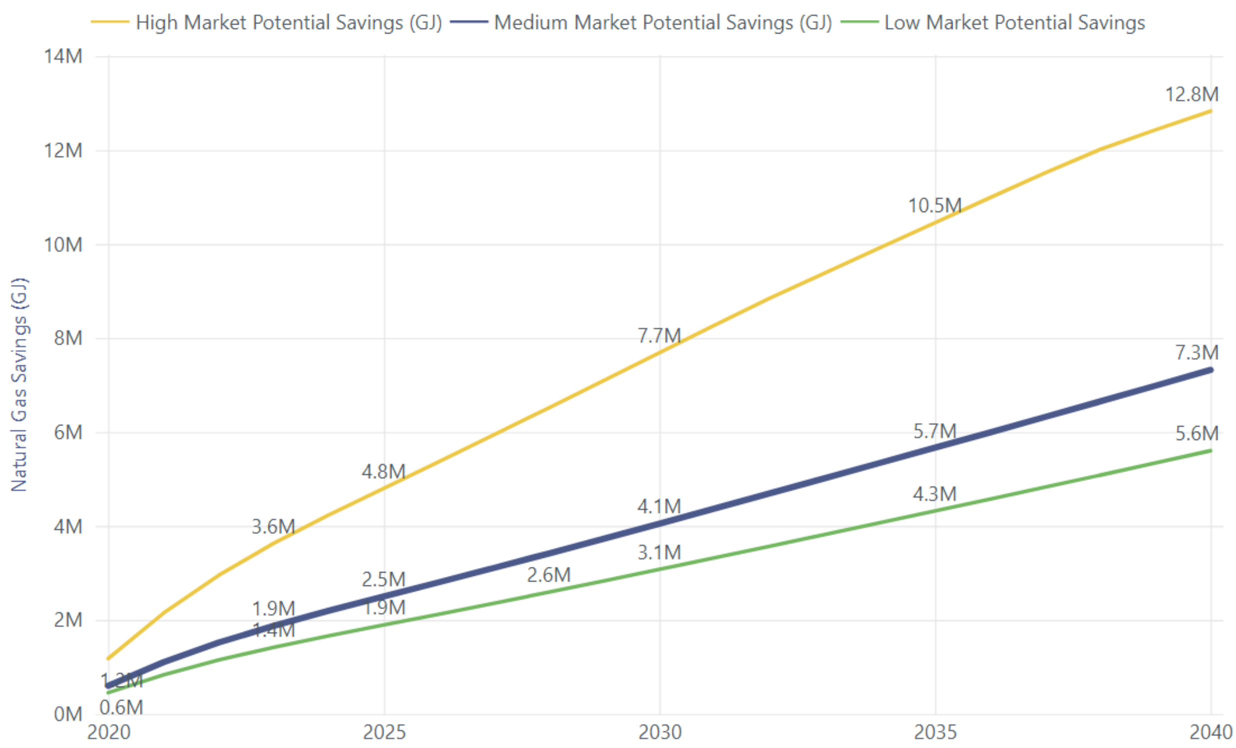
This section provides an overview of the low, medium, and high market potential results for the industrial sector.

Low, medium, and high scenarios assume that measure incentive levels will be 25%, 50% and 100% of incremental costs, respectively. For example, assume that a high-efficiency boiler may cost $10,000 more than a standard boiler, meaning the boiler would have an incremental cost of $10,000. In the medium scenario, this measure's hypothetical incentive from FortisBC would be $5,000. The other $5,000 would be paid by the end user. In all scenarios, the non-incentive program costs are assumed to be 15% of the incentive cost. In the example above, FortisBC's non-incentive spending would be $750. FortisBC's total cost for providing the measure to an end user would be $5,750.

The market potential savings results, with a TRC screen and with an MTRC screen, are shown in Exhibit 132 and Exhibit 133, respectively. These graphs are very similar because of the 39 measures included in the assessment, 34 pass the TRC screen and 38 pass the MTRC screen.

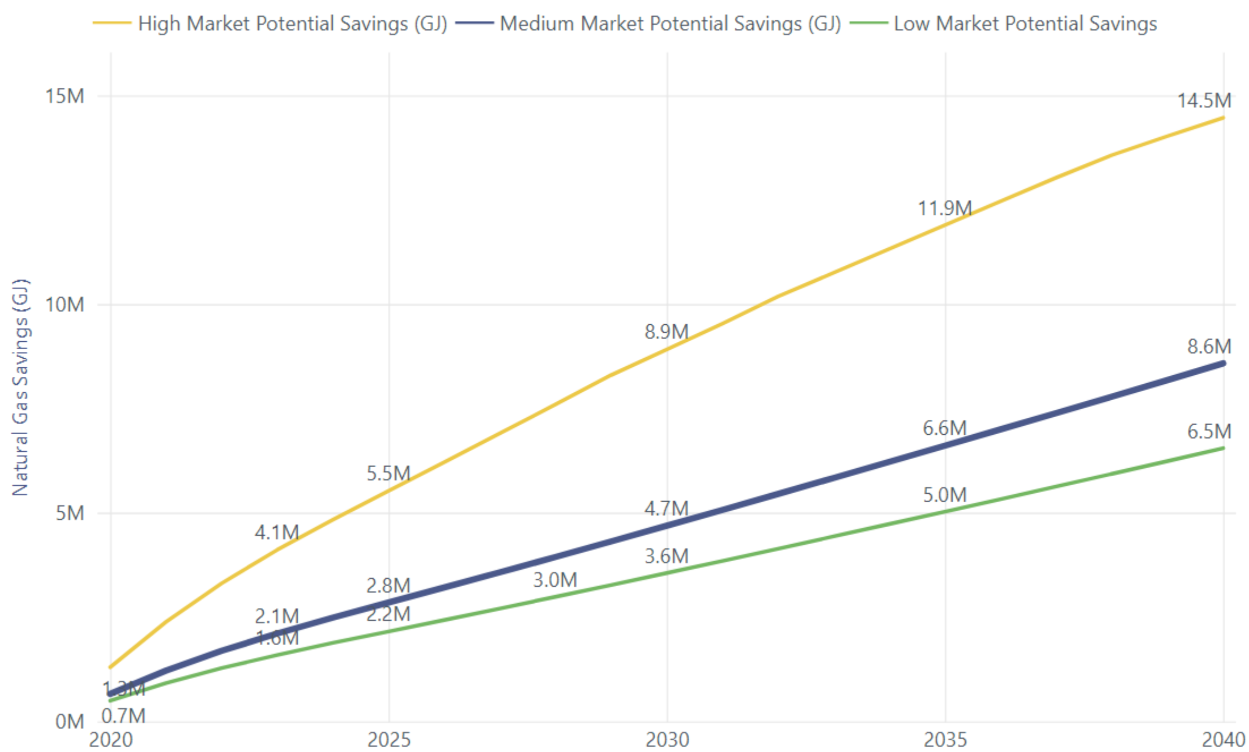
By 2040, the industrial low, medium, and high market TRC potential savings are estimated to be 5.6 PJ, 7.3 PJ, and 12.8 PJ, respectively.

Exhibit 132 – Market Potential Savings (GJ) – Industrial, TRC



By 2040, the industrial low, medium, and high market MTRC potential savings are estimated to be 6.5 PJ, 8.6 PJ, and 14.5 PJ, respectively.

Exhibit 133 – Market Potential Savings (GJ) – Industrial, MTRC



The market potential consumption results, with a TRC screen and with an MTRC screen, are shown in Exhibit 134 and Exhibit 135 respectively. These graphs are very similar because of the 39 measures included in the assessment, 34 pass the TRC screen and 38 pass the MTRC screen.

By 2040, the industrial low, medium, and high market TRC potential consumption levels are estimated to be 81 PJ, 79 PJ, and 73 PJ, respectively, while reference consumption is forecasted to reach 86 PJ.

By 2040, the industrial low, medium, and high market MTRC potential consumption levels are estimated to be 80 PJ, 78 PJ, and 72 PJ, respectively, while reference consumption is forecasted to reach 86 PJ.

Exhibit 134 – Market Potential Consumption (GJ) Forecasts – Industrial, TRC

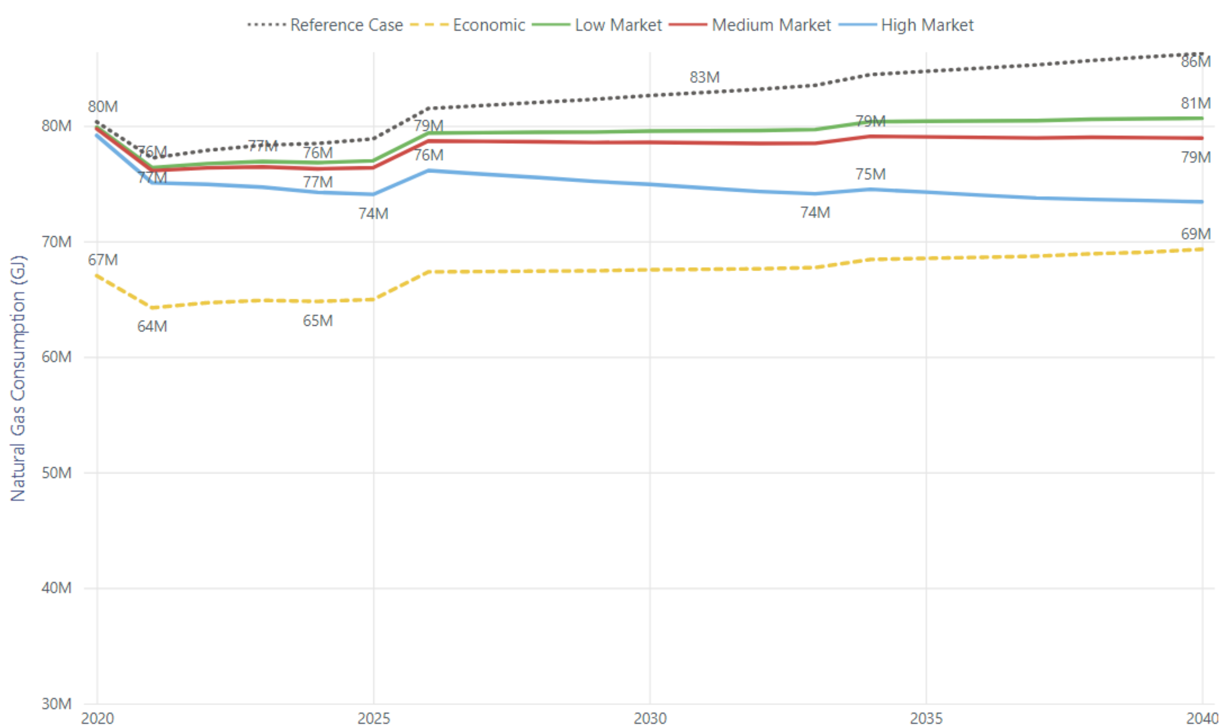
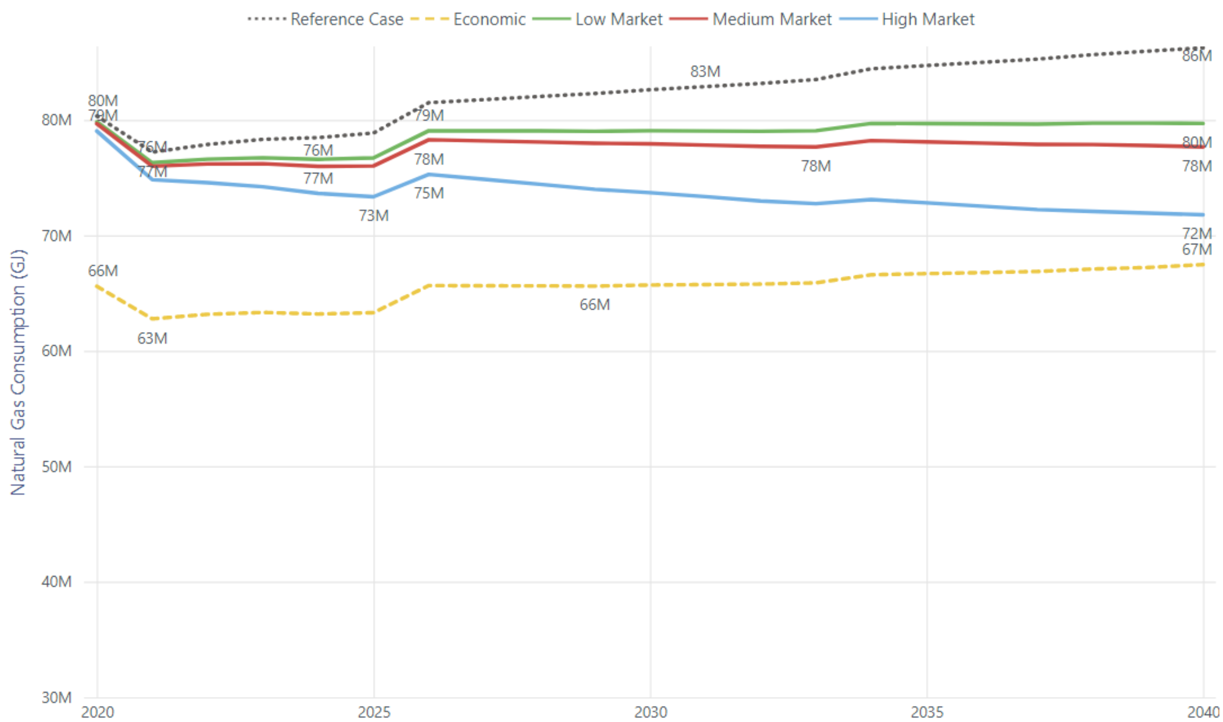


Exhibit 135 – Market Potential Consumption (GJ) Forecasts – Industrial, MTRC



The remainder of this section presents detailed results of the medium market potential scenario only. Similarly detailed results of the low and high market potential scenarios can be found on the Power BI dashboard and the Excel workbooks.

Results by Region

The medium market potential savings for 2025 are presented by region in Exhibit 136 (TRC) and Exhibit 137 (MTRC). TRC medium market potential savings for 2025 are estimated to be between 3% and 4% of reference case consumption in all regions, other than Whistler, where they are estimated to be less than 1%. MTRC medium market potential percentages are similar except in City of Vancouver (5%) and Whistler (11%).

Exhibit 136 – Medium Market Potential Savings by Region in 2025 – Industrial, TRC

Region	Ref Case Consumption (GJ)	Medium Market Potential Savings (GJ)	% of Consumption
Lower Mainland x Van	28,893K	1,108K	4%
Southern Interior	19,995K	535K	3%
Northern BC	15,774K	483K	3%
Vancouver Island	8,407K	299K	4%
City of Vancouver	5,788K	76K	1%
Whistler	7K	0K	0%
Total	**78,864K**	**2,501K**	**3%**

Exhibit 137 – Medium Market Potential Savings by Region in 2025 – Industrial, MTRC

Region	Ref Case Consumption (GJ)	Medium Market Potential Savings (GJ)	% of Consumption
Lower Mainland x Van	28,893K	1,186K	4%
Southern Interior	19,995K	547K	3%
Northern BC	15,774K	496K	3%
City of Vancouver	5,788K	317K	5%
Vancouver Island	8,407K	301K	4%
Whistler	7K	1K	11%
Total	**78,864K**	**2,848K**	**4%**

Results by Segment

The medium market potential savings for 2025 are presented by segment in Exhibit 138 (TRC) and Exhibit 139 (MTRC). In TRC medium market potential, the highest percentages savings are estimated to occur in the agriculture (5%) and fabricated metal segments (8%). The largest medium market potential savings (725 TJ) is estimated to occur in the pulp & paper – kraft segment. In MTRC medium market potential, the highest percentages savings are estimated to occur in the agriculture (5%), fabricated metal (8%) and district energy (7%) segments. The largest medium market potential savings (744 TJ) is still from the pulp & paper – kraft segment.

Exhibit 138 – Medium Market Potential Savings by Segment in 2025 – Industrial, TRC

Segment	Ref Case Consumption (GJ)	Medium Market Potential Savings (GJ)	% of Consumption
Pulp & Paper - Kraft	20,542K	725K	4%
Agriculture	11,951K	608K	5%
Food & Beverage	4,966K	220K	4%
Mining	9,044K	217K	2%
Wood Products	10,195K	206K	2%
Manufacturing	4,877K	158K	3%
Pulp & Paper - TMP	3,291K	134K	4%
Non-metallic Mineral	4,856K	112K	2%
Chemical	3,627K	71K	2%
Fabricated Metal	643K	50K	8%
District Energy	4,029K	0K	0%
Utilities	842K	0K	0%
Total	**78,864K**	**2,501K**	**3%**

Exhibit 139 – Medium Market Potential Savings by Segment in 2025 – Industrial, MTRC

Segment	Ref Case Consumption (GJ)	Medium Market Potential Savings (GJ)	% of Consumption
Pulp & Paper - Kraft	20,542K	744K	4%
Agriculture	11,951K	617K	5%
District Energy	4,029K	273K	7%
Food & Beverage	4,966K	223K	4%
Mining	9,044K	219K	2%
Wood Products	10,195K	208K	2%
Manufacturing	4,877K	171K	4%
Non-metallic Mineral	4,856K	137K	3%
Pulp & Paper - TMP	3,291K	134K	4%
Chemical	3,627K	72K	2%
Fabricated Metal	643K	51K	8%
Utilities	842K	0K	0%
Total	**78,864K**	**2,848K**	**4%**

Results by End Use

The medium market potential savings for 2025 are presented by end use in Exhibit 140 (TRC) and Exhibit 141 (MTRC). The highest percentages of economic potential savings are estimated to occur in the heat-treating end use (7% in both TRC and MTRC scenarios).

Under both economic screens, almost three quarters of savings are attributable to the Process Boilers end uses (1,500 TJ for TRC and 1,773 TJ for MTRC, distributed across all segments except utilities).

Exhibit 140 – Medium Market Potential Savings by End Use in 2025 – Industrial, TRC

Parent End Use	Ref Case Consumption (GJ)	Medium Market Potential Savings (GJ)	% of Consumption
Process Boilers	29,383K	1,500K	5%
Product Drying	20,665K	407K	2%
Direct-fired Heating	11,270K	231K	2%
Space Heating	6,400K	196K	3%
Heat Treating	755K	55K	7%
Kilns	3,428K	51K	1%
Ovens	1,204K	32K	3%
Petrochem Refining	1,219K	18K	1%
Other	1,382K	8K	1%
Water Heaters	942K	3K	0%
Direct Gas Use	1,376K	0K	0%
On-Site Generation	842K	0K	0%
Total	**78,864K**	**2,501K**	**3%**

Exhibit 141 – Medium Market Potential Savings by End Use in 2025 – Industrial, MTRC

Parent End Use	Ref Case Consumption (GJ)	Medium Market Potential Savings (GJ)	% of Consumption
Process Boilers	29,383K	1,773K	6%
Product Drying	20,665K	407K	2%
Direct-fired Heating	11,270K	231K	2%
Space Heating	6,400K	230K	4%
Kilns	3,428K	91K	3%
Heat Treating	755K	55K	7%
Ovens	1,204K	32K	3%
Petrochem Refining	1,219K	18K	1%
Other	1,382K	8K	1%
Water Heaters	942K	3K	0%
Direct Gas Use	1,376K	0K	0%
On-Site Generation	842K	0K	0%
Total	**78,864K**	**2,848K**	**4%**

The TRC and MTRC medium market potential savings for 2040 are presented by end use in Exhibit 142. As only four measures pass the MTRC but not the TRC screen, most savings totals are the same, except for the process boilers end use (954 TJ higher in MTRC), kilns end use (188 TJ higher in MTRC), and the space heating end use (117 TJ higher in MTRC).

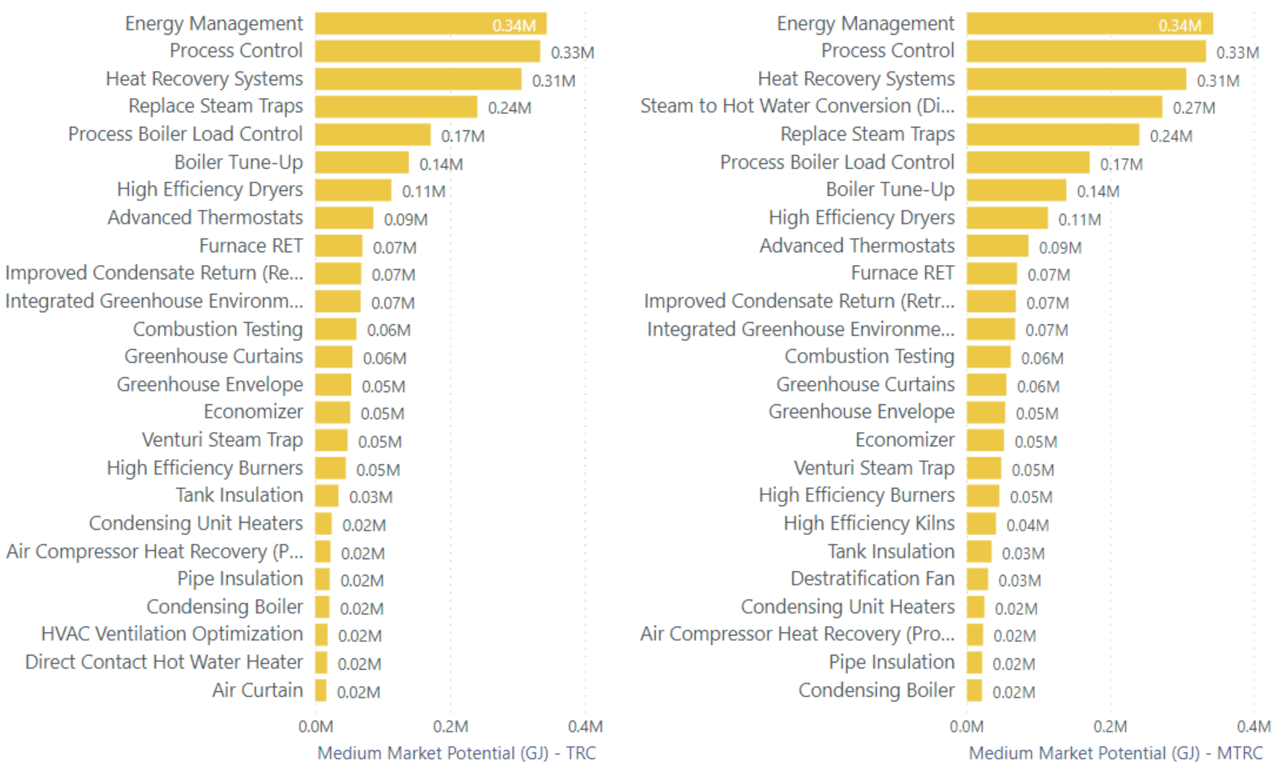
Exhibit 142 – Medium Market Potential Savings by End Use in 2040 – Industrial, TRC and MTRC

Parent End Use	Medium Potential Savings (GJ) - TRC	Medium Potential Savings (GJ) - MTRC	Difference (GJ)
Process Boilers	4,761K	5,716K	954K
Kilns	88K	276K	188K
Space Heating	522K	639K	117K
Direct Gas Use	0K	0K	0K
Direct-fired Heating	523K	523K	0K
Heat Treating	67K	67K	0K
On-Site Generation	0K	0K	0K
Other	15K	15K	0K
Ovens	118K	118K	0K
Petrochem Refining	31K	31K	0K
Product Drying	1,189K	1,189K	0K
Water Heaters	8K	8K	0K
Total	**7,323K**	**8,582K**	**1,259K**

Results by Measure

The total medium market potential savings (GJ per year) in 2025 of each of the top 25 industrial measures are shown in Exhibit 143, sorted by decreasing potential. As in the technical and economic potential scenarios, the top three measures (energy management, process control, and heat recovery systems) are expected to contribute a large portion of the medium market potential savings (approximately 0.34 PJ, 0.33 PJ, and 0.31 PJ in 2025).

Exhibit 143 – Medium Market Potential (TRC on Left, MTRC on Right) - Gas Savings from Top 25 Industrial Measures in 2025 (GJ)



6.7.1 Incentive and Non-Incentive Spending

The incentive and non-incentive spending required to achieve the medium and high market potential are shown in Exhibit 144 (TRC) and Exhibit 145 (MTRC). Medium and high market incentives are assumed to be 50% and 100% of measures' incremental costs, respectively. In both medium and high scenarios, non-incentive costs are estimated to be 15% of incentive costs. The tables also show the total as well as incremental (that is, savings from new measures installed in a year) savings every year.

Exhibit 144 – Medium and High Market Incentive Costs and Natural Gas Savings – Industrial, TRC

Year	Medium Market Incentive Cost	Medium Market Non-Incentive Cost	Medium Market Total Costs	Medium Market Potential Savings (GJ)	Medium Incremental Savings (Year-over-Year, GJ)	High Market Incentive Cost	High Market Non-Incentive Cost	High Market Total Costs	High Market Potential Savings (GJ)	High Incremental Savings (Year-over-Year, GJ)
2020	$3.3M	$0.5M	$3.8M	600K	600K	$13.0M	$2.0M	$15.0M	1,178K	1,178K
2021	$3.3M	$0.5M	$3.8M	1,099K	499K	$12.9M	$1.9M	$14.8M	2,144K	966K
2022	$3.2M	$0.5M	$3.7M	1,518K	419K	$12.7M	$1.9M	$14.6M	2,949K	805K
2023	$3.1M	$0.5M	$3.5M	1,874K	356K	$12.1M	$1.8M	$13.9M	3,631K	681K
2024	$3.0M	$0.4M	$3.4M	2,196K	323K	$11.5M	$1.7M	$13.2M	4,234K	603K
2025	$2.9M	$0.4M	$3.3M	2,501K	305K	$11.3M	$1.7M	$13.0M	4,805K	572K
2026	$2.9M	$0.4M	$3.4M	2,804K	303K	$11.4M	$1.7M	$13.1M	5,373K	568K
2027	$3.0M	$0.5M	$3.5M	3,109K	305K	$11.6M	$1.7M	$13.4M	5,944K	571K
2028	$3.1M	$0.5M	$3.6M	3,419K	310K	$12.0M	$1.8M	$13.8M	6,520K	577K
2029	$3.2M	$0.5M	$3.7M	3,733K	315K	$12.5M	$1.9M	$14.4M	7,103K	583K
2030	$3.4M	$0.5M	$3.9M	4,051K	317K	$13.0M	$2.0M	$15.0M	7,689K	585K
2031	$3.5M	$0.5M	$4.0M	4,371K	320K	$13.4M	$2.0M	$15.4M	8,276K	587K
2032	$3.5M	$0.5M	$4.0M	4,694K	323K	$13.2M	$2.0M	$15.2M	8,848K	572K
2033	$3.5M	$0.5M	$4.0M	5,018K	324K	$12.7M	$1.9M	$14.6M	9,386K	538K
2034	$3.5M	$0.5M	$4.0M	5,343K	325K	$12.6M	$1.9M	$14.4M	9,924K	538K
2035	$3.5M	$0.5M	$4.0M	5,667K	324K	$12.4M	$1.9M	$14.3M	10,458K	534K
2036	$3.5M	$0.5M	$4.0M	5,994K	327K	$12.4M	$1.9M	$14.2M	10,990K	532K
2037	$3.5M	$0.5M	$4.0M	6,323K	329K	$12.4M	$1.9M	$14.2M	11,518K	528K
2038	$3.6M	$0.5M	$4.1M	6,653K	331K	$12.0M	$1.8M	$13.8M	12,020K	502K
2039	$3.6M	$0.5M	$4.1M	6,986K	333K	$9.1M	$1.4M	$10.5M	12,434K	414K
2040	$3.7M	$0.6M	$4.2M	7,323K	337K	$8.8M	$1.3M	$10.1M	12,833K	399K

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Exhibit 145 – Medium and High Market Incentive Costs and Natural Gas Savings – Industrial, MTRC

Year	Medium Market Incentive Cost	Medium Market Non-Incentive Cost	Medium Market Total Costs	Medium Market Potential Savings (GJ)	Medium Incremental Savings (Year-over-Year, GJ)	High Market Incentive Cost	High Market Non-Incentive Cost	High Market Total Costs	High Market Potential Savings (GJ)	High Incremental Savings (Year-over-Year, GJ)
2020	$8.8M	$1.3M	$10.2M	658K	658K	$35.2M	$5.3M	$40.5M	1,298K	1,298K
2021	$8.8M	$1.3M	$10.1M	1,215K	557K	$35.0M	$5.3M	$40.3M	2,384K	1,086K
2022	$8.8M	$1.3M	$10.1M	1,692K	477K	$34.9M	$5.2M	$40.1M	3,309K	925K
2023	$8.6M	$1.3M	$9.9M	2,105K	414K	$34.3M	$5.1M	$39.4M	4,110K	801K
2024	$8.5M	$1.3M	$9.8M	2,486K	381K	$33.7M	$5.1M	$38.8M	4,833K	723K
2025	$8.5M	$1.3M	$9.7M	2,848K	362K	$33.5M	$5.0M	$38.6M	5,524K	691K
2026	$8.5M	$1.3M	$9.7M	3,209K	361K	$33.6M	$5.0M	$38.7M	6,211K	687K
2027	$8.6M	$1.3M	$9.8M	3,572K	363K	$33.9M	$5.1M	$39.0M	6,901K	690K
2028	$8.7M	$1.3M	$10.0M	3,940K	367K	$34.3M	$5.1M	$39.4M	7,597K	696K
2029	$8.8M	$1.3M	$10.1M	4,313K	373K	$34.8M	$5.2M	$40.0M	8,299K	703K
2030	$8.9M	$1.3M	$10.3M	4,688K	376K	$15.2M	$2.3M	$17.5M	8,914K	615K
2031	$9.1M	$1.4M	$10.4M	5,067K	379K	$15.7M	$2.3M	$18.0M	9,532K	618K
2032	$9.1M	$1.4M	$10.5M	5,451K	383K	$25.7M	$3.9M	$29.5M	10,182K	649K
2033	$9.1M	$1.4M	$10.5M	5,835K	384K	$15.2M	$2.3M	$17.5M	10,753K	571K
2034	$9.1M	$1.4M	$10.5M	6,221K	386K	$15.1M	$2.3M	$17.4M	11,326K	572K
2035	$9.1M	$1.4M	$10.5M	6,607K	386K	$15.1M	$2.3M	$17.3M	11,895K	569K
2036	$9.2M	$1.4M	$10.5M	6,997K	389K	$15.1M	$2.3M	$17.4M	12,464K	569K
2037	$9.2M	$1.4M	$10.6M	7,389K	392K	$15.2M	$2.3M	$17.5M	13,030K	566K
2038	$9.3M	$1.4M	$10.7M	7,783K	394K	$14.9M	$2.2M	$17.1M	13,572K	542K
2039	$9.4M	$1.4M	$10.8M	8,180K	397K	$12.1M	$1.8M	$13.9M	14,026K	454K
2040	$9.5M	$1.4M	$10.9M	8,582K	402K	$11.9M	$1.8M	$13.7M	14,467K	441K

7 Portfolio Level Results

This section provides the results of the market potential savings on a portfolio (i.e. total of residential, commercial, and industrial sectors) level. It also presents estimated emissions reduction and job creation possibilities that can result from the energy savings in market potential scenarios.

7.1 Market Potential

Low, medium, and high scenarios assume that measure incentive levels will be 25%, 50%, and 100% of incremental costs, respectively. For example, assume that a high-efficiency furnace may cost $200 more than a standard furnace, meaning the furnace would have an incremental cost of $200. In the medium scenario, this measure's hypothetical incentive from FortisBC would be $100. The other $100 would be paid by the end user. In all scenarios, the non-incentive program costs are assumed to be 15% of the incentive cost. In the example above, FortisBC's non-incentive spending would be $15. FortisBC's total cost for providing the measure to an end user would be $115.

7.1.1 Results

The total market potential savings for all sectors, with a TRC screen and with an MTRC screen, are shown in Exhibit 146 and Exhibit 147, respectively. The medium market potential using the MTRC screen is 50% higher than the market potential using TRC screen.

By 2040, the total low, medium, and high market TRC potential savings are estimated to be 12 PJ, 16 PJ, and 27 PJ, respectively. By 2040, the low, medium, and high market MTRC potential savings are estimated to be 19 PJ, 24 PJ, and 46 PJ, respectively.

Exhibit 146 – Market Potential Savings (GJ) – All Sectors, TRC

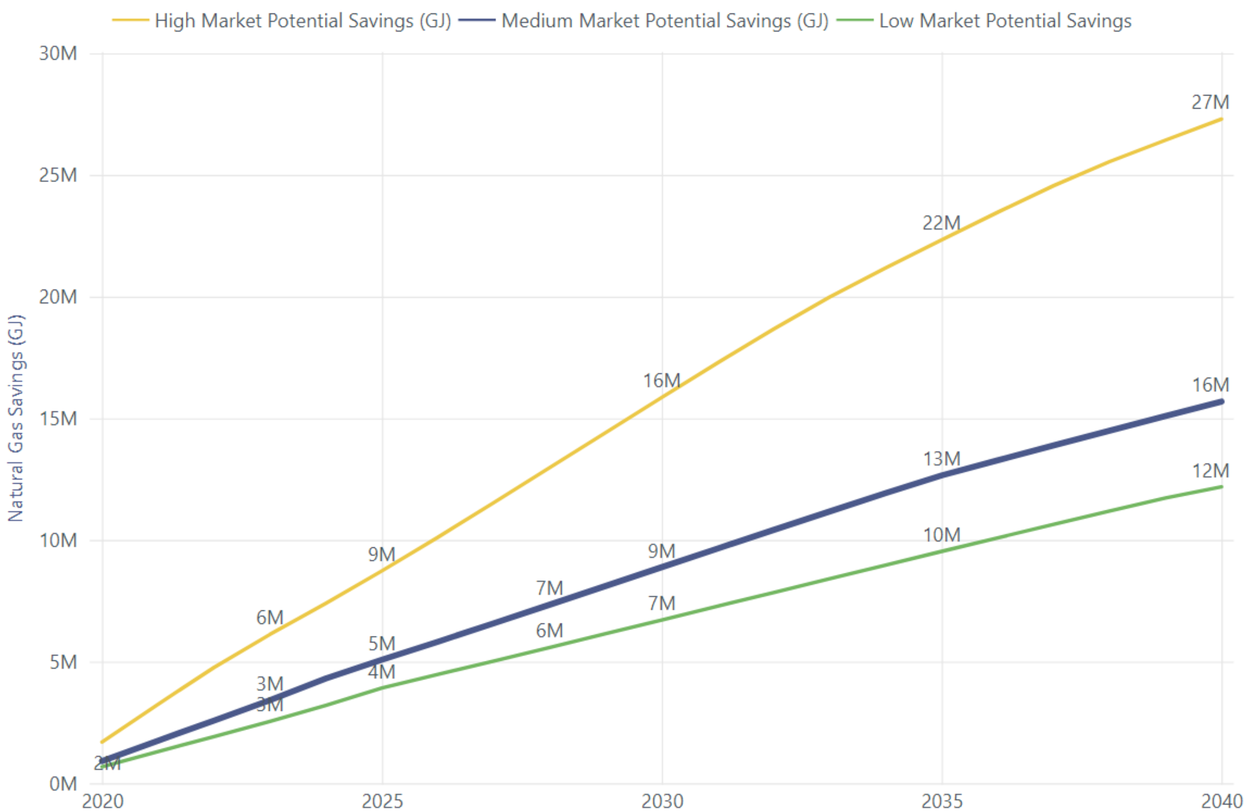
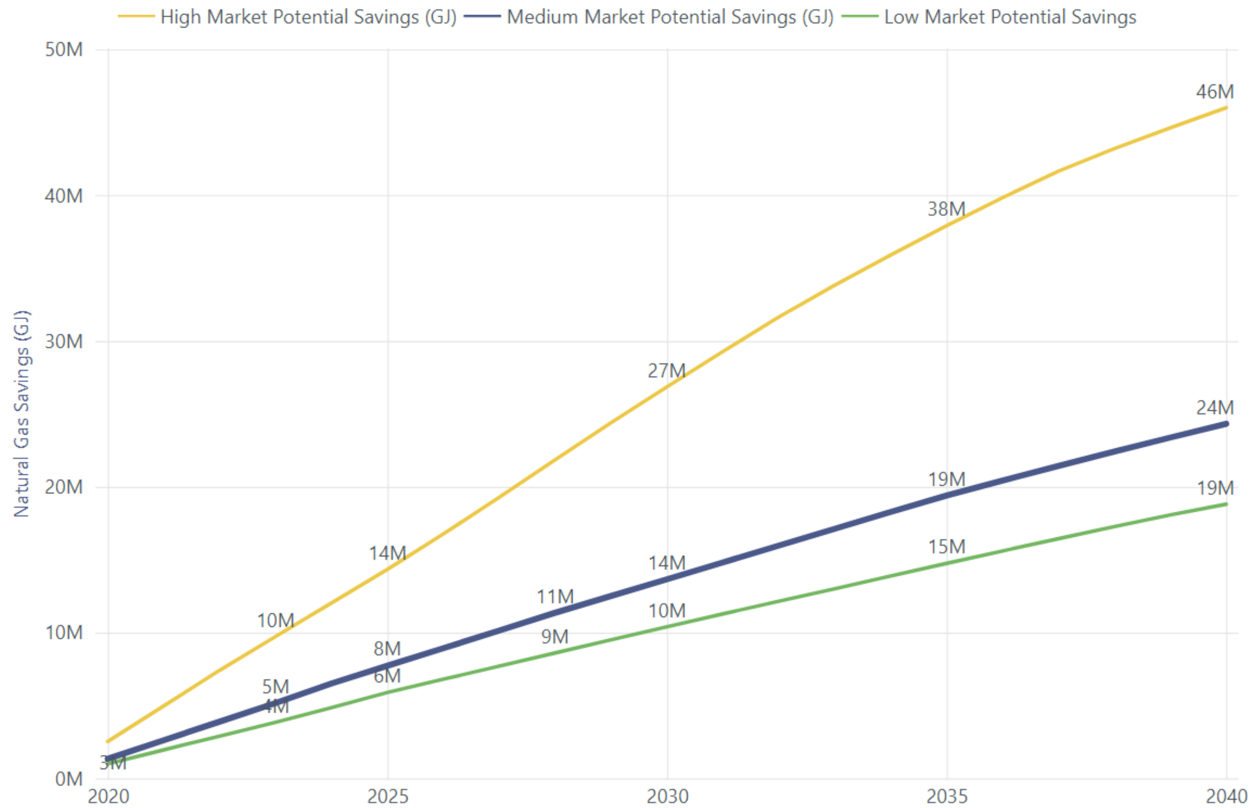


Exhibit 147 – Market Potential Savings (GJ) – All Sectors, MTRC



The forecasted total natural gas consumption under the three market potential scenarios relative to reference case forecast is shown in Exhibit 148 (TRC) and Exhibit 149 (MTRC). The reference consumption is forecasted to increase to 241 PJ – it is 222 PJ today. By 2040, the total low, medium, and high market TRC potential consumption levels are estimated to be 229 PJ, 226 PJ, and 214 PJ, respectively. By 2040, the low, medium, and high market MTRC potential consumption levels are estimated to be 222 PJ, 217 PJ, and 195 PJ, respectively.

Exhibit 148 – Market Potential Consumption (GJ) Forecasts – All Sectors, TRC

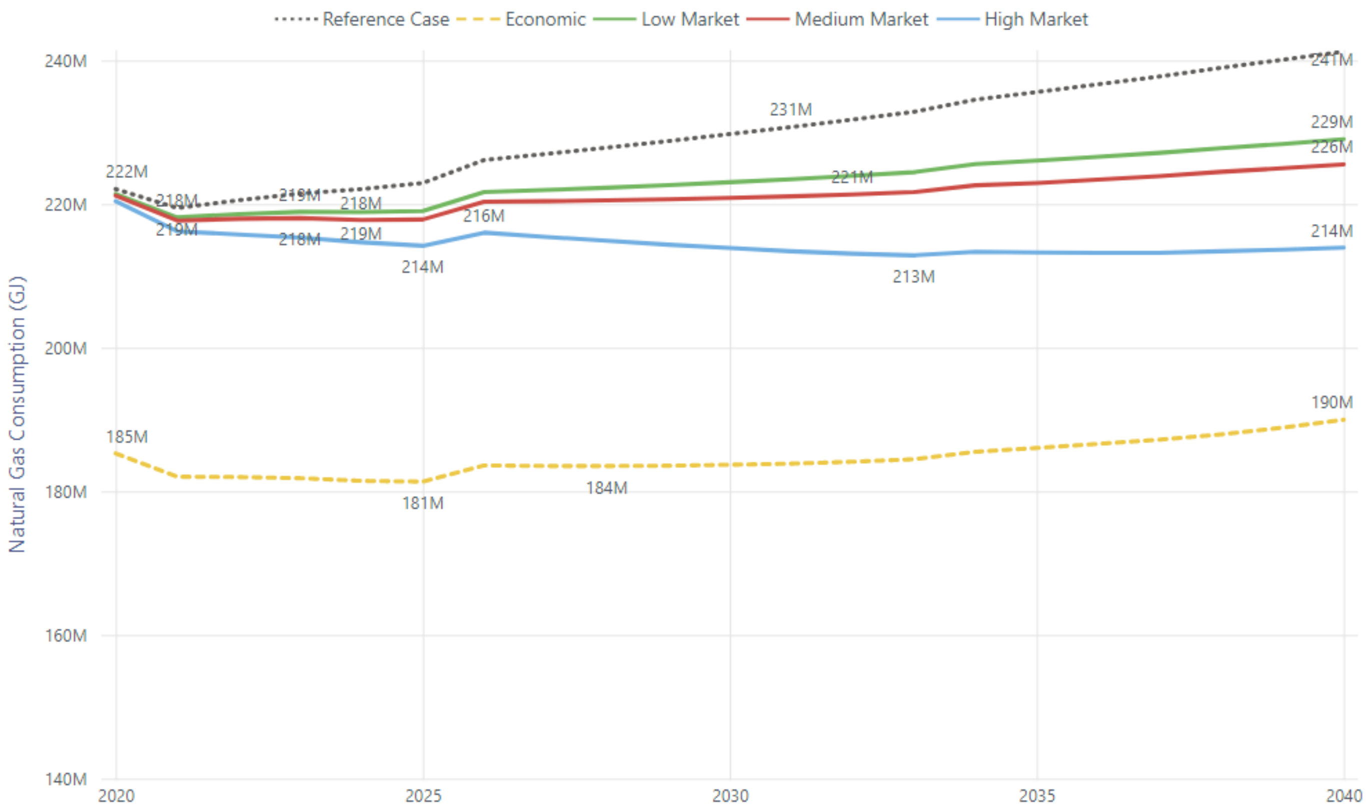
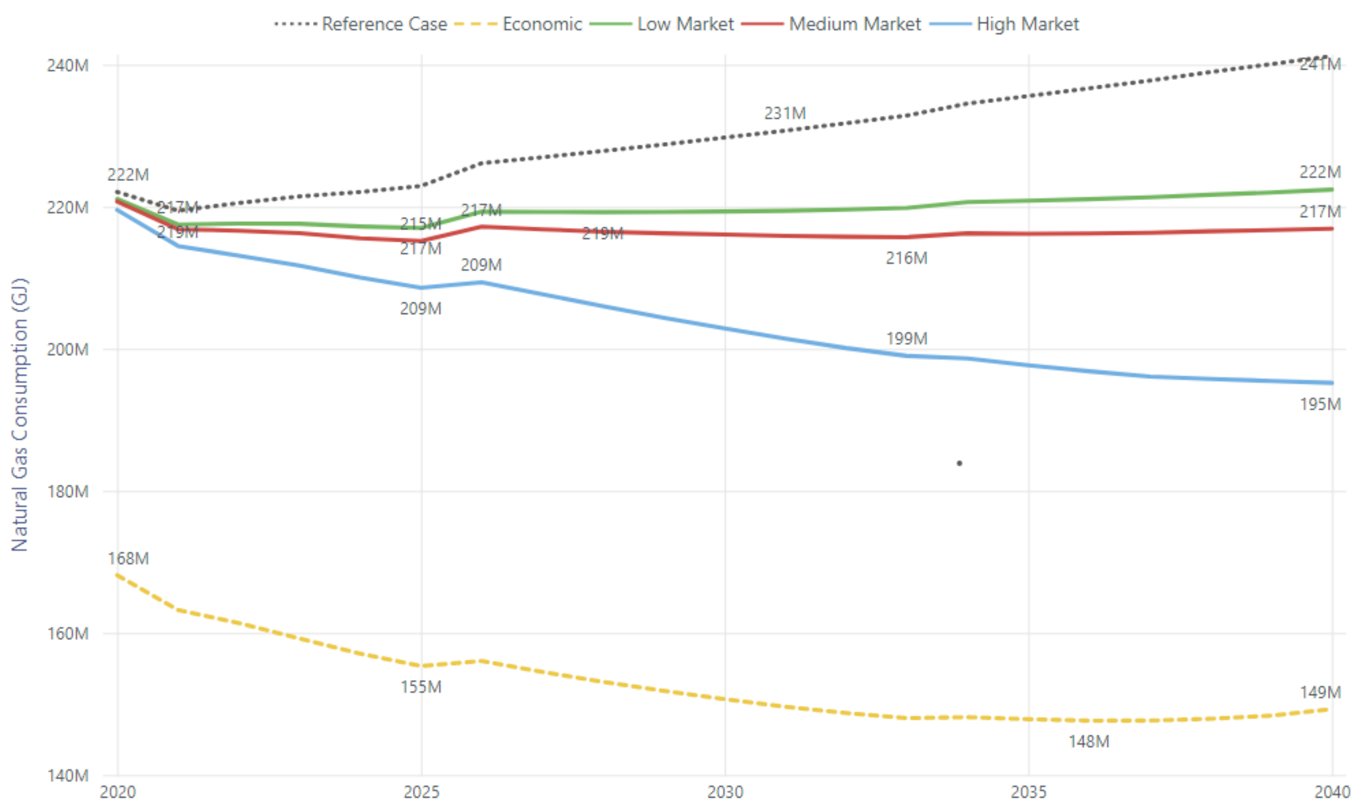


Exhibit 149 – Market Potential Consumption (GJ) Forecasts – All Sectors, MTRC



The medium market potential savings from the commercial, industrial, residential sectors are plotted together in Exhibit 150 (TRC) and Exhibit 151 (MTRC).

Under the TRC medium market scenario, by 2025, the industrial sector is estimated to have the most savings potential, followed by the residential and then commercial sectors. By 2030, the commercial sector overtakes residential. This is because there are only 14 residential measures that pass the TRC, and almost all of them are retrofit measures that can be implemented early in the study period. By 2040, potential savings from industrial, commercial, and residential sectors are estimated to be 7.3 PJ, 5.0 PJ, and 3.4 PJ, respectively.

Under the MTRC medium market scenario, the residential sector is estimated to have the most savings potential throughout the study period, followed by industrial and then commercial. By 2040, potential savings from residential, industrial, and commercial sectors are estimated to be 9.9 PJ, 8.6 PJ, and 5.8 PJ, respectively.

Exhibit 150 – Medium Market Potential Savings (GJ) – All Sectors, TRC

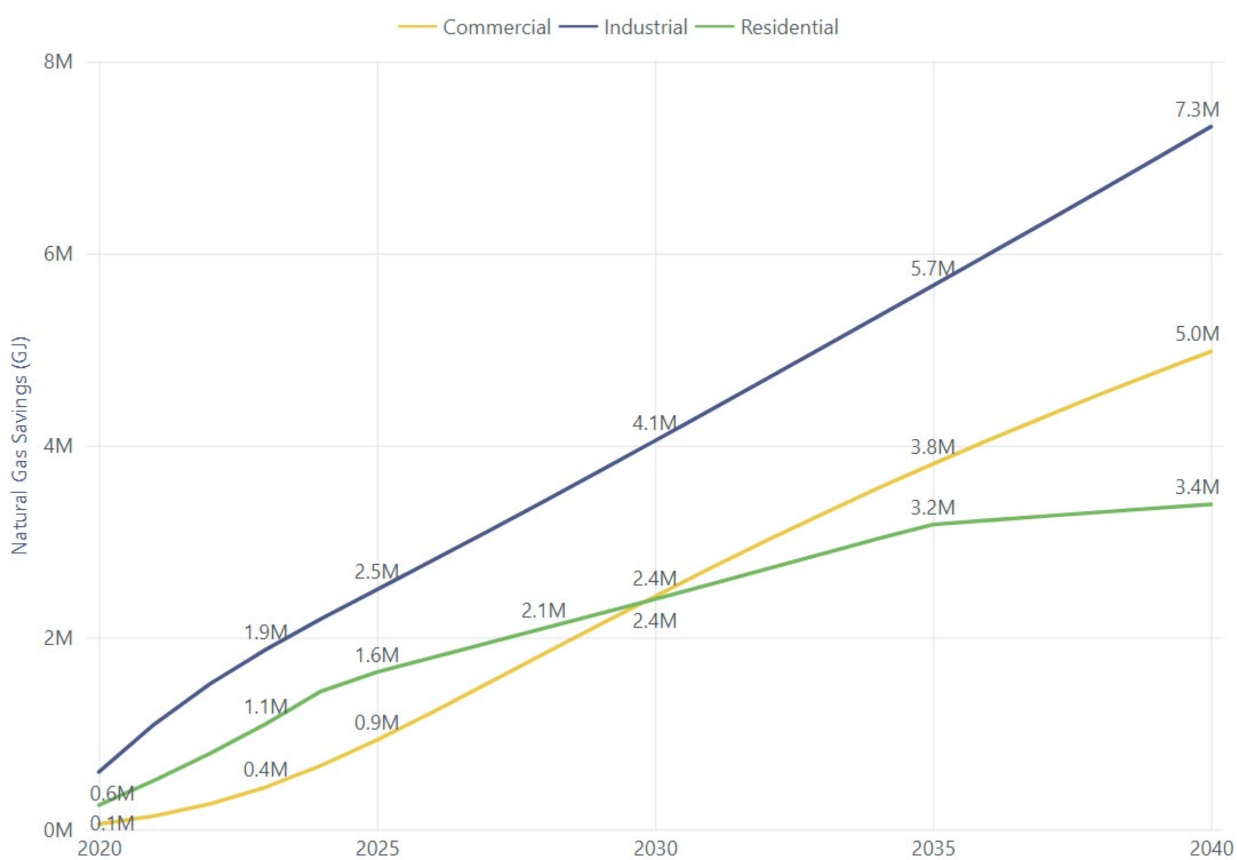


Exhibit 151 – Medium Market Potential Savings (GJ) – All Sectors, MTRC

7.1.2 Incentive and Non-Incentive Spending

The incentive and non-incentive spending required to achieve the medium and high market potential are shown in Exhibit 152 (TRC) and Exhibit 153 (MTRC). Medium and high market incentives are assumed to be 50% and 100% of measures' incremental costs, respectively. In both medium and high scenarios, non-incentive costs are estimated to be 15% of incentive costs. For each year, the tables show the total as well as incremental savings from new measures installed in each year.

Note that these costs and savings are not directly comparable to the costs and savings of FortisBC's current DSM portfolio for several reasons, including:

- Market potential includes a mix of measures that does not align exactly with the current DSM portfolio.
- The current DSM portfolio includes a mixture of measures that pass the TRC test and measures that pass the MTRC test only. This report presents TRC and MTRC analysis separately.
- Program-level incentive and non-incentive costs are estimated, and do not align exactly with current DSM costs.
- DSM spending includes portfolio-level non-incentive costs, whereas CPR modelling does not.

Exhibit 152 – Medium and High Market Incentive Costs and Natural Gas Savings – All Sectors, TRC

Year	Medium Market Incentive Cost	Medium Market Non-Incentive Cost	Medium Market Total Costs	Medium Market Potential Savings (GJ)	Medium Incremental Savings (Year-over-Year, GJ)	High Market Incentive Cost	High Market Non-Incentive Cost	High Market Total Costs	High Market Potential Savings (GJ)	High Incremental Savings (Year-over-Year, GJ)
2020	$7.8M	$1.2M	$8.9M	912K	912K	$31.5M	$4.7M	$36.3M	1,698K	1,698K
2021	$8.5M	$1.3M	$9.8M	1,754K	842K	$35.8M	$5.4M	$41.2M	3,252K	1,554K
2022	$9.9M	$1.5M	$11.3M	2,578K	824K	$42.9M	$6.4M	$49.4M	4,763K	1,511K
2023	$11.5M	$1.7M	$13.2M	3,415K	837K	$47.0M	$7.1M	$54.1M	6,120K	1,357K
2024	$13.5M	$2.0M	$15.5M	4,306K	891K	$53.7M	$8.1M	$61.8M	7,398K	1,278K
2025	$12.6M	$1.9M	$14.5M	5,077K	771K	$63.5M	$9.5M	$73.0M	8,733K	1,334K
2026	$13.5M	$2.0M	$15.5M	5,819K	743K	$73.0M	$11.0M	$84.0M	10,114K	1,382K
2027	$14.4M	$2.2M	$16.5M	6,578K	759K	$79.3M	$11.9M	$91.2M	11,536K	1,421K
2028	$15.1M	$2.3M	$17.4M	7,344K	766K	$84.5M	$12.7M	$97.1M	12,976K	1,441K
2029	$15.5M	$2.3M	$17.9M	8,114K	770K	$86.9M	$13.0M	$99.9M	14,422K	1,446K
2030	$15.9M	$2.4M	$18.3M	8,882K	769K	$88.5M	$13.3M	$101.8M	15,863K	1,440K
2031	$16.1M	$2.4M	$18.5M	9,650K	767K	$89.5M	$13.4M	$102.9M	17,288K	1,425K
2032	$16.4M	$2.5M	$18.9M	10,415K	766K	$90.1M	$13.5M	$103.6M	18,671K	1,384K
2033	$16.1M	$2.4M	$18.5M	11,172K	757K	$86.7M	$13.0M	$99.7M	19,991K	1,320K
2034	$16.2M	$2.4M	$18.7M	11,926K	754K	$86.5M	$13.0M	$99.5M	21,189K	1,198K
2035	$16.0M	$2.4M	$18.4M	12,655K	729K	$85.0M	$12.7M	$97.7M	22,338K	1,149K
2036	$15.5M	$2.3M	$17.8M	13,273K	618K	$83.7M	$12.5M	$96.2M	23,469K	1,131K
2037	$15.5M	$2.3M	$17.9M	13,885K	612K	$83.0M	$12.5M	$95.5M	24,565K	1,095K
2038	$15.4M	$2.3M	$17.8M	14,494K	609K	$78.2M	$11.7M	$90.0M	25,554K	989K
2039	$15.1M	$2.3M	$17.4M	15,094K	599K	$71.6M	$10.7M	$82.3M	26,434K	880K
2040	$15.2M	$2.3M	$17.5M	15,692K	598K	$72.4M	$10.9M	$83.3M	27,299K	865K

Exhibit 153 – Medium and High Market Incentive Costs and Natural Gas Savings – All Sectors, MTRC

Year	Medium Market Incentive Cost	Medium Market Non-Incentive Cost	Medium Market Total Costs	Medium Market Potential Savings (GJ)	Medium Incremental Savings (Year-over-Year, GJ)	High Market Incentive Cost	High Market Non-Incentive Cost	High Market Total Costs	High Market Potential Savings (GJ)	High Incremental Savings (Year-over-Year, GJ)
2020	$51.3M	$7.7M	$59.0M	1,343K	1,343K	$198.3M	$29.8M	$228.1M	2,538K	2,538K
2021	$53.1M	$8.0M	$61.1M	2,625K	1,282K	$210.7M	$31.6M	$242.3M	4,975K	2,437K
2022	$55.3M	$8.3M	$63.6M	3,892K	1,267K	$227.2M	$34.1M	$261.3M	7,418K	2,443K
2023	$57.7M	$8.7M	$66.3M	5,166K	1,274K	$240.8M	$36.1M	$276.9M	9,736K	2,317K
2024	$60.6M	$9.1M	$69.7M	6,514K	1,349K	$252.5M	$37.9M	$290.3M	12,032K	2,296K
2025	$60.2M	$9.0M	$69.2M	7,734K	1,219K	$255.2M	$38.3M	$293.5M	14,340K	2,308K
2026	$62.1M	$9.3M	$71.4M	8,931K	1,197K	$279.0M	$41.9M	$320.9M	16,766K	2,426K
2027	$63.9M	$9.6M	$73.5M	10,146K	1,215K	$296.2M	$44.4M	$340.6M	19,282K	2,516K
2028	$65.3M	$9.8M	$75.1M	11,365K	1,219K	$309.6M	$46.4M	$356.1M	21,852K	2,569K
2029	$58.0M	$8.7M	$66.7M	12,512K	1,147K	$302.5M	$45.4M	$347.8M	24,402K	2,550K
2030	$59.5M	$8.9M	$68.5M	13,663K	1,151K	$286.2M	$42.9M	$329.1M	26,862K	2,461K
2031	$60.8M	$9.1M	$69.9M	14,816K	1,153K	$284.5M	$42.7M	$327.2M	29,287K	2,424K
2032	$62.2M	$9.3M	$71.6M	15,972K	1,156K	$293.9M	$44.1M	$338.0M	31,650K	2,363K
2033	$63.0M	$9.5M	$72.5M	17,124K	1,152K	$275.4M	$41.3M	$316.7M	33,838K	2,188K
2034	$64.4M	$9.7M	$74.1M	18,277K	1,153K	$272.5M	$40.9M	$313.4M	35,907K	2,069K
2035	$65.4M	$9.8M	$75.3M	19,408K	1,131K	$267.1M	$40.1M	$307.2M	37,905K	1,999K
2036	$63.3M	$9.5M	$72.8M	20,430K	1,022K	$262.6M	$39.4M	$302.0M	39,832K	1,927K
2037	$62.9M	$9.4M	$72.3M	21,440K	1,011K	$254.1M	$38.1M	$292.2M	41,660K	1,828K
2038	$61.0M	$9.1M	$70.1M	22,425K	984K	$228.8M	$34.3M	$263.1M	43,199K	1,539K
2039	$58.9M	$8.8M	$67.7M	23,381K	957K	$220.3M	$33.0M	$253.3M	44,622K	1,423K
2040	$58.3M	$8.8M	$67.1M	24,325K	944K	$219.8M	$33.0M	$252.8M	46,010K	1,388K

7.2 Emissions

Reducing natural gas use results in lower greenhouse gas emissions. The estimated GHG emission reductions for the three sectors combined, in the medium and high market potential scenarios are shown in Exhibit 154 (TRC) and Exhibit 155 (MTRC).

These estimates use an emissions factor of 51.6 kg of CO_2e, or carbon dioxide equivalent, per GJ of natural gas saved.[46] The emissions reductions are shown in tCO_2e, or Tonnes of CO_2e.

Exhibit 154 – Estimated Greenhouse Gas Emissions Reduction (Tonnes of CO2e) – All Sectors, TRC

Year	Reference Case Emissions (tCO2e)	Medium Market Potential Emissions Reduction (tCO2e)	%	High Market Potential Emissions Reduction (tCO2e)	%
2025	11.5M	262k	2.3%	451k	3.9%
2030	11.8M	458k	3.9%	819k	6.9%
2035	12.1M	653k	5.4%	1.1M	9.5%
2040	12.5M	810k	6.5%	1.4M	11.3%

Exhibit 155 – Estimated Greenhouse Gas Emissions Reduction (Tonnes of CO_2e) – All Sectors, MTRC

Year	Reference Case Emissions (tCO2e)	Medium Market Potential Emissions Reduction (tCO2e)	%	High Market Potential Emissions Reduction (tCO2e)	%
2025	11.5M	399k	3.5%	740k	6.4%
2030	11.8 M	705k	5.9%	1.4M	11.7%
2035	12.1 M	1.0M	8.2%	1.9M	16.1%
2040	12.5 M	1.3M	10.1%	2.4M	19.1%

46 Lifecycle emissions factor derived from *Environment Canada National Inventory Report on Greenhouse Gases and Sinks, 1990-2007*, consistent with FortisBC practice.

7.3 Employment Impacts

Employment impacts from spending on energy conservation measures in the market potential are presented in this section. Using multipliers, this analysis illustrates the economic effect investing in energy efficiency can have on the labour market.

The literature defines three types of impacts on employment: direct, indirect, and induced. Details of the analysis approach for each employment category are provided below.

7.3.1 Direct/Indirect Jobs

Direct and indirect jobs are created by spending, as capital and labour are required to create and ship products, and conduct the work associated with an efficiency project.

The CPR includes a variety of measure types, each of which would have different employment impacts.[47] For the purpose of this analysis, impacts were estimated in aggregate using the following approach:

1. Estimate DSM spending: The total annual medium market incentive cost for all sectors, multiplied by two (as the incentive represents 50% of the incremental cost of implementing the measure). This value represents the spending injected into the economy from implementing the CPR measures.
2. Estimate direct and indirect employment impacts:
    a. Apply the multiplier for direct jobs – to estimate direct jobs supported by spending.
    b. Apply the multiplier for indirect jobs – to estimate indirect jobs supported by spending.
3. Sum results for the study period to derive the total estimated number of jobs supported by spending on CPR measures.

7.3.2 Induced Jobs

Induced jobs are created when people or businesses spend more money because they have lower fixed costs, such as energy bills.

Lower energy costs result in higher disposable income for households and people often spend disposable income in their local economy (going out for dinner or to the movies, for example). Similarly, businesses can become more competitive when lower energy costs reduce their operating expenses, creating more

47 Multipliers for job impacts may vary by measure type, as different measures involve different industries, and levels of labour and capital. For a more detailed analysis of employment impacts by measure type and sector, please see "Analysis of Job Creation and Energy Cost Savings from Building Energy Rating and Disclosure Policy" by the Institute for Market Transformation and the Political Economy Research Institute (2012) and "The Economic Impact of Improved Energy Efficiency in Canada" by Efficiency Canada (2018).

working capital. The Institute for Market Transformation estimates that 60% of net jobs created through energy efficiency projects are associated with the energy cost savings.[48]

The following steps were taken for the TRC and MTRC scenario to estimate induced jobs:

- Estimate cost savings: Annual retail rates by sector were multiplied by the medium market potential savings to generate an annual cost savings figure.
- Estimate employment impacts: Apply the multiplier for induced jobs to estimate induced jobs.

7.3.3 Summary of Employment Impacts

The analysis uses the following multipliers:[49]

- Direct jobs: 5 job-years[50] per $1 million CAD spent on energy efficiency measures.
- Indirect jobs: 4 jobs-years per $1 million CAD spent on energy efficiency measures.
- Induced jobs: 4 jobs-years per $1 million CAD saved, used to estimate induced jobs from bill savings resulting in energy efficiency measures.

Multipliers for direct and indirect jobs are net numbers, meaning they account for job losses in other sectors that may result from spending on energy efficiency.

Using the method described in the sections above, the following exhibits provide the cumulative incentive spending, total spending (double the incentive spending), direct and indirect jobs-years resulting from this spending, customer bill savings, induced jobs resulting from bill savings, and total employment impacts for the study period. Exhibit 156 and Exhibit 157 present results using spending and bill savings levels for the TRC and MTRC screens, respectively.

48 Institute for Market Transformation and Political Economy Research Institute. "Analysis of Job Creation and Energy Cost Savings." (2012).
49 Multipliers derived from Pembina Institute. "Deep emissions reductions in the existing building stock." April 11, 2017. (Online) Available at: http://www.pembina.org/pub/building-retrofits. Per dollar value multipliers were not converted from the source year to 2020 dollars.
50 A "Job-year" is defined as the resources to employ 1 person for 12 months.

Exhibit 156 – Annual and Cumulative Employment Impacts from CPR Measures, 2020-2040 - TRC Scenario

Year	Incentive Spending ($ Millions)	Total Spending ($ Millions)	Direct Job-years	Indirect Job-years	Bill Savings ($ Millions)	Induced Job-years	Total Job-years
2020	$7.8	$15.5	80	60	$13.5	55	195
2021	$8.5	$17.1	85	70	$27.0	110	265
2022	$9.9	$19.7	100	80	$40.7	165	345
2023	$11.5	$23.0	115	90	$54.8	220	425
2024	$13.5	$26.9	135	110	$73.3	295	540
2025	$12.6	$25.3	125	100	$90.3	360	585
2026	$13.5	$26.9	135	110	$104.5	420	665
2027	$14.4	$28.7	145	115	$118.7	475	735
2028	$15.1	$30.3	150	120	$133.3	535	805
2029	$15.5	$31.1	155	125	$148.3	595	875
2030	$15.9	$31.8	160	125	$163.9	655	940
2031	$16.1	$32.2	160	130	$179.9	720	1,010
2032	$16.4	$32.8	165	130	$196.4	785	1,080
2033	$16.1	$32.1	160	130	$213.4	855	1,145
2034	$16.2	$32.5	160	130	$230.8	925	1,215
2035	$16.0	$32.0	160	130	$248.3	995	1,285
2036	$15.5	$31.0	155	125	$263.9	1,055	1,335
2037	$15.5	$31.1	155	125	$279.8	1,120	1,400
2038	$15.4	$30.9	155	125	$296.1	1,185	1,465
2039	$15.1	$30.2	150	120	$312.8	1,250	1,520
2040	$15.2	$30.5	150	120	$330.1	1,320	1,590
TOTAL	$296	$592	2,955	2,370	$3,520	14,095	19,420

Exhibit 157 – Annual and Cumulative Employment Impacts from CPR Measures, 2020-2040 - MTRC Scenario

Year	Incentive Spending ($ Millions)	Total Spending ($ Millions)	Direct Job-years	Indirect Job-years	Bill Savings ($ Millions)	Induced Job-years	Total Job-years
2020	$51.3	$102.5	515	410	$21.4	85	1,010
2021	$53.1	$106.2	530	425	$43.0	170	1,125
2022	$55.3	$110.6	555	440	$65.4	260	1,255
2023	$57.7	$115.3	575	460	$88.0	350	1,385
2024	$60.6	$121.2	605	485	$116.0	465	1,555
2025	$60.2	$120.4	600	480	$142.8	570	1,650
2026	$62.1	$124.2	620	495	$166.7	665	1,780
2027	$63.9	$127.8	640	510	$190.8	765	1,915
2028	$65.3	$130.6	655	520	$215.4	860	2,035
2029	$58.0	$116.1	580	465	$239.1	955	2,000
2030	$59.5	$119.1	595	475	$263.8	1,055	2,125
2031	$60.8	$121.5	610	485	$289.1	1,155	2,250
2032	$62.2	$124.5	620	500	$315.3	1,260	2,380
2033	$63.0	$126.0	630	505	$342.3	1,370	2,505
2034	$64.4	$128.8	645	515	$370.2	1,480	2,640
2035	$65.4	$130.9	655	525	$398.4	1,595	2,775
2036	$63.3	$126.7	635	505	$425.1	1,700	2,840
2037	$62.9	$125.8	630	505	$452.4	1,810	2,945
2038	$61.0	$121.9	610	490	$479.7	1,920	3,020
2039	$58.9	$117.8	590	470	$507.3	2,030	3,090
2040	$58.3	$116.7	585	465	$535.6	2,140	3,190
TOTAL	**$1,267**	**$2,535**	**12,680**	**10,130**	**$5,668**	**22,660**	**45,470**

7.4 Findings and Conclusions

Readers are encouraged to use the CPR Data Visualization Tool to explore output data and draw their own insights for the purposes of DSM planning, program research and program design.

This section summarizes findings of this study at a high level:

- This study has found significant cost-effective and market achievable natural gas savings throughout the study period 2020-2040, and in all sectors and segments.

  Across all sectors, and using the MTRC screen, medium market potential savings are estimated at approximately 8 PJ, or 4% of reference consumption in 2025, rising to 24 PJ, or 10% of reference consumption in 2040.

  This estimated 24 PJ savings by 2040 includes potential savings from Residential, Industrial, and Commercial sectors of 9.9 PJ, 8.6 PJ, and 5.8 PJ respectively.
- In the ***residential sector***, only a small number of measures are cost-effective based on the TRC test, most being low-cost retrofit measures. Measures that pass the MTRC screen only become more important in the residential sector as the study period progresses.
  - The opportunities for equipment replacement measures, especially space heating measures, are much smaller relative to previous studies. This is primarily due to increasingly higher federal and provincial minimum energy performance standards (MEPS) for furnaces, which have caused DSM opportunities to become increasingly scarce.
  - In terms of percentage of reference case consumption forecast, more residential opportunities are available in the domestic hot water end use than the space heating end use throughout the study period. In absolute terms, savings potential for DHW measures (4 PJ by 2040 in the medium market potential scenario, MTRC screen) approaches that of space heating measures (5 PJ by 2040 in the medium market potential scenario, MTRC screen).
- ***Commercial sector*** savings show the most variance between the high and medium market potential scenarios. Using the MTRC screen, by 2040 the difference in potential between the medium and high market scenarios is 11.6 PJ.

  Gas heat pumps (GHPs) and efficient new construction are major contributing factors to this difference. These measures have high technical and economic potential, but future uptake is uncertain. For example, in the medium scenario, GHPs are modeled as an innovative technology with low forecasted growth. In the high scenario, they are modeled as an innovative technology with high forecasted growth, especially in the second half of the study period (2030-2040).
- The ***industrial sector*** is estimated to have the largest cost-effective savings potential on the TRC economic screen relative to other sectors. However, industrial customers require shorter payback periods relative to commercial and residential customers. Achieving savings from industrial measures that are cost-effective but have longer customer payback periods may be challenging and/or more expensive due to higher incentives and program costs.

- This CPR is the first to use a model that is fully compatible with the end use model developed for FortisBC's Long-Term Gas Resource Plan (LTGRP). The LTGRP provided the CPR's reference case, at a level of granularity not available to previous CPRs.

  Questions about the trends or assumptions in the reference case were easily answered by delving into the LTGRP model and the data upon which it was based. Furthermore, the results of the CPR will be provided to the LTGRP project for further analysis. Because the models are compatible, the LTGRP can easily explore variations in the CPR's potential estimates with different assumptions about economic conditions in the province or different budget envelopes for DSM programs.

- This CPR does not consider announcements related to the federal carbon tax made in 2021, which were made after modelling was complete for this project. Increases in the federal carbon tax are expected to positively impact the savings potential presented in this CPR: as natural gas costs rise, more measures will become cost-effective and pass the benefit/cost tests, and all measures will become more attractive financially to end users.

Appendix E

LEGACY EXPENDITURES COST-EFFECTIVENESS METHODOLOGY

5. COST EFFECTIVENESS APPROACH

5.1 COST-EFFECTIVENESS UNDER THE DSM REGULATION

FEI's proposed DSM portfolio for 2023 is cost effective, with a Portfolio (TRC/MTRC hybrid) cost effectiveness result of 1.4, based on the methodology set out in section 4 of the 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 2023. The following sections explain these cost-effectiveness tests and demonstrate that the 2023 DSM Plan meets the requirements of the DSM Regulation.

5.1.1 Portfolio-Level Analysis

Section 4(1) of the DSM Regulation stipulates that the BCUC, 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 (option (c) above) remains the appropriate method for testing the cost-effectiveness of the 2023 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 BCUC first determined that assessment of cost-effectiveness be based on the portfolio as a whole in its decision on FEI's 2008 DSM Application[12] 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 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.

[12] Order G-36-09.

- According to Sections 4(4) and 4(5) of the DSM Regulation, the BCUC must, at a minimum, use the portfolio approach in assessing the cost effectiveness of "specified demand-side measures"[13] and "public awareness programs".[14]
- 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 2023 DSM Plan included as Appendix A.

5.1.2 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.

The DSM Regulation also includes special treatment for specified measures (section 4(4)) and low income programs (section 4(2)). Specifically, section 4(4) of the DSM Regulation states that

[13] "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.

[14] 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.

the cost-effectiveness of a "specified demand-side measure" must be determined by the cost effectiveness of the portfolio as a whole. Under section 1 of the DSM Regulation, specified demand-side measures include: education programs; energy efficiency training; community engagement programs; technology innovation programs; and resources supporting the development of energy conservation or efficiency standards. 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 BCUC must use, "in addition to any other analysis the BCUC 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 increase the value of the benefit of the DSM measure by 40 percent. FEI has applied this approach in the cost-effectiveness analysis of the Low Income programs presented in the 2023 DSM Plan.

5.1.3 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 to stay within this MTRC Cap, as shown in Exhibit 4 of the 2023 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 5-1 below 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.

5.1.3.1 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 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[15], 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 $106/MWh in F2018$.[16] This value is consistent with the value used to calculate the MTRC for FEI's DSM 2021 Annual Report. For Low Income programs the ZEEA is applied when calculating the TRC (see Section 7.1.2).

5.1.3.2 Inclusion of Non-Energy Benefits

Section 4(1.1)(c) of the DSM Regulation requires the BCUC to allow the inclusion of Non-Energy Benefits (NEBs), the amount of which may be determined either by the BCUC 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 2023 DSM Plan.

5.2 *COST EFFECTIVENESS RESULTS*

While the TRC and mTRC continue to be the governing tests that FEI uses to determine the cost-effectiveness of its DSM Plan on a portfolio basis, the Company has also historically reported and considered a range of other industry standard cost-effectiveness tests, including the Ratepayer Impact Measure (RIM)[17], the Utility Cost Test (UCT)[18] and the Participant Cost Test (PCT)[19] applied at the program, program area, and portfolio levels. These cost-effectiveness tests are from the California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects (California Manual)[20]. **Error! Reference source not found.** shows the standard test results at the portfolio level and demonstrates that the 2023 DSM Plan is cost effective under the standard TRC test and also under the mTRC, UCT and PCT tests. Although the 2023 DSM Plan does not pass the RIM test, the BCUC may not determine that a proposed DSM measure is not cost effective based on the result of the RIM test.[21]

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[15] FEI notes that BC Hydro has suggested a new, lower LRMC value in their 2021 Integrated Resource Plan, but since BC Hydro's Integrated Resource Plan remains under review by the BCUC, FEI has not included it for the purposes of the one-year DSM Plan, as it has yet to be determined, per the DSM Regulation, that "the commission is satisfied" that this new value "represents the authority's long-run marginal cost of acquiring electricity generated from clean or renewable resources in British Columbia".

[16] 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.

[17] The Ratepayer Impact Measure (RIM) test measures what happens to customer bills or rates due to lost utility revenues and recovery of costs caused by the program (incentives + administration) less avoided costs (e.g. power purchase reductions).

[18] Referred to as Program Administrator Cost Test in the California Manual. The Program Administrator Cost Test measures the net costs of a demand side management program as a resource option based on the costs incurred by the program administrator (including incentive costs) less avoided costs e.g. power purchase reductions.

[19] The Participants Test is the measure of the quantifiable benefits (Utility incentive, reduction in utility bills) and costs (principally the Measure cost) to the customer due to participation in a program.

[20] California Public Utilities Commission, 2001. California Standard Practice Manual – Economic Analysis of Demand Side Program and Projects. Retrieved from: https://www.cpuc.ca.gov/-/media/cpuc-website/files/uploadedfiles/cpuc_public_website/content/utilities_and_industries/energy_-_electricity_and_natural_gas/cpuc-standard-practice-manual.pdf.

[21] Demand Side Measures Regulation, Section 4 (6).

Table 5-1: 2023 DSM Plan Portfolio Level Cost Effectiveness Results – All Tests

	TRC	Portfolio	UCT	PCT	RIM
Total Portfolio	0.7	1.4	0.7	2.0	0.4

Note to Table: 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 percent of the portfolio per the DSM regulation as explained in Section 7.1.3 below.

Appendix F

FEI DSM EVALUATION PLAN 2024-2027

DSM Evaluation Plan

2024-2027

July 2023

Table of Contents

1. INTRODUCTION

This DSM Evaluation Plan presents the studies and timing for FEI's Evaluation, Measurement & Verification (EM&V) activities through the 2024-2027 time period. These activities are aligned with the 2024-2027 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.

[1] Types of evaluation activities include: Communications evaluations, which focus on advertising and media outreach, and focus groups; Evaluation studies, where quality assurance is conducted to gain more insight on the incented measure, and literature reviews conducted to better understand 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 and validation of energy savings through energy study and energy model reviews.

[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 F-1 provides a list of programs and pilot studies currently planned for evaluation from 2024 to 2027. 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 Appendix E, Section # of the 2024-2027 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 2024-2027; 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 2024-2027 is approximately $11.3 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 F-1 represents approximately 1.9 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.

1 **Table F-1: FEU Evaluation Plan for 2024-2027**

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	$608
New Home Program	Residential	FEU	Market Studies, Process & Impact	BC Hydro, FortisBC Inc., NRCan, MEMPR, Municipal Government	$80
Prescriptive Program	Commercial	FEU	Market Studies, Process & Impact	FortisBC Inc.	$200
Performance Program - Existing Buildings	Commercial	FEU	Process & Impact, Measurement & Verification	FortisBC Inc.	$600
Performance Program - New Buildings	Commercial	FEU	Process & Impact, Measurement & Verification	FortisBC Inc.	$400
Rental Apartment Efficiency Program	Commercial	FEU	Process & Impact	FortisBC Inc.	$188
Performance Program	Industrial	FEU	Process, Measurement & Verification	FortisBC Inc.	$500
Prescriptive Program	Industrial	FEU	Measurement & Verification	FortisBC Inc.	$100
Direct Install Program	Low Income	FEU	Process & Impact, Evaluation Studies	BC Hydro, FortisBC Inc.	$1,792
Self Install Program	Low Income	FEU	Process & Impact	BC Hydro, FortisBC Inc.	$80

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Table F-1: FEU Evaluation Plan for 2024-2027 (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	$128
Support Program	Low Income	FEU	Process	None	$12
Performance Program	Low Income	FEU	Process & Impact	None	$0
Prescriptive Program	Indigenous	FEU	Process & Impact	FortisBC Inc.	$70
Performance Program	Indigenous	FEU	Process & Impact	FortisBC Inc.	$70
Customer Education and Outreach Programs	Customer Education and Outreach	FEU	Process & Impact	FortisBC Inc.	$1,003
Pilot Projects	Innovative Technology	FEU	Measurement & Verification	None	$2,880
Customer Research	Enabling Activities	FEU	Communications	None	$700
Commercial Energy Specialist	Enabling Activities	FEU	Process & Impact	FortisBC Inc.	$215
Community Energy Specialist	Enabling Activities	FEU	Process & Impact	FortisBC Inc.	$140
Codes & Standards	Enabling Activities	FEU	Process	none	$284
Trade Ally Network	Enabling Activities	FEU	Evaluation Studies	none	$1,260

Appendix G

EM&V FRAMEWORK

Evaluation, Measurement & Verification Framework (Final)

Revised, April 2023

Acknowledgments

The authors wish to acknowledge and express our appreciation to the many individuals who contributed to the update process of the FortisBC Evaluation Measurement & Verification Framework, including FortisBC Internal Stakeholders and VEIC.

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1. INTRODUCTION

1.1 *BACKGROUND*

FortisBC Energy Inc. (FEI) provides primarily natural gas distribution throughout most of British Columbia (BC). FortisBC Inc. (FBC) is an integrated electric utility that generates, transmits, and distributes electricity to customers in the southern interior of 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.

The Companies have been involved with delivering DSM programs, and thus program evaluation, since the 1990s. This EM&V Framework (also referred to as “the Framework”) was originally 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. The principles and policies articulated in this document were derived from orders, policies, and procedures developed by the Companies, and best practices from similar Canadian and U.S. DSM EM&V frameworks.

Provincial and Federal regulations also influence a utility’s 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. EVALUATION FRAMEWORK

2.1 *PURPOSE OF THE EVALUATION FRAMEWORK*

This 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, lay the groundwork for a transparent and rigorous evaluation process, outline the types of evaluation that can be conducted, and facilitate a discussion of approaches for conducting those evaluations. It is expected that this document will be reviewed and updated from time to time in consultation with industry and stakeholders as the Companies' programs change and/or 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 detailed explanation of the Companies' evaluation objectives and the role of the Framework.

2.2 *EVALUATION OBJECTIVES*

The Companies' have five overriding objectives for conducting evaluations on Conservation & Efficiency Management (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, provincial regulations, and the British Columbia Utilities Commission's (BCUC) 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 programs and the Companies' management on the performance of DSM programs.* Evaluations provide unbiased information to help program managers understand how their programs are performing and to help them improve their programs over time to be more effective, or perhaps determine if some programs should be altered, expanded, or discontinued.
4. *Examining the relationship between a program's activities and any market influences through the use of market effects evaluation.* Market effects 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 transparency and 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:

- Evaluation for all DSM programs will be determined on a program-by-program basis. 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, including the number of completed projects.
    - Amount of risk that a program may not meet cost-effectiveness expectations.
    - Budget constraints (see Section 5 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.
    - Assumptions made during the conducting of an evaluation study will be documented.
    - Evaluation activities will be transparent and auditable.
    - Summaries of completed evaluations will be presented in the Companies' DSM Annual Reports. Final evaluation reports will be made available to the BCUC, if requested.
- The use of third-party evaluators:
    - In most cases, the Companies retain external consultants to conduct evaluation activities. Some aspects of evaluation may also be conducted internally by the

Companies' staff. For example, project-level measurement and verification (M&V) activities may be outsourced or conducted by the Companies' 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 detailed evaluation work required, and the program priorities, noted above.
  - The Companies' evaluation and program manager staff 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 are determined by the Companies' evaluation staff.

- The evaluation process is integral to DSM planning:
  - Evaluation activities are an important consideration during portfolio and program planning, and as part of the program business case process.
  - Early consideration of evaluation requirements helps 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:
  - The Companies will strive to conduct and complete evaluations at appropriate times within the program lifecycle, given resource constraints and program growth.

2.4 *EVALUATION PLANNING*

This Framework is not intended to be or to replace the DSM Plan. The DSM Plan is prepared by the Companies' staff for inclusion with the Companies' applications to the BCUC for DSM funding and incorporates a proposed evaluation approach. The evaluation approach in the DSM Plan provides an overview of the programs that the Companies intend to evaluate, the potential 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 activities set forth in the DSM Plan will be provided in the Companies' Annual DSM reports.

2.5 *EVALUATION ORGANIZATION*

Wherever possible, the evaluation of programs that span across the Companies' 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, evaluations of joint electric and gas DSM programs will be conducted as a single for the partners involved in delivering the program.

3. EVALUATION STAFFING, ROLES, AND RESPONSIBILITIES

3.1 *Staffing Resources*

The Companies recognize that a combination of internal staffing resources and external professional consulting services are 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 and that the Companies do not have in-house and/or 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 5).

Sufficient internal staff resources are needed to plan evaluation activities, manage evaluation projects, review third-party consultation studies / reports, and conduct some evaluation analysis. Typical activities include:

- Development of the evaluation scope and Request for Proposals (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 (especially Stakeholders and Advisory Groups)

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. The number of internal staff will be sufficient to manage base-level workload, provide consistent project management, and be managed relative to overall DSM budgeting requirements.

3.2 ROLES AND RESPONSIBILITIES

Evaluations will be conducted or managed by the Companies' evaluation staff who are independent of the Companies' program staff and who are responsible for designing and implementing DSM programs.

The Companies' evaluation staff is responsible for:

- Participating in the program planning process to help determine the major evaluation activities for each program and ensuring that sufficient evaluation resources are available.
- Selecting one or multiple independent third-party evaluators, or team of evaluators, to undertake program-level evaluation activities.
- Providing the following typical documents to the selected evaluator for DSM program evaluation purposes:
  - Program databases
  - Program manuals or guidelines
  - Communication and marketing strategies
  - Partner, participant, and program process flowcharts
  - Past evaluation reports, if available
- Developing and updating the program-level evaluation Recommendations Tracker and working collaboratively with the Companies' program staff to ensure a plan is developed to address evaluation recommendations, as relevant.
- Coordinating with the BCUC and relevant stakeholder groups on an as-needed basis.
- Ensuring a summary of completed DSM program evaluation activities is included in the Companies' Annual DSM report.
- Making any final evaluation report summaries available to Advisory Group members if requested. Members can contact the Companies' staff for more detailed discussions/explanations if desired.
- Reviewing evaluation issues and results with the Advisory Groups for discussion and feedback, as relevant.

The prime independent third-party evaluator is responsible for:

- Working collaboratively with the Companies' Evaluation staff to coordinate, supervise, conduct, and prepare an evaluation report on all agreed-upon evaluation activities for a specified program evaluation. If a team of evaluators is selected, the prime evaluation contractor is responsible for oversight of all subcontractor evaluation activities.

- Providing useful findings and recommendations resulting from a specified program-level evaluation.

The Companies' program implementation staff is responsible for:

- Administrating its DSM programs and ensuring that the necessary data is collected to allow for evaluation activities, including tracking DSM activities and calculating savings at the project and program levels.
- Working collaboratively with the Companies' Evaluation staff to ensure a plan is developed to address evaluation recommendations, as relevant.
- Coordinating with the BCUC and relevant stakeholder groups on an as-needed basis.

Advisory Groups made up of key stakeholders external to the Companies have been established by the Companies 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. Advisory Group members are responsible for:

- Participating in a review of EM&V issues and results with the Companies, as relevant.
- Reviewing the Companies' DSM Plan that is submitted through either their Revenue Requirements Application or other filings for approval by the BCUC. Any stakeholder can participate in the review of the DSM Plan through the BCUC's regulatory review process.

4. TYPES OF EVALUATION STUDIES

There is a range of typical EM&V studies that could be undertaken to evaluate the Companies' DSM programs. The type, timing, and frequency of these studies, and the evaluation activities 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. The three main types of evaluation are described in Sections 4.1, 4.2, and 4.3.

4.1 *PROCESS EVALUATIONS*

Process evaluations examine the effectiveness of program delivery. Objectives for process evaluations include improving program implementation and program delivery as well as helping to ensure high satisfaction levels among customers, trade allies, and other program participants. Areas reviewed could 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.

The timing of process evaluations and their associated activities can vary substantially across the industry and is jurisdictionally specific. Generally, process evaluations are first conducted within 6 to 18 months following the launch of a new program and for long-duration programs on a periodic basis thereafter.

4.2 *MARKET EFFECTS EVALUATIONS*

Market effects evaluations test a DSM program's effectiveness at increasing the market penetration of an efficient technology or measure, or the behavior of participants in a market, that results from one or more program efforts. Objectives for market effects evaluations include measuring increases in market penetration of energy-efficient technologies, assessing the share of measures attributable to the program, or analyzing behavior change. 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 typically 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 these barriers, and/or
- assessing how much of the remaining market the program can be expected to address.

The use and timing of market effects evaluations and their associated activities can vary substantially across the industry and is jurisdictionally specific. When a market effects evaluation is determined to be necessary, the timing must allow a sufficient period for program implementation and uptake. These evaluations are therefore generally conducted after a program has been implemented for at least two years following a program launch.

4.3 *IMPACT EVALUATIONS*

Impact evaluations measure energy savings achieved. Impacts can be measured at the project, program, sector, and/or portfolio level. Objectives for impact evaluations include:

- evaluating the energy savings,
- estimating free rider and spillover (market) effects to determine net savings impacts, and
- determining cost-effectiveness according to a set of cost-benefit analyses based on industry and/or regulatory standards. Cost-effectiveness may be assessed at the project, program, sector, and/or portfolio level.

Impact evaluations will draw on information available from project-level data, 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 the appropriateness of program design and/or suggestions for changes to increase effectiveness.

The timing of impact evaluations and their associated activities vary across the industry and is jurisdictionally specific. Depending on the jurisdiction and program life cycle, impact evaluations may be conducted annually to provide assurances on the engineering savings estimates. In some jurisdictions where there is a multi-year DSM plan approved, impact evaluations may be completed only once for each program during the multi-year plan cycle.

For some programs, the Companies may implement impact evaluations in two stages. The first stage will involve participant survey work to improve the Companies' knowledge about the implementation of individual measures, and the second stage that involves a billing or other more detailed analysis.

4.4 *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 a 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. The Companies limit 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.

4.5 *MEASUREMENT AND VERIFICATION ACTIVITIES*

M&V refers to a range of activities or studies used to determine the performance (e.g., energy savings) of an installed DSM measure or project. 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) in conducting M&V activities for determining and evaluating DSM programs and pilots. The Companies' review of industry standards, guidelines, and protocols indicates that IPMVP is 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, IPMVP provides guidelines for the evaluator to follow under less-than-ideal conditions and in the face of budget and timing constraints. IPMVP, therefore, allows room for judgment by the evaluator under less-than-ideal evaluation circumstances.

The following M&V principles 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 trade-offs should be accompanied by increased conservativeness in any estimates and judgments.

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 underestimate 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 a 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.

Whether the evaluation condition is ideal or less than ideal, the Companies and the evaluator will ensure and document a common understanding of the level of M&V rigor to be undertaken.

4.6 *IMPACT 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 a toolbox, with each methodology being a different tool that can be applied. The best tool (or methodology) to use depends on the circumstances of the project or program being evaluated and the available resources. In some cases, more than one methodology could be applied to evaluate the energy savings achieved from an efficiency measure or program of measures. Common impact evaluation methodologies, which include M&V described above, 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 that was implemented. 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 for in the analysis. Billing analysis is generally more effective for measures 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 occasionally 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 the energy usage of appliances over time.

In the commercial and industrial sectors metering is sometimes 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, there are a variety of models 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

Engineering estimates are based on equations used to calculate energy usage and savings. This method is based on an engineering analysis of the difference in efficiency between the "standard" measure and the installed efficient measure. It may be based on standard efficiency measurements, such as the difference in Energy Factor (EF) rating for hot water tanks or the difference in Annual Fuel Utilization Efficiency (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. In practice, these models may be reduced to simple equations in spreadsheets that calculate energy usage or savings as a function of measurable attributes of customers, facilities, or equipment (e.g., lighting use = watts × hours of use). (e.g., lighting use = watts × hours of use). (e.g., lighting use = watts × hours of use).

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

Surveys are often implemented for process, market effects, 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 may include 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 as part of a detailed review of a small number of specific efficiency measure(s) to determine if they are "market ready" but not in wide use or newer to the market. 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. Often field studies, the data collected, and evaluation methodologies follow the IPMVP protocols.

Site Visits

Site visits can be used to examine projects across all customer classes to confirm that the target efficiency measure was 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.

4.7 OTHER EVALUATION CONSIDERATIONS

Evaluation activities also sometimes 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

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

As resources allow, 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 Companies and between the Companies 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 DSM 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, the Companies undertake a number of studies that 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.

4.8 *FEEDING EM&V STUDY RESULTS INTO DSM PLANNING*

Evaluation and program management staff at the Companies 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 assists 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 consider additional factors such as human, technical, budgetary resources, portfolio priorities, and any feedback received from stakeholders.

5. EVALUATION BUDGETS

Industry practice for budget spending on EM&V activities typically ranges 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. 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.

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.

APPENDIX A: GLOSSARY OF TERMS

This glossary is drawn from three evaluation-related reference documents:

- 2007 IPMVP
- 2004 California Evaluation Framework
- 2006 DOE EERE Guide for Managing General Program Evaluation Studies

8760s: Full-year hourly consumption loads.

Accuracy: The correspondence between the measurements made on an indicator and the actual value of the indicator at the time of measurement.

Additionality: A criterion that says avoided emissions should only be recognized for project activities or programs that would not have "happened anyway." While there is general agreement that additionality is important, its meaning and application remain subject to interpretation.

Adjustments: For M&V analyses, factors that modify baseline energy or demand values to account for independent variable values (conditions) in the reporting period.

Allowances: Allowances represent the amount of a pollutant that a source is permitted to emit during a specified time in the future under a cap-and-trade program. Allowances are often confused with credits earned in the context of project-based or offset programs, in which sources trade with other facilities to attain compliance with a conventional regulatory requirement. Cap-and-trade program basics are discussed on the following EPA website: http://www.epa.gov/airmarkets/captrade/index.html"www.epa.gov/airmarkets/cap-trade/index.html.

Analysis of Covariance (ANCOVA): A type of regression model also referred to as a "fixed effects" model.

Assessment Boundary: The boundary within which all the primary effects and significant secondary effects associated with a project are evaluated.

Baseline: Conditions, including energy consumption and related emissions, which would have occurred without implementation of the subject project or program. Baseline conditions are sometimes referred to as "business-as-usual" conditions. Baselines are defined as either project-specific baselines or performance standard baselines.

Baseline Period: The period of time selected as representative of facility operations before the energy efficiency activity takes place.

Bias: The extent to which a measurement, sampling, or analytic method systematically underestimates or overestimates a value.

Coincident Demand: The metered demand of a device, circuit, or building that occurs at the same time as the peak demand of a utility's system load or at the same time as some other peak of interest, such as building or facility peak demand. This should be expressed in a way that indicates the peak of interest (e.g., "demand coincident with the utility system peak"). Diversity factor is defined as the ratio of the sum of the demands of a group of users to their coincident maximum demand. Therefore, diversity factors are always equal to one or greater.

Comparison Group: A group of consumers who did not participate in the evaluated program during the program year and who share as many characteristics as possible with the participant group.

Confidence: An indication of how close a value is to the true value of the quantity in question. Confidence is the likelihood that the evaluation has captured the true impacts of the program within a certain range of values (i.e., precision). An indication of how close a value is to the true value of the quantity in question.

Control Group: A randomly selected group of individuals or organizations that have not had the opportunity to receive program benefits. A control group is measured to determine the extent to which its members have taken actions promoted by the program. These measurements are used to estimate the degree to which the promoted actions would have been taken if the program did not exist.

Cost-effectiveness: An indicator of the relative performance or economic attractiveness of any energy efficiency investment or practice. The present value of the estimated benefits produced by an energy efficiency program is compared to the estimated total costs to determine if the proposed investment or measure is desirable from a variety of perspectives (e.g., whether the estimated benefits exceed the estimated costs from a societal perspective).

Deemed Savings: An estimate of an energy savings or energy demand savings outcome (gross savings) for a single unit of an installed energy efficiency measure. This estimate (a) has been developed from data sources and analytical methods that are widely accepted for the measure and purpose and (b) is applicable to the situation being evaluated.

Demand: The time rate of energy flow. Demand usually refers to electric power measured in kW (equals kWh/h) but can also refer to natural gas, usually as Btu/hr., kBtu/hr., therms/day, GJs/day, etc.

Dependent Variable: One that changes and is affected by the independent variables. Examples include weather, energy usage, housing type, or location.

Defensibility: The ability of evaluation results to stand up to scientific criticism. Defensibility is based on the assessment by experts of the evaluation's validity, reliability, and accuracy.

Direct Emissions: Direct emissions are changes in emissions at the site (controlled by the project sponsor or owner) where the project takes place. Direct emissions are the source of avoided emissions for thermal energy efficiency measures (e.g., avoided emissions from burning natural gas in a water heater).

Effective Useful Life (EUL): An estimate of the median number of years that the efficiency measures installed under a program are still in place and operable.

Energy Efficiency Measures: Installation of equipment, subsystems or systems, or modification of equipment, subsystems, systems, or operations on the customer side of the meter, for the purpose of reducing energy and/or demand (and, hence, energy and/or demand costs) at a comparable level of service. “Energy conservation” is a term that has also been used, but it has the connotation of doing without a service in order to save energy rather than using less energy to perform the same function.

Error: Deviation of measurements from the true value.

Evaluation Effectiveness: The performance of studies and activities aimed at determining the effects of a program; any of a wide range of assessment activities associated with understanding or documenting program performance, assessing program or program-related markets and market operations; any of a wide range of evaluative efforts including assessing program-induced changes in energy efficiency markets, levels of demand or energy savings, and program cost-effectiveness.

Evaluation, Measurement & Verification (EM&V): The undertaking of studies and activities aimed at assessing and reporting the effects of an energy efficiency program on its participants and/or the market environment. Effectiveness is measured through energy efficiency and cost-effectiveness.

Evaluator: The individual(s) or firm(s) selected to develop and implement the evaluation plan based on the scope defined by the evaluation administrator. The evaluation contractor could also be referred to as the “independent, third-party evaluator” or the “evaluator”.

Free Rider: One who would have implemented the program measure or practice in the absence of the program. Free riders can be total, partial, or deferred. Free rider rate is typically determined by a series of questions, and then analysis of those questions, and can vary by measure type and /or program type.

Gross Savings: The change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated.

Gross Verified Savings: Gross verified savings calculations are based on the difference between energy and demand use after the implementation of a program and an assumed set of baseline conditions that estimate what energy consumption and demand would have been in the absence of the program. The gross verified savings are determined by multiplying the reported savings with the realization rate.

Independent Variables: The stand-alone factors that affect energy use and demand, but cannot be controlled (e.g., weather, occupancy, age, gender). Regression analysis tries to determine the relationship between dependent and independent variables.

Indicator: An indicator is the observable evidence of accomplishments, changes made, or progress achieved. An indicator is also a particular characteristic used to measure outputs or outcomes; a performance quantifiable expression used to observe and track the status of a process.

Indirect Emissions: Changes in emissions that occur at the emissions source (e.g., the power plant). Indirect emissions are the source of avoided emissions for electric energy efficiency measures.

Interactive Factors: Applicable to IPMVP Options A and B; changes in energy use or demand occurring beyond the measurement boundary of the M&V analysis. A and B; changes in energy use or demand occurring beyond the measurement boundary of the M&V analysis.

Leakage: Cross-territory sales that occur when program-incented efficient products are installed outside of the funding utility's service territory.

Load Shapes: Representations such as graphs, tables, and databases that describe energy consumption rates as a function of another variable, such as time or outdoor air temperature.

Measurement: A procedure for assigning a number to an observed object or event.

Measurement Boundary: The boundary of the analysis for determining direct energy and/or demand savings.

Monitoring: The gathering of relevant measurement data, including but not limited to energy consumption data, over time to evaluate equipment or system performance. Examples include chiller electric demand, inlet evaporator temperature and flow, outlet evaporator temperature, condenser inlet temperature, and ambient dry-bulb temperature and relative humidity or wet-bulb temperature, for use in developing a chiller performance map (e.g., kW/ton vs. cooling load and vs. condenser inlet temperature).

Non-Energy Benefits (NEBs): Typically, the benefits of electricity, natural gas, and liquid propane energy savings (i.e., other fuels); benefits of public water and wastewater savings; benefits of avoided and deferred equipment replacement costs as conditioned herein. 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.

Net-to-Gross (NTG) Ratio: A factor representing net program savings divided by gross program savings that are applied to gross program impacts, converting them into net program load impacts after adjustments for free ridership and spillover.

NTG Ratio = 1 - Free Ridership + Spillover

Net Verified Savings: Net verified savings recognize behavioural factors and represent benefits that are only attributable to, and the direct result of, the program in question. Program net verified savings are calculated by multiplying the gross verified savings with the realization rate and the net-to-gross (NTG) ratio. Generally, net savings can be calculated using the following equation.

Net Savings = Gross Savings x Realization Rate x NTG Ratio

Non-participant: Any consumer who was eligible, but did not participate, in the subject efficiency program in a given program year. Each evaluation plan should provide a definition of a nonparticipant as it applies to a specific evaluation.

Non-Response Bias: Non-response bias occurs when there is a significant difference between those who responded to a survey and those who did not due to an influencing factor preventing them from responding (for example, lack of familiarity with the survey instrument).

Participant: A consumer who received a service offered through the subject efficiency program in a given program year. The term “service” is used in this definition to suggest that the service can be a wide variety of services, including financial rebates, technical assistance, product installations, training, energy efficiency information, or other services, items, or conditions. Each evaluation plan should define “participant” as it applies to the specific evaluation.

Peak Demand: The maximum level of metered demand during a specified period, such as a billing month or a peak demand period. The maximum level of metered demand during a specified period, such as a billing month or a peak demand period.

Portfolio: Either (a) a collection of similar programs addressing the same market (e.g., a portfolio of residential programs), technology (e.g., motor-efficiency programs), or mechanisms (e.g., loan programs) or (b) the set of all programs conducted by one organization, such as a utility (and which could include programs that cover multiple markets, technologies, etc.).

Potential Studies: Studies conducted to assess market baselines and savings potentials for different technologies and customer markets. Potential is typically defined in terms of technical potential, market potential, and economic potential.

Precision: The indication of the closeness of agreement among repeated measurements of the same physical quantity.

Prescriptive Measures: A prescriptive measure uses defined or fixed input assumptions embedded into the energy and demand savings equations. These input assumptions can include default efficiencies for a type of equipment specified or annual operating hours for the type of building selected.

Primary Effects: Effects that the project or program is intended to achieve. For efficiency programs, this is primarily a reduction in energy use per unit of output.

Probability Sampling: A method for drawing a sample from a population such that all possible samples have a known and specified probability of being drawn.

Program: A group of projects, with similar characteristics and installed in similar applications. Examples could include a utility program to install energy-efficient lighting in commercial buildings, a developer's program to build a subdivision of homes that have photovoltaic systems, or a state residential energy efficiency code program.

Program Evaluation: Program evaluations are independent systematic studies conducted periodically on an ad hoc basis to assess how well a program is working and whether the program is achieving its intended objectives. Program evaluations are conducted by experts external to the program staff.

Program Manager: The individual/group responsible for implementing a program.

Project: An activity or course of action involving one or multiple energy efficiency measures, at a single facility or site.

Qualitative Data: Information expressed in the form of words.

Quantitative Data: Information expressed in the form of numbers. Measurement gives a procedure for assigning numbers to observations.

Quasi-prescriptive Measure: A quasi-prescriptive measure has varying resource savings estimates according to the technology or type of equipment and the context in which they are used. It contains key, measure-specific inputs to estimate energy and peak demand savings for each program participant. It provides a methodology that allows estimating resource savings for various scenarios rather than relying on a fixed savings value for all scenarios. A quasi-prescriptive approach will allow different parameters or variables to be assumed to estimate different levels of resource savings for different retrofits in different business segments.

Random Assignment: A method for assigning subjects to one or more groups by chance.

Realization Rate: At the program level, the ratio of gross verified savings to the reported savings is referred to as the realization rate.

Realization Rate: A factor representing the ratio of the verified savings to the reported savings. Realization Rate = Verified Savings / Reported Savings

Regression Analysis: Equation analysis of the relationship between a dependent variable (response variable) to specified independent variables (explanatory variables). The mathematical model of their relationship is the regression equation.

Reliability: Refers to the likelihood that the observations can be replicated.

Reporting Period: The time following the implementation of an energy efficiency activity during which savings are to be determined.

Reported Savings: Reported savings are the energy and demand savings reported, or claimed, by applicants or program implementation vendors. The savings are determined by the applicants or implementation vendors.

Representative Sample: A sample that has approximately the same distribution of characteristics as the population from which it was drawn.

Resource Acquisition Program: Programs designed to directly achieve energy and/or demand savings, and possibly avoided emissions, through the installation of new equipment.

Retrofit Isolation: The savings measurement approach defined in IPMVP Options A and B, and ASHRAE Guideline 14 determines energy or demand savings through the use of meters to isolate the energy flows for the system(s) under consideration.

Rigor: The level of expected confidence and precision. The higher the level of rigor, the more confident one is that the results of the evaluation are both accurate and precise.

Secondary Effects: Unintended impacts of the project or program such as rebound effect (e.g., increasing energy use as it becomes more efficient and less costly to use), activity shifting (e.g., movement of generation resources to another location), and market leakage (e.g., emission changes due to changes in supply or demand of commercial markets). These secondary effects can be positive or negative.

Self-Selection Bias: Self-selection bias occurs when people volunteer to participate in a study/survey. Those who choose to participate (self-select into the study) may share a characteristic that makes them different from non-participants. In most instances, self-selection will lead to biased data, as the respondents who choose to participate will not be representative of the entire target population.

Simple Random Sample: A method for drawing a sample from a population such that all samples of a given size have an equal probability of being drawn.

Spillover: Reductions in energy consumption and/or demand caused by the presence of the energy efficiency program that exceeds the program-related gross savings of the participants. There can be participant and/or non-participant spillover rates depending on the rate at which participants (and non-participants) adopt energy efficiency measures or take other types of efficiency actions on their own (i.e., without an incentive being offered). Spillover rate is typically determined by a series of questions, and then analysis of those questions, and can vary by measure type and /or program type.

Stipulated Values: See "deemed savings."

Uncertainty: The range or interval of doubt surrounding a measured or calculated value within which the true value is expected to fall with some degree of confidence.

Verified Savings: The net evaluated energy and demand savings of a program. Verified savings are used as the base for the allocation of savings to targets or for official reporting purposes.

Appendix H

MINISTERIAL ORDER NO. M193

PROVINCE OF BRITISH COLUMBIA

REGULATION OF THE MINISTER OF ENERGY, MINES AND LOW CARBON INNOVATION

Utilities Commission Act

Ministerial Order No. M193

I, Josie Osborne, Minister of Energy, Mines and Low Carbon Innovation, order that, effective June 30, 2023, the Demand-Side Measures Regulation, B.C. Reg. 326/2008, is amended as set out in the attached Schedule.

June 27, 2023

Date

Minister of Energy, Mines and Low Carbon Innovation

(This part is for administrative purposes only and is not part of the Order.)

Authority under which Order is made:

Act and section: *Utilities Commission Act*, R.S.B.C. 1996, c. 473, s. 125.1

Other: M271/2008

R20653616

SCHEDULE

1 Section 1 of the Demand-Side Measures Regulation, B.C. Reg. 326/2008, is amended

(a) by adding the following definitions:

"annual percentage change" means the annual percentage change in the annual average All-items Consumer Price Index for British Columbia, as published by Statistics Canada under the authority of the *Statistics Act* (Canada);

"building code" means the British Columbia Building Code established by the order of the Minister of Municipal Affairs and Housing numbered BA 2018 1 and dated July 16, 2018;

"class A demand-side measure" means

(a) a demand-side measure referred to in section 3 (1) (a), (c), (d) or (g),

(b) a charity program,

(c) the funding of energy efficiency training,

(d) a community engagement program,

(e) an energy management program,

(f) a technology innovation program, and

(g) 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 British Columbia,

but does not include a class B demand-side measure;

"class B demand-side measure" has the meaning given to it in section 1.1;

"climate zone" has the meaning given to it in section 1.2;

"fiscal year" means the period from April 1 in one year to March 31 in the next year;

"gas-fired" means fueled by natural gas, renewable natural gas or propane;

"Indigenous entity" means any of the following:

(a) an Indigenous governing body;

(b) a non-profit organization that provides services to Indigenous peoples, as defined in the *Declaration on the Rights of Indigenous Peoples Act*;

"Indigenous governing body" has the same meaning as in the *Declaration on the Rights of Indigenous Peoples Act*;

"integrated dual-energy space heating system" means a space heating system consisting of an electric heat pump and gas-fired equipment all of which are

(a) operated by a single system of controls,

(b) connected to a single heat distribution system, and

(c) either

(i) designed, rated and sold together as a single heating system, or

(ii) combined into a single package and sold together as a single heating system;

"integrated hybrid gas-fired heat pump system" means a space or domestic water heating system, or a space and domestic water heating system, consisting of a gas-fired heat pump that serves as the principal source of heat and another type of gas-fired equipment all of which are

(a) operated by a single system of controls,

(b) connected to a single heat distribution system, and

(c) either

(i) designed, rated and sold together as a single heating system, or

(ii) combined into a single package and sold together as a single heating system; *,*

(b) in paragraph (a) of the definition of **"low-income household"** *by striking out "*multiplied by 1.3*" and substituting "*multiplied by 1.6*",*

(c) by adding the following definitions:

"new building" means a building that is being constructed;

"public building" means a school, library, theatre, recreation centre, public hall, church or other building used to provide services to the public; *,*

(d) by repealing the definition of **"specified demand-side measure"***,*

(e) in paragraph (c) of the definition of **"specified standard"***, by striking out "*the British Columbia Building Code*" and substituting "*the building code*",*

(f) by adding the following definition:

"step" means the requirements of a step, as described in Article 9.36.6.3. or 10.2.3.3. of Division B of the building code; *, and*

(g) by repealing the definition of **"step code"***.*

2 The following sections are added:

Meaning of "class B demand-side measure"

1.1 (1) A demand-side measure is a class B demand-side measure if it

(a) directly or indirectly encourages the acquisition or installation of gas-fired space or domestic water heating equipment, and

(b) is not excluded under subsection (2) from the definition of "class B demand-side measure".

(2) The following demand-side measures are excluded from the definition of "class B demand-side measure":

(a) a demand-side measure that encourages the acquisition or installation of a domestic water heating system that

(i) consists of an electric heat pump and gas-fired equipment, and

(ii) has a modelled seasonal coefficient of performance equal to or greater than 1;

(b) a demand-side measure that encourages the acquisition or installation of a gas-fired heat pump that has a modelled seasonal coefficient of performance equal to or greater than 1;

(c) a demand-side measure that encourages the acquisition or installation of a gas-fired radiant tube or unit heater for use in a building that is

(i) described in Article 1.3.3.2. or Sentence 1.3.3.3. (1) (d) of Division A of the building code, whether or not the building code applies to the building, and

(ii) used for an industrial occupancy, as defined in the building code;

(d) a demand-side measure that encourages the acquisition or installation of a gas-fired radiant tube or unit heater for use in a farm building, as defined in the building code;

(e) a demand-side measure that encourages the acquisition or installation of an integrated dual-energy space heating system for use in a location in climate zone 6, 7A, 7B or 8;

(f) a demand-side measure that encourages the acquisition or installation of an integrated hybrid gas-fired heat pump system that has a modelled seasonal coefficient of performance equal to or greater than 1;

(g) a demand-side measure referred to in section 3 (1) (a) or (g)

(i) that, by an offer made before January 1, 2028 to provide money or services in kind, encourages the acquisition or installation of gas-fired domestic water heating equipment for use in a building described in Article 1.3.3.3. of the building code, whether or not the building code applies to the building, and

(ii) that does not encourage the acquisition or installation of gas-fired space heating equipment other than

(A) gas-fired space heating equipment described in paragraph (b), (c), (d), (e) or (f), or

(B) by a demand-side measure described in paragraph (h) or (i);

(h) a demand-side measure referred to in section 3 (1) (g) that

(i) encourages the acquisition or installation of gas-fired space heating equipment for use in locations in climate zones 6, 7A, 7B and 8, and

(ii) does not encourage the acquisition or installation of gas-fired domestic water heating equipment other than

(A) gas-fired domestic water heating equipment described in paragraph (a) or (f), or

(B) by a demand-side measure described in paragraph (g);

(i) a program that

(i) encourages the acquisition or installation of integrated dual-energy space heating systems for use in locations in climate zones 4 and 5, but only if all of the integrated dual-energy space heating systems acquired or installed, when considered in aggregate, are, in the commission's opinion, likely to have an annual average seasonal coefficient of performance equal to or greater than 1.5, and

(ii) does not encourage the acquisition or installation of gas-fired domestic water heating equipment other than

(A) gas-fired domestic water heating equipment described in paragraph (a) or (f), or

(B) by a demand-side measure described in paragraph (g).

(3) For certainty, the definition of "class B demand-side measure" includes a demand-side measure that, by an offer of money or services in kind for the purpose of increasing energy efficiency in a new building, may encourage the acquisition or installation of gas-fired space or domestic water heating equipment for use in the new building.

Climate zone

1.2 (1) For the purposes of section 1.1 (2) (e), (h) (i) and (i) (i), the climate zone of a location is to be determined, based on the annual number of heating degree days below 18°C at the location, as follows:

(a) if the number is 3 000 or less, the climate zone is 4;

(b) if the number is between 3 000 and 4 000, the climate zone is 5;

(c) if the number is between 4 000 and 5 000, the climate zone is 6;

(d) if the number is between 5 000 and 6 000, the climate zone is 7A;

(e) if the number is between 6 000 and 7 000, the climate zone is 7B;

(f) if the number is 7 000 or more, the climate zone is 8.

(2) For the purposes of subsection (1), the annual number of heating degree days below 18°C at a location must, subject to subsection (3), be determined as follows:

(a) by taking an average over at least 10 years of climatic data from the weather station that is most representative of the location, or

(b) if 10 years of data are not available from that weather station, based on the available climatic data, whether or not from that weather station, that is most representative of the location.

(3) If the name of the location is shown in the column headed "Location" in Table C-2 *[Climatic Design Data for Selected Locations in British Columbia]* of Appendix C to Division B of the building code, the number of heating degree days below 18°C at the location is shown opposite in the column headed "Degree-Days Below 18°C".

3 ***Section 3 (1) is amended***

(a) by striking out "or" ***at the end of paragraph (a) (ii) (A),***

(b) by repealing paragraph (a) (ii) (B),

(c) by adding "or" ***at the end of paragraph (a) (ii) (C),***

(d) by striking out "or" ***at the end of paragraph (a) (ii) (D),***

(e) by repealing paragraph (a) (ii) (E),

(f) in paragraph (e) by striking out "paragraph (e) of the definition of "specified demand-side measure"" ***and substituting*** "paragraph (g) of the definition of "class A demand-side measure"",

(g) in paragraph (f) by striking out "a step code or more stringent requirements within a step code" ***and substituting*** "a step", ***and***

(h) by adding the following paragraph:

(g) a demand-side measure intended specifically to reduce energy consumption in any of the following:

(i) housing owned or operated by an Indigenous governing body or located on reserve land;

(ii) a public building owned or operated by an Indigenous governing body.

4 ***Section 4 is amended***

(a) in subsection (1) by striking out "subsections (1.5), (4) and (5), the commission, in determining for the purposes of section 44.1 (8) (c) or 44.2 (5) (d) of the Act" ***and substituting*** "subsections (2.1), (4) and (5), the commission, in determining for the purposes of section 44.1 (8) (c) or 44.2 (5) (d) or (5.1) (d) of the Act",

(b) in subsection (1.1) by striking out "Subject to subsection (2), the commission must make determinations of cost effectiveness by applying the total resource cost test" ***and substituting*** "The commission must make determinations of cost-effectiveness by applying the utility cost test",

(c) in subsection (1.1) (a) by striking out everything after "the avoided capacity cost," ***and substituting*** "is as follows:

(i) in the 2023/2024 fiscal year, the amount is $34.07 per GJ;

(ii) for fiscal years subsequent to the 2023/2024 fiscal year, the amount is calculated on April 1 of each year by multiplying

(A) the amount in effect in the immediately preceding fiscal year, and

(B) the sum of 1 and the annual percentage change for the previous calendar year;",

(d) by repealing subsection (1.1) (c),

(e) ***in subsection (1.1) (d) by striking out "***had no step code been adopted***" and substituting "***had no step been adopted***",***

(f) ***by repealing subsections (1.5) to (2),***

(g) ***by adding the following subsection:***

(2.1) In determining the cost-effectiveness of a class B demand-side measure,

(a) the commission must compare the costs and benefits of the demand-side measure individually, and

(b) the commission must not determine that the demand-side measure is cost-effective unless the application of the utility cost test results in a benefit to cost ratio equal to or greater than 50.***,***

(h) ***in subsection (4) by striking out "***a specified demand-side measure***" and substituting "***a class A demand-side measure***", and***

(i) ***by repealing subsection (6).***

5 The following section is added:

Transition

5 (1) In this section:

"filed" means filed under section 44.2 (1) of the Act;

"legacy expenditure" means an expenditure

(a) in relation to a legacy measure,

(b) made by a public utility after the test period of the pre-filed expenditure schedule that includes an expenditure on the legacy measure,

(c) to provide to a customer money or services in kind in return for the customer's action

(i) taken in relation to the legacy measure during the test period of the legacy measure, or

(ii) taken in relation to the legacy measure in response to a written commitment to the customer made by the public utility during the test period of the legacy measure;

"legacy measure" means a demand-side measure in relation to which an expenditure is included in a pre-filed expenditure schedule;

"public utility" does not include the authority;

"pre-filed expenditure schedule" means an expenditure schedule

(a) referred to in subsection (2) (a), or

(b) accepted before June 30, 2023 under section 44.2 (3) of the Act;

"test period", when used in reference to a pre-filed expenditure schedule, means the period addressed by the pre-filed expenditure schedule.

(2) In considering the following under section 44.2 (5) (d) or (5.1) (d) of the Act, the commission must apply sections 1, 3 and 4 of this regulation, as they read immediately before June 30, 2023:

(a) an expenditure schedule filed before May 1, 2023 and in relation to which the commission has not, before June 30, 2023, made a final determination under section 44.2 (3) of the Act;

(b) a legacy expenditure that is the subject of an expenditure schedule filed after May 1, 2023.