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BCUC File: 58243
Batch: 58265

August 2, 2018

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

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

Dear Mr. Wruck:

Re: FortisBC Inc. (FBC)

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

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

If further information is required, please contact the undersigned.

Sincerely,

FORTISBC INC.

Original signed:

Diane Roy

Attachments

cc (email only): Registered Interveners of the FBC Annual Review for 2018 Rates

FORTISBC INC.

Application for Acceptance of Demand-Side Management Expenditures 2019 to 2022

August 2, 2018

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1. INTRODUCTION

FortisBC Inc. (FBC or the Company) submits this Application for Acceptance of Demand Side Management (DSM) Expenditures for 2019 to 2022 (the Application) to the British Columbia Utilities Commission (BCUC or the Commission) pursuant to section 44.2(1)(a) of the *Utilities Commission Act*, R.S.B.C. 1996, c. 473 (UCA). The funding request outlined in the Application is supported by a detailed 2019 to 2022 DSM Plan (DSM Plan), found in Appendix A. The DSM Plan provides details on each of FBC's program areas and individual DSM programs, including cost-effectiveness test results.

On November 30, 2016, FBC filed its 2016 Long Term Electric Resource Plan (LTERP) and Long Term DSM Plan (LT DSM Plan). The LT DSM Plan was accepted by the BCUC on June 28, 2018 in Decision and Order G-117-18. The 2016 LTERP and LT DSM Plan included Conservation Potential Review (CPR) results for the FBC service territory (FBC CPR)[1]. The LT DSM Plan included an assessment of the appropriate level of cost-effective DSM resource acquisition to match FBC's resource needs over the LTERP's 20-year planning horizon. The High DSM scenario FBC selected for its LT DSM Plan contemplated annual DSM expenditures for 2019 and 2020 of $7.9 million ($2016) and annual DSM savings of 26.4 GWh[2].

The LT DSM Plan was premised on a ramp up in DSM spending and savings, beginning in 2021, that would offset an average of 77 percent of FBC's forecast load growth annually over the LTERP's planning horizon. In response to emerging customer activities, the DSM Plan builds on and is an escalation of the target savings contemplated in the LT DSM Plan. Table 1-1, below, shows that the proposed budget for the DSM Plan is $7.7 million more, in total, than the pro-forma budget contemplated in the LT DSM Plan (inflation adjusted) and is expected to achieve an additional 18.7 GWh of electricity savings for this period. Section 3.3 provides an overview of the customer activities that prompted the plan escalation and additional detail is provided in the DSM Plan (Appendix A).

Table 1-1: 2019-2022 DSM Plan compared with the LT DSM Plan

Plan	2019	2020	2021	2022	Total
Expenditures ($000s)					
2019-2022 DSM Plan	$10,900	$10,600	$11,100	$11,400	**$44,000**
LT DSM Plan	$8,100	$8,200	$9,400	$10,600	**$36,300**
Difference	*$2,800*	*$2,400*	*$1,700*	*$800*	***$7,700***
Energy savings (GWh)					
2019-2022 DSM Plan	32.6	32.1	32.4	33.1	**130.3**
LT DSM Plan	26.4	26.4	28.4	30.4	**111.6**
Difference	*6.2*	*5.7*	*4.0*	*2.7*	***18.7***

FBC has created a DSM Plan that is compatible with the LT DSM Plan using a number of inputs: Conservation and Energy Management (C&EM) guiding principles; review of historical

[1] FBC's CPR Technical and Economic report can be found in Appendix A of the LT DSM Plan.
[2] 2016 LTERP and LT DSM Plan, Volume 2, Section 3.3, Table 3-2: Pro-forma DSM Savings Targets, pg. 16.

and forecasting of future program activity levels; consultation with stakeholders; and calibration to the FBC CPR Market Potential Report that was received in January 2018 (Appendix B).

FBC uses the market potential estimated in its CPR as an input to the planning process. The market potential is an estimate of energy savings for a list of technologies that could be achieved over time. Broad assumptions about customer acceptance and adoption rates are made to estimate the potential. Market potential differs from program potential in that it does not account for the various mechanisms that can be used to deliver DSM programs for a specific measure and/or customer segment. FBC evaluates the potential identified for each energy end-use, compares it to program activity, and calibrates programs where appropriate. Detailed discussion of the FBC CPR Market Potential Report is contained in Section 5.4 of the Application and the full report is included in the Application as Appendix B.

2. APPROVALS SOUGHT AND PROPOSED REGULATORY PROCESS

FBC seeks an order from the Commission pursuant to section 44.2(3) of the UCA accepting the DSM expenditure schedule totalling $44.0 million, inflation adjusted, as set out in Table 1-1 and Table 5-1 of the Application. The Company believes these expenditures are cost-effective, fulfil the adequacy requirements of the DSM Regulation[3], and that making them would be in the public interest.

In addition, FBC is seeking approval to move to a 15-year amortization period for DSM expenditures as set out in Section 8.1, and flexibility in the timing of expenditures within the proposed program areas as set out in Section 8.2.

A Draft Order is attached as Appendix C.

FBC believes that a written public hearing with one round of Information Requests is appropriate for this Application based on the stakeholder reviews undertaken on the key inputs to, and the consultation process carried out for, the DSM Plan.

The reviews undertaken on key inputs included the advisory groups for the BC CPR Economic potential study and for the 2016 LTERP/LT DSM Plan. The BC CPR advisory group reviewed, amongst other aspects, the approximately 200 item measure list to ensure it was comprehensive. The LTERP advisory group proposed FBC add the High DSM scenario to 32 GWh/yr, or 80 percent annual load growth offset, that FBC incorporated into the accepted LT DSM Plan and subsequently into this filing.

Additionally FBC has undertaken, in conjunction with FEI, a wide ranging consultation leading up to this DSM Plan expenditure schedule. Section 5.2 outlines the extent of the consultation, which included integration of the FBC DSM Advisory Council into the FEI Energy Efficiency and Conservation Advisory Group (EECAG) and two consultations with the EECAG regarding the DSM Plan.

Table 2-1 outlines FBC's proposed regulatory timetable.

Table 2-1: Proposed Regulatory Timetable

Regulatory Timetable	Date (2018)
Registration of Interveners	Friday September 7, 2018
BCUC Information Request No. 1	Wednesday September 19, 2018
Intervener Information Request No. 1	Tuesday September 25, 2018
FBC Response to Information Request No. 1 from BCUC and Interveners	Thursday October 18, 2018
FBC Final Submission	Thursday November 1, 2018
Intervener Final Submission	Thursday November 15, 2018
FBC Reply Submission	Wednesday December 5, 2018

3 Demand-Side Measures Regulation 326/2008, as amended by B.C. Reg. 117/2017.

3. BACKGROUND

3.1 LEGAL FRAMEWORK

FBC is filing this Application pursuant to section 44.2(1)(a) of the UCA, which provides that a utility may file with the Commission an "expenditure schedule" containing "a statement of the expenditures on demand-side measures the public utility has made or anticipates making during the period addressed by the schedule." All proposed activity in the DSM Plan qualifies as "demand-side measures", as defined in the *Clean Energy Act* (CEA)[4]. Under section 44.2(2) of the UCA, the Commission must accept a schedule of DSM expenditures before those expenditures are included in a utility's rates.

Pursuant to sub-sections 44.2(3) and (4) of the UCA, the Commission must accept all (or a part of) a DSM expenditure schedule if it considers that making the expenditures in the schedule (or a part of it) would be in the public interest. In considering whether an expenditure schedule put forward by a public utility, other than the British Columbia Hydro and Power Authority (BC Hydro), is in the public interest, the Commission must consider the following criteria according to section 44.2(5):

- the applicable of British Columbia's energy objectives;
- the most recent long-term resource plan filed by the public utility under section 44.1 of the UCA, if any;
- 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.[5]

Section 3.2, below, addresses how the DSM Plan supports the applicable of BC's energy objectives. Consistency with FBC's most recently filed long-term resource plan (the 2016 LTERP) is addressed in Section 3.3. Consideration of adequacy, as defined in the DSM Regulation, is discussed in Section 3.4. The Commission's comments in its decision regarding the 2018 DSM Plan are addressed in Section 4. The discussion in the DSM Application and these supporting materials confirms that the DSM Plan is in the interests of persons in British Columbia who receive or may receive service from FBC.

3.2 CONSISTENCY WITH BRITISH COLUMBIA ENERGY OBJECTIVES

British Columbia's energy objectives are set out in section 2 of the CEA. A summary of how the DSM Plan supports the applicable of these energy objectives is provided in the table below.

[4] *Clean Energy Act*, S.B.C. 2010, c. 22, s. 1(1) (Definitions)

[5] Section 44.2(5) also includes "(c) the extent to which the schedule is consistent with the applicable requirements under sections 6 and 19 of the [CEA]"; however, neither of those provisions is applicable to FBC in respect of the Application.

Table 3-1: BC's Energy Objectives Met by FBC DSM Plan

Energy Objective	FBC DSM Plan
(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%;	FBC's DSM proposals are designed to implement cost-effective (as defined by the DSM Regulation) demand-side measures. See Section 3.3.
(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;	FBC's DSM Plan includes provision for Innovative Technology projects and the Kelowna area Demand Response (DR) pilot, see Appendix A, Section 8.3 and 9.1 respectively.
(h) to encourage the switching from one kind of energy source or use to another that decreases greenhouse gas emissions in British Columbia;	FBC pursues electrification (fuel switching) measures pursuant to s. 18 of the CEA and s. 4 of the Greenhouse Gas Reduction (Clean Energy) Regulation[6]. For example: FBC undertook construction of the Kootenay Electric Vehicle (EV) charging network and plans to pursue the construction of further EV charging facilities.
(i) to encourage communities to reduce greenhouse gas emissions and use energy efficiently;	Local government and institutional strategic energy planning, and Community Education and Outreach, are enabled through Supporting Initiatives. Provision for, and further development of, the BC Step Code are included within Program areas. See Section 3.4.5 and Appendix A, Section 6.

3.3 CONSISTENCY WITH LONG TERM RESOURCE PLAN

Under section 44.2(5)(b) of the UCA, in determining whether to accept an expenditure schedule filed by a utility, the Commission must consider the utility's most recent long-term resource plan filed under section 44.1 of the UCA. For FBC, the reference plan is the 2016 LTERP, which included the LT DSM Plan. The DSM measures included in the 2019-2022 DSM Plan are consistent with the measures assessed and the benefit/cost methodology used in the 2016 LTERP and LT DSM Plan. More specifically, the measures included within programs in the DSM Plan pass the Total Resource Cost (TRC) test[7] and address the key end-uses of the principal customer rate classes - consistent with the 2016 LTERP (and accepted for the 2018 DSM Plan).

The 2016 LTERP indicated that FBC's long run marginal cost (LRMC) of acquiring electricity from BC "clean or renewable" resources is $100.45/MWh (nominally $100/MWh).[8]

In the DSM Plan, FBC continues to use the previously accepted $100/MWh[9] as the LRMC, and the DCE factor of $79.85 per kW-yr[10] as its avoided costs for the purposes of DSM benefits

[6] Greenhouse Gas Reduction (Clean Energy) Regulation, B.C. Reg. 102/2012, as amended

[7] The TRC test is the ratio of the benefits of a DSM measure divided by the DSM measure's cost, including the utility's program costs. The TRC is further described in Section 5.1.2.

[8] 2016 LTERP and LT DSM Plan, Volume 1, Section 9.3.1, pg. 119

[9] Order G-113-18 (FBC's 2018 DSM Expenditure Application)

[10] Order G-19-17 (FBC's 2017 DSM Expenditure Application)

calculations. The DSM Plan achieves a TRC Benefit/Cost ratio of 1.5 on a portfolio basis using the same LRMC and DCE factor.

The 2016 LTERP contemplated a number of load drivers, including #6 "Large Load Sector Transformation: unanticipated growth of large load customers not associated with traditional energy intensive industries".[11] Such unanticipated load growth at the time of the 2016 LTERP is now materializing as FBC is aware of 14 cannabis production facilities that are proposed in its service area. The LT DSM Plan called for a ramp up in DSM spending and savings to a target of 32 GWh/yr in 2023. However in response to the DSM opportunities presented by the proposed cannabis facilities, FBC has advanced the 32 GWh/yr DSM savings target to 2019. Similarly the LT DSM Plan pro-forma expenditures have been advanced.

3.4 *ADEQUACY PURSUANT TO THE DSM REGULATION*

Section 44.1(8)(c) of the UCA provides that, in considering whether to accept a utility's long term resource plan, the Commission must consider whether the plan "*shows that the public utility intends to pursue adequate, cost-effective demand-side measures*". In practice, the on-going adequacy of a long-term resource plan is achieved through the DSM measures funded through a utility's expenditure schedules under section 44.2(a) of the UCA. A public utility's DSM plan is "adequate" for these purposes, if it includes measures that satisfy the requirements set out in section 3 of the DSM Regulation.

The DSM Regulation was amended in March 2017 to include new adequacy requirements that revise the Low Income program area (to include charitable organizations that provide goods and services to low-income persons), add expenditure requirements for codes and standards support and add requirements to provide one or more measures for BC Energy Step Code support.

The full section 3 requirements, inclusive of the March 2017 Amendment, are as follows:

(a) a demand-side measure intended specifically

(i) to assist residents of low-income households to reduce their energy consumption, or

(ii) to reduce energy consumption in housing owned or operated by

(A) a housing provider that is a local government, a society as defined in section 1 of the Societies Act, other than a member-funded society as defined in section 190 of that Act, or an association as defined in section 1 (1) of the Cooperative Association Act, or

(B) the governing body of a first nation,

if the benefits of the reduction primarily accrue to

(C) the low-income households occupying the housing,

[11] 2016 LTERP, Volume 1, section 4.1.1, pg. 66

(D) a housing provider referred to in clause (A), or

(E) a governing body referred to in clause (B) if the households in the governing body's housing are primarily low-income households;

(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;

(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;

(e) one or more demand-side measures to provide resources as set out in paragraph (e) of the definition of "specified 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;

(f) one or more demand-side measures intended to result in the adoption by local governments and first nations of a step code or more stringent requirements within a step code.

While the DSM Regulation adequacy requirements are applicable to the Commission's review of long-term resource plans, because the requirements are in practice met through DSM expenditure schedule applications, FBC addresses how the DSM Plan is compliant with each of these considerations in the following sections.

3.4.1 Low Income Program

FBC's low income program is designed to meet the needs of qualified low income customers within its service area and is provided at no cost to eligible participants. It is offered in collaboration with FortisBC Energy Inc. (FEI) and BC Hydro to ensure consistency and delivery of best practices. The eligibility criteria for low income DSM programs are established in section 1 of the DSM Regulation.

The Low Income Program portfolio includes mail-out and bulk distribution of Energy Saving Kits (ESKs) and the collaborative Energy Conservation Assistance Program (ECAP) for single-family and housing society operated multi-unit residential buildings (MURB). FBC proposes to launch new measures in the DSM Plan including insulation and advanced draft-proofing for manufactured homes, and assistance with heat pump installations. Qualifying housing societies can also receive support in the form of energy assessments and implementation, and access the Commercial prescriptive offers with an incentive increase (to address affordability issues) for common area improvements.

3.4.2 Rental Accommodations

In 2016, FBC, in collaboration with FEI, launched a direct-install program with measures such as low flow fixtures and ENERGY STAR lighting products for rental MURB suites in its service territory. The program also provides no cost whole-building energy assessments to identify additional measures (common area lighting, central space heating and hot water boilers) that could be undertaken by the building owners, and provides two years of technical support and access to the FBC Commercial rebate programs. The DSM Plan continues this offer to MURBs in this target segment.

3.4.3 Education Programs

FBC, in collaboration with FEI, has developed a curriculum-connected online resource for BC elementary and secondary school teachers called Energy Leaders. Teachers can now download lesson plans to assist them with the energy related sections of the curriculum. Program design for grades 10-12 began in 2018 and be piloted in school year 2018-19.

FBC also provides financial and in-kind support for post-secondary initiatives for curriculum-based classroom instruction and broader campus-wide behaviour change programs.

3.4.4 Codes and Standards

The new paragraph 1(e) of the definition of "specified demand-side measure" referenced in the amended section 3(e) of the DSM Regulation is as follows:

> (e) financial or other resources provided
>
> > (i) to a standards-making body to support the development of standards respecting energy conservation or the efficient use of energy, or
> >
> > (ii) to a government or regulatory body to support the development of or compliance with a specified standard or a measure respecting energy conservation or the efficient use of energy in the Province.

In addition, a new paragraph was added under section 4(1.1) of the DSM Regulation, the Cost-effectiveness test, as follows:

> (d) the benefit of the demand-side measure is what is would have been had no step code been adopted in the Province.

A new definition of the term “step code”, used in the amended sections 3(f) and 4.1(d), was also added to section 1 of the DSM Regulation as follows:

> “step code”, in relation to a building to which Part 3 or 9 of the British Columbia Building Code (the Code) applies, means energy efficiency requirements in a regulation made under section 3 of the *Building Act* that are more stringent than the requirements in [baseline code construction].

FBC’s proposed DSM Plan expenditure schedule addresses section 3(e) of the DSM Regulation by including funding of $435 thousand for Codes and Standards under Supporting Initiatives. This funding represents one percent of the proposed DSM expenditure budget of $43.3 million ($2019).

Section 7.4 of the DSM Plan (Appendix A) provides more details on the proposed Codes and Standards expenditures.

3.4.5 Step Codes for Local Government and First Nations

FBC’s Supporting Initiatives for its DSM programming includes funding for Community Energy Planning (CEP) assistance that local governments, including First Nations, can access to assist in adopting the progressive provincial Step Code for new construction using FBC’s New Home Program under its Residential DSM programs.

With the addition of the funding to Codes and Standards, and the continuation of the CEP as part of Supporting Initiatives, FBC’s DSM programs in the DSM Plan are in compliance with the existing and new adequacy requirements under the DSM Regulation.

Furthermore, FBC’s New Home program offering uses the BC Building Code as the baseline to calculate the benefit/cost ratio in compliance with section 4(1.1)(d) of the amended DSM Regulation.

4. RESPONSE TO COMMISSION DIRECTIVES

Commission Decision and Order G-113-18 accepting FBC's 2018 DSM Application and Commission Decision and Order G-117-18 accepting FBC LT DSM Plan as part of the 2016 LTERP did not include any directives with respect to FBC's next DSM expenditure filing.

However, in the 2018 DSM Plan Decision and Order G-113-18 at p. 4, the Commission stated that: "*In its next DSM expenditure schedule filing and long term electricity resource plan (as applicable), the Panel encourages FBC to provide a clear explanation of how the CPR and market potential study results have been utilized in the development of the respective DSM plan*". This has been addressed in Section 5.4 of the Application.

5. DSM PLAN AND PROPOSED EXPENDITURES

The DSM Plan (Appendix A) provides program details and projected cost-effectiveness test results by program, sector and at the portfolio level. FBC's funding proposal for 2019 to 2022 includes all major customer sectors and program areas: Residential (including Rental), Low Income, Commercial (including Irrigation and Lighting), Industrial, Conservation Education and Outreach, Supporting Initiatives, and Portfolio. The DSM Plan also includes funding for a Demand Response (DR) pilot project in the Kelowna area.

The DSM Plan increases the level of expenditures and cost-effective programs comparable to the previously accepted 2018 DSM Plan[12] and the pro-forma expenditures[13] in FBC's LT DSM Plan. The DSM Plan continues many of the cost-effective programs previously accepted in the 2018 DSM Plan, with some additions and modifications to simplify offers for customers, align programs with provincial partners, and comply with changes to applicable legislation.

The following subsections describe FBC's guiding principles, consultation with stakeholders, proposed DSM expenditures forecast by program area, and the FBC CPR results and reports including Market potential.

5.1 *GUIDING PRINCIPLES*

FBC's DSM guiding principles have been updated from those presented in previous DSM applications to reflect the FEI and FBC (collectively FortisBC) C&EM department's[14] common guiding principles. FortisBC's DSM guiding principles are the following:

1. Programs will have a goal of being universal, offering access to energy efficiency and conservation for all residential, commercial and industrial customers, including low-income customers.
2. C&EM expenditures will have a goal of incentive costs exceeding 50 percent of the expenditures in a given year.
3. C&EM expenditure schedule plans and results will be analyzed on a program, sector and portfolio level basis, with acceptance based at the portfolio level.
4. The combined Total Resource Benefit/Cost, including the Modified Total Resource Benefit/Cost where applicable, of the Portfolio will have a ratio of 1.0 (unity) or higher.
5. FortisBC will submit its annual DSM Reports 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.

[12] Order G-113-18
[13] 2016 LTERP Volume 2 (LT DSM Plan) Table 3-2 p.16
[14] The C&EM department is the combined and renamed DSM departments of FEI, previously EEC, and FBC, previously PowerSense.

7. FortisBC 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 FortisBC's DSM activities.

9. DSM expenditure schedules will be multi-year, where feasible, so as to create the funding certainty necessary to support effective implementation in the marketplace – this Application requests funding for a four-year Portfolio of DSM programs.

10. Programs will support market transformation by incenting efficient measures through customers and/or trade allies (contractors, equipment manufacturers, distributors, retailers, etc.), developing trade ally capacity, and supporting codes and standards development and implementation.

11. FortisBC will retain a DSM stakeholder group, comprised of government, industry, trades, manufacturers, non-governmental organizations, advocacy groups, other utilities and customers to provide it with strategic advice. Additionally, FortisBC will undertake program area specific stakeholder consultation(s) on effective program design and implementation.

5.2 *CONSULTATION*

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

- Include any type of interaction (whether oral or written) that allows adequate expression and consideration of views;
- Make a genuine effort, which allows sufficient time for feedback;
- Consultation involves the statement of a proposal not yet finally decided on, listening to what others have to say, considering their responses, and then deciding what to do;
- Make available sufficient information to enable parties who are consulted to be adequately informed and therefore able to make "intelligent and useful" responses;
- Agreement is not required (although consultation does require more than mere telling, or presenting);
- "Consultation" is not equated with "negotiation". Negotiation implies a process that has as its objective arriving at agreement. Strive for something mutually agreeable but not something which is expected to get agreement across the board;

- Approach the matter with an open mind, and be prepared to change or even start a process afresh; and
- Provide reasonable opportunity for interested parties to provide feedback.

FBC engaged in and documented over 50 interactions and consultations related to the DSM Plan. The range of entities consulted with included: communities, customers, contractors, manufacturers, government, First Nations, vendors, interest groups, and the Energy Efficiency and Conservation Advisory Group (EECAG)[15]. The forms of consultations included workshops, surveys, in-person interviews, webinars, and conference calls. FBC also provided confidential draft versions of its DSM Plan to EECAG members for review and input.

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

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

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

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

[15] EECAG is FEI's long-standing advisory group. As part of ongoing C&EM integration efforts, the November 2017 EECAG meeting was "joint" with both gas and electric stakeholders present to discuss FEI and FBC's 2019-22 DSM Plans.

5.3 DSM EXPENDITURE FORECAST BY PROGRAM AREA

Table 5-1 summarizes the DSM Plan forecast energy savings and expenditures (inflation adjusted) by program area (sector), non-program areas and portfolio level totals. The table also presents TRC Benefit/Cost ratios by program area and at the portfolio level. FBC used an inflation rate of two percent (2% annually) for program expenses and two and a half percent (2.5% annually) for program labour. Inflation is only accounted for in Table 5-1 for the plan years 2019 to 2022 and not the approved 2018 Plan figures.

Overall, the DSM Plan expenditures are 21 percent higher (at $44.0 million) than the pro-forma budgets provided in the 2016 LTERP ($35.7 million inflation adjusted). Over half ($4.0 million) of the $7.7 million increase is allocated to lighting measures in the Industrial sector, largely to address agriculture process lighting in the emergent cannabis industry. Other large increases are from the Residential Customer Engagement Tool ($1.1 million), the Demand Response pilot ($1.0 million), and the DSM tracking tool ($0.6 million) under Supporting Initiatives.

Table 5-1: 2019-2022 DSM Plan Proposed Expenditures (inflation adjusted)

Program Area (Sector)	2018 Plan	Expenditures ($000s)					Energy savings (GWh)					TRC 2019-2022
	Approved	2019	2020	2021	2022	Total	2019	2020	2021	2022	Total	Ratio
Residential	$1,591	$2,086	$2,304	$2,519	$2,795	$9,703	6.0	5.6	6.0	6.5	24.1	1.8
Low Income	$731	$843	$873	$899	$930	$3,545	1.0	1.0	1.0	1.1	4.1	1.5
Commercial	$3,592	$3,178	$3,031	$3,052	$3,047	$12,308	15.5	15.5	15.3	15.5	61.8	1.7
Industrial	$377	$1,762	$1,788	$1,813	$1,815	$7,178	10.0	10.0	10.1	10.1	40.2	1.7
Program sub-total	*$6,291*	*$7,870*	*$7,995*	*$8,284*	*$8,587*	*$32,735*	*32.6*	*32.1*	*32.4*	*33.1*	*130.3*	*1.7*
Education and Outreach	$165	$566	$497	$595	$666	$2,324						
Supporting Initiatives	$742	$1,218	$838	$1,024	$1,044	$4,124						
Portfolio	$743	$776	$913	$1,019	$956	$3,663						
Demand Response		$477	$324	$130	$133	$1,064						
Total	**$7,940**	**$10,900**	**$10,600**	**$11,100**	**$11,400**	**$44,000**	**32.6**	**32.1**	**32.4**	**33.1**	**130.3**	**1.5**
LT DSM Plan	**$7,900**	**$8,100**	**$8,200**	**$9,400**	**$10,600**	**$36,300**	**26.4**	**26.4**	**28.4**	**30.4**	**111.6**	**1.9**

The DSM Plan was developed using the conservation potential review as an input.

5.4 CONSERVATION POTENTIAL REVIEW (CPR)

As part of the 2016 LTERP and LT DSM Plan, FBC partnered with three other BC utilities[16] to undertake a provincial, dual-fuel, conservation potential review (BC CPR). Navigant Consulting (Navigant) was engaged to determine the energy efficiency potential for electricity and natural gas across British Columbia in the residential, commercial, and industrial sectors over the planning horizon of 2016 to 2035.

[16] (BC Hydro, FEI and Pacific Northern Gas (PNG) (collectively, the BC Utilities)

Although the BC CPR was developed collaboratively, each of the participating BC Utilities, including FBC, received its own CPR Results and Report (FBC CPR)[17] based on its specific inputs (e.g., avoided costs, discount rate, load forecast etc.).

The scope of the FBC CPR included assessing the conservation potential of the total loads in FBC's service territory, including those partially supplied by self-generating customers. In the case of Nelson Hydro, its self-generation was allocated to the Residential and Commercial sectors, and for the Industrial sector its self-generation was allocated to the relevant segments (e.g., Pulp and Paper). The FBC CPR was a key input to the LT DSM Plan.

The BC CPR used three distinct steps to estimate potential: generating a reference case forecast, characterizing energy savings measures, and estimating the savings potential.

For the first step, Navigant developed a base year and a reference case forecast of energy consumption. The base year establishes a profile of energy consumption for each of the BC Utilities based on an assessment of energy consumption by customer sector and segment, end-use, fuel, and types of equipment used. After calibrating the 2014 base year to actual FBC utility energy sales, Navigant generated a reference case forecast that estimates the electricity demand over the CPR period absent incremental DSM activities. The technical and economic potential scenarios were then calculated against the reference case forecast. Navigant used two key inputs to construct the Reference Case forecast for each customer sector: stock growth rates and energy use intensity trends.

The next step was to develop a comprehensive list of energy efficiency measures that provide the potential estimate. Over 200 energy savings measures were included from the residential, commercial, and industrial sectors, covering electric and natural gas fuel types. Navigant prioritized measures with high impact, data availability, and most likely to be cost-effective as criteria for inclusion in the study.

Once the reference case forecast and list of measures were established, Navigant estimated the technical and economic savings potential for electric energy and electric demand across FBC's service territory. Technical potential includes energy savings that could be achieved if all installed measures were immediately replaced with the efficient measure, wherever technically feasible, regardless of the cost, market acceptance, or whether a measure has failed. Economic potential is a subset of the technical potential, using the same assumptions as the technical potential, but includes only measures that have passed the TRC test.

The TRC is the governing test used to determine the cost-effectiveness of a utility's DSM portfolio. It comprises of benefits (the present value of the measures' energy savings, over their effective measure life, valued at the utility's avoided costs) divided by the costs[18] (incremental cost of the measures plus program administration costs). The TRC can be expressed on an

[17] The FBC CPR Technical and Economic report can be found in Appendix A of the LT DSM Plan.

[18] TRC costs are already expressed in present value, since the measure cost and program administration cost are in current dollars.

individual measure basis, for a program (group of measures), on a sector level and/or at the portfolio level.

The TRC test was done at the measure level in the DSMSim™ modelling tool[19]. The benefits are FBC's "avoided costs", calculated as the present value over the effective measure life of:

- the measures' energy savings, valued at the LRMC of $100 per MWh; and
- the measures' demand savings, valued at the DCE of $79.85 per kW-yr.

A 6 percent discount rate, representing FBC's weighted average cost of capital (WACC), as accepted in the LT DSM Plan and the 2018 DSM Plan, was again used to calculate the present value of the benefits.

The results of the technical and economic potential study were filed with the LT DSM Plan as part of the 2016 LTERP. Navigant completed FBC's Market Potential Report, as part of the scope of the BC CPR Additional Scope Services, in January 2018.

Market potential is a subset of economic potential that estimates the rate of adoption, over the planning horizon, of DSM measures using factors like equipment turnover (a function of a measure's lifetime), simulated incentive levels, consumer willingness to adopt efficient technologies, and marketing activities. Table 5-2 provides an overview of the approach used for each of the factors.

[19] Navigant uses DSMSim™ a proprietary bottom-up technology diffusion and stock tracking model implemented using a System Dynamics framework.

Table 5-2: Market Potential Methodology Overview

Methodology Parameters	Approach
Benefit-cost test screen	Use the TRC as the primary screen for technical, economic, and market potential.
Diffusion parameters	Adjust diffusion parameters within ranges recommended by industry standard data sources to produce savings that are reasonably aligned with FBC's DSM sector-level historical achievements. Customize the diffusion parameters for five high impact measures selected to align with historic and planned savings.
Budget constraints	Do not apply budget constraints.
Incentive strategy	Set incentive levels on a levelized $ per kWh of savings basis, such that the simulated percentages of total spending from incentives versus non-incentive costs aligns with planned 2017 values across the sector.
Treatment of administrative costs	Include portfolio-level fixed costs and sector-level variable costs derived from planned 2017 non-incentive program spending.
Net-to-Gross (NTG)	Focus on gross savings within the report, and include discussion on impacts of NTG factors at the sector level for high-level estimates of net savings (consistent with the approach used for technical and economic potential)
Persistence	Assume 100% of measures are replaced as an efficient measure at the end of the initial measure life
Codes and standards	Use the same assumptions about codes and standards as in technical and economic potential

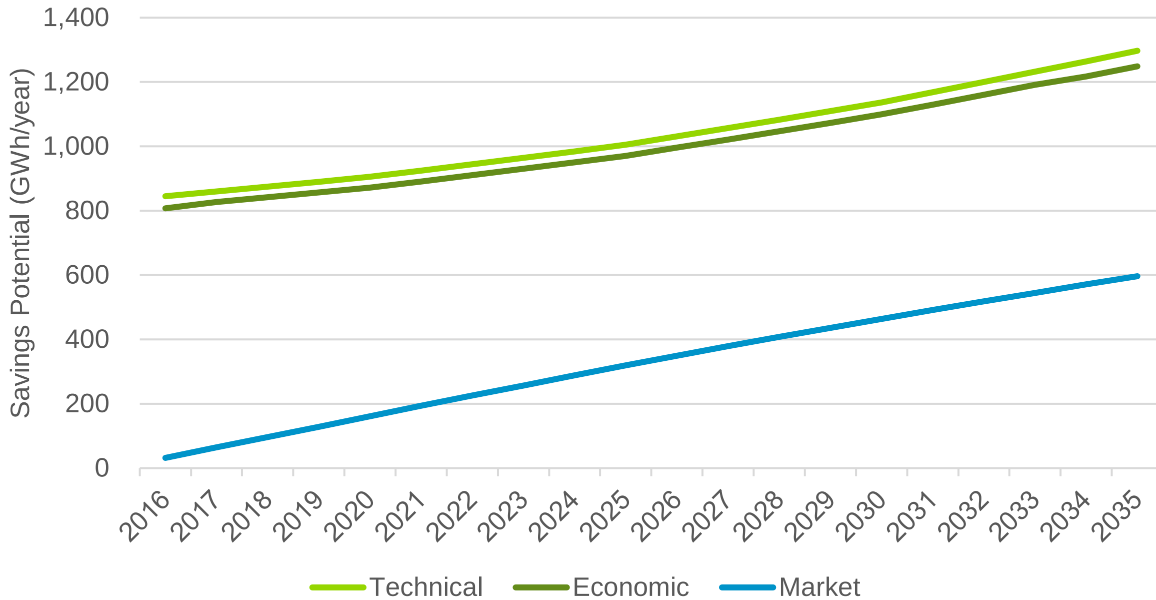
The following section presents key results of the market potential phase of the FBC CPR. Navigant's January 2018 report on Market Potential in FBC's service area is included as Appendix B to the Application.

5.4.1 Market Potential Results

Figure 5-1 shows that the cumulative market potential increases steadily throughout the CPR period, reaching 596 GWh/year in 2035. By 2035, market potential reaches nearly 48 percent of the economic potential. Incremental annual market potential added year-over-year to the cumulative potential averages 30 GWh/year over the study horizon.[20]

[20] The time horizon for the CPR is 2016-2035 (20 years).

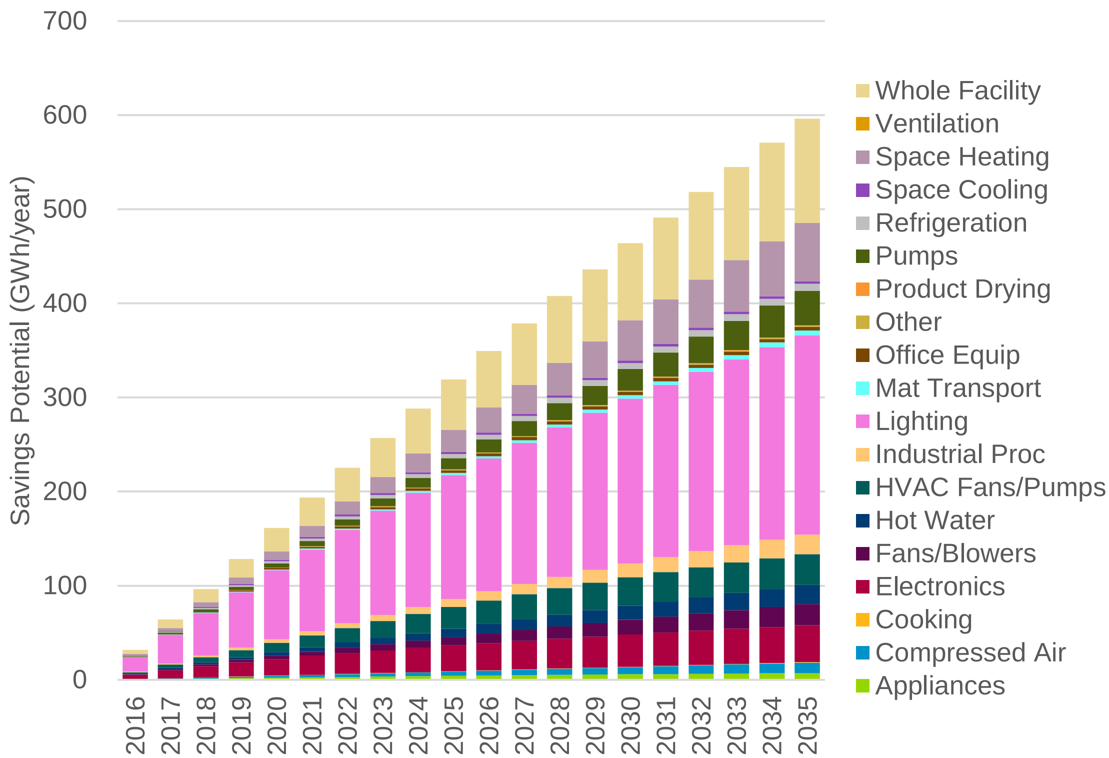
Figure 5-1: Total Cumulative Electric Energy Savings Potential (GWh/year)



Source: Navigant

Figure 5-2 shows the electric energy market savings potential across end-uses aggregated across all sectors. The dominant end-uses are lighting and whole facility. The bulk of savings potential in the lighting end-use comes from LEDs and General Service Lamp (GSL) code changes. The whole facility end-use primarily consists of savings from building automation controls, whole-building new construction practices 30 percent above code and smart thermostats. As such, whole-facility savings implicitly include savings from multiple end-uses.

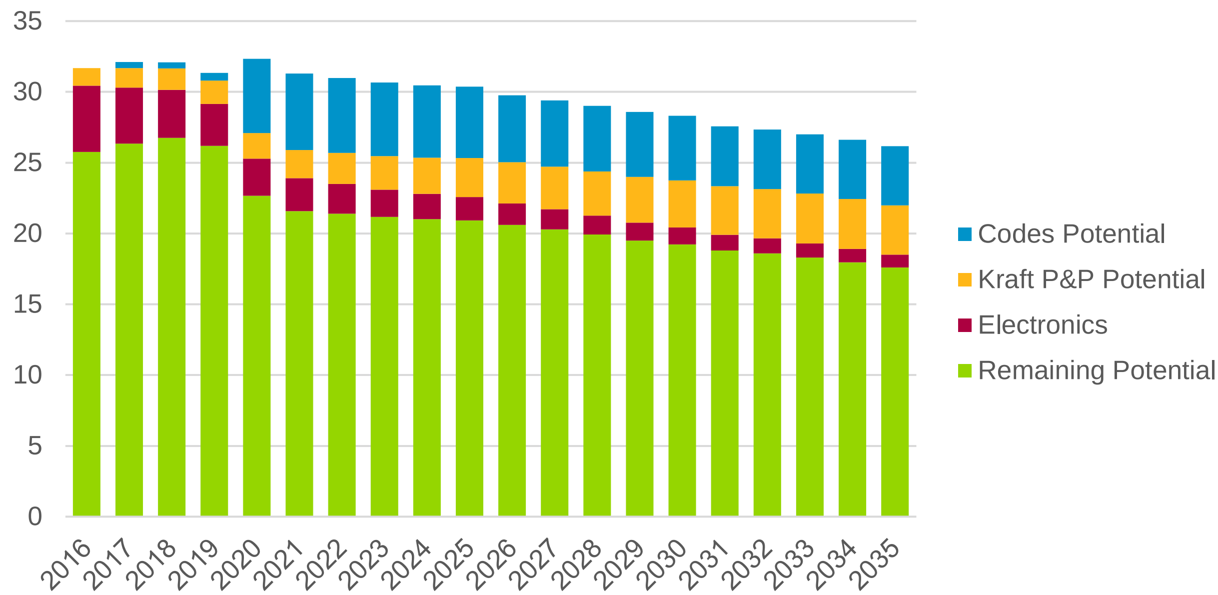
Figure 5-2: Cumulative Electric Energy Savings Market Potential by End-Use (GWh/year)



Source: Navigant

Figure 5-3 illustrates the amount of electric savings in the market potential included in consumer electronics, the kraft pulp and paper customer segment, and from codes and standards, which historically have not contributed to FBC's DSM program savings. Savings from those areas represent 168 GWh or nearly 28 percent of the total cumulative market potential by 2035. The remaining 425 GWh of market potential comes from measures typically included in FBC's DSM programs.

Figure 5-3: Annual Electric Energy Savings Market Potential by Source (GWh/year)

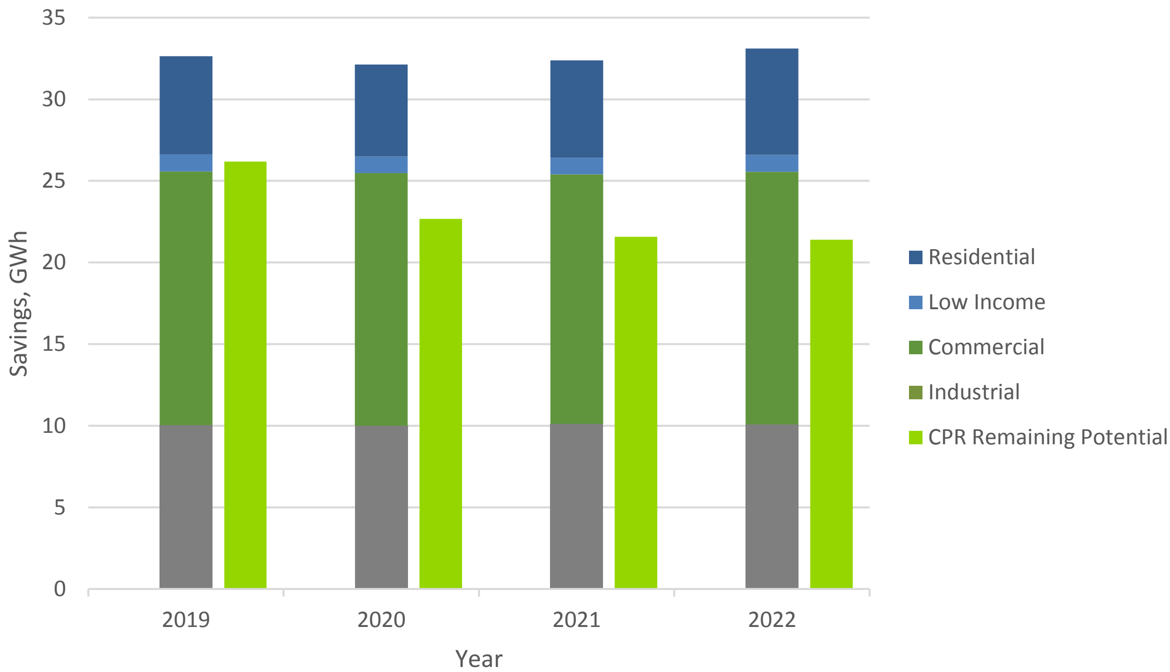


Source: Navigant

FBC uses market potential as an input to the planning process. Market potential differs from program potential in that it does not account for the various mechanisms that can be used to deliver DSM programs for a specific measure or market. Rather, market potential represents a high-level assessment of savings that could be achieved over time, factoring in broader assumptions about customer acceptance and adoption rates that are not dependent on a particular program design. Additional effort is typically undertaken by program managers, using the directional guidance from a market potential study, to develop detailed plans for delivering conservation programs.

Figure 5-4 below compares the remaining market potential (that excludes savings from electronics, kraft pulp and paper, and codes and standards) to the DSM Plan program savings. The DSM Plan savings forecast exceeds the market potential due largely to newly anticipated activity in cannabis production facilities in FBC's service area.

Figure 5-4: 2019-2022 DSM Plan compared to remaining market potential



Source: FortisBC

6. COST EFFECTIVENESS APPROACH

The following section explains the TRC cost-effectiveness test required under the provincial DSM Regulation and shows how the DSM Plan meets those requirements.

6.1 *COST-EFFECTIVENESS UNDER THE DEMAND-SIDE MEASURES REGULATION*

FBC's proposed DSM portfolio for 2019 to 2022 is cost-effective, with a TRC of 1.5, based on the methodology set out in section 4 of the DSM Regulation. The approach to determining the cost-effectiveness of FBC's DSM programs is comprehensive, benefits customers and should be carried forward through the plan period.

The following sections discuss the relevant parameters for calculating the TRC cost-effectiveness test as set out in the DSM Regulation.

6.1.1 Portfolio-Level Analysis

Section 4(1) of the DSM Regulation provides that the Commission, in determining the cost-effectiveness of a demand-side measure proposed in an expenditure portfolio or a plan portfolio, may assess 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 Commission has historically considered the cost-effectiveness of FBC's DSM plans at the portfolio level. In its Decision on FBC's 2012-13 Revenue Requirements Application the Commission stated:

> Regarding the cost effectiveness of the DSM programs, the Commission has previously assessed FortisBC's DSM programming at a portfolio level and will continue to do so in this case.[21]

In its Decision concerning FBC's 2015-2016 DSM Expenditure Schedule, the Commission confirmed this approach:

> In undertaking this review, the Commission Panel approached it on a holistic basis, considering the entire DSM portfolio. […]
>
> [The portfolio approach] provides FBC with the flexibility to undertake programs that are expected to provide a net BC benefit but where energy savings are hard to measure or low in the short term, provided there are other programs in its portfolio that provide offsetting benefits and/or savings.[22]

FBC proposes that the Commission apply the same portfolio level approach to cost effectiveness in its review of the DSM Plan.

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[21] Order G-110-12, page 136
[22] Order G-186-14, page 4

Individual program cost-effectiveness estimates are provided in the DSM Plan (Appendix A to the Application), and FBC will continue to report on individual DSM program cost-effectiveness results in its DSM Annual Reports.

6.1.2 Total Resource Cost (TRC) Test

The governing TRC test is often expressed as a ratio of the benefits of a DSM measure divided by the measure's cost, including the utility's program costs. The benefits are the "avoided costs", calculated as the present value over the effective measure life of:

i. the measure's energy savings, valued at the LRMC; and

ii. the measure's demand savings, valued at the DCE.

The measures' energy and demand savings are grossed-up by the avoided transmission and distribution energy losses ("line losses") of 8 percent before the benefits are calculated. In its DSM Plan, FBC uses the LRMC of $100 per MWh ($2015) accepted in the 2016 LTERP for cost effectiveness testing under the DSM Regulation. The DCE value of $79.85[23] per kW-yr ($2015), accepted in the Commission's 2017 DSM Plan Decision, is again used for this Application. Likewise, the Company again used a 6 percent discount rate in the current filing.

Section 4 of the DSM Regulation requires that DSM cost effectiveness be evaluated using the governing TRC test and, as necessary, the modified TRC (mTRC) test for up to 10 percent of the expenditure portfolio (per section 4(1.5)(b)(iv)). Where the evaluation occurs at the portfolio level, the total costs of the portfolio are compared to the total value of the benefits of the programs contained in the portfolio.

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 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. FBC has included specified demand-side measures within its Conservation Education and Outreach and Supporting Initiatives program areas, including increasing its Codes and Standards support to comply with the March 2017 Amendment to the DSM Regulation.

For a DSM measure(s) intended specifically to assist residents of low-income households to reduce their energy consumption (which would include the activities within FBC's Low Income Program), the Commission must, per section 4(2) of the DSM Regulation, in addition to any other analysis the Commission considers appropriate, use the TRC test and, in so doing,

[23] FBC Application for Acceptance of Demand Side Management Expenditures for 2017, Appendix C, Deferred Capital Expenditure Study, July 2016. Table 4 (p. 23).

increase the value of the benefit of the DSM measure by 40 percent. FBC has applied this approach in the cost-effectiveness analysis of the Low Income programs presented in the DSM Plan.

6.1.3 Avoided Cost Sensitivity

As stated in the previous section, the DSM Plan uses the accepted LRMC of $100 per MWh for clean or renewable BC resources from the 2016 LTERP to determine the avoided energy cost benefits of DSM program measures. This LRMC value is considered “firm” energy, i.e. inclusive of generation capacity benefits. The Company also includes a DCE value of $79.85 per kW per year to represent the incremental capacity savings of deferred infrastructure. The estimated Benefit/Cost ratios, using the two factors, are shown at the sector and portfolio levels in Table 5-1 above.

By comparison, based on a regulatory filing in 2016,[24] BC Hydro’s LRMC is approximately $106 per MWh, including energy and capacity, which approximates the $100 per MWh value that FBC uses to value DSM savings as a reliable resource that can defer the need to acquire additional generation capacity. As a result, no sensitivity runs were undertaken.

6.1.4 Non-energy benefits and the modified total resource cost expenditure cap

Section 4(1.1)(c) of the DSM Regulation requires the Commission to allow the inclusion of non-energy benefits (NEBs) for all DSM measures other than charity programs and low-income measures, which receive a different benefits adder under section 4(2), as described above. The amount of the NEBs which may be allowed by the Commission under s. 4(1.1)(c) is based on either evidence from the utility or by using a deemed 15 percent increase to the benefits side of the DSM expenditure portfolio of which the measure is a part. FBC uses the latter approach in its mTRC calculations. Section 4(1.5) limits this use of NEBs to a maximum of 10 percent of the total expenditures in an electricity DSM expenditure portfolio.

The measures contained in the DSM Plan all passed the standard TRC test, without resorting to use of the 15 percent NEB adder, hence there are no expenditures falling into the 10 percent mTRC cap.

6.2 *OTHER STANDARD COST BENEFIT TESTS*

While the TRC and mTRC continue to be the governing tests that FBC used 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)[25], the Utility Cost Test (UCT)[26] and the Participant Cost

[24] BC Hydro. 2015 Rate Design Application. Evidentiary Update on Load Resource Balance and Long Run Marginal Cost. Conclusion Section. February 18, 2016.

[25] 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).

Test (PCT)[27] applied at the program, program area (or sector) and portfolio levels. These cost-effectiveness tests are from the California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects (California Manual). Table 6-1 shows the standard test results at the portfolio level.

Table 6-1: Portfolio level cost effectiveness results

Program Area (Sector)	TRC	mTRC	UCT	PCT	RIM	TRC	Utility Cost
	Ratio	Ratio	Ratio	Ratio	Ratio	$/MWh	$/MWh
Total	1.5	1.7	2.8	3.1	0.8	84.5	45.1

[26] 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.

[27] 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.

7. EVALUATION, MEASUREMENT AND VERIFICATION

Evaluation, Measurement and Verification (EM&V) are important aspects of managing a DSM portfolio. FBC adopted the EM&V framework that FEI created with stakeholder review which is attached as Appendix D.

The Company employs Measurement and Verification (M&V) protocols on individual DSM projects, using IPMV[28] best practices, to ensure energy savings estimates are sound. Furthermore, the Company conducts Monitoring and Evaluation (M&E) activities on all programs, with comprehensive impact, process and/or market reviews[29] at appropriate times in program life cycles. The evaluation results inform program design, and summaries of M&E reports are shared with stakeholders and the Commission through FBC's DSM Annual Reports.[30]

7.1 *MONITORING AND EVALUATION*

Section 8.1 of the DSM Plan (Appendix A) details the M&E expenditures FBC proposes to make to ensure an adequate M&E review is in place for the DSM Plan period.

FBC's portfolio expenditures include costs for EM&V activities. The total proposed expenditure for EM&V activities to be conducted over the 2019-2022 DSM Plan period is approximately $1.7 million, or four percent of the DSM expenditure portfolio.

7.2 *NET-TO-GROSS RATIO: SPILL-OVER AND FREE RIDERS*

Historically, FBC calculated the net-to-gross (NTG) ratio by adjusting the benefits downward for the presumed presence of free riders[31]. Additionally, FBC has included known spill-over[32] effects in the NTG ratio, which is a recognized approach used by other utilities including BC Hydro. Spill-over is the conceptual opposite of free riders, thus including both effects presents a more complete and balanced view of program impacts.

FBC will continue to evaluate and quantify free-rider and spill-over effects on a program-by-program basis. Where adequate estimates are developed or acquired based on the results of an evaluation, free-rider and spill-over effects will be accounted for in the NTG ratio, as appropriate.

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[28] International Performance Measurement and Verification Protocol® (IPMVP) http://evo-world.org/en/

[29] Types of evaluation activities include: Process evaluations, where surveys and interviews are used to assess customer satisfaction and program success; Impact evaluations, including NTG assessment, to measure the achieved energy savings attributable to the program; and Market reviews to gauge Market Transformation progress.

[30] See Appendix E – FBC 2017 Annual DSM Report

[31] Individuals who participate in an incentive program who would have undertaken the measure even in the absence of an incentive.

[32] Spillover effects involve non-participants who acquired an energy conservation measure (ECM), and who did not receive an incentive, but were influenced by the operation of the utility's DSM program

Table 7-1 below lists the free-ridership and spill-over rates currently used by FBC. The figure "0%" indicates zero [free-ridership], and a "blank" space indicates that spill-over has not been determined in prior M&E studies.

Table 7-1: FBC Program Free-Rider and Spill-Over Rates

Program Area	Free-rider	Spill-over	Source of Justification
Residential			
Home Improvement Program	20%		LiveSmart, BC Hydro, 2012
Heat Pumps - rebates	44%	20%	Research Into Action, 2018
Heat Pumps - loans	15%	20%	Research Into Action, 2018
Heat Pump Water Heaters	18%		Evergreen Economics, 2014
Lighting	36%	77%	Evergreen Economics, 2014
Appliances	57%	39%	Evergreen Economics, 2014
New Home Program	20%		per BC Hydro (Cooper and Habart, 2014)
Rental (in-suite)	0%		Dunsky Consulting, 2016
Commercial			
Commercial Lighting	34%		Evergreen Economics, 2013
Custom Building Improvement	24%		Evergreen Economics, 2018
Building & Process Improvement	30%	12%	Sampson Research, 2012
Custom Lighting	41%	9%	Evergreen Economics, 2018 & Sampson 2009
Building Improvement New	25%		Sampson Research, 2011
Industrial			
Industrial Efficiency	12%		Sampson Research, 2013
Low Income Housing			
Energy Savings Kit	0%		as per BC Hydro
Energy Conservation Assistance Program	0%		as per BC Hydro

8. ADDITIONAL APPROVALS SOUGHT

8.1 *AMORTIZATION PERIOD*

FBC currently uses a ten-year straight-line amortization of its DSM expenditures. FBC has undertaken the analysis for an amortization period that is in line with the average weighted measure life of all the measures in the DSM Plan, which is more appropriate from a cost/benefits matching perspective. The Company has determined the average weighted measure life to be 15.6 years, meaning that customers benefit from FBC's DSM measures for an average time period of approximately fifteen years. It is therefore appropriate that the costs also be amortized over this same period.

Table 8-1 shows the average measure life for each program, sector and at the portfolio level weighted by incentives.

Table 8-1: Average measure life weighted by incentives, 2019-2022 DSM Plan

Sector	Incentives $(000s)	Measure life (years)
Residential	**$8,829**	**19.0**
Home Renovation	$5,243	18.7
Lighting	$481	10.7
Low Income	$1,966	19.6
New Home	$1,013	23.8
Rental Apartment	$126	11.9
Commercial	**$8,101**	**14.3**
Commercial Custom	$3,503	15.8
Commercial Prescriptive	$4,599	13.2
Industrial	**$5,841**	**12.4**
Industrial Custom	$4,950	12.3
Industrial Prescriptive	$891	13.5
Total	**$22,771**	**15.6**

FBC provides the incremental rate change from switching from the current 10-year to a 15-year amortization period in the following Table 8-2. The table shows the rate impact of the proposed spending for the 2019-2022 period amortized over the currently approved 10-year period, compared to the rate impact of amortizing the deferral account, including the existing balance and proposed spending, over a 15-year period. At spending levels consistent with 2018, the proposed change in amortization results in a rate impact lower by 0.51 percent in 2019 than under the existing 10-year amortization.

Table 8-2: DSM rate impact comparison

Incremental Rate Impact Compared to Prior Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Current Treatment: Amortizing DSM Expenditures over 10 years	0.28%	0.27%	0.23%	0.17%	0.14%	0.14%	0.22%	0.20%	0.12%	0.09%
Proposed Treatment: Amortizing DSM Expenditures over 15 years	-0.22%	0.27%	0.25%	0.21%	0.22%	0.21%	0.12%	0.18%	0.17%	0.16%
Difference	-0.51%	0.01%	0.02%	0.04%	0.08%	0.06%	-0.10%	-0.02%	0.05%	0.07%

Incremental Rate Impact Compared to Prior Year	2029	2030	2031	2032	2033	2034	2035	2036	2037
Current Treatment: Amortizing DSM Expenditures over 10 years	0.07%	0.00%	0.01%	0.00%	0.00%	-0.01%	0.00%	-0.01%	-0.01%
Proposed Treatment: Amortizing DSM Expenditures over 15 years	0.17%	0.16%	0.08%	0.11%	0.10%	0.04%	0.00%	0.00%	-0.01%
Difference	0.10%	0.15%	0.07%	0.11%	0.11%	0.04%	0.00%	0.01%	0.00%

For the above reasons, FBC is requesting approval to move to a 15-year amortization period for its DSM expenditures.

8.2 *FUNDING TRANSFERS*

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

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

9. CONCLUSION

The DSM Plan attached as Appendix A to this Application includes a range of DSM measures and programs and uses the LRMC of $100/MWh, all of which are consistent with the 2016 LTERP and the previously accepted 2018 DSM Plan. The cost-effectiveness of the DSM Plan is also based on the DCE of $79.85/kW-yr and discount rate of 6 percent as accepted in the Commission’s 2017 DSM Plan decision.

The Company believes that its 2019-2022 DSM Plan, as filed, is in the interests of its customers and is compliant with the relevant provisions of the governing legislation and is cost-effective under the tests stipulated by the DSM Regulation. FBC therefore requests that the Commission accept the 2019-2022 DSM expenditures of $44 million as filed to support and implement the DSM Plan.

Appendix A

FBC 2019-2022 DSM PLAN

FortisBC Inc.

Appendix A:

2019 to 2022 Demand-Side Management (DSM) Plan

August 2, 2018

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APPENDIX A: DEMAND-SIDE MANAGEMENT

1 Introduction

FortisBC Inc. (FBC or the Company) has offered demand-side management (DSM) programs to customers since 1989 that are available to eligible customers served by FBC and its wholesale customers of Grand Forks, Nelson Hydro, Penticton, and Summerland.

The 2019-2022 DSM Plan continues many of the cost-effective programs previously accepted in FBC's 2018 DSM Plan, with some additions and modifications to simplify offers for customers, align programs with provincial partners, and comply with changes to applicable legislation. All figures in the 2019-2022 DSM Plan are expressed in constant 2019 dollars ($2019).

1.1 Summary of 2019-2022 DSM Plan

The 2019-2022 DSM Plan includes programs for: the Residential, Commercial, and Industrial customer classes; Low Income customers (formerly included in the Residential Program Area); and Irrigation and Street Lighting classes (included in the Commercial Program Area). The 2019-2022 DSM Plan also includes non-program expenditure categories: customer engagement and outreach; supporting initiatives; portfolio activities; and a new Demand Response pilot. Supporting initiatives contains funding for Codes and Standards (C&S) including support for the BC Energy Step Code to advance the energy efficiency performance of new building stock. The DSM Plan provides an overview and high-level description of each DSM program that FBC offers to its customers. Detailed Terms & Conditions for each program govern the actual measure incentives available, and process required, for qualifying customers.

Table 1-1, below, summarizes the proposed 2019-2022 DSM Plan energy savings and expenditures by program area (sector), non-program areas and at the portfolio level. The table also presents Total Resource Cost (TRC) Benefit/Cost ratios by program area and at the portfolio level.

Overall, the 2019-2022 DSM Plan expenditures are 21 percent higher (at $43.3 million) than was contemplated by the pro-forma budgets provided in the 2016 LT DSM Plan ($35.7 million). Over half ($4.0 million) of the $7.6 million total increase in proposed DSM spending is allocated to lighting in the Industrial sector, largely to address agriculture process lighting in the emergent cannabis industry. Other large increases are from the addition of a Residential Customer Engagement Tool ($1.1 million), the Demand Response pilot ($1.0 million), and the DSM tracking tool ($0.6 million) under Supporting Initiatives. The program area sections that follow below provide more details on each of these items.

The 2019-2022 DSM Plan energy savings are also 17 percent higher (130.3 GWh) compared to the 2016 LT DSM Plan forecast (111.6 GWh) due largely to the estimated savings from the proposed cannabis production projects in the industrial sector.

Table 1-1: DSM Plan Expenditures & Savings, 2019-2022

Program Area (Sector)	Expenditures 2019 dollars (000s)					Energy savings (GWh)					TRC 2019-2022
	2019	2020	2021	2022	Total	2019	2020	2021	2022	Total	Ratio
Residential	$2,086	$2,290	$2,489	$2,750	$9,614	6.0	5.6	6.0	6.5	24.1	1.8
Low Income	$843	$870	$894	$923	$3,530	1.0	1.0	1.0	1.1	4.1	1.5
Commercial	$3,178	$3,008	$3,006	$2,980	$12,173	15.5	15.5	15.3	15.5	61.8	1.7
Industrial	$1,762	$1,783	$1,804	$1,801	$7,151	10.0	10.0	10.1	10.1	40.2	1.7
Program sub-total	*$7,870*	*$7,951*	*$8,193*	*$8,453*	*$32,467*	*32.6*	*32.1*	*32.4*	*33.1*	*130.3*	*1.7*
Education and Outreach	$566	$488	$572	$627	$2,252						
Supporting Initiatives	$1,218	$820	$981	$980	$4,000						
Portfolio	$776	$893	$975	$894	$3,536						
Demand Response	$477	$318	$125	$125	$1,045						
Total	**$10,900**	**$10,500**	**$10,800**	**$11,100**	**$43,300**	**32.6**	**32.1**	**32.4**	**33.1**	**130.3**	**1.5**
LT DSM Plan	**$8,100**	**$8,100**	**$9,200**	**$10,300**	**$35,700**	**26.4**	**26.4**	**28.4**	**30.4**	**111.6**	**1.9**

1.2 The Long Run Marginal Cost and Cost Effectiveness Results

The proposed 2019-2022 DSM Plan uses a long run marginal cost (LRMC) of $100 per MWh (2015 dollars) for clean or renewable BC resources accepted[1] by the Commission in the Company's 2016 LTERP. FBC continues to use the approved DCE factor of $79.85 per kW-yr[2] (2015 dollars). FBC updated these avoided costs to 2019 dollars using an inflation rate of 2% annually.

Based on those avoided costs, the 2019-2022 DSM Plan achieves a TRC Benefit/Cost ratio of 1.5 at the portfolio level.

1 Accepted in BCUC Order G-117-18

2 Accepted in BCUC Order G-9-17

2 Residential Program Area

For the 2019-2022 DSM plan, the Residential Program Area offers four overarching programs:

- Home Renovation Program;
- New Home Program;
- Lighting Program; and
- Rental Apartment Efficiency Program

FBC is integrating programs to simplify them for easier customer understanding and to streamline the customer experience. Simplifying program offers will also enable FBC to scale-up program offerings to capture additional energy savings opportunities and integrate partner offers more easily.

Table 2-1 outlines the list of Residential programs, expenditures and energy savings, and the Benefit/Cost ratio on a Total Resource Cost (TRC) basis. Overall the Residential Program Area expenditures will grow by approximately 8 percent each year to support FBC customers in reducing their energy consumption and support industry to improve overall home energy performance.

Table 2-1: Residential Program Expenditures and Savings, 2019-2022

Program	Expenditures 2019 dollars (000s)					Energy savings (GWh)					TRC 2019-2022
	2019	2020	2021	2022	Total	2019	2020	2021	2022	Total	Ratio
Home Renovation	$1,200	$1,356	$1,501	$1,656	$5,713	3.3	3.9	4.3	4.8	16.2	2.2
New Home	$184	$226	$307	$428	$1,145	0.3	0.4	0.6	0.8	2.1	2.2
Lighting	$157	$163	$136	$120	$576	2.3	1.1	1.0	0.8	5.2	1.9
Rental Apartment	$54	$54	$54	$54	$215	0.1	0.1	0.1	0.1	0.6	3.0
Labour and expenses	$491	$491	$491	$491	$1,965						
Total	**$2,086**	**$2,290**	**$2,489**	**$2,750**	**$9,614**	**6.0**	**5.6**	**6.0**	**6.5**	**24.1**	**2.1**

A description of each residential program and the primary delivery mechanisms follows.

2.1 Home Renovation

This program encourages customers to take a whole-home approach to their energy efficiency upgrades by consolidating ENERGY STAR appliances, space heating, water heating, and building envelope measures into one overarching Home Renovation program. By design, the program enables partnerships with BC Hydro, FEI, and all levels of government. At the time of writing, the current program partners are in discussion with the Ministry of Energy, Mines, and Petroleum Resources (MEMPR) regarding program design for the upcoming Retrofit Partnership Program. Deep retrofits will be encouraged through Bonus Offers while EnerGuide home labeling initiatives will be encouraged through energy advisor supported upgrades.

FBC and its program partners will support BC's evolving home performance industry with activities that include trades outreach, training, development of program registered contractor directories, site visits for program compliance, quality installation, and contractor accreditation initiatives. These activities provide value to participating customers through improved performance and longevity of installed equipment and improved comfort of their homes.

2.2 Heat Pumps

Central and ductless heat pump incentive offers are consolidated within the Home Renovation program. With its temperate winters and hot summers, the FBC service area is an ideal climate for air source heat pumps (ASHP). Customers can upgrade electric heating systems to either central split (forced-air) or ductless mini-split (for customers with electric baseboard heating) air source heat pumps.

2.3 Water Heating

Water Heating incentives are consolidated under the Home Renovation program. Approximately half of FBC customers have electric resistance hot water heaters. To encourage efficient water heating, FBC offers rebates for the installation of heat pump water heaters (HPWH) for customers with electrically heated hot water.

2.4 New Home

To stimulate uptake of energy-efficient construction the new home program is aligning with the performance-based approach of the BC Step Code with a graduated incentive structure. The BC Energy Step Code is a provincial standard that encourages energy efficiency in new buildings by establishing measurable energy-efficiency requirements for new construction. Local governments interested in better-than-code building energy efficiency can voluntarily reference the BC Energy Step Code in their policies and bylaws.

FBC, in partnership with FEI, supports local governments in their adoption of the BC Energy Step Code as part of an ongoing initiative for market transformation to high performance homes.

FBC and its program partners[3] will support[4] adoption of the BC Energy Step Code through builder and trades outreach, training and customer education about the benefits of high performance homes and other initiatives. Rebates for ENERGY STAR appliances in new homes are available for further energy savings.

2.5 Residential Lighting

To help build market transformation and improve customer participation in lighting incentive programs, FBC collaborates with BC Hydro, retailers and distributors to offer point-of-sale incentives on LED light bulbs and luminaires in retail stores.

[3] These initiatives may be partially co-funded by program partners FortisBC Energy Inc., BC Hydro, the BC Ministry of Energy, Mines and Petroleum Resources and BC Housing

[4] Industry support funds may be provided through the Program funding envelope, or where appropriate, the Supporting Initiatives funding envelopes.

2.6 Rental Apartment Efficiency Program

FBC provides the Rental Apartment Efficiency Program in collaboration with FEI. This program provides the direct installation of in-suite measures, including LED light bulbs and low flow showerheads, and faucet aerators for rental suites in multi-unit residential buildings (MURBs). The program also provides no cost whole-building energy assessments to identify additional measures (common area lighting, central space heating and hot water boilers) that could be undertaken by the building owners and provides two years of technical support and access to FBC's Commercial rebate programs.

2.7 Selected Highlights

The key changes, compared to the previously approved programs in the 2018 FBC DSM Plan, are:

- Aligning new home rebates with the BC Energy Step Code. By broadening rebates and adding tiers, FBC will be able to encourage and capture additional savings from Step 4 and 5 homes; and
- Accounting for the upcoming changes to lighting standards. Program energy savings from light bulbs, fixtures, and controls peak in 2019 prior to the code change and taper down in the following years.

The 2019-2022 DSM Plan includes the addition of new measures to the Home Renovation and New Home programs including:

- Drain water heat recovery systems; and
- Communicating thermostats

3 Low Income Program Area

This program area specifically focuses on creating opportunities for energy savings for low income customers both directly through programs that low income customers can apply to and indirectly through programs that serve social housing providers which in turn benefits FBC's low income customers. It was previously included within the Residential Program area and is in a stand-alone section in the 2019-2022 DSM Plan because it is a distinct program area and includes both residential and commercial-type measures.

For the 2019-2022 DSM Plan, the suite of Low Income Program rea customer offerings are organized in the following programs:

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

Table 3-1 outlines the Low Income programs planned expenditures, energy savings and the Benefit/Cost ratio on a Total Resource Cost (TRC) basis. Overall, the Low Income Program Area continues to grow throughout the plan period.

Table 3-1: Low Income Expenditures and Savings, 2019-2022

Program	Expenditures 2019 dollars (000s)					Energy savings (GWh)				
	2019	2020	2021	2022	Total	2019	2020	2021	2022	Total
Self Install (ESK)	$74	$74	$74	$74	$296	0.2	0.2	0.2	0.2	1.0
Direct Install (ECAP)	$665	$687	$704	$726	$2,781	0.7	0.7	0.7	0.7	2.8
Social Housing Support										
Prescriptive Rebate	$15	$16	$18	$20	$68	0.1	0.1	0.1	0.1	0.4
Support	$26	$30	$35	$40	$130					
Labour and expenses	$64	$64	$64	$64	$254					
Program	**$843**	**$870**	**$894**	**$923**	**$3,530**	**1.0**	**1.0**	**1.0**	**1.1**	**4.1**

3.1 Self-Install Program

This program is simple to apply to and provides a means by which low-income customers can take initial steps to improve the energy efficiency of their homes. The primary measure within the self-install program is the Energy Saving Kit (ESK) which is a bundle of energy efficiency measures that participants install themselves. The kits are delivered to the participant's home address or picked up at a FortisBC attended venue (e.g. Food Bank).

3.2 Direct Install Program

The primary measure within the Direct Install program is the Energy Conservation Assistance measure. The Direct Install program recognizes that some low-income customers do not have the expertise and/or physical capabilities to install energy efficient measures themselves. In the case of the Energy Conservation Assistance measure, a program contractor visits the eligible customer's homes to perform the installation of basic energy efficiency measures, provides customized customer coaching on behaviours that could increase their conservation efforts, and assesses the customer's homes for eligibility for additional measures. If the customer qualifies for additional measures, such as fridges and insulation, subsequent visits are scheduled for those measure installations.

3.3 Prescriptive Rebate Program

The Prescriptive Rebate program provides rebates and implementation support for social housing providers and may include rebates for individual low income customers as well. Prescriptive rebates provide a straightforward path for participants to participate in energy efficiency programs. Prescriptive rebates are available for measures such as commercial lighting, heat pumps and kitchen equipment.

3.4 Support Program

FBC provides energy studies, training and implementation support for participants that are seeking to better understand energy systems and improve the efficiency of their homes and buildings.

3.5 Selected Highlights

All measures that were offered to low income customers in the 2018 plan will continue and grow within the 2019-2022 DSM Plan. Some work that has either already begun or will begin shortly includes:

- Studies, implementation support and rebates to assist social housing providers
- Launch of new measures in the 2019-2022 DSM Plan including insulation and advanced draft-proofing for manufactured homes, and assistance with heat pump installations in electrically heated homes.
- Strengthening awareness and engagement among low income individuals through attending relevant venues (e.g. Food banks), direct mail, program collateral at MLA offices, partnerships (e.g. Ministry of Social Development), attending social housing events (e.g. Cooperative Housing Federation of BC, BC Non-Profit Housing Association), digital campaigns, and other opportunities that arise.

4 Commercial Program Area

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

- Prescriptive Program; and
- Custom Program

The change in program organization, compared with the 2018 DSM Plan (where incentives were grouped by end-use), streamlines reporting and aligns with the FEI commercial programs. Customers in the commercial market have diverse business types, wants, needs, and degrees of sophistication. The proposed groupings enable a non-measure specific approach that FBC will employ to deliver its energy efficiency offers to the commercial market. This approach allows FBC to adapt the market-facing aspects of each program to suit the needs of the various target customer segments. The scope of Commercial DSM programs includes landlords and low income housing providers upgrading common areas of rental buildings. The proposed commercial programs are described in the following sub-sections.

Table 4-1: Commercial Expenditures and Savings, 2019-2022

Program	Expenditures 2019 dollars (000s)					Energy savings (GWh)					TRC 2019-2022
	2019	2020	2021	2022	Total	2019	2020	2021	2022	Total	Ratio
Commercial Custom	$980	$963	$1,005	$1,095	$4,043	4.4	5.3	6.0	6.8	22.6	1.3
Commercial Prescriptive	$1,371	$1,218	$1,174	$1,057	$4,819	11.1	10.1	9.2	8.7	39.1	2.8
Labour and expenses	$828	$828	$828	$828	$3,312						
Total	**$3,178**	**$3,008**	**$3,006**	**$2,980**	**$12,173**	**15.5**	**15.5**	**15.3**	**15.5**	**61.8**	**2.0**

4.1 Prescriptive Program

The Prescriptive Program includes fixed incentives for the purchase and installation of specific qualifying new construction and retrofit measures. The prescriptive program provides rebates for energy efficient measures where the savings are well understood and their installation may not be a part of a larger, more complex upgrade. Current measures available for rebate under the Prescriptive Program include, but are not limited to:

- LED lighting and lighting controls;
- Commercial refrigeration;
- Commercial food service;
- Variable speed drives; and
- Heat pumps and heat pump water heaters.

The Prescriptive Program has two market delivery channels. Commercial customers are able to purchase qualifying measures at the vendor of their choice and apply for rebate directly from FBC. Alternatively, for select qualifying measures (such as lighting and kitchen equipment), commercial customers can receive a rebate as a point-of-sale rebate from participating trade allies. Trade allies then apply for reimbursement of the point-of-sale rebates from FBC.

4.2 Custom Program

The Custom Program provides offers to encourage commercial customers to identify, assess, and implement custom building energy-efficiency projects for existing and new buildings. The program is administered jointly with FEI, providing customers with a one-stop program in the FBC service territory to evaluate and implement building-scale energy efficiency projects. FBC Technical Advisors provide customer outreach and engagement for the Custom Program.

The commercial retrofit offer in the Custom Program provides incentives for customers to engage a qualified energy consultant to study potential building-scale electrical and natural gas energy efficiency and retrocommissioning opportunities. DSM incentives are also available to encourage the implementation of cost-effective electric energy efficiency measures.

The commercial new construction offer in the Custom Program encourages the design of high performance commercial buildings. Capital incentives are available for customers that design new buildings that exceed BC Building Code.

4.3 Selected Highlights

Below is a list of highlights for the Commercial Program Area:

- **Updated measures in the Prescriptive Program.** In the 2018 FBC DSM Plan, FBC introduced additional non-lighting energy efficiency measures in the suite of offerings of the Prescriptive Program. The Company will continue to review and revise its list bi-annually to ensure measures are meeting customer demand and technological trends in energy efficiency. Future measures may include LED grow lighting for agricultural products and commercial computer and server energy efficiency measures.
- **BC Step Code adoption in Custom Program.** FBC's support for high efficiency Commercial New Construction will be revised to support the adoption of the BC Energy Step Code based on input from industry stakeholders. The joint FBC and FEI program aims to provide incentives to encourage the efficient use of both electricity and natural gas in new construction. The program incentives will align with the BC Energy Step Code levels (and equivalent improvement percentages over building code for non-BC Energy Step Code buildings).
- **Re-launch of retrocommissioning offers in Custom Program.** FBC and FEI are currently developing a retrocommissioning offer. Retrocommissioning refers to the identification and implementation of low- and no-cost measures to improve building energy performance. FBC and FEI had a joint retrocommissioning offer in market (the Building Optimization Program) from 2014-2017. While the incentive levels and program offers for the re-launch have not been finalized, FBC is considering support for retrocommissioning investigation studies, completion studies, coaching and/or performance incentives.

5 Industrial Program Area

Table 5-1 provides a summary of the estimated savings, program expenditures and cost-effectiveness results for each of the programs noted above.

Table 5-1: Industrial Expenditures and Savings, 2019-2022

Program	Expenditures 2019 dollars (000s)					Energy Savings (GWh)					TRC 2019-2022
	2019	2020	2021	2022	Total	2019	2020	2021	2022	Total	Ratio
Industrial Custom	$1,288	$1,308	$1,308	$1,308	$5,210	8.2	8.2	8.2	8.2	32.9	1.8
Industrial Prescriptive	$290	$290	$311	$308	$1,199	1.8	1.8	1.9	1.9	7.3	1.4
Labour and expenses	$185	$185	$185	$185	$742						
Total	**$1,762**	**$1,783**	**$1,804**	**$1,801**	**$7,151**	**10.0**	**10.0**	**10.1**	**10.1**	**40.2**	**1.7**

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

- Prescriptive Program; and
- Custom Program

The Industrial Program Area has changed from the 2018 DSM Plan (with its single Industrial Efficiency program) to providing two core programs, Prescriptive and Custom, per the Commercial Program Area.

5.1 Prescriptive Program

The Prescriptive Programs includes fixed incentives for the purchase and installation of specific qualifying new construction and retrofit 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. Current measures available for rebate under the Prescriptive Program include, but are not limited to:

- LED lighting and lighting controls;
- Variable speed drives;
- Energy efficient irrigation equipment; and
- Compressed air.

The Prescriptive Program has two delivery marketing channels. Industrial customers are able to purchase qualifying measures and apply for rebates directly from FBC. Alternatively, for select qualifying measures such as lighting and irrigation equipment, industrial customers can receive their incentive as a point-of-sale rebate from participating trade allies. Trade allies then apply for reimbursement of the paid rebates from FBC.

5.2 Custom Program

The Custom Program provides offers to encourage customers to identify, assess and implement measures that use energy for process-related activities. The program is administered jointly with FEI, providing customers with a one-stop program in the FBC service territory to evaluate and implement industrial energy efficiency projects. FBC Technical Advisors provide customer outreach and engagement for the Custom Program.

The Custom Program offers co-funding for plant wide audits, feasibility studies, and capital incentives. The Plant Wide Audit offer in the Custom Program provides incentives for customers to engage a qualified energy consultant to perform a high-level, whole facility audit to identify opportunities to use electricity and natural gas more efficiently within an industrial facility. The Feasibility Study offer in the Custom Program provides incentives to study a specific process or system within an industrial facility to use electricity and natural gas more efficiently. DSM incentives are available to encourage the implementation of cost-effective electric energy efficiency measures.

5.3 Selected Highlights

Below is a list of highlights for the Industrial Program Area:

- **Cannabis industry growth.** With the upcoming legalization of recreational cannabis, the Okanagan has seen an influx of new cannabis greenhouses and growing facilities. To date, fourteen new industrial cannabis operations are in the planning or construction stage in the Southern Interior. FBC has received a number of requests to provide incentives for LED grow lights compared to baseline high intensity discharge grow lights. Cannabis producers have also expressed interest in investigating other electric energy efficiency opportunities, including ventilation and air conditioning.

  FBC estimates than an additional $1 million in incentives may be required annually to support the energy efficient construction and retrofit of new cannabis facilities for the 2019-2022 DSM Plan period. This increase in incentives due to growth in the cannabis industry results in a large overall increase in the Industrial Program Area budget and savings over previous years.

6 Conservation Education and Outreach

The Conservation Education and Outreach (CEO) initiatives provide education about conserving energy and non-program specific outreach communications. This program area fosters a culture of conservation within the province by providing education to a broad range of customers, including residential and commercial customers and students. The goal of these programs is to teach customers about taking steps towards energy conservation and about incentive programs.

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

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

Table 6-1 contains CEO expenditures from 2019 to 2022.

Table 6-1: Conservation Education and Outreach Expenditures, 2019-2022

Program	Expenditures 2019 dollars (000s)				
	2019	2020	2021	2022	Total
Residential Education Program	$217	$217	$220	$220	$875
Residential Customer Engagement Tool	$281	$203	$254	$321	$1,059
Commercial Education Program	$21	$21	$28	$28	$99
School Education Program	$46	$47	$69	$58	$219
Total	**$566**	**$488**	**$572**	**$627**	**$2,252**

The following sections describe the CEO initiatives.

6.1 Residential Education Program

The program provides information to residential customers and the general public on electric conservation and energy literacy by seeking opportunities to engage with customers directly (either face-to-face or through online tools). This audience also includes low income and multilingual customers. Ongoing partnerships with Canadian Home Builders Associations and local sports organizations continue to expand outreach opportunities to engage with Residential customers.

Promotional activities include a multimedia rebate awareness campaign, engagement campaigns, educational seminars, and participation in home shows and community events. The program also includes the cost of producing materials for events and prizes for audience engagement such as draft proofing kits used at events targeting Residential customers and children.

6.2 Residential Customer Engagement Tool

The Residential Customer Engagement Tool initiative plans to provide home energy reporting and other tools that will provide energy consumption analysis to customers, increase customer awareness of energy efficiency and conservation and foster conservation behaviours. The 2018 DSM Plan included this program under the Residential Behavioural program but, after further refinement and development, FBC determined this program would be more appropriately placed within the CEO program area for the 2019-2022 DSM Plan. This initiative is in partnership with FEI to develop an online portal where customers can access targeted energy conservation content and are aware of FBC's other DSM offers.

Industry research on similar tools indicate electric savings for this type of initiative are approximately 2% of total participant electric consumption. However, since these savings are based on behavior changes and there is uncertainty on their relative magnitude, they cannot be effectively forecast at this time and have not been included in this DSM Plan. Once savings are realized, they will be reported in FBC's annual DSM reports to the British Columbia Utilities Commission.

6.3 Commercial Education Program

The Commercial Education program provides ongoing communication and education about energy conservation initiatives as well as encouraging behavioural changes 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, print and online communications, and industry association meetings and tradeshows. FBC also plans to continue the Efficiency in Action Awards, which recognizes commercial customers for their innovation in energy efficiency and the electric savings they achieve. In addition, FBC will further partnerships with organizations such as Business Improvement Association BC and BC Non-Profit Housing Association, which work with small to medium-sized businesses and organizations.

Finally, this area will also guide and support behavior education campaigns delivered by energy specialists (or an energy manager) in their respective organizations.

6.4 School Education Program

Activities in the School Education program include FBC's corporate school initiatives: Energy is Awesome; the kindergarten to grade 12 curriculum-connected resource Energy Leaders; and the assembly style presentation, Energy Champions, which is currently delivered in collaboration with the BC Lions.

FBC enjoys ongoing partnerships with post-secondary institutions, e.g. UBCO Wilden Living Lab[5], and is currently developing additional proposals and funding support for other post-secondary initiatives. These initiatives may include in-class programs, in-residence and on-campus education campaigns, as well as supporting education campaigns delivered by energy specialists (or an energy manager).

[5] See https://wildenlivinglab.com. In brief two identical homes built side by side, one to 2017 "code" and the other featuring many energy-efficient technologies, with energy monitoring provided by UBCO engineering students.

7 Supporting Initiatives

Supporting Initiatives complement the incentive-based programs discussed in the 2019-2022 DSM Plan because they provide program support, build trade ally capacity, and promote market transformation to more energy efficient options. Supporting initiatives are included in portfolio level spending because they do not result in direct DSM savings. Table 7-1 lists the proposed Supporting Initiatives.

Table 7-1: Supporting Initiative Expenditures, 2019 to 2022

Program	Expenditures 2019 dollars (000s)				
	2019	2020	2021	2022	Total
Commercial Energy Specialist Program	$60	$60	$60	$60	$240
Community Energy Specialist Program	$150	$200	$250	$250	$850
Trade Ally Network	$152	$148	$200	$200	$700
Codes and Standards	$97	$105	$117	$116	$435
Reporting Tool & Customer Application Portal	$466	$14	$61	$61	$602
Labour and expenses	$293	$293	$293	$293	$1,173
Total	**$1,218**	**$820**	**$981**	**$980**	**$4,000**

The following sections outline the role for each supporting initiative.

7.1 Commercial Energy Specialist Program

The Commercial Energy Specialist Program is a joint initiative between FBC and FEI that co-fund Energy Specialist positions in large commercial organizations. FBC provides up to $30,000 per year in an annual contract with the remaining $30,000 provided by FEI. Energy Specialists' key priority is to identify and implement opportunities for their organization to participate in FBC and FEI's DSM programs, while also identifying and implementing non-program specific opportunities to use electricity and natural gas more efficiently. FBC considers this an energy management program, and hence a specified demand-side measure, as defined in the DSM Regulation.

7.2 Community Energy Specialist Program

This element of Supporting Initiatives provides financial assistance to local governments, including Indigenous communities, and institutional customers to facilitate energy efficiency planning activities like the development of community energy plans, energy efficient design practices and organizational policies such as adopting advanced energy efficiency standards for the entities' own buildings. The planning must be targeted at reducing electricity usage and demand.

7.3 Trade Ally Network

FBC relies heavily on trade allies, such as contractors and distributors that provide the qualifying products and capacity to install energy efficiency measures. Through its Trade Ally Network (TAN), FBC provides sponsorships for training and support for a number of initiatives for the building trades and electrical trade organizations,[6] as well as support for energy management planning training like Natural Resources Canada's "Spot the Savings" workshops.

7.4 Codes and Standards

FBC has increased its Codes and Standards budget for 2019 to 2022 to one percent of its proposed portfolio expenditures. FBC supports codes and standards policy development and research, through in-kind and financial co-funding arrangements.

A portion of the codes and standards funding is allocated to advancing the BC Energy Step Code as FBC will support the education and awareness of this new voluntary building standard. The budget includes support for high performance builder training, quality installation manuals, as well as energy modelling and blower door testing by certified energy advisors.

FBC also works with and supports a number of international, national, and provincial entities such as:

- CEATI International Inc.;
- Consortium for Energy Efficiency;
- Canadian Standards Association;
- Design Lighting Consortium;
- Natural Resources Canada; and
- BC Ministry of Energy, Mines, and Petroleum Resources

to set new efficiency standards for buildings, HVAC equipment, appliances, and lighting products. Funding for codes and standards research is provided on a case-by-case basis.

7.5 Reporting Tool & Customer Application Portal

The Demand-side Management Tracking System ("DSMS") Project will transition FBC and FEI from their existing DSM tracking systems onto a new, joint workflow system. These tracking systems are used to manage DSM rebates from the application stage through to payment, including application review, approval, payment file exports, reporting, and customer communications. There are several reasons for transitioning both utilities to a new system: an improved ability to operate joint programs by sharing a platform; the introduction of online application forms for gas customers; improved reporting via integrated dashboards; and a powerful communications management system.

Key benefits for FBC DSM participants include:

- Improved security;
- Ease of checking application status;
- Less chance of making application errors;

[6] TECA (Thermal Environmental Comfort Association), SICA (Southern Interior Construction Association), CHBC (Canadian Home Builders Association), BCEA (BC Electrical Association), etc.

- Faster rebate fulfilment; and
- Single DSM portal for joint gas and electric customers;

The DSMS project implementation began in Q4 2017 and is expected to conclude by Q2 2019.

8 Portfolio Expenditures

Expenditures on portfolio activities are required to properly plan and implement the proposed DSM programs and support efforts to meet the energy savings targets. This expenditure includes provisions for planning and evaluation staff who: perform DSM project due diligence, including savings verification, and oversee program evaluation studies; prepare long term DSM Plans and DSM Expenditure Plans at regular intervals; undertake conservation potential and avoided costs studies; and pilot innovative technologies for inclusion in programs.

The following Table 8-1 shows the major planning and evaluation cost elements for the 2019-2022 DSM Plan.

Table 8-1: Portfolio Expenditures, 2019-2022

Program	Expenditures 2019 dollars (000s)				
	2019	2020	2021	2022	Total
Monitoring and Evaluation	$104	$116	$103	$117	$440
DSM Studies	$25	$130	$175	$30	$360
Innovative Technologies	$100	$100	$150	$200	$550
Labour and expenses	$547	$547	$547	$547	$2,186
Total	**$776**	**$893**	**$975**	**$894**	**$3,536**

The following sections provides an overview of portfolio activities.

8.1 Monitoring and Evaluation

Monitoring & Evaluation (M&E) studies are necessary to determine if FBC's DSM program targets are being met and whether the programs are operating effectively. M&E of energy efficiency programs provides internal and external accountability by reducing uncertainty in the estimates of energy and demand savings. These studies evaluate the cost effectiveness of programs using the total resource cost (TRC) benefit/cost test, which adjusts savings for realization, free-rider and spill-over effects.

Table 8-2 provides a list of M&E studies for the 2019-2022 DSM Plan and proposed expenditures. M&E activities and studies are done in collaboration with FEI. The cumulative total for M&E expenditures, including labour, is $1.7 million representing four percent (4.0%) of the Company's total 2019-2022 DSM Plan expenditure which aligns with the Company's EM&V Framework and industry general practice[7] for expenditures on M&E activities.

[7] California Evaluation Framework. June 2004. TecMarket Works.

Table 8-2: Monitoring & Evaluation Plan Expenditures, 2019-2022

2019 - 2022 Evaluation Budget						
	SHARED EVALUATIONS:	**2019**	**2020**	**2021**	**2022**	**Total 4 Years**
Residential	Building envelope	40	60	40	60	200.0
Residential	Appliance rebate program	45	25	0	0	70.0
Residential	New Home Program	45	60	40	0	145.0
Residential	Rental Apartment Efficiency program	37.5	37.5	37.5	37.5	150.0
Residential	Residential Customer Engagement Tool	34.2	32.4	38.7	47.7	153.0
Supporting Initiatives	Residential Education Program	62	62	62	62	248.0
Supporting Initiatives	Commercial Energy Specialist	15	15	15	15	60.0
Low Income	Low Income	50	50	50	50	200.0
	Residential Subtotal	329	342	283	272	1,226
	12%	39	41	34	33	147
Commercial	Commercial Prescriptive Program	0	0	25	200	225
Commercial	Performance Program (custom)	0	0	50	0	50
Commercial	Performance Program - New Buildings	0	0	80	0	80
Industrial	Industrial Optimization Program	0	0	45	0	45
	Comm Industrial Subtotal	0	0	200	200	400
	12%	0	0	24	24	48
	Total Shared Evaluations	39	41	58	57	195
	SOLO EVALUATIONS:					
Residential	Lighting	40			45	85
Commercial	Custom - see Performance above					0
Commercial	Prescriptive - see above					0
	Heat Pump		75			75
	Unspecified	25		45	15	85
	TOTAL 4 YR SPEND FBC EVAL	104	116	103	117	440
	Labour for M&E only (excludes Planning)					1,288
	Total 4 year M&E Budget					1,728
	Total Expenditures 4 year Plan					43,300
	M&E as a Percent of Plan					**4.0%**

8.2 DSM Studies

FBC funds studies on an ongoing basis that support its DSM programs, including the residential and commercial end use surveys, conservation potential review, and avoided cost studies. The four-year total for these studies is estimated to be $360,000.

8.3 Innovative Technologies

Innovative technology funding supports the development of or increased use of a "technology, a system of technologies, or a building or industrial facility design that could achieve significant reductions of energy use or significantly more efficient use of energy"[8]. FBC supports feasibility studies, field studies,

[8] Technology innovation program defined in the Demand-Side Measures Regulation 326/2008 (amended Mar. 24, 2017).

and pilots to validate customer acceptance and energy savings of innovative equipment and systems. Technologies that have potential are incorporated into DSM programs.

An example of a field study is to monitor cold climate heat pumps (CCHP). FBC has submitted a proposal to NRCan to co-fund a CCHP study, in collaboration with BC Hydro and BC Ministry of Energy and Mines.

Innovative technologies are considered to be a specified demand-side measure, which means that the program and the technologies are evaluated as part of the DSM portfolio as a whole.

9 Demand Response

9.1 Kelowna Area Demand Response Pilot

FBC is investigating the potential use of Demand Response (DR) to mitigate system peaks and local congestion. FBC retained a qualified consultant to evaluate and quantify the DR potential for large commercial, industrial and institutional customers in the Kelowna area. The study indicates there is sufficient DR capacity that could defer capital infrastructure investments. Appendix A-1 contains the Kelowna area DR potential assessment report. The second phase of work will simulate the customers' DR potential against a backdrop of the past 3-year system load profile for the Kelowna area.

The final phase of work, subject to RFP, would be to proceed with a Kelowna area DR pilot project to validate proof of concept. Table 9-1 outlines FBC planned pilot study over 2019-2022 to assess the ability of DR to defer capital infrastructure investment in the electric system. The DR pilot anticipates testing both summer and winter potential over 2019-20. The initial expenditures to implement the Kelowna area DR pilot project include customer recruitment, demand control apparatus, licensing and configuration costs. The additional costs ($125 thousand per year) are FBC's estimate to sustain the DR capacity.

Table 9-1: Demand Response Expenditures, 2019-2022

Program	**Expenditures 2019 dollars (000s)**				
	2019	2020	2021	2022	Total
Demand Response	$477	$318	$125	$125	$1,045
Total	**$477**	**$318**	**$125**	**$125**	**$1,045**

10 Detailed Benefit-Cost Ratios

The following table provides the governing (TRC, mTRC) benefit-cost ratios for the 2019-2022 DSM Plan, at the Program, Sector and Portfolio levels; as well as the auxiliary B/C ratios calculated according to the California Standard Practice manual.

Table 10-1: DSM Plan Benefit-Cost Tests, 2019-2022

Program Area (Sector)	TRC	mTRC	UCT	PCT	RIM	TRC	Utility Cost
	Ratio	Ratio	Ratio	Ratio	Ratio	$/MWh	$/MWh
Total	**1.5**	**1.7**	**2.8**	**3.1**	**0.8**	**84.5**	**45.1**
Residential Program							
Home Renovation	2.2	2.4	4.2	4.3	0.8	77.2	39.7
New Home	2.2	2.4	3.9	4.0	1.0	92.0	52.4
Lighting	1.9	2.2	13.6	1.9	1.1	58.3	8.2
Rental Apartment	3.0	3.4	3.0	-	0.7	38.2	38.2
Total	**2.1**	**2.3**	**4.8**	**3.5**	**0.9**	**72.6**	**32.4**
Low Income Program							
Self Install	3.6	3.6	3.6	-	0.3	30.6	30.6
Direct Install	1.6	1.6	1.6	-	0.7	73.5	73.5
Social Housing Rebate Support Prescriptive Rebate Support	1.5	1.5	10.2	1.4	1.1	75.7	11.3
Total	**1.7**	**1.7**	**1.8**	**-**	**0.6**	**68.4**	**62.9**
Commercial Program							
Commercial Custom	1.3	1.5	4.7	1.9	0.8	92.5	25.2
Commercial Prescriptive	2.8	3.2	6.7	5.2	0.8	43.9	18.4
Total	**2.0**	**2.2**	**5.8**	**3.2**	**0.8**	**62.2**	**21.0**
Industrial Program							
Industrial Custom	1.8	2.1	5.1	2.3	1.0	58.7	21.2
Industrial Prescriptive	1.4	1.5	4.9	1.7	0.9	91.6	25.4
Total	**1.7**	**2.0**	**5.1**	**2.2**	**1.0**	**64.0**	**21.8**

Appendix A-1

KELOWNA DEMAND RESPONSE ASSESSMENT
PHASE 1: SCREENING STUDY

DEMAND RESPONSE ASSESSMENT
PHASE I: SCREENING STUDY

July 2018

Prepared by

enbala

YOUR GRID. IN BALANCE.

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1 EXECUTIVE SUMMARY

FBC Inc. (FBC or the Company) is investigating the potential use of Demand Response (DR) for mitigating both system peaks (winter and summer) and regional congestion within the Kelowna area. FBC has engaged Enbala to examine the potential for commercial, industrial and institutional sectors in the Kelowna area to provide sufficient DR capacity to provide capacity relief during grid peak times.

This study project is conducted in two phases:

I. Phase 1: screening study that determines whether sufficient DR potential exists in the Kelowna area and what value this may provide to FBC, and
II. Phase 2: simulation[1] study that models and tests the behaviour of individual DR resources to ensure that the portfolio will deliver sufficient Effective Load Carrying Capability (ELCC) to provide reliable capacity relief across a range of scenarios in coming years.

This report contains the Phase 1 findings and consists of two main parts:

- Kelowna Area Load Analysis – This analysis identifies the characteristics of peak demand events (i.e. magnitude, time of the day, duration and frequency) in the foreseeable future, using the historical load profiles and load growth forecasts. This is performed in the context of the capacity at Lee Terminal substation, the main interconnection point with BC Hydro's transmission network
- DR Potential Assessment – This assesses the load shedding potential of the 200 largest, Institutional, Commercial and Industrial (ICI) sites in the Kelowna area.

Key Findings

Comparing the load forecasts in the Kelowna area against the existing network's reliability limits show that the projected summer load will surpass the current summer reliability limit in 2023 and the projected winter load is not expected to exceed the winter reliability limit in the next 20 years. Therefore, the focus of this study is on analyzing the summer peak periods

The DR Potential Assessment, using a data-driven approach, shows that sufficient DR potential exists from the large ICI sector to provide a positive net benefit to the FBC system. Enbala estimates that a demand response program would provide a combined utility benefit of $172/kW-year from Avoided Transmission, Distribution and Generation costs. An example financial analysis for using DR capacity to defer transmission or distribution capacity is provided in the report.

Recommendation

Enbala recommends that FortisBC proceed with an ICI Demand Response Pilot targeting 1.75 MW of capacity per year, and, at a minimum, maintain this level of DR capacity for a period of 3 years.

[1] The simulation study will model the aggregation and dispatch of up to 50 ICI customers to curtail peak demand events in the Kelowna area

2 INTRODUCTION AND BACKGROUND

Electricity system components are typically designed and built for peak load, which usually occurs over a small number of hours per year. When the system load reaches its capacity, the traditional solution is to install more wires or reinforce (e.g. reconductor) existing ones, and/or upgrade substation capacity, which is often associated with considerable capital costs. Instead of traditional wire solutions, there are non-wire alternatives (i.e. distributed generation, energy storage, energy efficiency, and demand response) that can manage customers' loads to avoid, or at least delay, the need for capacity expansion.

FBC is considering Demand Response (DR), where electricity consumers reduce their load by responding to a signal from the utility at critical times, as a potential low-cost solution to defer system upgrades. A study conducted by Navigant identified 50-60 MW of DR potential across FBC's entire territory from the residential & commercial sectors. With this information, FBC has decided to conduct a DR screening study (Phase 1 and 2), and subject to the results, conduct a pilot to determine if DR can cost-effectively and reliably provide avoided capacity benefits in the Kelowna area.

Figure 1 shows a one-line diagram of the Kelowna area. Lee Terminal, the main interconnection point with BC Hydro's system, consists of two 168 MVA (nominal capacity) transformers. Along with DG Bell substation, a 200 MVA transformer, Lee Terminal provides service to the Kelowna area.

Enbala is working with FBC to examine the potential DR resource in detail and its possible benefits for the Kelowna area in two phases:

- Phase I- Screening Study; is an initial feasibility assessment that will determine whether sufficient DR potential exists at a macro level. The screening also provides insight into customer engagement and lays the ground-work for the in-depth simulation work that follows.
- Phase II- Simulation; this will model and project the real-time behaviour of the load portfolio in the Kelowna area over time and demonstrate the ability of demand response to alter the peak load profile in the Kelowna area.

The outcome of the study will inform FBC of the ICI potential for DR, allowing them to make an investment decision into a Demand Response pilot program.

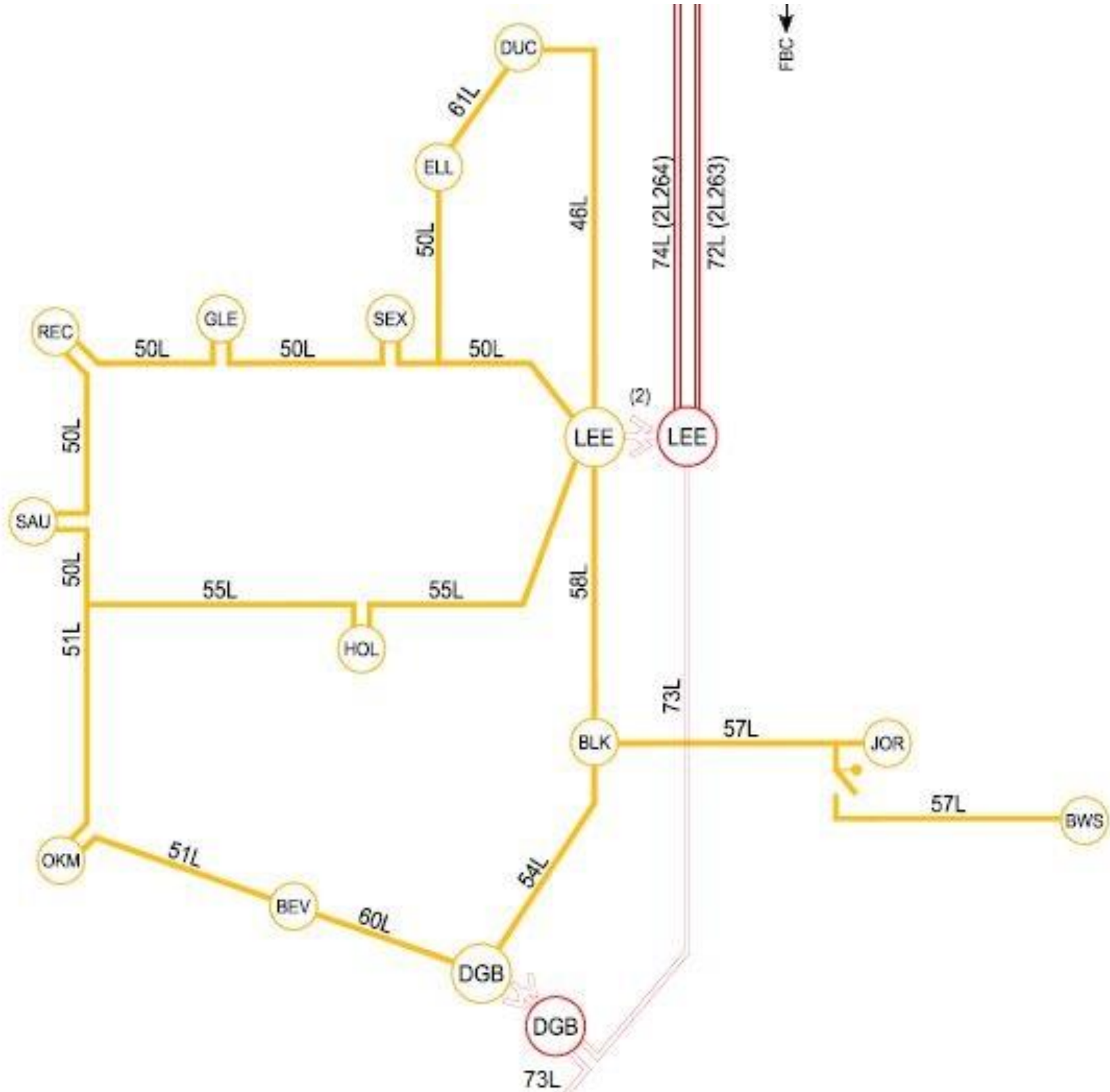

Figure 1: FBC Kelowna area one-line diagram.

The total load forecast for both summer and winter is shown in Figure 2 for the Kelowna area. This plot includes the overall reliable capacity of bulk supply substations, Lee Terminal and DG Bell together. Currently there is a narrow margin between the peak loads and reliability limit[2] in summer, whereas winter contains significant additional capacity. Therefore, the study is focused on analyzing the summer peak periods only. The forecast shown here is based on historical load drivers expected in the Kelowna area and does not include proposals for cannabis facilities or block-chain which may increase the load

[2] The summer reliability limit is 310 MW according to FBC Transmission Planning Department; this capacity becomes 400 MW in the winter. At peak load the power factor is approximately 0.99. To be conservative, Enbala has used the 310 MW and 400 MW reliability limits at a power factor of 1.0 (i.e. the summer reliability limit is assumed to be 310 MVA). These limits are carried through the entire analysis

growth significantly. Enbala has focused this study on the Kelowna area load as a proxy to represent peak demands system wide.

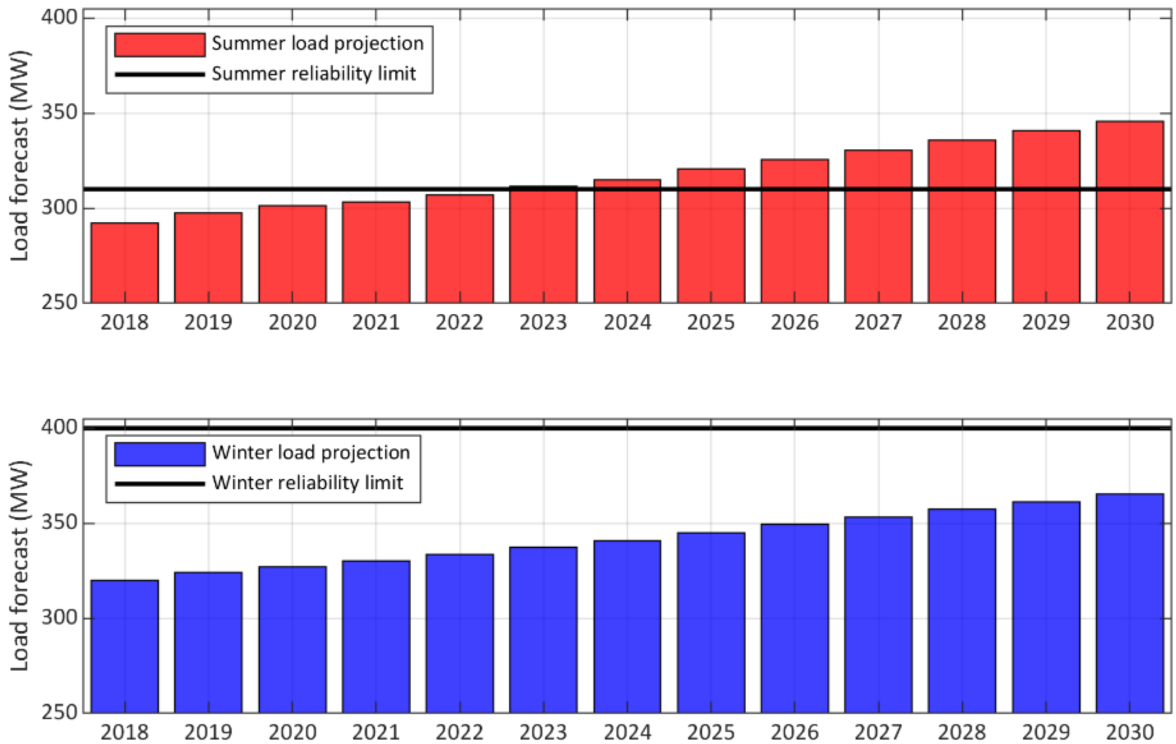

Figure 2: Kelowna area total load forecast against the reliability limits.

FBC's forecast estimates the summer load in Kelowna will surpass the reliability limit in 2023. The Company does not currently operate any Demand Response programs, so a good starting point for a DR pilot program would be to target the largest loads, for which DR at customer sites can be implemented at the lowest cost per kW of capacity. Thus, Enbala has examined the top 200 largest ICI customers in the Kelowna area for Phase I of this study.

Enbala views Demand Response as the beginning of a continuum towards implementing a Virtual Power Plant (VPP) product that can use distributed energy resources to meet multiple utility goals. Load flexibility can be harnessed in a VPP for fast bi-directional control to balance energy flows in real time, which can further be expanded to grid ancillary services such as frequency regulation. Finally, voltage and reactive power flows can be managed to mitigate the localized impact to distribution networks from resources such as roof-top solar PV. This is discussed further in Section 4.2.3.

3 SUBSTATION LOAD ANALYSIS

To design a VPP capable of reliably delivering the required capacity, a good understanding of the characteristics of potential future overloading events is required. These characteristics are focused on the magnitude, time of day, duration and frequency of the peak demands. Enbala used historical substation load profiles (as the load shape) and the FBC forecasted demand to build a load profile representative of the Kelowna area future load profile. FBC provided Enbala with 3 years of 15-minute load data (April 2015 to March 2018) on Lee Terminal and DG Bell transformers. Enbala aggregated the transformers load data to estimate the Kelowna area historical load profile.

3.1 Kelowna Area Historical Data

Figure 3 illustrates the daily energy consumption in the Kelowna area versus average daily outdoor ambient temperature (OAT), based on June- August 2015-2017 load data, excluding holidays and weekends. This plot suggests a significant dependency between the energy consumption and ambient temperature.

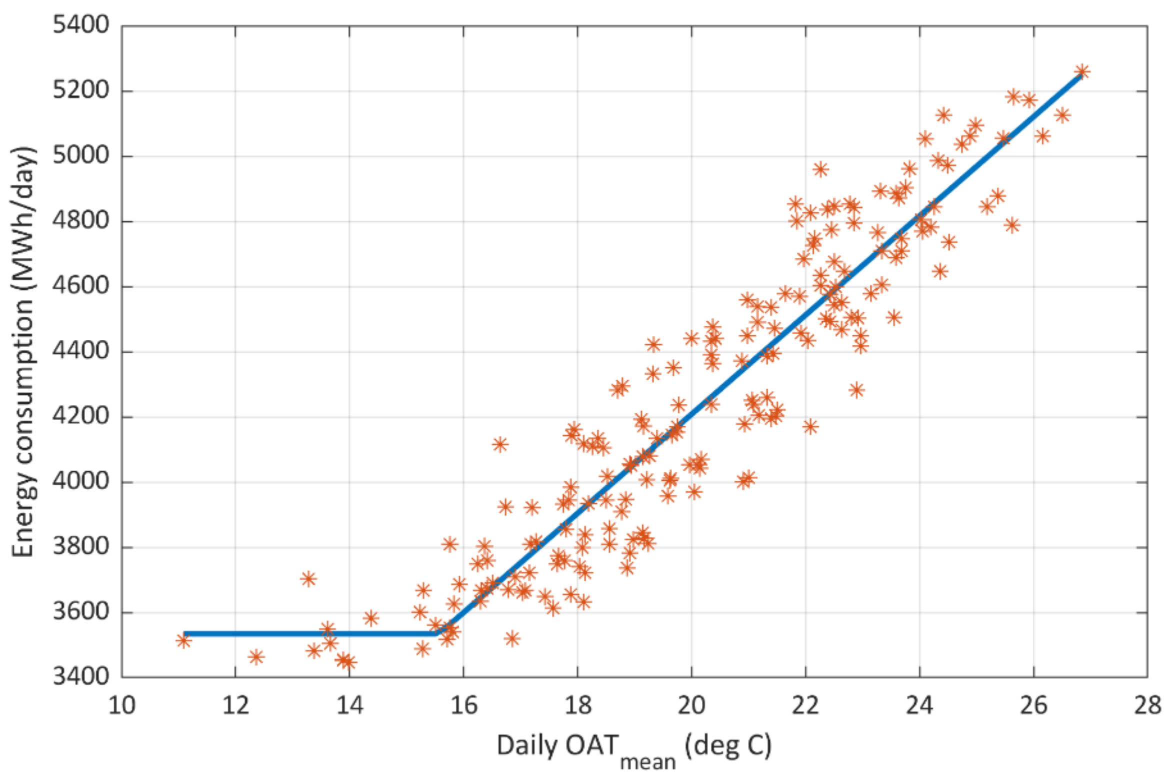

Figure 3: Kelowna area total load ambient temperature-dependency (June-August 2015-2017).

Figure 4 shows the daily peak loads during summer 2015-2017, respectively. There are few days with daily peak load close to the reliability limit within the last 3 years. Therefore, only the top 30 days are used for further investigations. The highest instantaneous load was 303.5 MVA happening in July 2015. The second and the third highest loads similarly happened in 2015. The highest and lowest total energy consumption belong to the years 2017 and 2016, respectively.

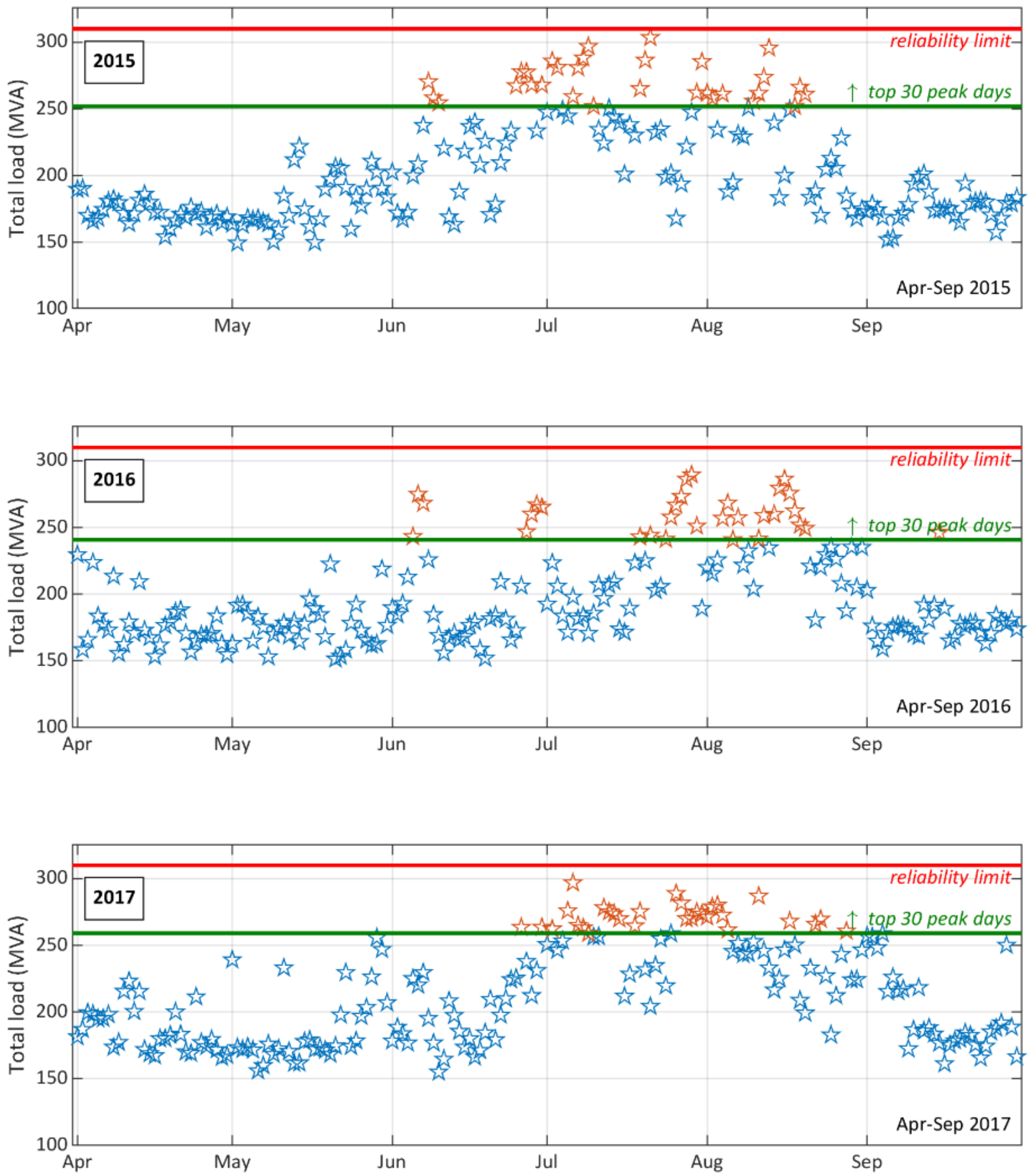

Figure 4: Daily peak load in summer 2015-2017.

The Kelowna area is a dual peaking system, however the winter reliability load limit (400 MW) is significantly larger than the summer reliability limit as shown in Figure 5. This is due to the higher capacity of the transformers at lower temperatures. Winter shows higher overall demands in terms of MVA.

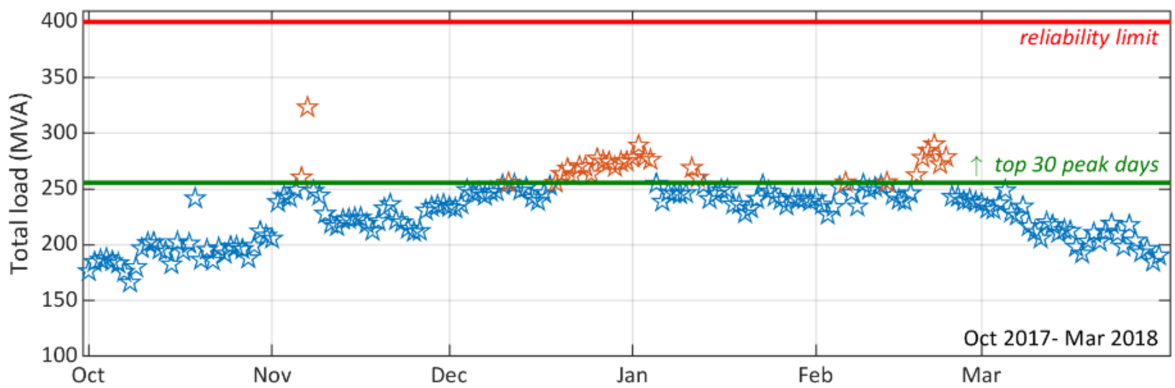

Figure 5: Daily peak load in winter 2017.

Figure 6 illustrates the daily load variation for the top 30 peak load days (in order of daily peak load magnitude) for summer 2015. This surface plot shows the highly repetitive shape of the profile, showing the peak demand occurring in the 3:00 PM to 6:00 PM time frame.

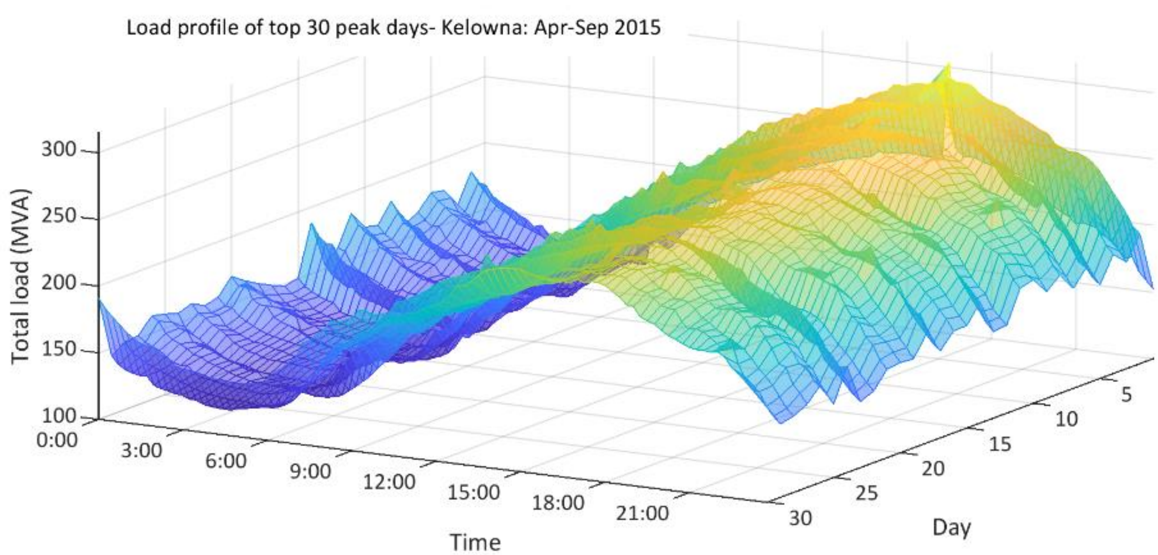

Figure 6: Load profile of top 30 days summer 2015.

Figure 7 shows a statistical comparison of the daily load profiles from the top 30 days from summer 2015 – 2017. These plots are shown using a graphical technique called box plots, which are described in Appendix A. In addition to the box plots, Figure 7 contains a curve setting an upper boundary that is equal to the mean value + 3 times the standard deviation of the 15-minute load. This curve represents an absolute extreme case; notably there are no outliers beyond this point. Similarly, Figure 8 illustrates the daily load profiles in winter 2017.

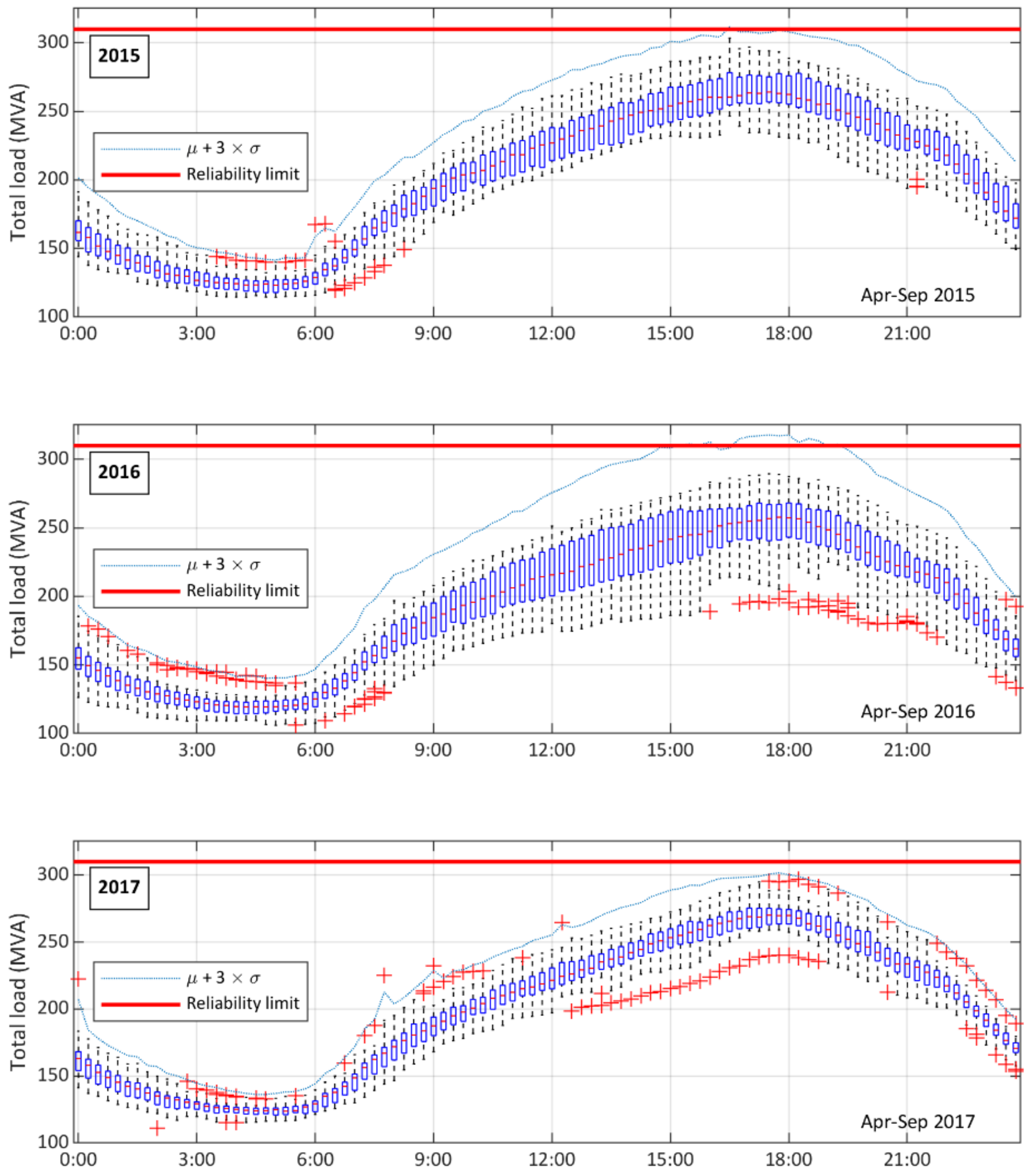

Figure 7: Load profile variation summer 2015-2017.

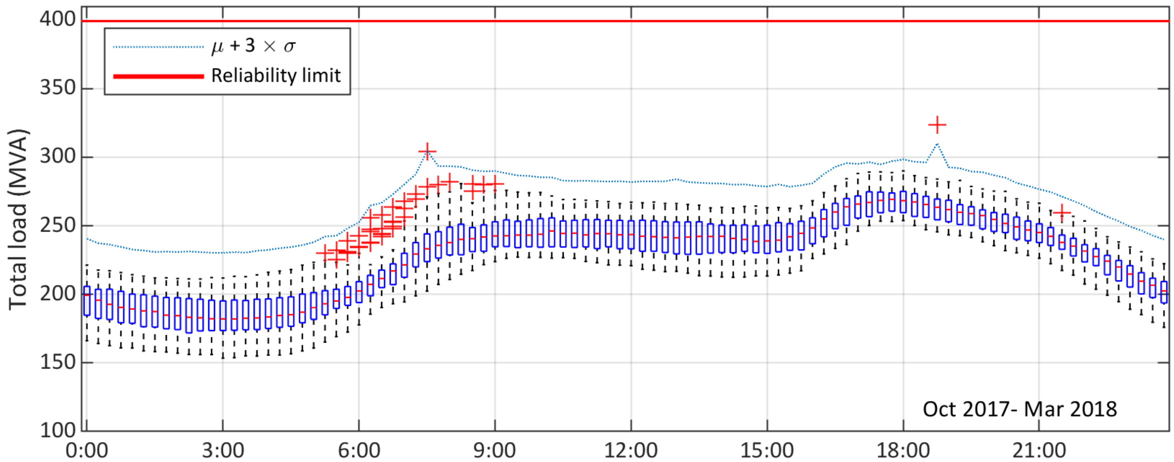

Figure 8: Load profile variation winter 2017.

3.2 Substation Load Forecast

To investigate the magnitude, frequency and duration of peak events, Enbala used the Kelowna area historic load profiles (base shapes) as well as the FBC forecasted load projections. This results in three different summer load profiles for future years.

Enbala analyzed the forecasted load profiles to understand the characteristics of the peak events that would cause the load to exceed the reliability limit. Table 1 shows the worst-case projection of reliability limit exceedances for years 2023 to 2027 based on projections using the load shape from 2015 through 2017. These results indicate the size of DR resource needed at different years. For example, in 2023, a 1.5 MVA capacity would be required for 15-minutes only at a 1-hour duration.

Table 1: Peak event projections - based on summer 2017 (worst case scenario)

Worst-case projection	2023	2024	2025	2026	2027
Maximum overload (MVA)	1.5	5.3	10.8	15.8	21.0
Annual hours overloaded	1	2	5	7	13
Maximum duration of overload (hours)	1	1.75	3.25	4.25	5.25

Figure 9 shows the required DR event characteristics for the year 2025, based on projecting from base year 2017. The top left chart of the figure is a cumulative distribution function (CDF) of the event magnitude, showing a peak requirement of 10.8 MVA. The top right chart is a probability density function (PDF) showing the peak event time of the day, while the lower chart shows the event duration and frequency. For 2025, when based on the 2017 projection, only two peak events are forecasted, one lasting 2 hours and 45 minutes, the other lasting only 45 minutes; the magnitude of the DR capacity required is

12 MVA, considering a safety factor of 10%. The safety factor is used because site conditions and operations may prevent some customers from participating.

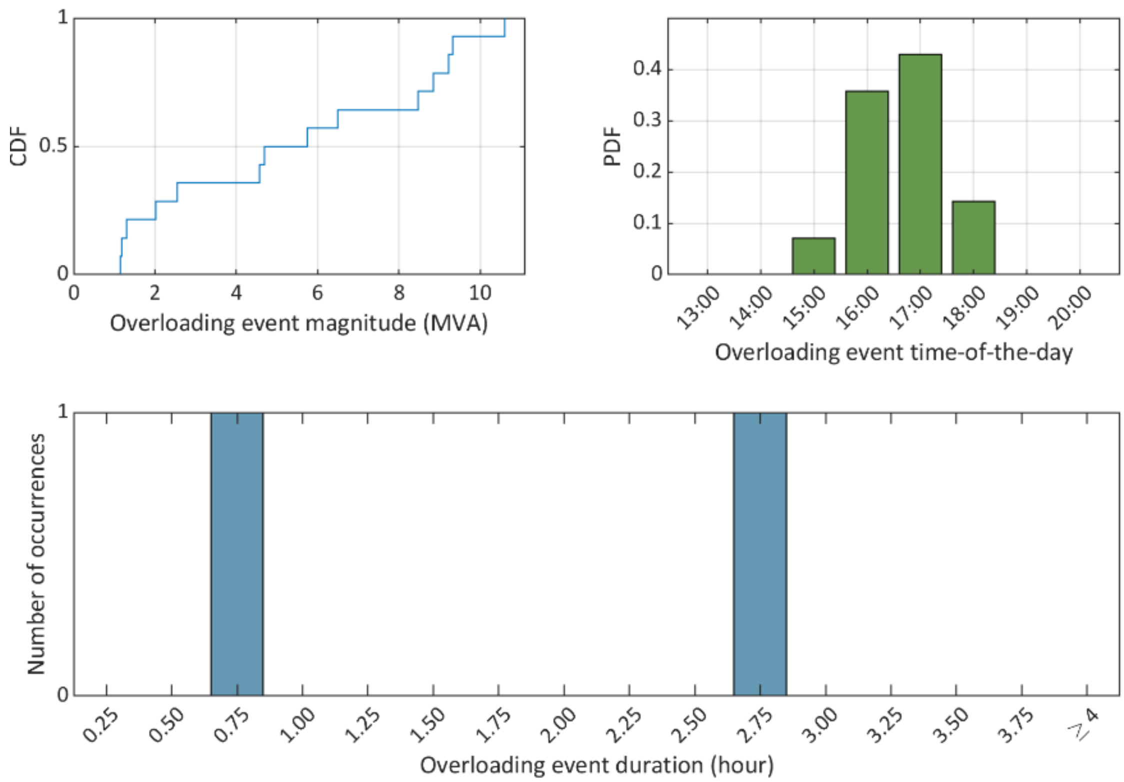

Figure 9: Summer 2025 overloading event characteristics (based on 2017 profile)

Figure 10 shows the projected load duration curves for only the top 30 summer days, for the year 2025 based on the summer profile of 2017. The horizontal axis is plotted in a log scale to highlight the load magnitude during peak times. Whenever the load is above the reliability limit, it is a peak event.

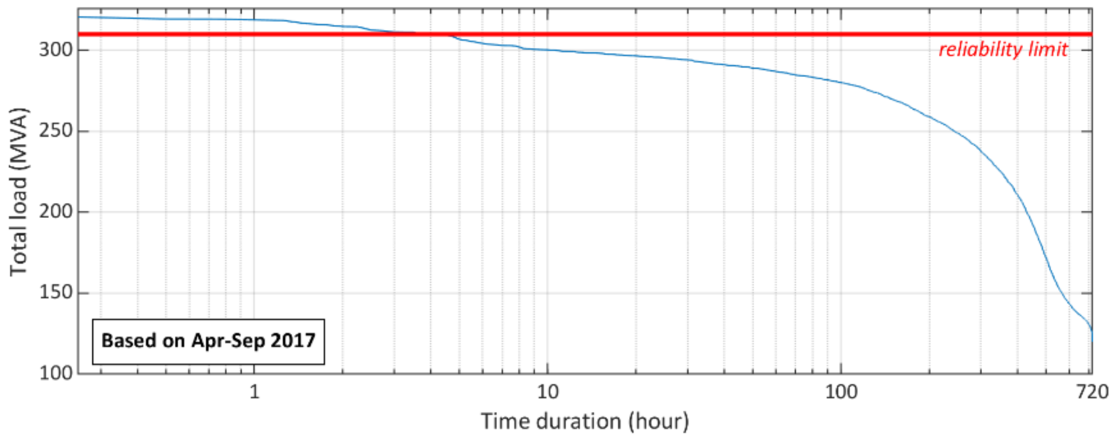

Figure 10: Summer 2025 projected load duration curve based on 2017 profile.

3.3 Limitations and Assumptions

The substation load data FBC has supplied are the maximum instantaneous MVA recorded over a 15-minute time interval on each transformer (two at Lee and one at DG Bell substations). This means that aggregating the two loads results in an MVA greater than or equal to what the actual simultaneous Kelowna area load would have been over the matching 15-minute intervals. As a conservative design approach, Enbala uses this summation of transformer loads as Kelowna area load.

4 DR POTENTIAL ASSESSMENT

The DR potential assessment was designed to estimate the load flexibility potential from the top 200 ICI sites in the Kelowna area. This will assist in determining the availability of a dispatchable resource capable of providing capacity relief to the Kelowna area. When aggregating load resources to deliver capacity, DR programs generally overbuild by 10% to 15% to ensure the capacity can be provided reliably each time.

Load flexibility can be derived either manually or through automation. The former means that curtailing the load will be done by an operator in a manual process with minimal feedback to the DR aggregator. Manual operation is usually seen at industrial sites with limited centralized control systems and can provide significant capacity to a DR program. However, because there is no automation, they provide inherently less reliable capacity. For automated systems, the flexibility is derived from the process and dispatched in a fully or semi-automated way. With automated demand response, the goal is to use the flexibility of a site while not disturbing the end user or impacting operations significantly (e.g. HVAC temperature setpoint control).

FBC provided monthly energy consumption (in kWh) and monthly peak load (in kVA) data from their largest 200 customers. Using this data, Enbala estimated the site load flexibility (in kVA), based on the largest 102 customers. Enbala maintains a database of estimated site flexibility that conservatively estimates a sites' ability to perform demand response. (NAICS codes were used to distinguish customer segments[3]). The flexible load estimation process involves the following steps:

1. Extracting the site kWh and kVA data for June, July and August 2016-2017 (critical months).
2. Looking up the "typical" manual/automated portions of the electric load in accordance to the site type, based on the customers NAICS code.
3. Calculating the site load factor, which is the average of monthly energy consumption divided by multiplication of site peak load (assuming a conservative power factor value of 0.85) by the average number of hours in a month (30.667 times 24).
4. Adjusting the load flexibility proportions based on site load factor, if the load factor is not in the range of 30%-70%.
5. Estimating the potential manual/automated flexible kVA by multiplying adjusted load flexibility portions by site peak load.

Figure 11 illustrates the total DR capacity of the top 102 large ICI sites in the Kelowna area. Accordingly, the potential manual and constraint-based loads are 2.15 MVA and 10.03 MVA, resulting in a conservative estimate of 12.18 MVA of potential capacity amongst the largest 102 customers. Note that the top 25 sites combined, can deliver up to 7.1 MVA of capacity on their own. Figure 12 shows the capacity breakdown by type of customer.

[3] NAICS code information was only available for the largest 102 customers. NAICS = North American Industry Classification System

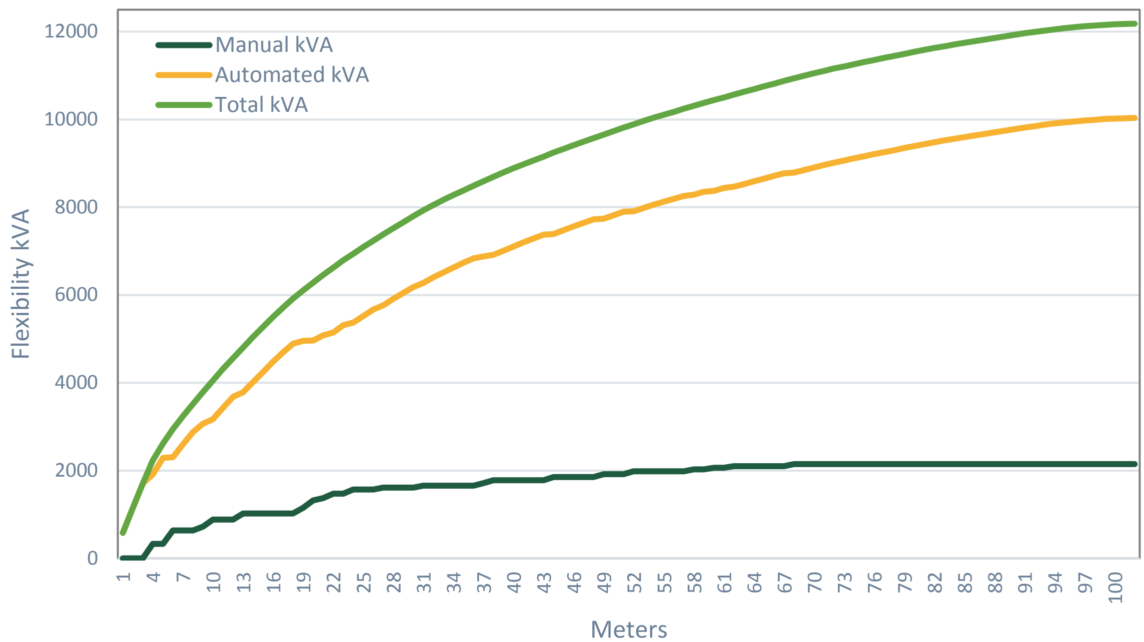

Figure 11: Cumulative capacities of top 102 customers.

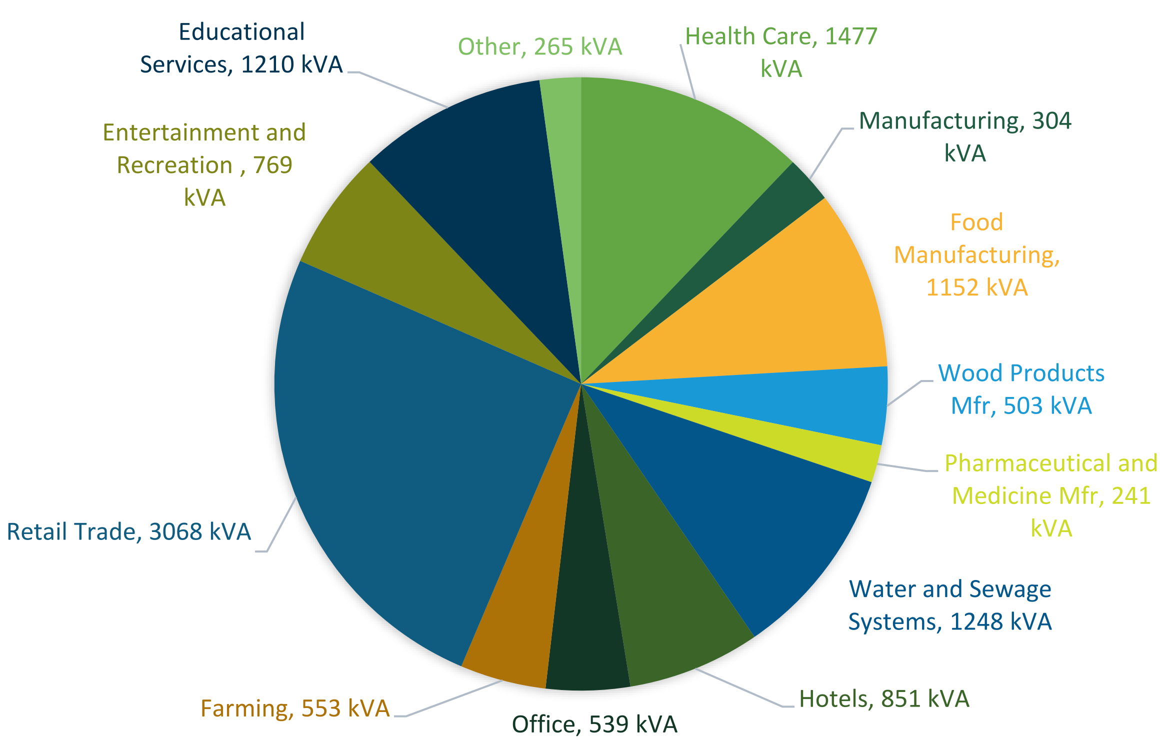

Figure 12: Flexible load break-down by customer segment.

Figure 13 shows a histogram of the total DR capacity associated with the 102 customer sites. Most sites (the first two bars) are lower than 500 kVA maximum demand and could provide up to 100 kVA load flexibility.

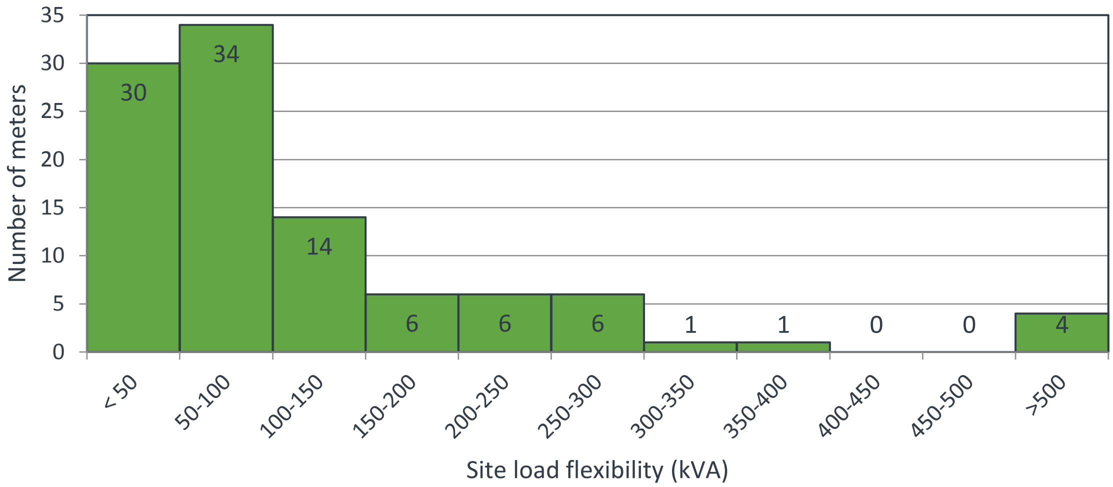

Figure 13: Histogram of flexible load.

The manual portion of the DR capacity from the top 102 customers is 2.37% of the site peak load on average, whereas the automated demand response portion is 11.08%, indicating most of the above sites are institutional or commercial. Enbala used these percentages to estimate the remaining load potential from the next 100 largest ICI sites for which the monthly kVA data was available, but no customer type information. Accordingly, the additional DR capacity from the second tranche of ICI sites in Kelowna is 4.0 MVA. Hence, the technical potential for demand response of the top 200 ICI sites is 16.2 MVA.

4.1 Limitations and Assumptions

The manual and automated load proportions are estimated using a typical load decomposition of genericized load profiles, which can be significantly different from the reality at an individual load, depending on the site equipment and operation strategy. For example, from site auditing we found out that the City of Kelowna Waste Water Treatment Facilities and Water Pumping Stations (Cedar Creek and Poplar Point) can provide 700 kVA load shedding, compared to the initial estimation for these sites of 665 kVA. The site visit revealed an additional 600 kVA of diesel generator capacity.

Another simplification is that Enbala used the site peak to estimate the load curtailment capacities; however, using the coincident load would give a better approximation of load curtailment potentials during events. This coincident load issue will be tested in Phase II with the use of interval data.

In Phase II of the project, Enbala will analyze specific site load profile data to more accurately estimate the DR capacity than using the high-level approximation. Although load flexibility is site specific, the overall difference in estimated versus true capacity is expected to be minimal because of aggregation. In other words, even though the approximated capacities could be off at some sites, the overall estimation is close to the overall actual potential flexible load at the aggregate level.

4.2 Demand Response Benefit Evaluation

4.2.1 Case Example of Kelowna Substation Deferral

FortisBC is experiencing large potential uncertainty in load growth in the Kelowna region due to emergent cannabis production facilities and cryptocurrency miners. Given this uncertainty, it is difficult for FBC to be certain that even 11 MVA of DR as identified in this study will be sufficient to avoid a capital upgrade. That said, the Kelowna area constraint can still serve as a specific example of how to quantify the benefit of deferring a capital upgrade.

FBC projects that the Kelowna area will require an additional transformer to be operational by Jan 1, 2023 to secure reliable service for the Kelowna area and meet N-1 contingency criterion. Under a modest load-growth scenario FBC could achieve the same outcome by aggregating large institutional, commercial and industrial (ICI) customers in the Kelowna area to provide a sufficient load relief to defer the costly upgrade at Lee Terminal or DG Bell.

A new terminal transformer (and related balance-of-plant expenditures) is anticipated to cost $17 million and take 3 years to plan and build. Therefore, anticipating the load to exceed the reliability limit in summer 2023, FBC is planning to begin the substation upgrade project in 2020.

The simulated results from phase 2 will provide insight into how a DR program may be implemented to postpose a substation upgrade such as the Lee Terminal project. As discussed above, summation of flexible loads from large ICI customers in the Kelowna area is estimated to be 16.2 MVA. Applying a market participation rate of 75% and a safety factor of 10%, Enbala expects controlling an aggregation of large ICI loads would provide approximately 11 MVA of DR capacity that is adequate to meet the load growth in 2025 (See Table 1). Figure 14 shows a timeline of the alternate (non-wires) solution versus the traditional solution.

The net present value (NPV)[4] of the upgrade deferral from 2020 to 2023 is estimated to be $2.43 million (2018), assuming a discount rate of 6%. The cost of implementation and operation of a DR program as

[4]The NPV calculation was computed for both the traditional (wire) solution and the non-wires alternative. For the wires case, the full $17M expenditure was assumed to happen in 2020. In the non-wires alternative, the expenditure was expected to happen in 2023. The NPV of the two solutions is subtracted to arrive at the savings

$$NPV = NPV_{Wires} - NPV_{Traditional} = \left(\frac{-1}{1.06^5} - \frac{-1}{1.06^2}\right) \times \$17\ M\ = 2.43\ M\$$$

well as the avoided cost of transmission, distribution and generation capacity has not been included in this analysis.

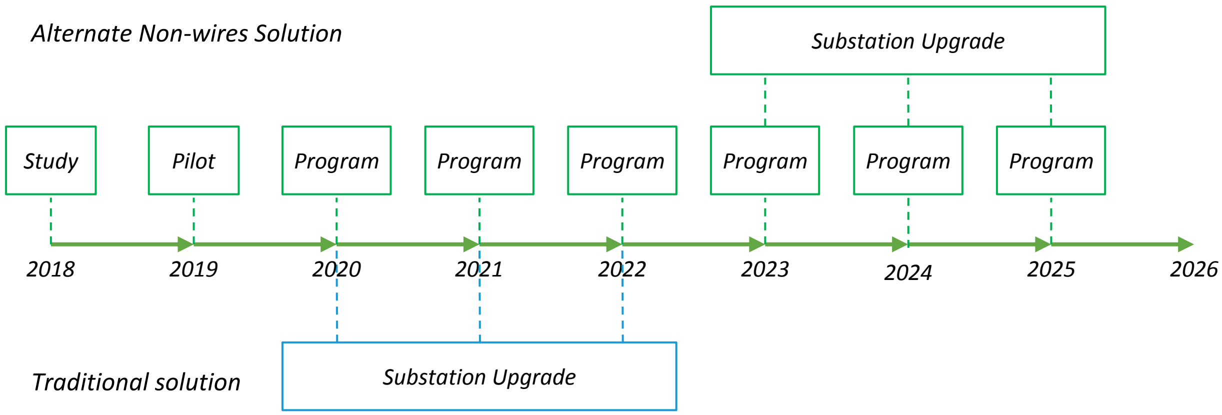

Figure 14: DR (non-wires) solution vs Traditional Utility Solution.

For the cost of DR Programs, FBC can look to the IESO in Ontario which publishes system-wide DR Auction prices. The latest settled price from the IESO is $116/kW-yr (318 $/MW-day). This value is close to what FBC can expect for program costs as this represents a good proxy for a mature DR program. From Enbala's experience, programs in the US are in a similar range as the IESO value. Analysis of the additional benefits are summarized in Section 4.2.2 and 4.2.3.

4.2.2 General Assessment of the Value of Demand Response

Given it is uncertain that an additional terminal transformer can be deferred, Enbala also examined this DR valuation through the lens of more generic cost metrics used by utilities to evaluate Demand Response programs. FBC has two main avoided cost estimates that can be used to further assess the value of DR:

- Transmission and Distribution (T&D) Avoided Cost. This is a system-wide value, including all FBC territory, and has a value of $83.87/kW-year[5]
- Generation Avoided Capacity Cost. The value of long run peak generation capacity is $120.8/kW-year, for a purely dependable capacity resource

Many utilities across North America provide adjustment factors[6] to the demand response capacity that is based on the availability of the resource in comparison to purely dispatchable generation using an effective load carrying capability (ELCC) approach. This factor is generally impacted by program

[5] T&D and Generation capacity costs have been adjusted to 2018 dollars from values of $79.85/kW-year and $115/kW-year, respectively from 2015.

[6] An excellent reference that covers a broad framework for evaluating the cost-effectiveness of DR programs was provided by Lawrence Berkeley National Labs in 2013: http://eta-publications.lbl.gov/sites/default/files/napdr-cost-effectiveness.pdf

elements/rules such as the maximum number of hours per month or the event length that the DR resource can be called and the overall reliability of the resource.

To estimate the value of this DR program to FortisBC, Enbala used the following assumptions and inputs:

- Effective load carrying capacity of 80%
- T&D losses of 8%
- Combined generation and capacity cost of $204/kW-year

Based on these values, Enbala estimates an annual benefit (avoided cost) to FBC from DR at $177/kW-year[7].

Note that the avoided T&D cost provided above is only the system-wide average value and may not take into consideration a specific substation or distribution network that may require upgrading and could benefit from a targeted DR program. Specific networks or substations may have individual business cases for Demand Response that can be evaluated by FBC separately.

4.2.3 Stacked Services and Gateway to VPP

In addition to the standard DR programs discussed above, a network of flexible load as contemplated here will also deliver several other benefits to the utility, specifically:

1) **Alignment with BCUC** – that FBC evaluate and consider non-wires alternatives, e.g. Demand Response, in its resource and system planning, and that FBC support innovative technologies by undertaking pilot projects;
2) **Customer Engagement** - The proposed modest portfolio of DR serves as a foundation from which FBC can build additional internal capability and customer engagement in an environment where customers have more distributed options for their energy;
3) **Risk Mitigation** – Large 30+ year capital investments carry inherent risks, especially in todays world of increasing DER penetration[8]. However, DR and other forms of load flexibility are highly scalable and inherently low-risk because the majority of the assets are already built (by the customer) for another purpose. DR is simply using the asset for a second purpose when it can with a small upfront investment.
4) **Gateway to a complete Virtual Power Plant** – These same DR enabled loads can, in future, be used to provide additional value-added services generally associated with a fully functioning Virtual Power Plant. These include Operating Reserves (generally non-spinning but loads are

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[7] Annual DR Benefit = $204/kW-year * ELCC (80%) / (1-8%) = $177/kW-year

[8] The Rocky Mountain Institute (RMI) address this concept in a recent report https://rmi.org/billion-dollar-costs-forecasting-electricity-demand/

eligible to provide spinning reserves in some markets), Regulating Reserves, Volt/VAR Optimization and other advanced services. Lastly,

5) **Increased Capacity Factor of the FBC Electrical System** – The most forward-looking utilities in the US (generally those with heavy penetration of solar, wind, EV's, batteries) recognize that significant MW's of load-flexibility is vital to increasing the utilization rate (capacity factor) of their systems. One utility Enbala works with expects that 20% of their future flexibility will come from load.

4.3 Site Audits and Customer Engagement

As part of Phase I, Enbala visited three customer sites to discuss their potential interest in DR, as well as provide a preliminary implementation design for their site and a more detailed assessment of the site's capacity. Enbala also attended a brief in-person meeting with a large hotel to discuss their interest in DR and Peak Demand Management (PDM). The main purpose of conducting the site audits was to gain visibility into customer preferences, installed equipment, and control system protocols in use at sample key customer sites. Table 2 shows the customer sites audited.

Table 2: Customer engagement meetings and site audits

Customer name	Site audit or meeting date
University of British Columbia- Okanagan Campus	May 18, 2018
Interior Health Authority - Cottonwoods Site	May 31, 2018
City of Kelowna- Waste Water Treatment Facility and Water Pumping Stations	June 1, 2018
Large Hotel	May 18, 2018

In general, the customers visited were all interested in participating in a future demand response program or pilot program. During the site audits and meetings, customers were able to quickly identify applicable loads, preferred control strategies and connection types.

4.3.1 UBC Okanagan

The main campus buildings of UBCO campus are served by a single FBC meter, which has roughly 4 MW peak summer demand. The site was very receptive to being involved in a potential demand response program, and they are currently implementing an advanced peak demand management program into their campus-wide building automation system. This program could be modified slightly to allow the site to automate demand response by putting all the buildings into peak demand limit mode.

The HVAC cooling system there is primarily a ground water sourced geo-thermal system. This system has a primary loop that maintains a consistent temperature with heat pumps and heat exchangers in individual buildings to maintain their temperature. Some of the older buildings have rooftop chillers to attain building cooling.

The site's buildings are fully automated and integrated into a campus wide building automation system (BAS). The BAS monitors kVA power consumption in real time at the campus level and building level. Enbala estimates the site can conservatively achieve 300 kVA of Demand Response capacity.

4.3.2 IHA – Cottonwoods Care Facility

The Interior Health Authority operates health-care facilities throughout the Interior. The Cottonwoods facility is an elder care facility with approximately 300 beds and 120,000 sq ft of conditioned spaces. The site demand during summer is primarily cooling and lighting. The site recently installed a new BAS to control all the HVAC devices throughout both wings of the facility. The site peak demand is approximately 600 kVA in summer.

The site operates a large air-cooled chiller for primary cooling throughout the facility. The chilled water is pumped to air handlers, which maintain zone temperatures. Most air handlers serve only a single zone and fans are controlled by a VFD. Demand response can be easily automated at this site using zone temperature resets. Other sections of the facility are cooled by 5 different Roof-top Units (RTUs) which are also controlled via the BAS.

The site operator mentioned a few manual actions that could be taken, such as turning off some lighting in certain areas, resetting freezer temperatures, and shutting off laundry equipment if it is safe to do so.

The site has two emergency back-up diesel generators that power the emergency loads in the building (e.g. ventilation/lighting). The total capacity of the generators is approximately 260 kVA. These generators are tested for two hours each month and could likely be used in a DR program if the rules allow it.

The site meter is not currently integrated to the BAS, so this would need to complete as part of the project. Enbala estimates the site can achieve 106 kVA of demand response capacity from the HVAC system with manual actions included.

4.3.3 City of Kelowna – WWTP and Water Pumping Facilities

Enbala and FBC met with engineers and operations staff at the City of Kelowna water department to discuss the possibility of using the waste-water treatment plant (WWTP) and the primary water distribution pumping stations for Demand Response. Both facilities expressed interest in joining a demand response program and presented a number of options for load shedding.

COK Supply Water and Pumping Stations

Enbala discussed using the two largest pumping stations, Poplar and Cedar Creek. In the peak of summer, the main demand on the system is during the midnight to 6 AM period to cover irrigation uses. Each of the primary pumping stations has significant storage capacity in reservoirs higher up in elevation. These reservoirs are generally kept at a constant level. The DR strategy suggested by the sites, was to ramp up the pumping operation during the daytime to fill the reservoirs, then shut off or curtail pumping during the DR event (mid-afternoon through early evening). The site would like to keep this a manual approach driven by their operations, at least for the start of a DR program. The estimated load shed from the two largest stations is a combined 400 kW. The primary pumping stations have metering information already integrated into their SCADA systems. There is also a diesel generator at each location that could be included, the operators would likely only run one of the two 1.5 MW generators during an event if required. The site load would be offset to ensure no export of power to the grid, which would add an additional 400 kVA to the DR capacity.

COK WWTP

The WWTP has a peak summer demand of approximately 1 MVA, primarily from process equipment such as pumps and blowers. The WWTP would be a more challenging site to achieve consistent DR due to uncertain and changing conditions at the site during a day. However, the site did express interest in joining a program and offered a few good ideas to implement DR. The site has implemented some demand reduction techniques, where non-critical loads are turned off for short durations while large loads are started. Taking this action is likely to reduce a minimum of 290 kW. The site's control is all centrally automated, like many WWTP facilities, and the site power consumption as well as many of their major loads are sub-metered and available on the site SCADA system.

The site has an older 200 kW diesel generator that they would be willing to operate during DR events. Further, Enbala estimates there is a further load reduction possible from taking the centrifuge off-line (150 kW). For the bio-reactors, the process should be able to tolerate a dissolved oxygen setpoint change, that would reduce power in the blowers by 15% (40 kW).

The site does not have substantial upstream storage in the sewer system, so would likely not reduce flow through the plant during a DR event.

4.3.4 Large Hotel

Enbala and FBC held a brief in-person meeting with the head of operations for a large hotel in Kelowna. The hotel is primarily interested in reducing billing charges from peak demand periods in the summer. The site may be also able to provide some DR from zone temperature resets in multiple zones throughout the buildings and would be interested in joining a program, specifically if peak demand management (PDM) were included in the scope of a program. Most of the building's HVAC system is controlled by a central BAS, so integration to an automated DR system to provide both PDM and DR is achievable. This customer shows how adding additional value streams to a program can help in the recruitment process, this is discussed further in Section 5.

5 CONCLUSIONS AND RECOMMENDATIONS

FBC is considering non-wires alternatives to create additional capacity in the Kelowna area, with the goal of deferring capital investment through acquisition of a cost-effective demand response resource. According to analysis presented above Demand Response can provide significant benefits in terms of avoided transmission, distribution, and generation capacity costs. Enbala estimates an annual utility value of $172/kW-year for each kW of DR capacity. Given this value and the estimated potential for DR in the Kelowna area, Enbala recommends FBC first implement a pilot program as proof of concept. This pilot program would include up to a dozen ICI customers and would allow FBC to gain experience with demand response programs with key customers before implementing on a larger scale.

Phase I of the study evaluated the DR potential from the top 200 ICI customers in the Kelowna area. Enbala estimates the total DR potential from this customer segment to be 16.2 MVA. When considering capital projects such as the Kelowna area transformer upgrade, this DR resource alone could notionally provide sufficient load shedding to defer the capital expenditure, in the context of the Lee Terminal station upgrade, for potentially; three years. This deferral would provide an NPV of $2.43 million (2018) to FBC. Additional T&D and Generation avoided capacity benefits for DR were calculated to be $172/kW-yr. For the cost of implementing DR capacity, Enbala recommends FBC consider the recent experience in IESO, which procured DR capacity resources at $116/kW-yr.

In designing and operating a demand response program, Enbala recommends FBC gradually build the program over time, eventually expanding to new customer segments and technologies. This will provide the engineering and planning departments with confidence in the DR resource. It will also provide a means for FBC to further engage with their customer base.

While some customers may choose not to participate in the DR program despite the potential financial incentives, large energy consumers usually intend to participate in the program to save money and/or generate revenue. A factor that can further encourage ICI customers to participate in the program, in addition to DR incentives, is to combine an additional value stream into the program. For example, with automated approaches, monthly demand charge costs can be reduced by doing peak demand shaving in summer and winter. Such additional value streams can contribute significantly to the customer economics and the business case for FBC.

Some large ICI customers have on-site emergency diesel-generators that can potentially be included in a DR program to provide a greater net load shedding. As part of normal maintenance, these generation units should be operated a minimum of 2 hours per month to ensure they are operational. The testing times could be performed during DR events in some instances.

FBC’s load projections, by necessity, are constantly adapting to new information. The rapid adoption of plug-in electric vehicles (PEV) and air conditioning units may pose a significant challenge on the electricity network, which not only impacts the peak load, but also impacts the load shape. Interestingly, both of these end-use technologies are loads that can be included in DR programs. Moreover, there is a significant uncertainty associated with energy impact of cannabis cultivation and cryptocurrency mining in the Kelowna area. On the other hand, the deployment of solar PV panels, batteries, and energy/demand savings from energy efficiency programs or further residential/commercial DR programs, may moderate some of the load growth.

Enbala believes that Demand Response can be a significant factor in mitigating load forecast uncertainty while providing cost-effective capacity to the system. Building an aggregation of loads for DR would allow FBC to meet BCUC expectations, engage further with customers and mitigate risks of large capital investments. Demand Response programs pave the way for building a virtual power plant to meet the needs of the grid in the future.

6 NEXT STEPS

In Phase II, the main task is to simulate an aggregation of large ICI loads that can provide adequate load relief on the utility's Kelowna area substations to reliably meet the demand growth with the existing network configuration. Enbala will analyze the historical site interval data for at least 50 customers to create representative load profiles. Only the large ICI customers in the Kelowna area will be considered in the simulation.

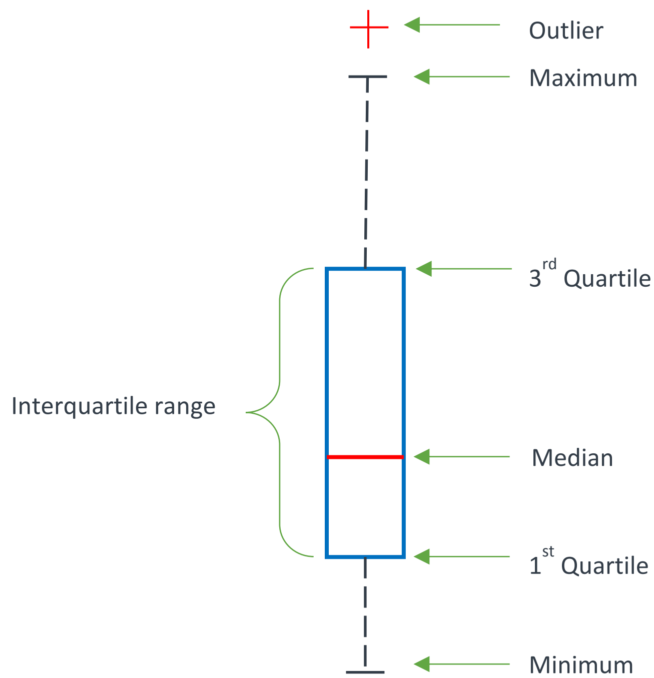
Phase II (simulation study) consists of the following steps:

- Assessing the characteristics of an optimal DR capacity resource, in accordance to substation peak event characteristics forecasted in coming years
- Developing a VPP optimal dispatch model that maintains the overall load below the reliability limit considering site flexibility constraints
- Discussing the synergy between the required transformer load relief and the expected available DR capability

The outcome of the simulation work will provide essential insights to selecting sites based on their detailed load profiles (type/number/target kVA) and configure the aggregation in the pilot and the post-pilot stages. Phase I and II findings will inform the basis for a ICI commercial DR pilot in 2019.

APPENDIX A: BOX PLOT DESCRIPTION

Boxplots were used in Section 3.1 to view the historical load profile of the top 30 days for summer and winter (Figure 7 and Figure 8). Boxplots are used in statistical analyses to display the pattern and the variation of groups of data, in this case 15-minute time intervals. A box plot sample diagram is shown below. The central mark indicates the median of the data associated with the data sample, and the bottom and top edges of the box indicate the 25th and 75th percentiles, respectively. The whiskers extend to the most extreme data points not considered outliers, and the outliers are plotted individually in red.



Appendix B

CPR MARKET POTENTIAL REPORT

British Columbia Conservation Potential Review

Section 5. Market Potential

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DISCLAIMER

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

1. MARKET POTENTIAL FORECAST

This section contains details of the market potential analysis that Navigant conducted for FortisBC Electric's service territory, including the following:

- Section 1.1 describes the approach to estimating market potential, including discussion of the model calibration steps and the strategy selected for simulating incentives in the analysis.
- Section 1.2 provides overall electric market potential estimates, as well as savings by sector, customer segment, end use, and certain measures.
- Section 1.3 follows with cost effectiveness results across all sectors.

1.1 Approach to Estimating Market Potential

Market potential is a subset of economic potential that considers the likely rate of demand-side management (DSM) resource acquisition, given factors like the rate of equipment turnover (a function of a measure's lifetime), simulated incentive levels, consumer willingness to adopt efficient technologies, and the likely rate at which marketing activities can facilitate technology adoption. The adoption of DSM measures can be broken down into calculation of the "equilibrium" market share and calculation of the dynamic approach to equilibrium market share, as discussed in more detail below.

Market potential differs from program potential in that market potential does not specifically take into account the various delivery mechanisms that can be used by program managers to tailor their approach depending on the specific measure or market. Rather, market potential represents a high-level assessment of savings that could be achieved over time, factoring in broader assumptions about customer acceptance and adoption rates that are not dependent on a particular program design. Additional effort is typically undertaken by program designers, using the directional guidance from a market potential study, to develop detailed plans for delivering conservation programs.

Market potential in this report rely on a Total Resource Cost (TRC) measure screen for cost effectiveness. This is consistent with cost effectiveness screen employed in Navigant's previous Conservation Potential Report (CPR) that estimated technical and economic potential.

Table 1-1 summarizes the key methodology considerations and decision points informing the analysis in this report, with more detail provided in the report sections noted in the right-hand column of the table. Navigant and FortisBC Electric agreed upon this methodology through discussions about which approach best serves the needs of the utility for understanding market savings potential. Since this study's scope for market potential estimates are not intended to be program-specific and are most reasonable when results are considered in aggregate, the methodology presented here focuses primarily on portfolio-level or sector-level approaches. However, FortisBC Electric selected five high impact measures for measure-level calibration, which is discussed in Section 1.1.7.

Table 1-1. Market Potential Methodology Overview

Methodology Parameters	Approach	Report Section
Benefit-cost test screen	Use the TRC as the primary screen for technical, economic, and market potential.	1.1
Diffusion parameters	Adjust diffusion parameters within ranges recommended by industry standard data sources to produce savings that are reasonably aligned with FortisBC Electric's DSM sector-level historical achievements. Customize the diffusion parameters for the five high impact measures selected to align with historic and planned savings at the measure level.	1.1.1, 1.1.2, and 1.1.7
Budget constraints	Do not apply budget constraints.	1.1.4
Incentive strategy	Set incentive levels on a levelized $ per kWh of savings basis, such that the simulated percentages of total spending from incentives versus non-incentive costs aligns with planned 2017 values across the sector.	1.1.5 and 1.1.8
Treatment of administrative costs	Include portfolio-level fixed costs and sector-level variable costs derived from planned 2017 non-incentive program spending.	1.3.1 and 1.3.2
Net-to-Gross (NTG)	Focus on gross savings within the report, and include discussion on impacts of NTG factors at the sector level for high-level estimates of net savings (consistent with the approach used for technical and economic potential)	1.2.6
Re-participation	Assume 100% of measures re-participate as an efficient measure at the end of their measure life	1.1.6
Codes and standards	Use the same assumptions about codes and standards as in technical and economic potential	1.2.5

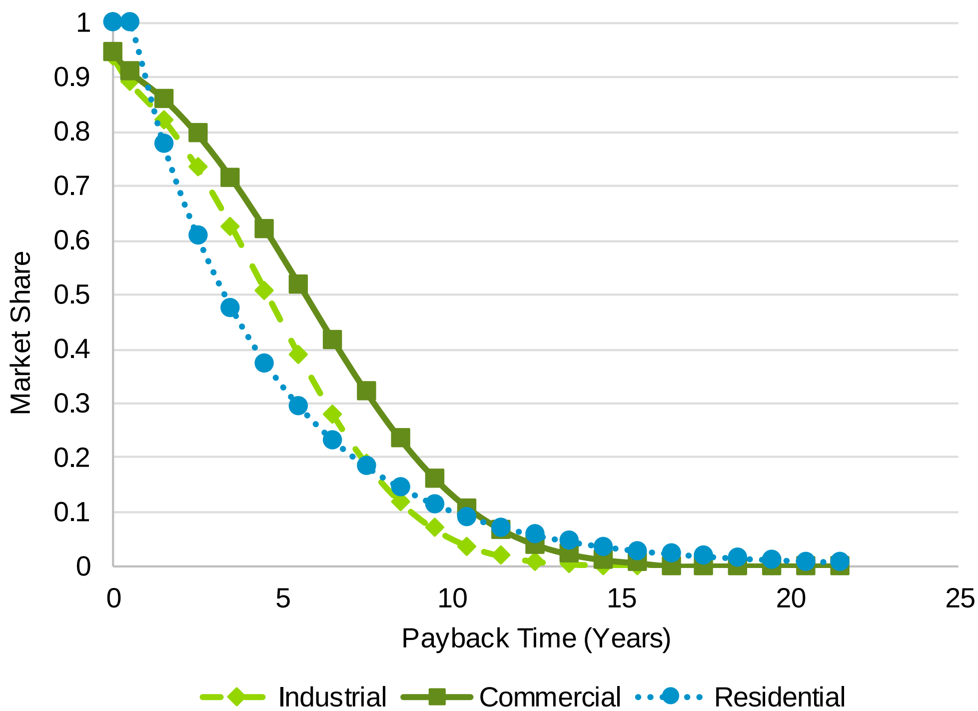
1.1.1 Calculation of "Equilibrium" Market Share

The equilibrium market share can be thought of as the percentage of individuals choosing to purchase a technology provided those individuals are fully aware of the technology and its relative merits (e.g., the energy- and cost-saving features of the technology). For DSM measures, a key differentiating factor between the base technology and the efficient technology is the energy and cost savings associated with the efficient technology. Of course, that additional efficiency often comes at a premium in initial cost. This study calculates an equilibrium market share as a function of the payback time of the efficient technology relative to the baseline technology. In effect, measures with more favorable customer payback times will have higher equilibrium market share, which reflects consumers' economically rational decision making. While such approaches certainly have limitations, they are nonetheless directionally reasonable and simple enough to permit estimation of market share for the hundreds of technologies appearing in most potential studies.

To inform this CPR, the team used equilibrium "payback acceptance" curves that Navigant developed using primary research in the US Midwest in 2012.[1] To develop these curves, Navigant relied on surveys of 400 residential, 400 commercial, and 150 industrial customers. These surveys presented decision makers with numerous "choices" between technologies with low up-front costs, but high annual energy costs, and measures with higher up-front costs but lower annual energy costs. Navigant conducted statistical analysis to develop the set of curves shown in Figure 1-1, which Navigant used in this CPR. Though FortisBC Electric-specific data were not available to estimate these curves, Navigant considers that the nature of the customer decision-making process is such that the data developed using North American customers represents the best industry-wide data available at the time of this study.

As the curves show, the proportion of customers who will accept different payback periods for an energy efficiency investment is different for residential, commercial and industrial customers.[2] The model uses this information to simulate how customers in each sector will accept measures with differing payback periods.

Figure 1-1. Payback Acceptance Curves



Source: Navigant

Since the payback time of a technology can change over time, as technology costs and/or energy costs change over time, the "equilibrium" market share can also change over time. The equilibrium market share is therefore recalculated for every year of the forecast to ensure the dynamics of technology

[1] A detailed discussion of the methodology and findings of this research are contained in "Demand Side Resource Potential Study," prepared for Kansas City Power and Light, August 2013.

[2] These payback curves represent customer payback acceptance in aggregate across each sector. In practice, customer behavior can vary across sub-sectors. However, there is minimal industry-wide data available on customer payback acceptance at the sub-sector level.

adoption take this effect into consideration. As such, “equilibrium” market share is a bit of an oversimplification and a misnomer, as it can itself change over time and is therefore never truly in equilibrium, but it is used nonetheless to facilitate understanding of the approach.

1.1.2 Calculation of the Approach to Equilibrium Market Share

Two approaches are used for calculating the approach to equilibrium market share, one for technologies being modeled as retrofit (RET) measures, and one for technologies simulated as replace-on-burnout (ROB) or new construction (NEW) measures.[3] A high-level overview of each approach is provided below.

1.1.2.1 Retrofit Technology Adoption Approach

RET technologies employ an enhanced version of the classic Bass diffusion model[4,5] to simulate the S-shaped approach to equilibrium that is observed again and again for technology adoption. Figure 1-2 provides a stock/flow diagram illustrating the causal influences underlying the Bass model. In this diagram, market potential adopters “flow” to adopters by two primary mechanisms – adoption from external influences, such as marketing and advertising, and adoption from internal influences, or “word-of-mouth.” Navigant estimated the “fraction willing to adopt” using the payback acceptance curves illustrated in Figure 1-1.

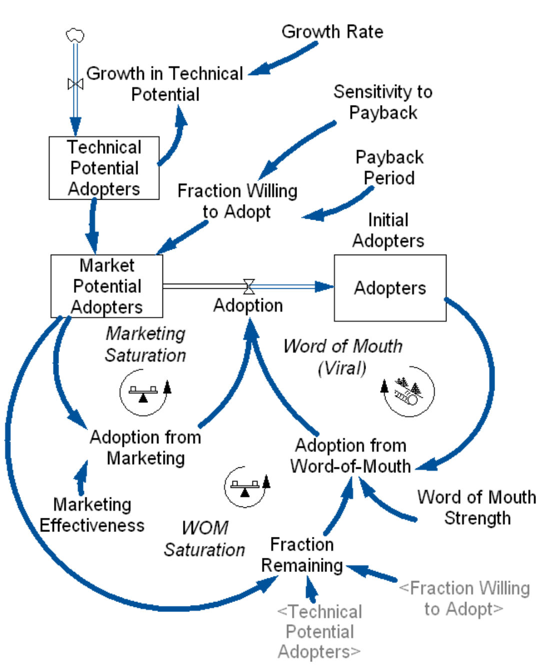
[3] Each of these approaches can be better understood by visiting Navigant’s technology diffusion simulator, available at: http://forio.com/simulate/navigantsimulations/technology-diffusion-simulation.

[4] Bass, Frank (1969). "A new product growth model for consumer durables". Management Science 15 (5): p215–227.

[5] See Sterman, John D. *Business Dynamics: Systems Thinking and Modeling for a Complex World*. Irwin McGraw-Hill. 2000. p. 332.

Navigant estimated the marketing effectiveness and word-of-mouth (WOM) parameters for this diffusion model by drawing upon case studies where these parameters were estimated for dozens of technologies.[6] Recognition of the positive, or self-reinforcing, feedback generated by the "word-of-mouth" mechanism is evidenced by increasing discussion of the concepts such as social marketing as well as the term "viral," which has been popularized and strengthened most recently by social networking sites such as Twitter, Facebook and YouTube. However, the underlying positive feedback associated with this mechanism has been ever present and a part of the Bass diffusion model of product adoption since its inception in 1969.

Figure 1-2. Stock/Flow Diagram of Diffusion Model for New Products and Retrofits



Source: Navigant

The diffusion model illustrated above generates the commonly seen S-shaped growth of product adoption and is a simplified representation of that employed in DSMSim™ software tool.[7]

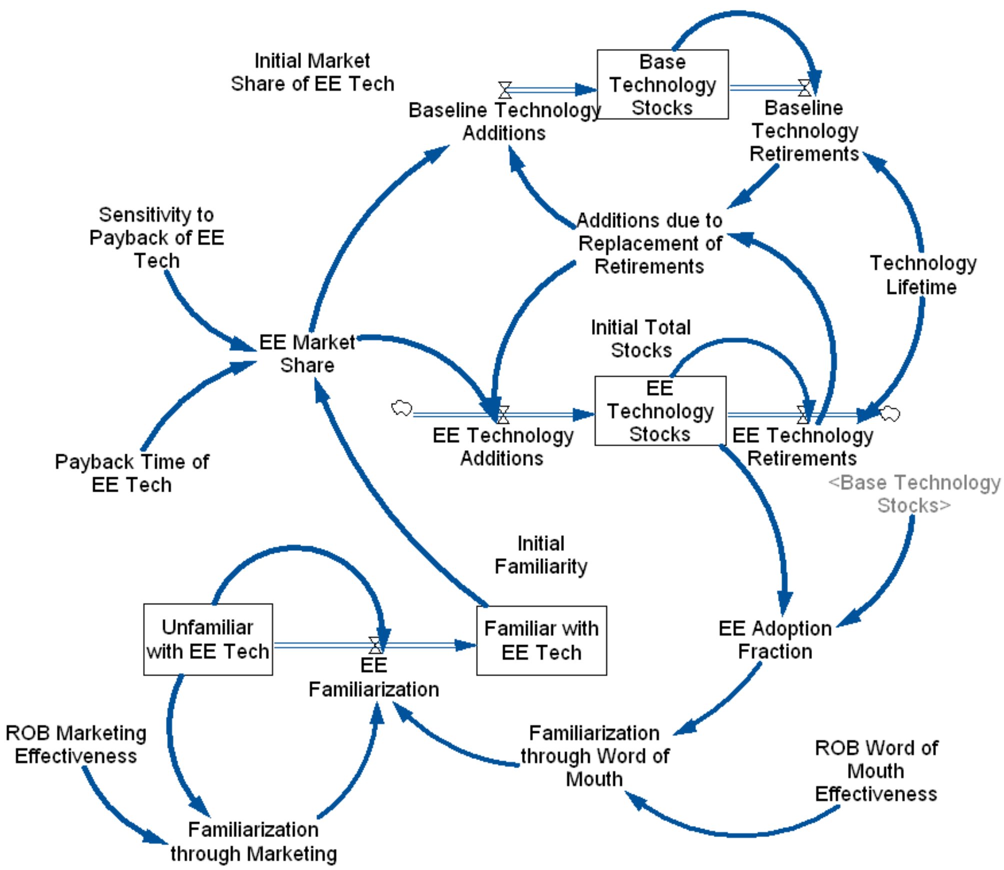
[6] See Mahajan, V., Muller, E., and Wind, Y. (2000). New Product Diffusion Models. Springer. Chapter 12 for estimation of the Bass diffusion parameters for dozens of technologies.

[7] DSMSim™ is a bottom-up technology diffusion and stock tracking model implemented using a System Dynamics framework. The model explicitly accounts for different types of efficient measures—such as retrofit, replace-on-burnout, and new construction—and the impacts these measures have on savings potential.

1.1.2.2 Replace-on-Burnout Technology Adoption Approach

The dynamics of adoption for ROB technologies are somewhat more complex than for NEW/RET technologies since it requires simulating the turnover of mostly long-lived technology stocks (e.g. major household appliances or building systems). The DSMSim™ model tracks the stock of all technologies, both base and efficient, and explicitly calculates technology retirements and additions consistent with the lifetime of the technologies. Such an approach ensures that technology "churn" is considered in the estimation of market potential, since only a fraction of the total stock of technologies are replaced each year, which affects how quickly technologies can be replaced. A model that endogenously generates growth in the familiarity of a technology, analogous to the Bass approach described above, is overlaid on the stock tracking model to capture the dynamics associated with the diffusion of technology familiarity. Figure 1-3 graphically illustrates a simplified version of the model employed in DSMSim™.

Figure 1-3. Stock/Flow Diagram of Diffusion Model for ROB Measures



Source: Navigant

1.1.3 Behavioral Measures

Behavior measures typically impose little to no direct costs to the participant[8] and their rate of adoption is highly dependent on the marketing and incentive efforts taken by program administrators. Given these unique characteristics of behavior measures, the payback acceptance curves and technology diffusion models have limited applicability to these types of measures. As such, this study models the adoption of behavior measures in terms of an equilibrium saturation level relative to economic potential and a given amount of time to reach that equilibrium state.

This study includes four measures that are distinctly behavioral:

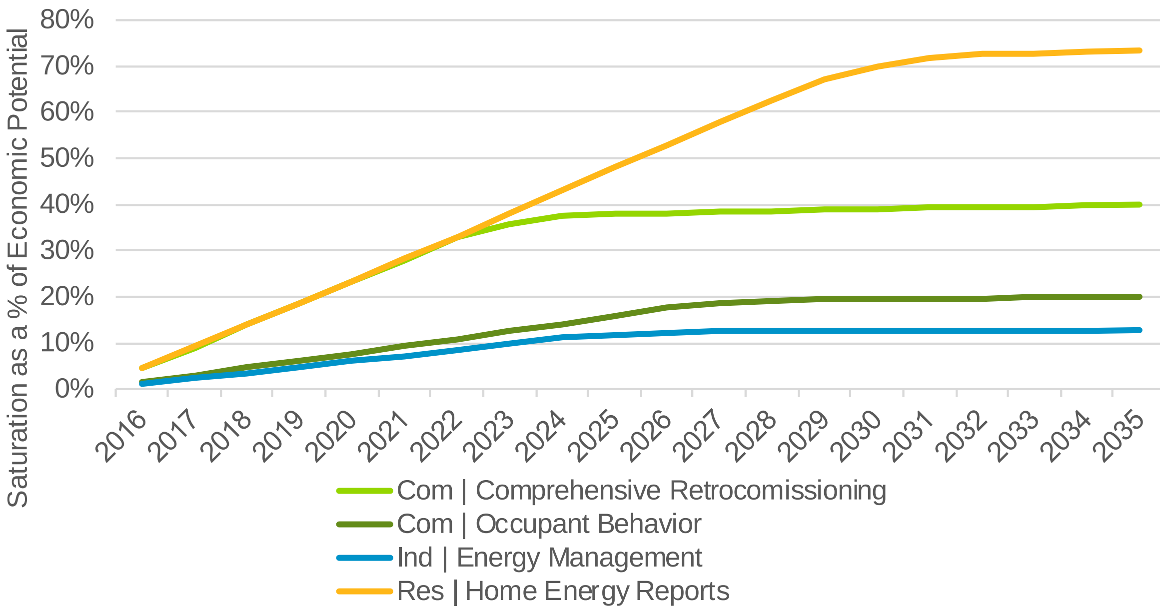
- Commercial Comprehensive Retrocommissioning[9]
- Commercial Occupant Behavior
- Industrial Energy Management
- Residential Home Energy Reports

For each of these measures, the team held discussions with FortisBC Electric to define the expected equilibrium saturation level and the duration of time required to reach that level. Figure 1-4 illustrates the saturation trajectory as a percentage of economic potential for each of the behavior measures. Although the adoption of behavior measures is not linked to customers' payback acceptance time, the market potential for behavior measures is still dependent on cost effectiveness by means of the economic potential.

[8] Participants may incur indirect costs through implementation of adjustments to typical operations in response to energy information feedback (e.g., through upgrading a water heater). However, estimating these indirect costs requires additional data on the actions taken by the participant beyond participating in the behavioral program and is beyond the scope of this analysis.

[9] Differing from the other behavioral measures, the characterization of retrocommisioning includes some upfront costs to the participant (e.g., paying for a portion of staff training). Since it is uncertain whether comparable training would be available absent program offerings and enrollment efforts, the study treats this measure as a behavior measure that is dependent on on-going support from program administrators.

Figure 1-4. Behavior Measure Market Saturation as a Percentage of Economic Potential (%)



Source: Navigant

1.1.4 Budget Strategy

FortisBC Electric elected to view market potential without imposing any budget constraints on the simulated results. The implication of this decision is that market potential is only constrained by stock turnover and customer willingness to adopt efficient measures. Without future budget constraints, the utility spending falls out naturally from the input assumptions for per-unit-of-savings incentive and administrative costs and a given year's level of market savings, without tying spending to a given budget level. In this study, the per-unit-of-savings incentive and administrative spending levels and fixed administrative spending are fixed at the same levels (in real dollars, compared with nominal dollars) over the study horizon. Therefore, changes in spending (in real dollars) only reflect a changing mix and magnitude of savings among measures.

1.1.5 Incentive Strategy

Per FortisBC Electric's guidance, this study calculates measure-level incentives based on a levelized dollar-per-kWh of savings basis. A levelized dollar-per-kWh incentive represents the dollar amount provided for each discounted kWh of savings over a measure's lifetime. The discount rates used to find the present value of savings are consistent with those applied to discounted cash flows. Since a single incentive level is found for each sector[10], the model bounds the actual incentive provided to each measure to be at least 25% of the incremental measure cost, and to not exceed more than 100% of the incremental measure cost. Section 1.1.8 discusses how the model calibration process informed the specified incentive percentage in more detail.

[10] Navigant applied incentive percentages at the sector level, as opposed to the measure level, per the focus of this study's scope on sector-level market potential, rather than program-level potential. Actual program design would define incentive levels for each measure.

1.1.6 Re-Participation

The model assumes that program participants always re-adopt energy efficient measures after the end of the efficient measures' expected useful lifetimes. This implies that efficient measures do not revert to a minimum code or lower efficiency level. As such, the model's cost accounting incurs an incentive cost upon the initial conversion of a minimum code or lower efficiency measure to an efficient measure, but it does not incur incentive costs when replacing incumbent equipment that was already updated to efficient equipment during the study horizon.[11]

Behavior measures, such as home energy reports, are an exception to this approach. When a behavior measure is re-adopted at the end of its expected useful lifetime, the incentives provided for those measures are added to total utility spending. The rationale is that similar savings opportunities provided by behavior measures are only available with ongoing support and/or administration from the utility. Since ongoing utility support is required to achieve behavior measure savings, the incentives provided to repeat adopters are incurred multiple times throughout the study horizon.

1.1.7 High Impact Measures

FortisBC Electric selected five measures that merit a more granular measure-level analysis, with the intent that Navigant would perform measure-level calibration customized to each measure's historic savings trajectories. These five high impact measures include:

- Commercial Interior Lighting
- Commercial New Construction Bundles 45% above Code
- Industrial Pump Equipment Upgrades
- Residential Clothes Dryers
- Residential Smart Thermostats

Section 1.1.8 discusses how Navigant customized the calibration of these measures in more detail.

[11] Navigant added functionality to the DSMSim model to allow the utilities to change the re-participation rates for the utilities' in-house analysis.

1.1.8 Model Calibration

Any model simulating *future* product adoption faces challenges with "calibration," as there is no future world against which one can compare simulated results to actual results. Engineering models, on the other hand, can often be calibrated to a higher degree of accuracy since simulated performance can be compared directly with performance of actual hardware. Unfortunately, DSM potential models do not have this luxury, and therefore must rely on other techniques to provide both the developer and the recipient of model results with a level of comfort that simulated results are reasonable. For this CPR, Navigant took a number of steps to ensure that forecast model results were reasonable, including:

- Identifying the subset of CPR measures that were included in historic FortisBC Electric program offerings in order to have a basis for comparison with historic program achievements.
- Ensuring similar trends and magnitudes between FortisBC Electric's planned 2017 sector-level savings and simulated sector-level savings from the measure subset in 2017.
- For the five high-impact measures, ensuring similar trends and magnitudes between FortisBC Electric's planned 2017 measure-level savings and 2017 simulated savings. Additionally, the team calibrated long-term trends to align reasonably with FortisBC Electric's projections for these measures.
- Seeking general alignment between FortisBC Electric's planned 2017 sector-level incentives as a percentage of total sector-level spending and simulated 2017 values.

Before making comparisons of model results to historic achievements, it was first necessary to identify the CPR measures that were included in FortisBC Electric's historic program offerings. The simulated savings from this subset of CPR measures became the basis for comparing modelled savings to historic savings during the calibration process. It is important to note that although the team reached good alignment in trends between historic and simulated results for this subset of measures, the model's results for *total* market potential significantly exceed FortisBC Electric's historically achieved program savings. This is because the study includes many additional measures (e.g. EnergyStar TVs) that have historically not been included in programs, and those extra measures contribute significant savings to the total market potential results.

To obtain close agreement with FortisBC Electric's historic savings across a wide variety of metrics, Navigant adjusted incentive levels, technology diffusion coefficients and payback acceptance curves. Calibration required an iterative process of modifying the aforementioned parameters until all goals of calibration were reasonably satisfied. For example, the marketing effectiveness parameters are the key lever for calibrating the magnitude of 2017 savings for each sector, whereas the word-of-mouth parameter strongly influences how rapidly adoption and savings ramp up over time. Navigant varied these diffusion parameters within the commonly observed ranges until simulated savings were trending reasonably compared with historic savings at the sector level.[12]

For the five high impact measures, the team aligned simulated savings with the historic trends by customizing the marketing effectiveness and payback acceptance curves for these measures to achieve similar magnitudes and trends between modelled savings and historic savings.

[12] This study uses word-of-mouth strength, ranging from 0.255 to 0.425, which span from roughly the 25th percentile to the 57th percentile observed by Mahajan 2000. The marketing effectiveness parameter varied between 0.016 and 0.055, depending on the sector. These values span from roughly the 25th percentile to 75th percentile of observed marketing effectiveness, per Mahajan 2000.

Lastly, the team adjusted sector-level incentive levels to be different levelized $/kWh values until the percentage of 2017 total spending attributable to incentives was similar to the average of FortisBC Electric's planned 2017 values. The calibrated incentive levels produce a weighted average incentive percentage of 53% of incremental costs for FortisBC Electric's simulated portfolio in 2017.

To summarize, the calibration process ensures that forecast potential is grounded against real-world data considering the many factors that determine likely adoption of DSM measures, including both economic and non-economic factors.

1.2 Market Potential Results

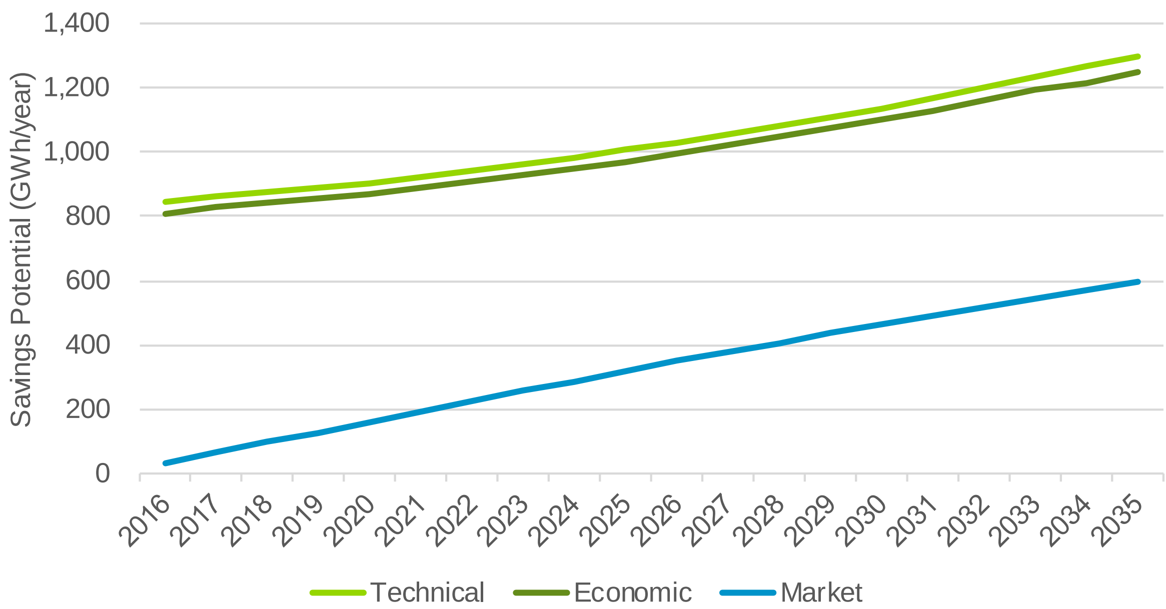
This section provides the market potential results calculated by the model at varying levels of aggregation, using the TRC benefit-cost test as a screen (which is consistent with the representation of economic potential in Section 4). At-the-meter gross savings results are shown by sector, customer segment, end-use category, and by highest-impact measures. The section concludes with a review of natural change and its impacts on market potential.

1.2.1 Comparison of Savings by Potential Type

Values shown below for market potential are termed "cumulative market" potential, in that they represent the accumulation of each year's annual incremental market potential (e.g., an annual incremental market potential of 0.8% per year for ten years would result in a cumulative market potential of 8.0% of forecast consumption). Economic potential, as defined in this study, can be thought of as a bucket of potential from which programs can draw over time. Market potential represents the draining of that bucket, the rate of which is governed by a number of factors, including the lifetime of measures (for ROB technologies), marketing effectiveness, incentive levels, and customer willingness to adopt, among others. If the cumulative market potential ultimately reaches the economic potential, it would signify that all economic potential in the "bucket"' had been drawn down, or harvested.

As shown in Figure 1-5 and data corresponding to Table B-1 in Appendix B, the cumulative market potential, which accounts for the rate of DSM acquisition, increases steadily throughout the CPR period, reaching 596 GWh/year in 2035. By 2035, market potential reaches nearly 48% of the economic potential. Incremental annual market potential added year-over-year to the cumulative potential averages 30 GWh/year over the study horizon.[13]

Figure 1-5. Total Cumulative Electric Energy Savings Potential (GWh/year)

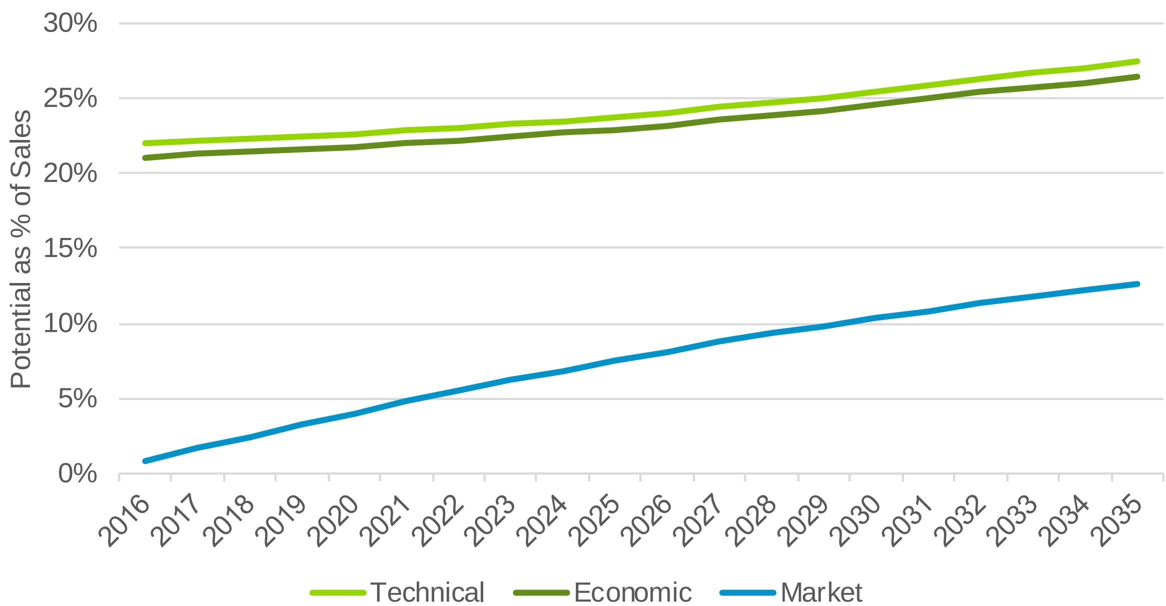


Source: Navigant

[13] The time horizon for the CPR is 2016-2035 (20 years).

Under the cost effectiveness screen requiring each measure to meet or exceed a TRC ratio of 1.0, market potential grows from 0.8% in 2016 to 12.6% of forecast electricity consumption, as shown in Figure 1-6 and and Table B-2 in Appendix B. The annual incremental market potential is approximately 0.6% per year on average over the CPR time horizon.

Figure 1-6. Total Cumulative Electric Energy Savings Potential as a Percentage of Consumption (%)



Source: Navigant

Figure 1-7 illustrates the electric energy savings market potential coming from the kraft pulp and paper (P&P) customer segment and from codes and standards, which historically have not contributed to FortisBC Electric's DSM program savings, along with the remaining potential. Savings from kraft P&P and codes and standards represents 129 GWh or nearly 22% of the total cumulative market potential by 2035. The remaining market potential comes from measures more similar to those traditionally considered in FortisBC Electric's DSM programs.

Figure 1-7. Cumulative Electric Energy Savings Market Potential by Source (GWh/year)

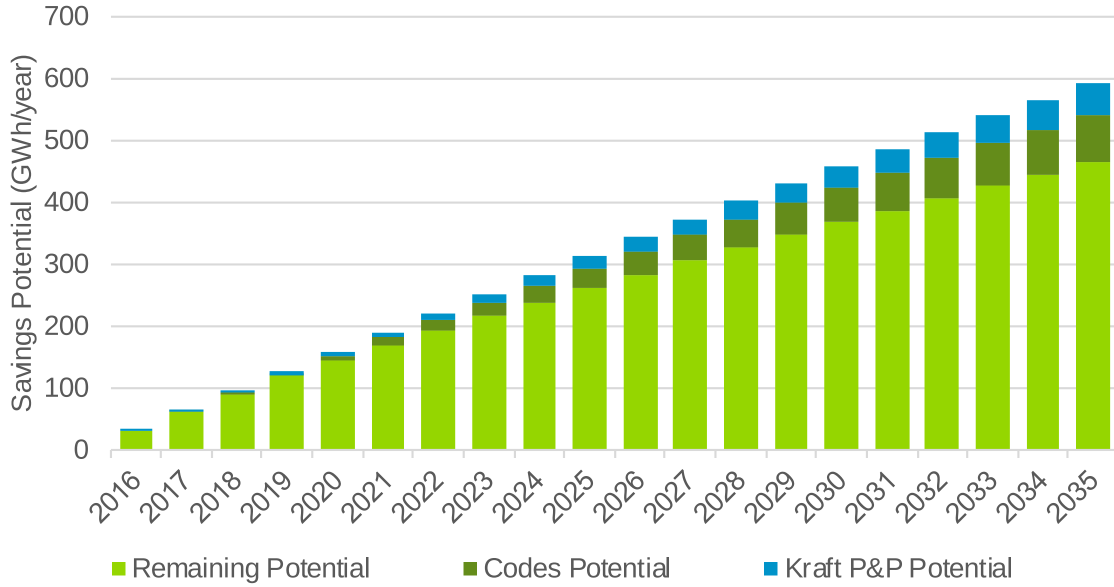
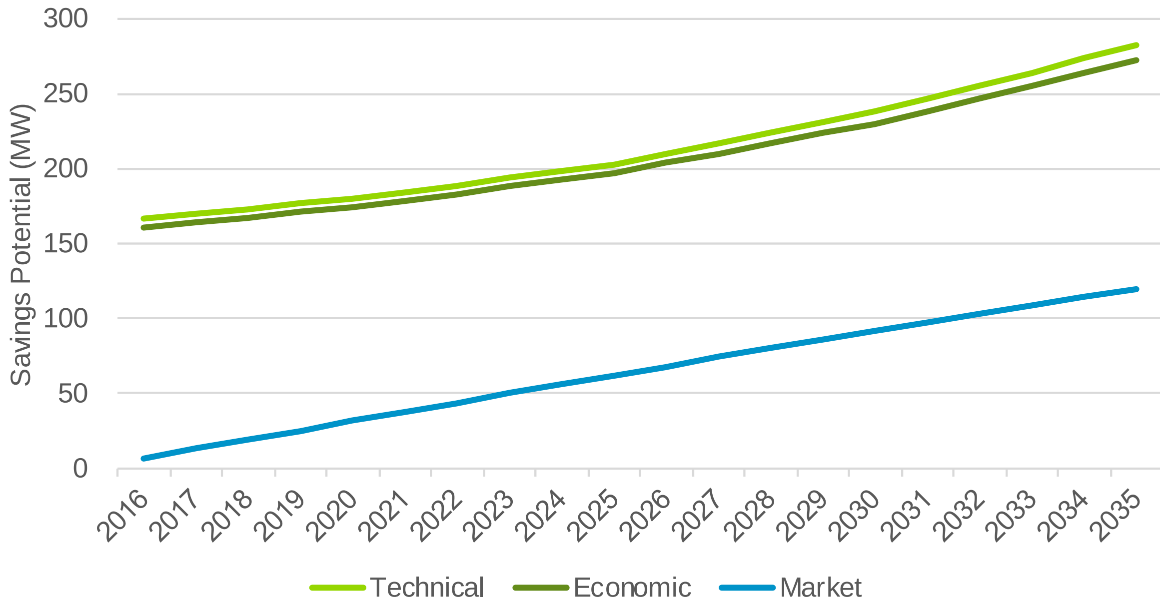


Figure 1-8 and Table B-3 in Appendix B shows the cumulative electric demand potential by potential type. These demand savings are auxiliary impacts from the installation of energy efficiency measures, whereas the demand savings from demand-focused measures are estimated in a separate report on demand response potential. The market potential increases steadily throughout the CPR period, reaching 120 MW/year in 2035. By 2035, market potential reaches nearly 44% of the economic potential. Incremental annual market potential added year-over-year to the cumulative potential averages 6 MW/year over the study horizon.

Figure 1-8. Total Cumulative Electric Demand Savings Potential (MW/year)

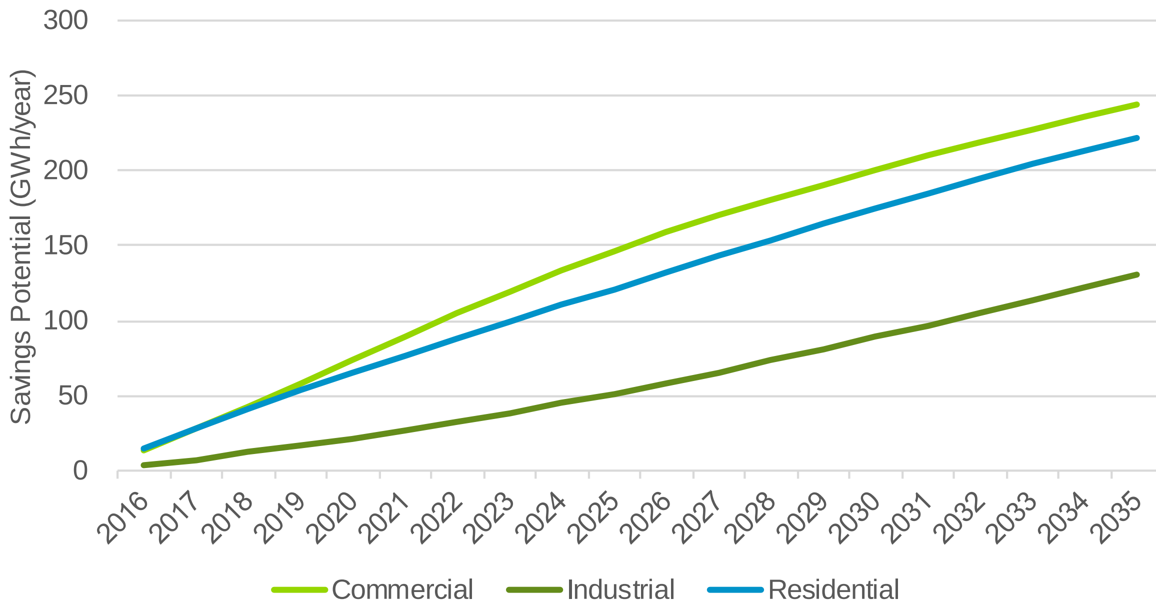


Source: Navigant

1.2.2 Results by Sector

Figure 1-9 and Table B-4 in Appendix B show the magnitude of electric energy market savings potential by sector. Navigant found the greatest potential exists in the commercial sector in terms of GWh/year and as a percentage of consumption. The commercial sector captured almost 41% of market potential by 2035, while the residential sector captured 37% of the market potential.

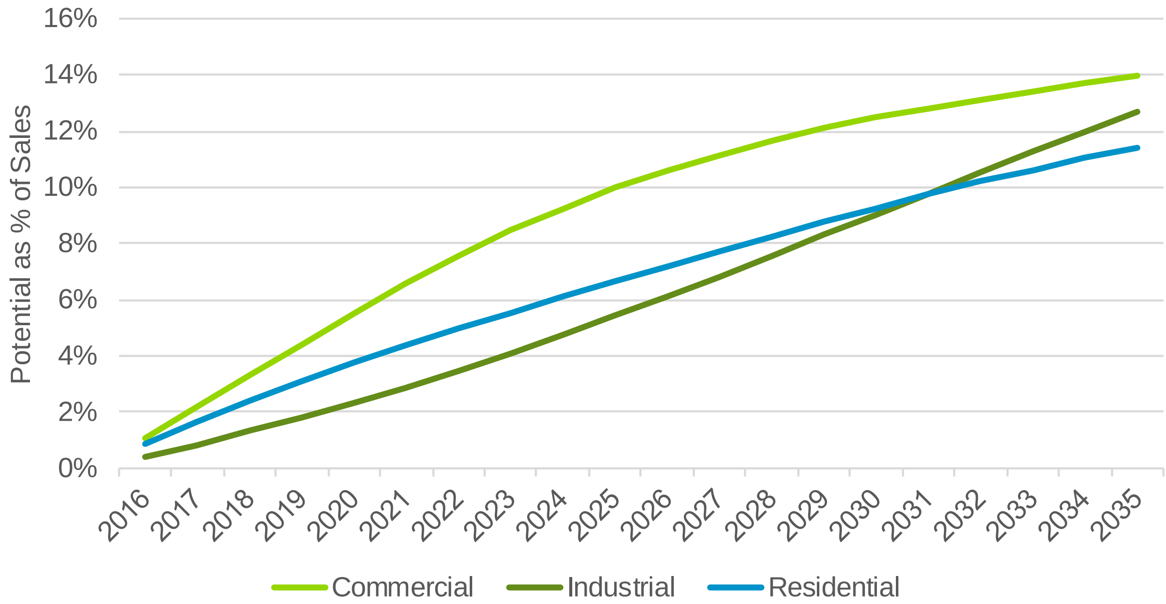
Figure 1-9. Cumulative Electric Energy Savings Market Potential by Sector (GWh/year)



Source: Navigant

When viewed as a percentage of consumption, similar sector-level trends in the market potential are evident, as shown in Figure 1-10 and Table B-5. The commercial sector's market potential reaches 14% of commercial consumption by 2035, and the industrial sector reaches just under 13% of industrial consumption. The commercial sector experiences slower growth later in the study horizon as the market potential from replace-on-burnout measures saturates, particularly for the lighting end use.

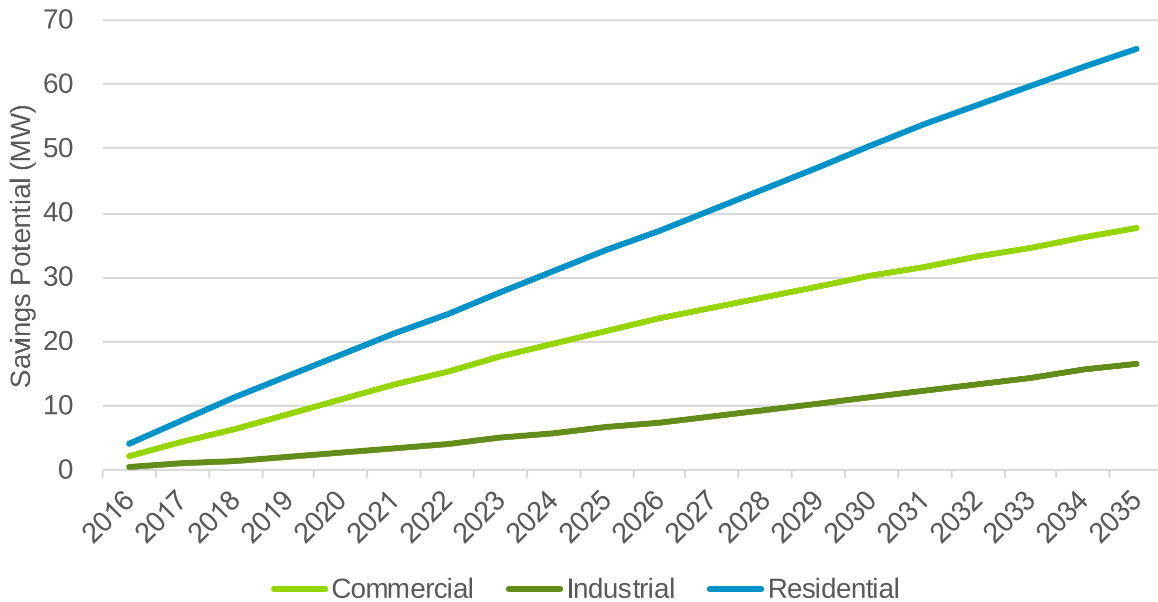
Figure 1-10. Cumulative Electric Energy Savings Market Potential as a Percentage of Consumption by Sector (%)



Source: Navigant

Figure 1-11 and Table B-6 shows the cumulative electric demand savings potential by sector. The residential sector market potential increases steadily throughout the CPR period, reaching 66 MW/year in 2035. By 2035, residential demand savings potential accounts for just under 55% of market potential, while commercial potential reaches just over 31%.

Figure 1-11. Cumulative Electric Demand Savings Market Potential by Sector (MW/year)

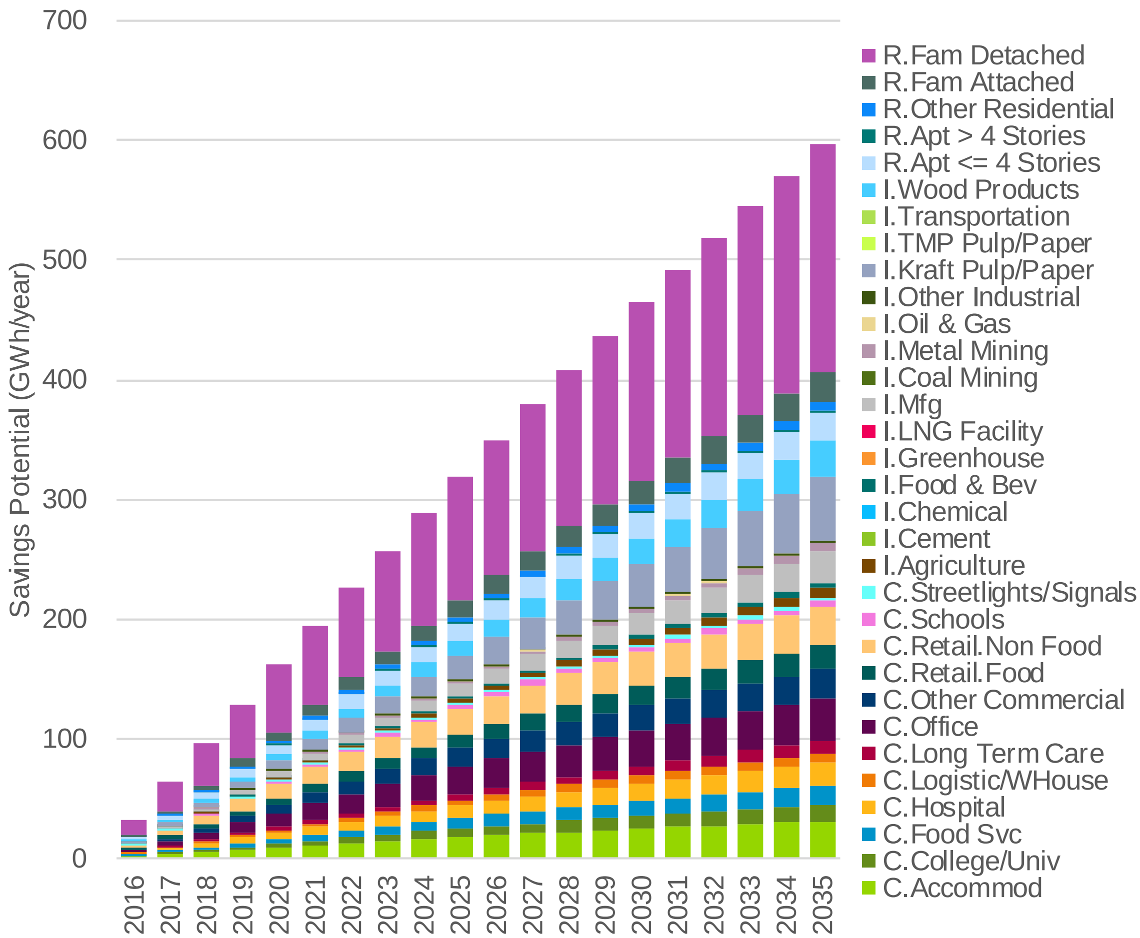


Source: Navigant

1.2.3 Results by Customer Segment

Figure 1-12 shows the electric energy market savings potential across all customer segments, and Table B-7 in Appendix B provides the associated data. This figure highlights the appreciable savings potential of the residential detached single-family home customer segment relative to other customer segments. The residential detached single-family home segment provides nearly 32% of the total market potential savings by 2035.

Figure 1-12. Cumulative Electric Energy Savings Market Potential by Customer Segment (GWh/year)



Source: Navigant

Figure 1-13, Figure 1-14, and Figure 1-15 break out the electric energy market savings potential for each sector by customer segment. For the residential sector, detached single-family homes represents the largest savings potential of any customer segment by far, accounting for 85% of the total savings potential. Offices, non-food retail and accommodations are the highest contributors in the commercial sector. In the industrial sector, TMP and kraft pulp and paper accounts for the largest share of energy savings at 38%. Wood products and manufacturing also provide significant savings among industrial segments.

Figure 1-13. Residential Electric Energy Market Potential Customer Segment Breakdown in 2025

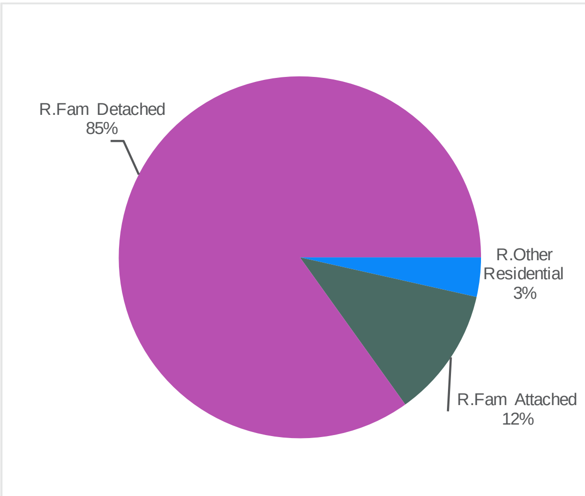


Figure 1-14. Commercial Electric Energy Market Potential Customer Segment Breakdown in 2025

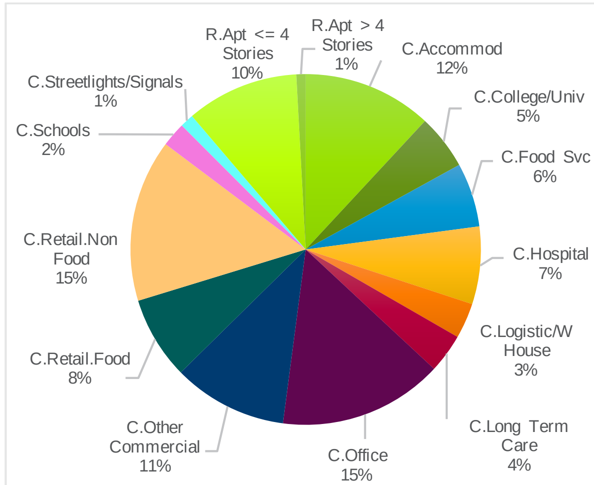
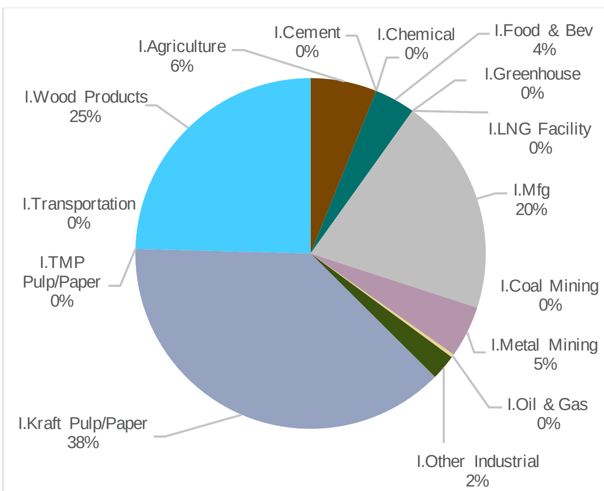


Figure 1-15. Industrial Electric Energy Market Potential Customer Segment Breakdown in 2025

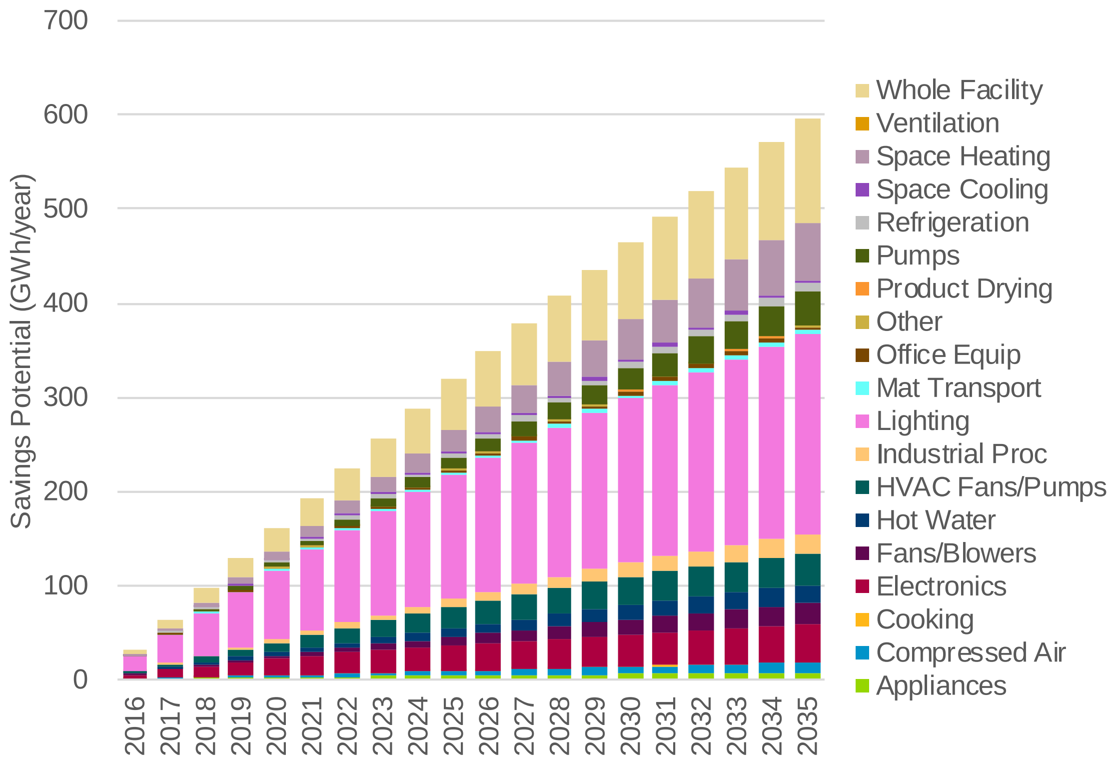


Source: Navigant

1.2.4 Results by End-use

Figure 1-16 shows the electric energy market savings potential across end-uses. The data used to generate the figure are in Table B-8 in Appendix B. The dominant end-uses are lighting and whole facility. The bulk of savings potential in the lighting end-use comes from LEDs and General Service Lamp (GSL) code changes. The whole facility end-use primarily consists of savings from building automation controls, whole-building new construction practices 30% above code and smart thermostats. As such, these whole-facility savings implicitly include savings from multiple end-uses.

Figure 1-16. Cumulative Electric Energy Savings Market Potential by End-Use (GWh/year)



Source: Navigant

Figure 1-17, Figure 1-18, and Figure 1-19 break out the electric energy market savings potential for each sector. The lighting end-use dominates the residential sector, accounting for 43% of the total savings potential. The residential electronics end-use is also a big contributor and stems from ENERGY STAR® televisions and desktop PCs. In the commercial sector, lighting and whole facility end-uses account for roughly 72% of the total market savings potential. Savings in commercial lighting come largely from general service LEDs and interior high bay LEDs. The whole-facility end-use's savings are driven by new building automation controls and whole-building new construction practices that are at least 30% above code. In the industrial sector, the pumping end-use plays the largest role, followed by high savings opportunities in lighting and fans & blowers.

Figure 1-17. Residential Electric Energy Market Potential End-Use Breakdown in 2025

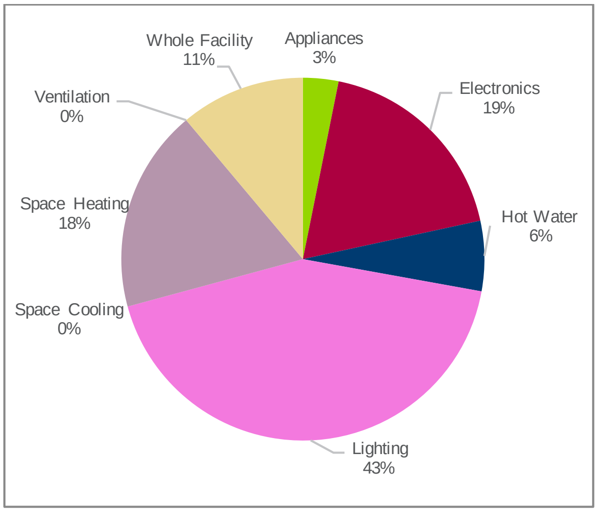


Figure 1-18. Commercial Electric Energy Market Potential End-Use Breakdown in 2025

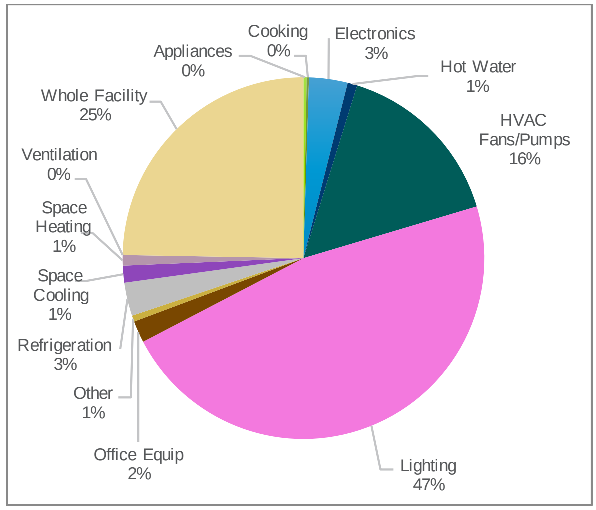
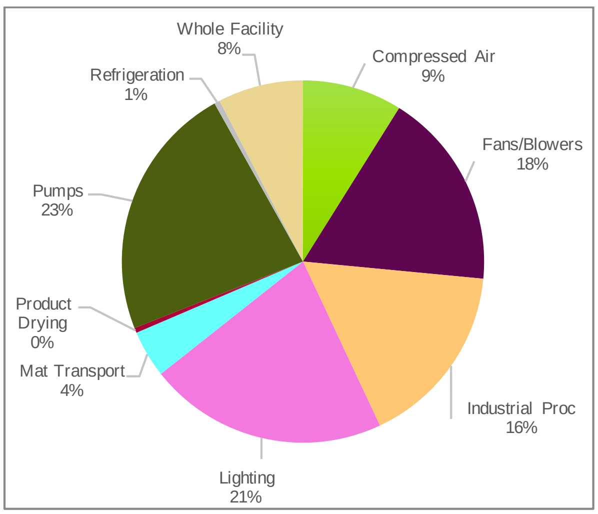


Figure 1-19. Industrial Electric Energy Market Potential End-Use Breakdown in 2025



Source: Navigant

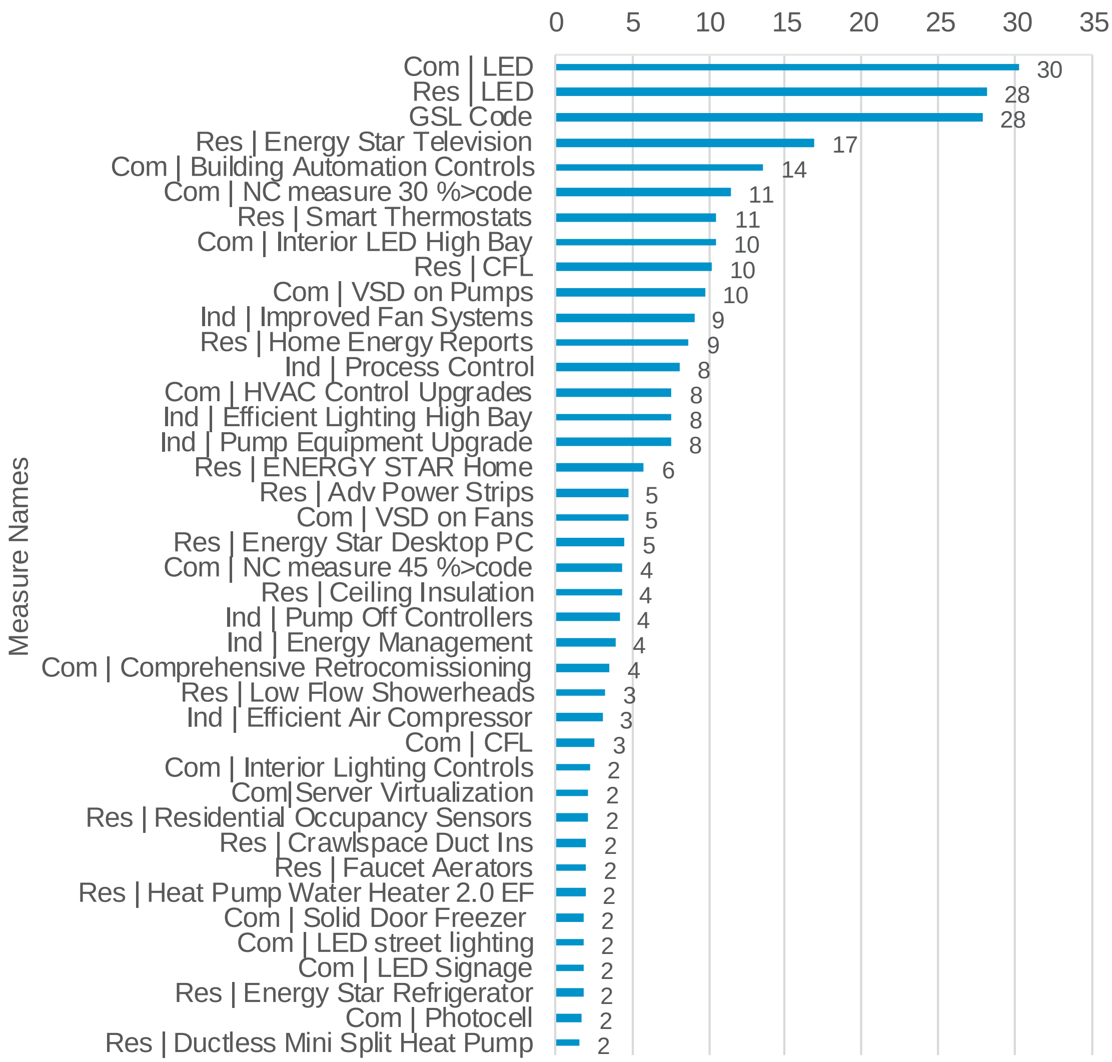
1.2.5 Results by Measure

Figure 1-20 and Table B-9 present the top 40 measures ranked by their electric energy market savings potential in 2025. Wherever a group of measures were similar in nature, Navigant consolidated their potential into a representative measure name to produce a more succinct view at the measure level. Unlike similar figures for economic and technical potential, these rankings already account for competition among measures providing the same service. Thus, one can add the potential shown without encountering issues of double counting.

When code-change measures become applicable, they "steal" savings potential from other related measures that may display significant savings in absence of the code. This ensures there is no double counting of savings from codes and the energy efficient measures impacted by the code.

The top ten energy savings measures come from the lighting, electronics, whole facility, space heating and HVAC fans and pumps end-uses. Notably, five of the top ten measures are associated with the lighting end-use. General service LEDs rank as the top two highest impact market potential measure. New construction practices 45% better than code, which has the highest economic savings potential, ranks 21st in terms of market potential because FortisBC Electric's program experience suggested the market is more likely to trend toward new construction measures 30% better than code. The top ten measures tally to 169 GWh, accounting for nearly 53% of the total market potential in 2025.

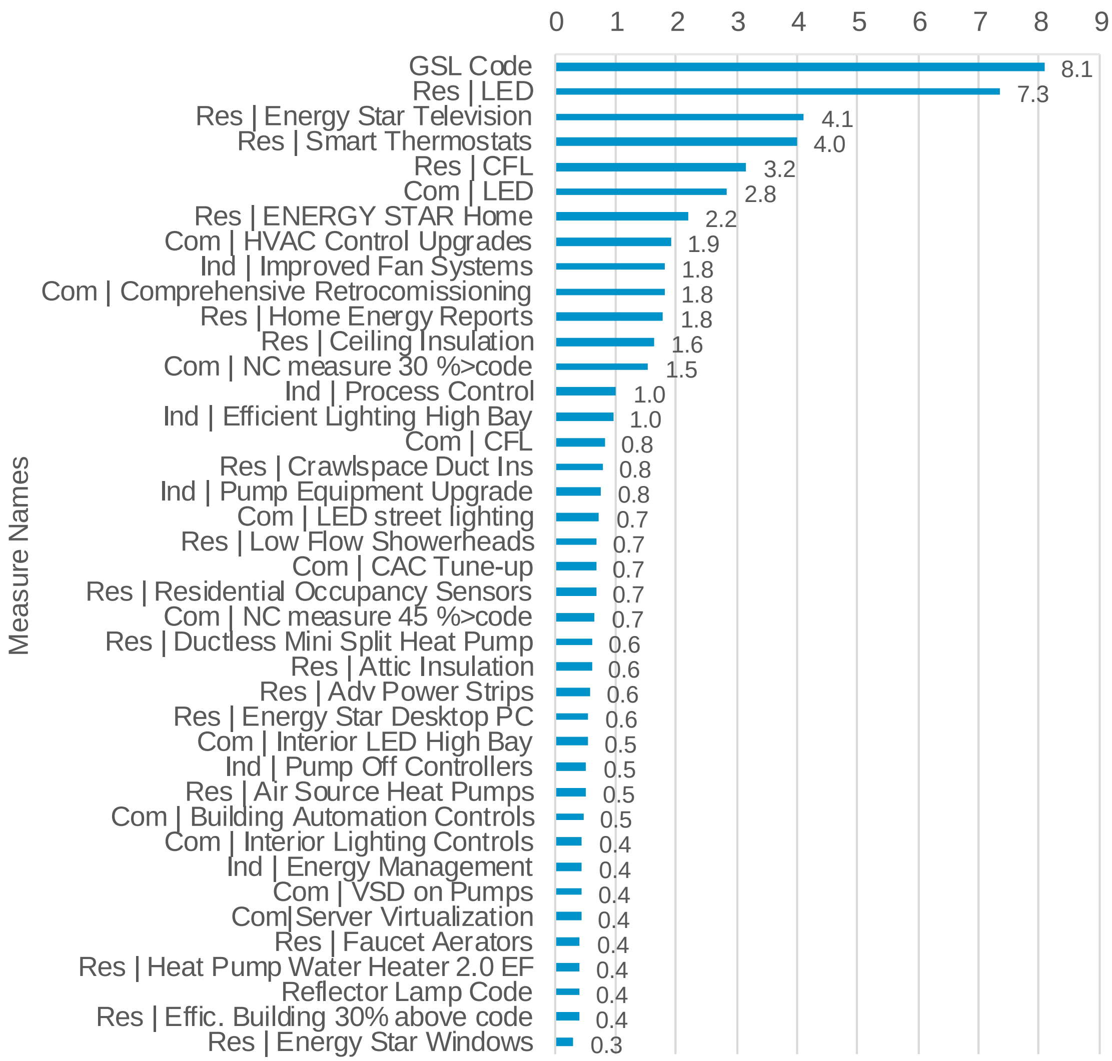
Figure 1-20. Top 40 Measures for Electric Energy Market Savings Potential in 2025 (GWh/year)



Source: Navigant

Figure 1-21 and Table B-10 show the top ten demand savings measures come from the lighting, electronics, space heating, whole facility and HVAC fans and pumps end-uses. Again, four of the top ten measures are associated with the lighting end-use. GSL code ranks as the highest demand-saving market potential measure, and its savings impact both the residential and commercial sectors. Whole-facility measures, such as smart thermostats, ENERGY STAR® homes, comprehensive retrocommissioning and home energy reports are large contributors to demand savings. The top ten demand-saving measures account for nearly 60% of the total market demand savings potential in 2025.

Figure 1-21. Top 40 Measures for Electric Demand Market Savings Potential in 2025 (MW/year)



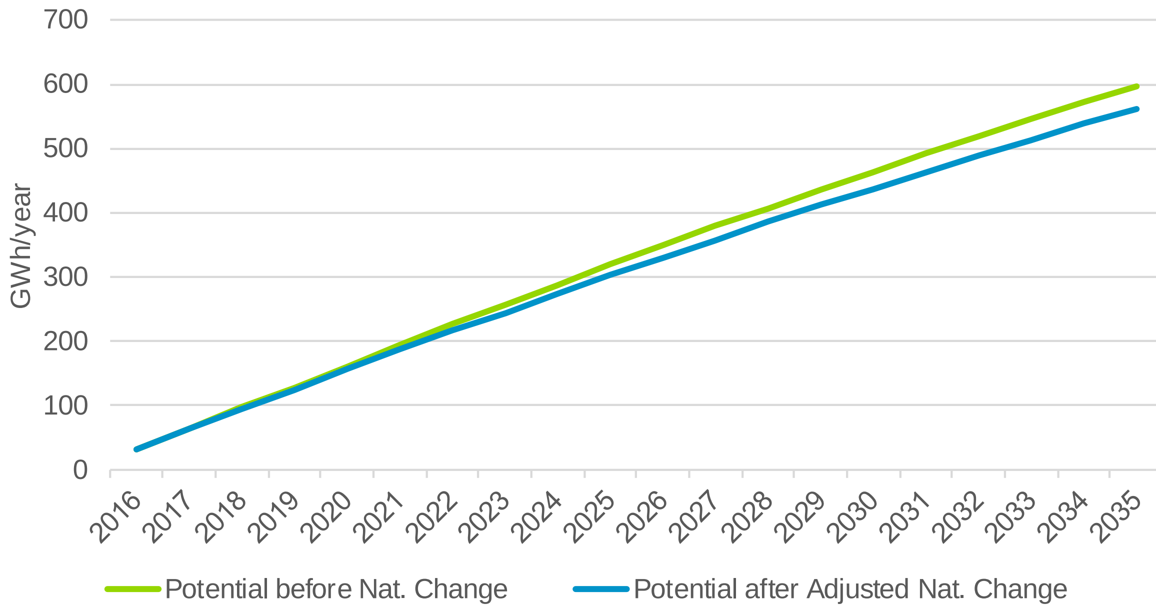
Source: Navigant

1.2.6 Adjustments for Natural Change

As discussed in Section 2.3.2, Navigant estimated natural change to account for differences in end-use consumption in the Reference Case compared to the frozen EUI case. Natural change accounts for changes in consumption that are naturally occurring and are not the result of utility-sponsored programs or incentives. Incorporating natural change led to modest (≤ 8%) reductions in the adjusted market potential estimates. Since results in previous sections are in gross terms and are not adjusted for natural change, this section compares the results before and after adjustments for natural change.

Figure 1-22 and Table B-11 in Appendix B show the total market potential across all sectors before and after adjusting for natural change. The total natural change across all sectors is negative in all years, indicating an overall natural tendency toward increased energy conservation rather than growth. The adjusted natural change is computed by accounting for the percentage of the gross natural change that could reasonably be attributed to measures experiencing savings potential for each end-use. Market potential after adjustment for natural change is on average about 6% lower than potential before natural change by 2035.

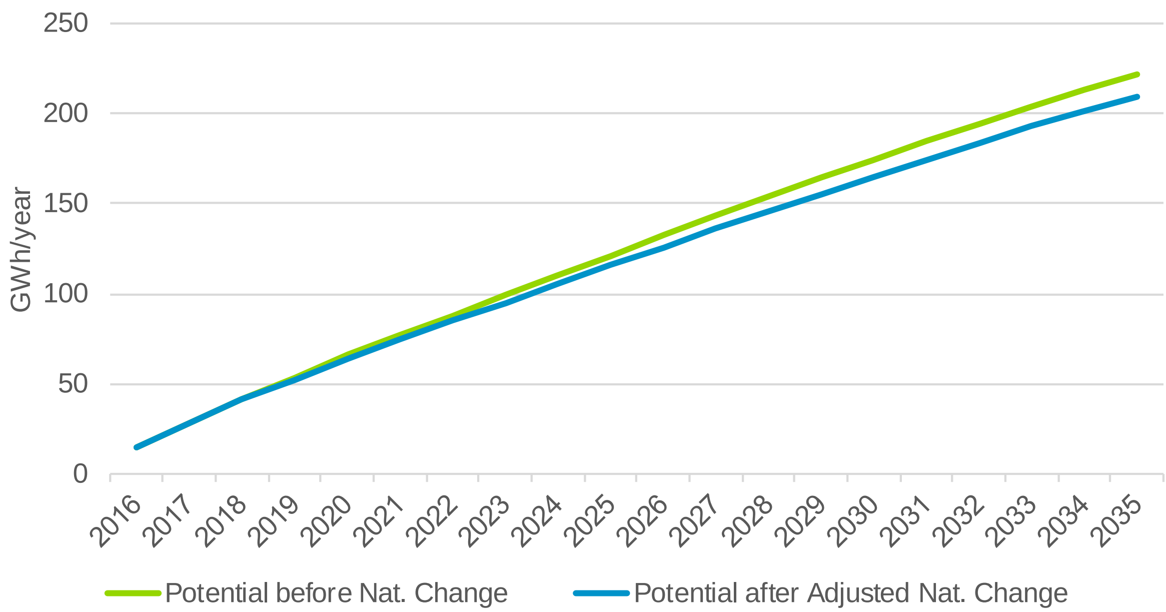
Figure 1-22. Electric Energy Market Savings Potential with Natural Change – All Sectors (GWh/year)



Source: Navigant

Figure 1-23 and Table B-12 show the effect of adjustments for natural change in the residential sector. Lighting and appliances end-uses account for significant natural conservation, while many other end-uses show natural growth. When aggregated to the sector level, natural conservation has a slightly larger effect than natural growth. On average across the study period, the residential technical potential after adjusted natural change is roughly 5% lower than the potential prior to natural change.

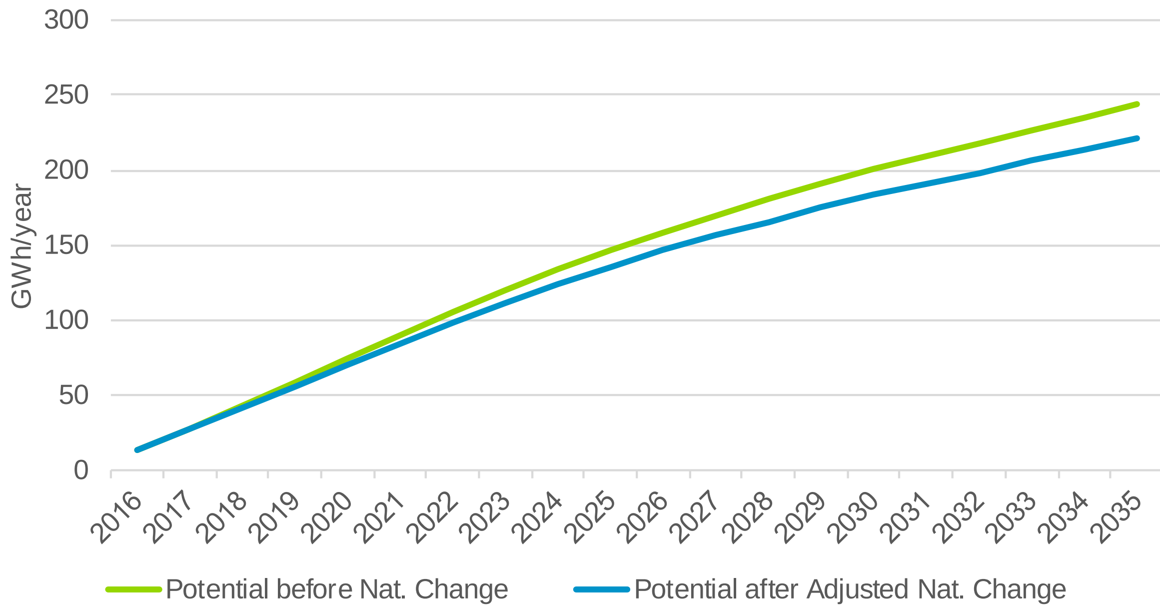
Figure 1-23. Residential Electric Energy Market Savings Potential with Natural Change (GWh/year)



Source: Navigant

The effect of adjustments for natural change on the commercial sector's market potential is greater than for the residential sector, as seen Figure 1-24 and data corresponding to Table B-13. Lighting and HVAC fans and pumps are the commercial end-uses experience the most natural change in the absence of DSM programs. On average across the study period, the commercial market potential adjusted for natural change is roughly 8% lower than the potential prior to natural change.

Figure 1-24. Commercial Electric Energy Market Savings Potential with Natural Change (GWh/year)



Source: Navigant

For the industrial sector, there is no forecasted natural change, so adjustments to the market potential results presented in previous sections are not necessary.

1.3 Market Potential Cost Effectiveness

The following section describes the approach that Navigant used to develop the cost effectiveness estimates for the market potential savings presented in this report.

1.3.1 Approach to Utility Spending Estimation

Navigant developed estimates of the portfolio-level DSM spending that FortisBC Electric would need to support the market potential savings forecast over the study period. Navigant calculated these estimates in the DSMSim™ model using incentive levels calibrated to align simulated 2017 incentive values with planned sector-level incentives as a percentage of total sector-level spending (as described in Section 5.1.7). The incentive spending reflects the amount of spending resulting from adoption levels projected for every measure included in the market potential estimates.

In addition to portfolio-level fixed administrative costs, the sector and total administrative spending includes variable administrative costs, which result from the amount of savings potential in a given year multiplied by the planned per-unit-of-savings administrative expenditures ($/kWh) provided by FortisBC Electric. The study escalates the historic fixed and variable administrative costs over time at the assumed inflation rate.[14]

Changes in the utility spending over time reflect cost inflation, a changing mix of measures, and changing levels of measure adoption.

[14] This study's portfolio total administrative costs focus on administrative costs related to direct energy savings. As such, this analysis is likely to underrepresent total administrative budgets at the portfolio level, which might also include non-modelled costs associated with outreach and educational programs. However, this underrepresentation may be partially offset by not accounting for efficiencies gained through program experience, which would reduce fixed and per-unit-of-savings administrative costs over time.

1.3.2 Cost Effectiveness Tests

The cost effectiveness approach is consistent with the methodology Navigant used for the economic potential presented in Section 4. Table 1-2 shows the benefit-cost test ratios by sector and for the portfolio for each benefit-cost test. The benefit-cost test ratios are significantly greater than 1.0 for all benefit-cost test types at the sector and portfolio level across all analysis years, with the exception of the Rate Impact Measure (RIM) test, which has benefit-cost tests slightly less than 1.0 for certain years and sectors.

Table 1-2. Benefit-Cost Test Ratios for the Portfolio and by Sector

Sector	Year	Total Resource Cost Test	Utility Cost Test	Participant Cost Test	Rate Impact Measure Test
Commercial	2016	2.6	4.4	3.1	0.97
	2020	3.1	4.2	3.8	0.97
	2025	2.8	5.2	3.1	1.03
	2030	2.4	5.4	2.5	1.04
	2035	2.2	5.3	2.3	1.03
	2016-2035	2.8	4.6	3.1	0.99
Industrial	2016	3.2	5.3	3.3	1.18
	2020	3.3	5.6	3.4	1.19
	2025	3.3	5.6	3.3	1.19
	2030	3.2	5.7	3.2	1.19
	2035	3.1	5.7	3.1	1.18
	2016-2035	3.3	5.6	3.3	1.19
Residential	2016	3.0	3.9	4.3	0.81
	2020	4.1	5.9	5.6	0.87
	2025	4.1	5.4	5.7	0.87
	2030	3.6	4.9	4.9	0.86
	2035	3.2	4.7	4.3	0.84
	2016-2035	3.6	4.8	5.0	0.84
Portfolio	2016	2.5	3.5	3.6	0.86
	2020	3.0	4.0	4.3	0.91
	2025	2.8	4.2	3.9	0.94
	2030	2.6	4.2	3.5	0.94
	2035	2.4	4.0	3.1	0.93
	2016-2035	2.7	3.9	3.8	0.91

Source: Navigant

Table 1-3 presents the net benefits by sector and for the portfolio under each benefit-cost test. Coinciding with the benefit-cost test ratios, net benefits are positive in all cases, with the exception of the RIM test. The analysis estimates that the total net present value for the portfolio over the 2016-2035 analysis timeframe is more than $245 million from the TRC perspective.

Table 1-3. Cost Test Net Benefits for the Portfolio and by Sector (Million $)

Sector	Year	Total Resource Cost Test	Utility Cost Test	Participant Cost Test	Rate Impact Measure Test
Commercial	2016	$9.0	$10.8	$9.0	-$0.4
	2020	$12.5	$13.7	$13.2	-$0.6
	2025	$11.0	$13.6	$11.1	$0.4
	2030	$8.9	$12.1	$8.8	$0.6
	2035	$8.2	$11.8	$8.2	$0.4
	2016-2035*	$105.7	$126.8	$108.9	-$1.5
Industrial	2016	$2.3	$2.7	$1.8	$0.5
	2020	$3.7	$4.3	$2.8	$0.8
	2025	$5.5	$6.5	$4.2	$1.3
	2030	$7.3	$8.8	$5.6	$1.7
	2035	$8.5	$10.3	$6.5	$1.9
	2016-2035*	$47.8	$56.7	$36.7	$11.0
Residential	2016	$10.4	$11.6	$13.6	-$3.7
	2020	$10.6	$11.6	$12.8	-$2.0
	2025	$11.3	$12.1	$14.0	-$2.2
	2030	$12.6	$13.8	$16.0	-$2.9
	2035	$11.5	$13.1	$15.1	-$3.1
	2016-2035*	$110.8	$121.0	$140.7	-$28.3
Portfolio	2016	$20.0	$23.5	$24.3	-$5.3
	2020	$25.0	$27.9	$28.9	-$3.6
	2025	$25.9	$30.3	$29.3	-$2.5
	2030	$26.7	$32.5	$30.3	-$2.7
	2035	$25.8	$32.8	$29.9	-$3.2
	2016-2035*	$245.4	$285.6	$286.2	-$37.7

**Total net benefits for 2016-2035 represent the total present values in 2016 dollars. Other yearly values represent non-discounted single-year net benefits.*
Source: Navigant

APPENDIX A. ADDITIONAL MODEL RESULTS

A.1 Detailed Model Results

For granular Base Case results from the model, see attachments

- "FortisElectric_Appendix_A1_2018-08-25.xlsx"

APPENDIX B. SUPPORTING DATA FOR CHARTS

Data corresponding to Figure 1-5:

Table B-1. Total Cumulative Electric Energy Savings Potential (GWh/year)[15]

	Technical	Economic	Market
2016	845	808	32
2017	860	827	64
2018	875	842	97
2019	890	857	128
2020	905	872	161
2021	925	891	194
2022	944	911	225
2023	964	930	257
2024	984	950	288
2025	1,005	971	319
2026	1,031	996	349
2027	1,057	1,021	379
2028	1,083	1,047	408
2029	1,110	1,073	436
2030	1,137	1,099	464
2031	1,168	1,130	491
2032	1,200	1,161	518
2033	1,232	1,192	545
2034	1,264	1,217	571
2035	1,297	1,249	596

Source: Navigant

[15] Technical and economic potential reflects a snapshot in time and assumes full adoption of efficient measures occurs immediately. Conversely, market potential savings reflect adoption that is a limited by stock turnover, customer willingness to adopt and other non-economic barriers to adoption.

Data corresponding to Figure 1-6:

Table B-2. Total Cumulative Electric Energy Savings Potential as a Percentage of Consumption (%)

	Technical	Economic	Market
2016	22.0%	21.0%	0.8%
2017	22.2%	21.3%	1.7%
2018	22.3%	21.5%	2.5%
2019	22.5%	21.6%	3.2%
2020	22.6%	21.8%	4.0%
2021	22.8%	22.0%	4.8%
2022	23.1%	22.2%	5.5%
2023	23.3%	22.5%	6.2%
2024	23.5%	22.7%	6.9%
2025	23.7%	22.9%	7.5%
2026	24.1%	23.2%	8.2%
2027	24.4%	23.6%	8.7%
2028	24.7%	23.9%	9.3%
2029	25.1%	24.2%	9.9%
2030	25.4%	24.6%	10.4%
2031	25.8%	25.0%	10.9%
2032	26.2%	25.4%	11.3%
2033	26.7%	25.8%	11.8%
2034	27.1%	26.1%	12.2%
2035	27.5%	26.5%	12.6%

Source: Navigant

Data corresponding to Figure 1-8:

Table B-3. Total Cumulative Electric Demand Savings Potential (MW/year)

	Technical	Economic	Market
2016	167	161	7
2017	170	165	13
2018	173	168	19
2019	177	171	25
2020	180	174	32
2021	185	179	38
2022	189	183	44
2023	194	188	50
2024	199	192	56
2025	203	197	62
2026	210	204	68
2027	217	210	74
2028	224	217	80
2029	231	224	86
2030	238	230	92
2031	247	239	98
2032	256	247	103
2033	264	256	109
2034	273	264	114
2035	282	272	120

Source: Navigant

Data corresponding to Figure 1-9:

Table B-4. Cumulative Electric Energy Savings Market Potential by Sector (GWh/year)

	Commercial	Industrial	Residential	Total
2016	13	4	15	32
2017	28	8	29	64
2018	43	12	42	97
2019	58	17	54	128
2020	74	22	66	161
2021	90	27	77	194
2022	105	32	88	225
2023	120	38	99	257
2024	133	45	110	288
2025	146	51	121	319
2026	159	59	132	349
2027	170	66	143	379
2028	181	73	154	408
2029	191	81	164	436
2030	201	89	175	464
2031	210	97	185	491
2032	218	106	194	518
2033	227	114	204	545
2034	235	122	213	571
2035	244	131	222	596

Source: Navigant

Data corresponding to Figure 1-10:

Table B-5. Cumulative Electric Energy Savings Market Potential as a Percentage of Consumption by Sector (%)

	Commercial	Industrial	Residential
2016	1.1%	0.4%	0.9%
2017	2.2%	0.8%	1.7%
2018	3.3%	1.3%	2.4%
2019	4.4%	1.8%	3.1%
2020	5.5%	2.4%	3.8%
2021	6.6%	2.9%	4.4%
2022	7.6%	3.5%	5.0%
2023	8.5%	4.1%	5.5%
2024	9.3%	4.7%	6.1%
2025	10.0%	5.4%	6.7%
2026	10.6%	6.1%	7.2%
2027	11.2%	6.8%	7.8%
2028	11.7%	7.6%	8.3%
2029	12.1%	8.3%	8.8%
2030	12.5%	9.0%	9.3%
2031	12.8%	9.8%	9.7%
2032	13.1%	10.5%	10.2%
2033	13.4%	11.3%	10.6%
2034	13.7%	12.0%	11.0%
2035	14.0%	12.7%	11.4%

Source: Navigant

Data corresponding to Figure 1-11:

Table B-6. Cumulative Electric Demand Savings Market Potential by Sector (MW/year)

	Commercial	Industrial	Residential	Total
2016	2	0	4	7
2017	4	1	8	13
2018	6	2	11	19
2019	9	2	15	25
2020	11	3	18	32
2021	13	3	21	38
2022	15	4	24	44
2023	18	5	28	50
2024	20	6	31	56
2025	22	7	34	62
2026	23	7	37	68
2027	25	8	41	74
2028	27	9	44	80
2029	29	10	47	86
2030	30	11	51	92
2031	32	12	54	98
2032	33	13	57	103
2033	35	14	60	109
2034	36	15	63	114
2035	38	17	66	120

Source: Navigant

Data corresponding to Figure 1-12:

Table B-7. Cumulative Electric Energy Savings Market Potential by Customer Segment (GWh/year)

	2016	2020	2025	2030	2035
C.Accommod	2	9	17	25	31
C.College/Univ	1	4	7	10	13
C.Food Svc	1	4	9	13	17
C.Hospital	1	5	10	15	19
C.Logistic/WHouse	0	2	5	7	9
C.Long Term Care	0	2	5	8	11
C.Office	2	12	22	29	34
C.Other Commercial	1	7	15	21	25
C.Retail.Food	1	5	11	16	21
C.Retail.Non Food	2	12	22	28	31
C.Schools	0	2	3	4	5
C.Streetlights/Signals	0	1	2	2	3
I.Agriculture	0	1	3	5	8
I.Cement	0	0	0	0	0
I.Chemical	0	0	0	0	0
I.Food & Bev	0	1	2	3	5
I.Greenhouse	0	0	0	0	0
I.LNG Facility	0	0	0	0	0
I.Mfg	1	5	10	17	27
I.Coal Mining	0	0	0	0	0
I.Metal Mining	0	1	2	4	6
I.Oil & Gas	0	0	0	0	0
I.Other Industrial	0	0	1	2	3
I.Kraft Pulp/Paper	1	8	20	35	53
I.TMP Pulp/Paper	0	0	0	0	0
I.Transportation	0	0	0	0	0
I.Wood Products	1	5	13	21	30
R.Apt <= 4 Stories	2	8	15	20	24
R.Apt > 4 Stories	0	1	1	2	2
R.Other Residential	1	2	4	6	7
R.Fam Attached	2	8	14	20	25
R.Fam Detached	12	56	103	149	189

Source: Navigant

Data corresponding to Figure 1-16:

Table B-8. Cumulative Electric Energy Savings Market Potential by End-Use (GWh/year)

	2016	2020	2025	2030	2035
Appliances	0	2	4	6	7
Compressed Air	0	2	5	8	11
Cooking	0	0	0	0	1
Electronics	5	18	27	34	39
Fans/Blowers	1	4	9	16	23
Hot Water	1	4	9	15	20
HVAC Fans/Pumps	2	10	23	30	33
Industrial Proc	1	3	8	15	21
Lighting	15	73	132	175	212
Mat Transport	0	1	2	4	5
Office Equip	0	2	3	3	4
Other	0	0	1	1	1
Product Drying	0	0	0	0	1
Pumps	1	4	12	23	37
Refrigeration	0	2	5	6	7
Space Cooling	0	1	2	3	3
Space Heating	2	9	23	43	62
Ventilation	0	0	0	0	0
Whole Facility	4	25	54	82	111

Source: Navigant

Data corresponding to Figure 1-20:

Table B-9. Top 40 Measures for Electric Energy Market Savings Potential in 2025 (GWh/year)

Rank	Measure	Market Potential
1	Com | LED	30
2	Res | LED	28
3	GSL Code	28
4	Res | Energy Star Television	17
5	Com | Building Automation Controls	14
6	Com | NC measure 30 %>code	11
7	Res | Smart Thermostats	11
8	Com | Interior LED High Bay	10
9	Res | CFL	10
10	Com | VSD on Pumps	10
11	Ind | Improved Fan Systems	9
12	Res | Home Energy Reports	9
13	Ind | Process Control	8
14	Com | HVAC Control Upgrades	8
15	Ind | Efficient Lighting High Bay	8
16	Ind | Pump Equipment Upgrade	8
17	Res | ENERGY STAR Home	6
18	Res | Adv Power Strips	5
19	Com | VSD on Fans	5
20	Res | Energy Star Desktop PC	5
21	Com | NC measure 45 %>code	4
22	Res | Ceiling Insulation	4
23	Ind | Pump Off Controllers	4
24	Ind | Energy Management	4
25	Com | Comprehensive Retrocomissioning	4
26	Res | Low Flow Showerheads	3
27	Ind | Efficient Air Compressor	3
28	Com | CFL	3
29	Com | Interior Lighting Controls	2
30	Com | Server Virtualization	2
31	Res | Residential Occupancy Sensors	2
32	Res | Crawlspace Duct Ins	2
33	Res | Faucet Aerators	2
34	Res | Heat Pump Water Heater 2.0 EF	2
35	Com | Solid Door Freezer	2
36	Com | LED street lighting	2
37	Com | LED Signage	2
38	Res | Energy Star Refrigerator	2
39	Com | Photocell	2
40	Res | Ductless Mini Split Heat Pump	2

Source: Navigant

Data corresponding to Figure 1-21:

Table B-10. Top 40 Measures for Electric Demand Market Savings Potential in 2025 (MW/year)

Rank	Measure	Market Potential
1	GSL Code	8
2	Res | LED	7
3	Res | Energy Star Television	4
4	Res | Smart Thermostats	4
5	Res | CFL	3
6	Com | LED	3
7	Res | ENERGY STAR Home	2
8	Com | HVAC Control Upgrades	2
9	Ind | Improved Fan Systems	2
10	Com | Comprehensive Retrocomissioning	2
11	Res | Home Energy Reports	2
12	Res | Ceiling Insulation	2
13	Com | NC measure 30 %>code	2
14	Ind | Process Control	1
15	Ind | Efficient Lighting High Bay	1
16	Com | CFL	1
17	Res | Crawlspace Duct Ins	1
18	Ind | Pump Equipment Upgrade	1
19	Com | LED street lighting	1
20	Res | Low Flow Showerheads	1
21	Com | CAC Tune-up	1
22	Res | Residential Occupancy Sensors	1
23	Com | NC measure 45 %>code	1
24	Res | Ductless Mini Split Heat Pump	1
25	Res | Attic Insulation	1
26	Res | Adv Power Strips	1
27	Res | Energy Star Desktop PC	1
28	Com | Interior LED High Bay	1
29	Ind | Pump Off Controllers	1
30	Res | Air Source Heat Pumps	1
31	Com | Building Automation Controls	0
32	Com | Interior Lighting Controls	0
33	Ind | Energy Management	0
34	Com | VSD on Pumps	0
35	Com | Server Virtualization	0
36	Res | Faucet Aerators	0
37	Res | Heat Pump Water Heater 2.0 EF	0
38	Reflector Lamp Code	0
39	Res | Effic. Building 30% above code	0
40	Res | Energy Star Windows	0

Source: Navigant

Data corresponding to Figure 1-22:

Table B-11. Electric Energy Market Savings Potential with Natural Change – All Sectors (GWh/year)

	Potential before Nat. Change	Potential after Adjusted Nat. Change
2016	32	32
2017	64	64
2018	97	95
2019	128	125
2020	161	156
2021	194	186
2022	225	216
2023	257	245
2024	288	274
2025	319	302
2026	349	331
2027	379	358
2028	408	385
2029	436	411
2030	464	437
2031	491	463
2032	518	488
2033	545	513
2034	571	537
2035	596	561

Source: Navigant

Data corresponding to Figure 1-23:

Table B-12. Residential Electric Energy Market Savings Potential with Natural Change (GWh/year)

	Potential before Nat. Change	Potential after Adjusted Nat. Change
2016	15	15
2017	29	28
2018	42	41
2019	54	53
2020	66	64
2021	77	74
2022	88	85
2023	99	95
2024	110	105
2025	121	116
2026	132	126
2027	143	136
2028	154	146
2029	164	156
2030	175	165
2031	185	175
2032	194	184
2033	204	193
2034	213	201
2035	222	209

Source: Navigant

Data corresponding to Figure 1-24:

Table B-13. Commercial Electric Energy Market Savings Potential with Natural Change (GWh/year)

	Potential before Nat. Change	Potential after Adjusted Nat. Change
2016	13	13
2017	28	28
2018	43	42
2019	58	56
2020	74	70
2021	90	85
2022	105	99
2023	120	112
2024	133	124
2025	146	135
2026	159	146
2027	170	156
2028	181	166
2029	191	175
2030	201	183
2031	210	191
2032	218	199
2033	227	206
2034	235	214
2035	244	221

Source: Navigant

Appendix C

DRAFT ORDER

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

BEFORE:
[Panel Chair]
Commissioner
Commissioner

on Date

ORDER

WHEREAS:

A. On November 30, 2016, FBC filed its 2016 Long Term Electric Resource Plan and Long Term Demand Side Management (2016 LT DSM) Plan. The 2016 LT DSM Plan included an assessment of the energy efficiency and conservation potential for FBC customers and identifies FBC's preferred DSM scenario for long term planning purposes;

B. On June 28, 2018, the Commission issued its Decision and Order G-117-18 accepting the 2016 LT DSM Plan as being in the public interest;

C. On November 15, 2017, FBC filed an Application for Acceptance of DSM Expenditures for 2018 of $7.9 million, which was accepted by the Commission on June 14, 2018 by way of Order G-113-18;

D. On August 2, 2018, FBC filed its Application for Approval of 2019-2022 Demand Side Management Expenditures Plan (DSM Plan);

E. FBC seeks acceptance, pursuant to section 44.2 of the *Utilities Commission Act* (UCA) of DSM total expenditures as set out in Table 5-2 of the Application of $44.0 million (inflation adjusted) for 2019 through 2022;

F. FBC also seeks approval to move to a 15-year amortization period for DSM expenditures as set out in Section 8.1 of the Application and flexibility in timing of expenditures within the proposed program areas as set out in Section 8.2 of the Application;

G. The Commission has reviewed FBC's DSM Plan and requested approvals for DSM expenditures for 2019 to 2022 and concludes that the requested expenditure schedules should be accepted.

NOW THEREFORE the Commission orders as follows:

1. Pursuant to section 44.2(a) of the UCA, the Commission accepts the FBC DSM expenditure schedule of total DSM expenditures of $44.0 million for 2019 through 2022 on the DSM program areas described in the DSM Plan.

2. FBC's request to move to a 15-year amortization period for DSM expenditures is approved.

3. FBC's request for flexibility in the timing of expenditures within the proposed program areas is approved.

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

BY ORDER

(X. X. last name)
Commissioner

Appendix D

EM&V FRAMEWORK – 2018 UPDATES

Evaluation, Measurement & Verification Framework

Revised, May 2018

Acknowledgements

The authors wish to acknowledge and express our appreciation to the many individuals who contributed to the development of the FortisBC Evaluation Measurement & Verification Framework.

Feedback and comments from FortisBC Internal Stakeholders, EEC Advisory Group members, BC Hydro, PowerSense, and Habart & Associates assisted in the development of the FortisBC Evaluation, Measurement & Verification Framework.

Table of Contents

1. INTRODUCTION

1.1 BACKGROUND

FortisBC Energy Inc. (FEI), provides primarily natural gas distribution throughout most of BC. FortisBC Inc. (FBC) is an integrated electric utility that generates, transmits and distributes electricity to customers in the southern interior of British Columbia (BC). Collectively these utilities, referred to as "FortisBC" or "the Companies", have developed a framework for evaluation, measurement and verification (EM&V) activities to examine the effectiveness of its Demand Side Management (DSM) programs.

FEI and FBC have been involved with delivering DSM programs, and thus program evaluation since the 1990s[1]. This Framework was original created in 2013 to guide DSM program evaluation activities as FEI's DSM activities and expenditures increased substantially between 2009 and 2013. FBC also adopted the Framework shortly thereafter. Minor updates to the Framework have been completed since 2013 as the Companies gained greater experience conducting higher levels of EM&V activity that followed the increase in DSM program spending for FEI.

Provincial and Federal regulations also influence a utilities' EM&V activities. In BC, the Demand-Side Measures Regulation, made pursuant to the Utilities Commission Act, sets out many of the definitions, cost effectiveness requirements and calculation considerations, and other demand side activity portfolio requirements for BC utilities, many of which are unique to this jurisdiction. For example, the need to consider non-energy benefits and the methodology for assigning value to such benefits are set out in the Province's Demand-Side Measures Regulation[2].

[1] The Companies' earlier EEC activities were referred to in previous regulatory filings with the BCUC as Demand Side Management (DSM) activities.

[2] http://www.bclaws.ca/EPLibraries/bclaws_new/document/ID/freeside/10_326_2008

2. EVALUATION FRAMEWORK

2.1 *PURPOSE OF THE EVALUATION FRAMEWORK*

The EM&V Framework documents the background, objectives, principles and general practices that will guide the Companies' approach, resources and timeframes for EM&V activities. The purpose of the Framework is to provide reliable and consistent guidance relating to when evaluations should be conducted, the types of evaluation that can be conducted, and a discussion of approaches for conducting those evaluations. It is expected that this document will be updated from time to time in consultation with industry and stakeholders as industry practices evolve and are adopted by the Companies.

The Framework is not a step-by-step evaluation manual, rather it is a guideline that allows for flexibility while complying with industry standards and practices. The intended audience includes government, policy staff, program managers, program planners and evaluators, and other internal and external stakeholders. Section 2.2 provides a detail explanation of the Companies' evaluation objectives and role of the framework.

2.2 *EVALUATION OBJECTIVES*

The Companies' have five overriding objectives for conducting evaluations on C&EM programs, which include:

1. *Determining whether DSM program objectives are being met.* Program design targets and objectives are determined based on available industry sources. Evaluation activities are conducted to determine if program design targets are being met, such as the amount of energy savings, the number and nature of participants, emission reductions and other targets.
2. *Ensuring that the Companies and ratepayers are obtaining value from their DSM investments.* Evaluation results provide inputs to the cost-benefit analyses in determining the effectiveness of DSM programs. The Companies prescribed cost-benefit analyses are also defined by; the industry standards[3], provincial regulations[4], and the British Columbia Utilities Commission's (BCUC's) directives. The cost and savings data obtained from evaluation activities can also be used for the Companies' resource planning purposes and for DSM program planning.
3. *Providing feedback to program and company management on the performance of DSM programs.* Evaluations help program managers understand how their programs are performing and provide information to help them improve their programs over time to be

[3] The Companies use the cost-effectiveness methodologies articulated in the *California Standard Practices Manual (SPM): Economic Analysis of Demand-Side Programs and Projects.*

[4] The Modified Total Resource Cost Test (MTRC) is defined in the *Utilities Commission Act Demand-Side Measures Regulation*

more effective, or perhaps determine if some programs should be altered, expanded or discontinued.

4. *Examining the relationship between a program's activities and a market effect through the use of Market Transformation evaluation.* Evaluations are conducted to assess changes within a market that are caused, at least in part, by the energy efficiency programs attempting to change that market.

5. *Providing assurance to both internal and external stakeholders for the continued support of DSM programs.* Proper evaluation activities ensure that results from DSM programs are credible. This assurance is critical for ongoing support from:

    - External interest groups including customers, BCUC, government, First Nations, communities and other interest groups, trade allies and market participants; and

    - Internal stakeholders including senior management, departments competing for resources, departments responsible for oversight, such as finance and internal audit, and shareholders.

2.3 *EVALUATION PRINCIPLES*

The Companies will conduct their EM&V activities based on the following principles:

- All DSM programs will be evaluated on a program by program basis[5]. The type of evaluations, level of resources dedicated to each evaluation and the extent of the evaluation study will depend upon:
    - Size of investment in the DSM program being evaluated.
    - Amount of risk that a program may not meet cost effectiveness expectations.
    - Amount of data and information available on the effectiveness and evaluation of similar programs by FortisBC and elsewhere in the marketplace,
    - Budget constraints (see Section 4.1 for additional discussion on budgets).

  Subject to the same considerations as above, programs with explicit energy savings targets will have impact evaluations, unless there is a valid reason and an explicit decision is made not to do so.

- Transparency:
    - Reasons for decisions on evaluation methodologies will be documented

[5] DSM programs for which we do not report direct energy savings, such as Educational or Research Programs, may not be subject to the same impact evaluation activities as programs that we do report energy savings for.

  - Assumptions made during the conducting of an evaluation study will be documented.
  - Evaluation activities will be auditable.
  - Summaries of completed evaluations will be presented in the Companies' DSM Annual Reports. Final evaluation reports will be made available to the BC Utilities Commission, if requested.

- The use of third party evaluators
  - In most cases, FEI retains external consultants to conduct evaluation activities. Some aspects of evaluation may also be conducted internally by FEI. Measurement and verification activities may be outsourced or conducted by FEI staff. (See Section 4.3 for additional discussion on staffing resources).
  - Third party evaluators are retained based on a combination of the consultant's qualifications, the level of detail evaluation work required and the program size.
  - Evaluation staff and Program Managers work collectively to select the suitable external consultant to ensure that evaluation objectives and industry best practices are maintained while providing the best result for program development where applicable. The selection process and format is determined by the evaluation staff.

- The evaluation process will be integral to DSM planning:
  - Evaluation activities will be an important consideration during portfolio and program planning, and as part of the program business case process.
  - Early consideration of evaluation requirements help ensure that the necessary and timely data is collected throughout the program development and implementation process.

- Continuous Improvement:
  - The Companies will continue to monitor the energy efficiency marketplace for industry best practices, standards and protocols for evaluation practices and will adopt those that make practical sense for evaluation activities in BC.
  - The Companies will strive to become industry leaders in evaluation activities.
  - This framework is expected to remain stable over time, but will be updated as necessary.

- Timeliness
    - FEI will strive to conduct and complete evaluations at appropriate times within the program lifecycle, given resource constraints and program growth.

2.4 *EVALUATION PLANS*

This framework is not intended to be or to replace an evaluation plan. Evaluation Plans will be prepared by FortisBC for inclusion with the Companies applications to the BCUC for DSM funding. These plans will detail the programs that the Companies intend to evaluate, the types of evaluations the Companies intend to undertake, and general time frames for the evaluation activities during the period of the funding request. Progress made toward completing the evaluation plan, and any needed adjustments to the plan, will be provided in the Companies' Annual DSM reports.

3. TYPES OF EVALUATION STUDIES

There are a range of EM&V studies that are undertaken to evaluate FortisBC DSM programs. The type, timing and frequency of studies, and the evaluation practices implemented for each study will depend on a variety of factors including the type of program being evaluated, the level of program spending, experience with similar programs, the number of program participants, the quality of data upon which any energy savings assumptions are based, and more. For clarity, the evaluation component of EM&V refers to the broad spectrum of evaluation activities that can make up an evaluation plan while Measurement and Verification refers more specifically to the range of methodologies used to measure and verify actual energy savings from implementing a program of demand side measures. Hence measurement and verification is a subset of evaluation activities.

3.1 *PROCESS EVALUATIONS*

Process evaluations examine the effectiveness of program delivery. Objectives for process evaluations include improving program implementation and program delivery as well as ensuring high satisfaction levels among customers, trade allies and other program participants. Areas reviewed include incentive and rebate levels; communication and promotional initiatives; program operations and implementation; customer awareness and acceptance as a customer service (satisfaction) of energy efficient technologies and measures; and trade ally (distribution & implementation) awareness and acceptance. Process evaluations are generally first conducted within 6 to 18 months following the launch of a new program and for long duration programs on a periodic basis thereafter.

3.2 *MARKET EVALUATIONS*

Market evaluations test a DSM program's effectiveness at increasing the market penetration of an efficient technology or measure. Objectives for market evaluations include measuring increases in market penetration of energy efficient technologies and assessing the share of measures attributable to the program. Market effects often have a larger impact on the adoption rate of a product or technology than they receive credit for, and taking credit for this can often negate some of the free rider impacts. Evaluation activities include:

- assessing market potential and market penetration over time through a review of the availability, accessibility and affordability of energy efficient technologies and measures,
- identifying barriers and assessing the program's effectiveness at overcoming barriers, and
- assessing how much of the remaining market the program can be expected to address.

When a market evaluation is determined to be necessary, the timing must allow a sufficient period for program implementation and uptake. These evaluations are therefore generally conducted between two and three years following a program launch.

3.3 *IMPACT EVALUATIONS*

Impact evaluations measure energy savings achieved by a DSM program. Objectives for impact studies include:

- evaluating the realized energy savings,
- estimating free-rider and spill-over (market) effects to determine net savings impacts, and
- determining the cost effectiveness of the program according to a set of cost-benefit analysis based on industry and/or regulatory standards.

Impact evaluations will draw on information available from measurement and verification studies, energy consumption data (billing analysis), results or key findings of similar programs and evaluations in other jurisdictions, and/or benchmarking studies as appropriate and where such information exists. As with process evaluations, an impact evaluation may include comments on appropriateness of program design and/or suggestions for changes to increase effectiveness.

The timing of impact evaluations must allow a sufficient period of program operation for implementation and uptake, including the adoption of process improvements that might be identified during the early program period. Generally, impact evaluations are conducted between two and three years following a program’s launch. However, depending on the program life cycle, impact evaluations may be conducted annually to provide a preliminary check on the engineering estimates or when findings are required to launch the program for a second year.

For some programs, impact evaluations may occur in two stages. The first stage will involve participant survey work to improve the Companies’ knowledge about the implementation of individual measures, and a second stage that involves a billing or other more detailed analysis.

3.4 *PILOT STUDIES*

Pilot studies are an important component of the Companies’ DSM portfolio and are conducted to provide necessary research into potential new efficiency measures or technologies in support of developing new programs or initiatives. New measures can include new emerging technology but also existing technology with low adaption rate or used in a new application. Research objectives can include understanding how the market may respond to the introduction of a new measure, obtaining adequate performance data for a new measure (valid for local conditions), or both. FortisBC limits pilot study activity to the assessment of new efficiency measures or technologies that are market ready, but not yet widely available or adopted within BC.

Studies focused on obtaining an understanding of the market include typical market research investigations such as participant surveys. Studies focused on obtaining measure performance data include measurement and verification studies. In both cases, the pilot is used to test the idea on a small scale and hence reduce risk and cost if the program concept requires modifying prior to the launch of a full scale program or if performance results are insufficient for the development of a full program.

3.5 *MEASUREMENT AND VERIFICATION ACTIVITIES*

M&V refers to a range of activities or studies used to determine the performance of an installed DSM measure. M&V activities may also be implemented as part of the evaluation of full scale programs if such activities are viewed as helpful to meet evaluation objectives.

Wherever practical, the Companies intend to follow the International Performance Measurement and Verification Protocol (IPMVP)[6] in conducting M&V activities for evaluating DSM programs and pilots. FortisBC's review of industry standards, guidelines and protocols indicates that IPMVP is growing in use as a standard resource for guiding the design of M&V activities and provides both a comprehensive and flexible approach. It should be noted that while IPMVP summarizes common industry practices for M&V activities and sets out a range of methodologies that can be followed under ideal study conditions and in absence of budget or timing constraints, it also acknowledges that ideal study conditions and large M&V budgets are seldom available. As such, the Protocol provides guidelines for the evaluator to follow under less than ideal conditions and in the face of budget and timing constraints. The Protocol therefore allows room for judgment by the evaluator under less than ideal evaluation circumstances.

The following M&V principles[7] are embedded in the IPMVP:

Accurate M&V reports should be as accurate as the M&V budget will allow. M&V costs should normally be small relative to the monetary value of the savings being evaluated. M&V expenditures should also be consistent with the financial implications of over- or under-reporting of a project's performance. Accuracy tradeoffs should be accompanied by increased conservativeness in any estimates and judgments.

[6] International Performance Measurement and Verification Protocol. Concepts and Options for Determining Energy and Water Savings. Prepared by the Efficiency Valuation Organization. www.evo-world.org. January 2012.

[7] These principles have been reproduced from Chapter 3 of the IPMVP (see also the preceding footnote).

Complete The reporting of energy savings should consider all effects of a project. M&V activities should use measurements to quantify the significant effects, while estimating all others.

Conservative Where judgments are made about uncertain quantities, M&V procedures should be designed to under-estimate savings.

Consistent The reporting of a project's energy conservation effectiveness should be consistent between:

- different types of energy efficiency projects;
- different energy management professionals for any one project;
- different periods of time for the same project; and
- energy efficiency projects and new energy supply projects.

'Consistent' does not mean 'identical,' since it is recognized that any empirically derived report involves judgments which may not be made identically by all reporters. By identifying key areas of judgment, IPMVP helps to avoid inconsistencies arising from lack of consideration of important dimensions.

Relevant The determination of savings should measure the performance parameters of concern, or least well known, while other less critical or predictable parameters may be estimated.

Transparent All M&V activities should be clearly and fully disclosed.

3.6 *EVALUATION METHODOLOGIES*

A range of evaluation methodology types can be utilized to determine the energy savings achieved from the implementation of an efficiency measure. One way to think of this range of methodologies is as of a tool box, with each methodology being a different tool that the evaluator can bring out of the tool box to apply to the evaluation problem. The best tool (or methodology) to use depends on the circumstances of the required evaluation and the available resources. In many cases, more than one methodology will be applied to evaluate the energy savings achieved from an efficiency measure or program of measures. Common evaluation methodologies are summarized as follows:

Billing Analysis

Billing analysis uses customer billing information to assess the effect of a DSM program (or measure) on customer billed energy consumption. The analysis typically requires a baseline billing history period in the absence of the measure being installed and typically one year of billing data following the measure installation. The fundamental assumption is that the only, or major, change in energy consumption over this period has resulted from the measure being evaluated. This approach requires both data cleaning to ensure the quality of the billing data (i.e.: no missed billing reads or estimated bills) and weather adjusting. Combining a participant survey with the billing analysis can provide additional information regarding the changes in occupancy or usage patterns. When possible, a billing analysis should include both participants and non-participants, so that outside influences, such as price changes for fuels, can also be accounted in the analysis. Billing analysis is generally more effective for programs with higher customer savings. Lower savings levels (1-3% for example) can be more difficult to explain using billing analysis due to the potential for other factors to influence energy use patterns.

Metering

Metering involves the installation of energy use meters around the measure being studied to determine specific energy inputs and outputs both prior to and subsequent to the installation of an energy efficiency measure. In the residential sector, metering is primarily used in pilot projects to improve the accuracy of determining the energy impact associated with a DSM measure. Metering can also be used as part of monitoring studies to determine energy usage of appliances over time.

In the commercial and industrial sector metering is commonly used to determine the impact of both custom and pilot programs, where there is insufficient information about the impact of specific measures. Metering analysis can be done on a short-term “spot” basis or on a longer term basis. Long term metering of end-use before and after the installation is preferable to spot metering where economic, and where the participant behavior is not expected to be affected by the measurement.

Simulation Modeling

The effects of efficiency improvements in both residential and commercial buildings can be estimated through simulation of energy use under various scenarios using computer based energy models. In the residential sector, HOT2000 is a commonly used model developed for this purpose, while commercial energy use modeling often requires more complex models such as DOE2. Simulation modeling may be used as part of program design, to obtain initial estimates of energy impact, and/or as part of an initial impact evaluation where billing or metering data is not yet available to refine the modeling estimates.

Engineering Estimates

This method is based on an engineering analysis of the difference in efficiency between the “standard” measure and the installed efficiency measure. It may be based on standard efficiency measurements, such as the difference in EF rating for hot water tanks or the difference in AFUE ratings for furnaces. At a more basic level, it may require analysis of the differences in design of the energy efficient equipment being installed.

Statistically Adjusted Engineering Estimates

This approach utilizes engineering models and statistical approaches to examine the amount and nature of customer end-use loads. The results of simulated end-use loads from engineering methods become inputs into statistical models and are adjusted on the basis of customers' observed loads (statistical data). The resulting end-use loads, called statistically adjusted engineering (SAE) loads, depend on a variety of conditioning variables such as weather and the size and type of the customer's dwelling, or perhaps income and other household characteristics identified as part of the statistical analysis.

Surveys

Survey data is often the basis of both process and impact evaluations. Surveys may take the form of mail, telephone, internet panels, and more recently social media analysis, and may be done with participants and non-participants in any given program. Data collected includes awareness of the program, satisfaction, persistence, usage of the efficiency measure and information to help establish levels of free riders and spillover.

Field Studies and Laboratory Research

This type of analysis can be undertaken are as part of pilot program projects when the utility is conducting a detailed review of a small number of a specific efficiency measures that are “market ready” but not in wide use in the utility’s service territory. Typically, the research combines survey data from the customer where the pilot project is being conducted (to understand parameters such as usability and satisfaction with the technology), and metering of baseline and post implementation periods to determine the change in energy use.

Site Visits

Site visits can be used to examine programs across all customer classes to confirm that the target efficiency measure has been successfully installed and is in operation. Site visits can be combined with interviews of homeowners or facility operators to provide additional data valuable to the evaluation process.

Statistical Analysis

Mathematical approaches such as regression analysis and conditional demand analysis are often used in evaluation studies. These approaches can approximate some of the benefits of metering, but through the use of surveys or audits combined with billing histories can include a much larger group of customers at a much lower evaluation cost. Offsetting the cost advantages of this approach, however, are increased uncertainties due to potential changes in energy use unrelated to the efficiency measure being studied.

3.7 OTHER EVALUATION CONSIDERATIONS

Evaluation activities need to consider a number of issues not yet discussed.

Multi – Fuel Impacts

DSM programs may impact the use of electricity, natural gas and other fuels. Often, a program aimed primarily at reducing natural gas consumption may also impact electricity consumption or vice versa. For example a furnace efficiency program that encourages the installation of a variable speed fan might reduce both natural gas and electricity consumption. Natural gas and electricity are the most commonly used energy fuels in BC's built environment; however, the potential exists for the consumption of other fuels, such as propane or heating oil, to similarly be impacted by a DSM program. The potential for such multi-fuel impacts needs to be addressed as part of program evaluation activities.

Persistence of Savings

For natural gas programs, the persistence of energy savings over time is often a function of the life span of the measure or technology. In some cases, however, persistence can be more complex. There may be a need to determine if the equipment or technology being installed will maintain its efficiency rating over time. Also, circumstances may require a shorter (than life span) duration of savings to be assessed such as may occur if the program accelerates the installation of a high efficiency measure that would otherwise require installment at a later date. These complexities must also be addressed as part of the evaluation activities.

Interactive Effects

Impact evaluations should look more broadly than just the energy savings that result from the change in efficiency of the energy conservation measure. Changes in the measure can cause a number of other changes. For example, the evaluation of the residential furnace program (from 2005 to 2007) illustrated that upgrading a furnace has larger impacts than just replacing one technology with another. This evaluation illustrated that the new furnace changed the usage of secondary heat for a share of participants, and also that increases in comfort may result in homeowners selecting lower temperatures in their dwellings. The changes can affect the overall efficiency of energy use, and can also result in changing the balance of all fuel types in use in the building usage including natural gas, electricity and wood.

Attribution of Savings from Joint Programs

The Companies also undertake and participate in integrated electricity and natural gas programs, both within the FortisBC utilities and between the FortisBC natural gas utility and BC Hydro. Attributing for the energy savings and carbon emission reductions that result from such projects among partner organizations needs to be fair, consistent and transparent. The Companies apply the following principles, which incorporate current practice based on established industry standards and provincial regulation, while considering the regulatory environment in BC. These principles align with current best practices as described in the 2014

ACEEE report, "Successful Practices in Combined Gas and Electric Utility Energy Efficiency Programs"(U1406).

- *Double-counting of savings will continue to be avoided by each utility reporting only energy savings associated with their respective delivered energy source for integrated programs. In its reporting to the Provincial Government and BCUC, the partner electric utilities will report only electric savings. In its reporting to the BCUC, the FEI will report only gas savings.*

- *Non-primary fuel savings (i.e., natural gas savings for the partner electric utilities and electricity savings for the FEI) resulting from program activities are tracked in order to inform cost-effectiveness calculations, but are not included in formal reporting.*

- *When attributing savings in the cost benefit analysis of EEC programs, any claimed savings will be matched with appropriate associated costs. That is, if it makes sense to conduct an all-fuel cost-effectiveness test for a particular joint program, the test should include the appropriate costs and energy savings from both electricity and gas measures. However, if it is appropriate to calculate the cost effectiveness only for the FEI portion (for example) of an integrated program, then only the costs and energy savings related to the gas portion of the program will be included. As program design affects the inputs to the cost-effectiveness test, each utility will develop an understanding of the other's deemed partner cost approaches by collaborating during the development of business cases to ensure claimed savings match with costs as per industry standards and best practices where they exist.*

Related Studies

In addition to evaluation programs, FEI undertakes a number of studies which are used to support both program development and evaluation. These include:

- Sector End Use Studies conducted periodically to provide a "snapshot" of customers' products and equipment. These studies often include supporting analysis such as "Conditional Demand Analysis" (CDA) components that provide estimates of the amount of natural gas usage by end uses.
- Conservation potential reviews, which are systematic assessments of the current status of energy efficiency in the installed appliance stock in the marketplace and projections of the main end uses where efficiency improvements are possible, along with estimates of potential energy reductions.

3.8 FEEDING EM&V STUDY RESULTS INTO DSM PLANNING

Evaluation and program management staff at FortisBC review the results of evaluation studies and reports to determine if changes to programs are needed. In the case of M&V activities, this review will assist staff in determining if new programs should be developed based on pilot study results or if adjustments need to be made to the data used to determine program or project cost effectiveness. For program design and development, project managers need to consider additional factors such as human, technical and budgetary resources, portfolio priorities and any feedback received from stakeholders.

4. EVALUATION RESOURCES

Effective management of evaluation activities requires both financial and staffing resources.

4.1 *EVALUATION BUDGETS*

Industry practice for budget spending on EM&V activities appears to range from just below 2 percent to 3 percent of spending on overall energy efficiency and conservation program budgets. The Companies examined the results of recent industry surveys on evaluation expenditures. Survey results obtained from E Source, an energy efficiency consultancy serving gas and electric utilities throughout North America, indicate that for utilities with DSM expenditures of between US$ 20 and 55 Million, DSM budgets are between 2 percent and 3 percent, and that the proportion of DSM expenditures on evaluation decreases as the size of the portfolio increases[8]. Utilities with expenditures greater than $US 55 million tend to spend just under 2 percent on evaluation. The Consortium for Energy Efficiency (CEE) found that in 2014 US and Canadian natural gas utilities spent about 2 percent of their overall DSM budgets on evaluation and in 2015 this value dropped to 1 percent for Canadian Utilities[9].

This level of spending is in keeping with the principle that evaluation budgets should be a small component of overall programming budgets. That is, an evaluation budget, and therefore evaluation efforts, should not be so extensive that they unnecessarily cause a program to fail a cost-benefit test and thereby prevent the program from being implemented. As such, the Companies will plan EM&V budgets to be between 2 and 3 percent of the overall DSM portfolio spending.

On a program by program basis, there may be occasions when either higher or lower budgets for individual programs may be appropriate. A new program for which there is very little industry data available and for which energy efficiency performance may have a higher degree of uncertainty, may warrant a higher spending level. Pilot studies that examine the actual performance of a newer technology or measure, for example. In other cases, a program being implemented may benefit from similar programs in other jurisdictions having similar geographic and climate settings may be abundant, evaluation data may be well established and smaller budgets are appropriate.

4.2 *EVALUATION ORGANIZATION*

Wherever possible, the evaluation of programs that span across FEI's and FBC's separate utility service territories will be conducted as a single evaluation in order to take advantage of evaluation cost efficiencies and incorporate consistency across service areas. Similarly,

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

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

evaluations of joint electric and gas DSM programs will be conducted as a single for the partners involved in delivering the program.

Evaluations will be conducted or managed by staff who are independent from the program managers and other staff responsible for designing and implementing DSM programs. Staff responsible for evaluation activities will have separate reporting lines from that of program development and implementation staff wherever practical within the utilities.

4.3 STAFFING RESOURCES

The companies recognize that a combination of internal staffing resources and external professional consulting services will be needed to undertake the full range of evaluation activities that are required for the level of DSM program activity being implemented. The level of internal staff resourcing for evaluation activities will be sufficient to ensure that a base level of evaluation activity can be managed as appropriate for the level of program activity being delivered by the Companies.

Evaluation studies are generally outsourced by the Companies to external consultants. For M&V projects, external consultants will be retained whenever specialized expertise is required that FEI does not have in house and whenever increased levels of activity occur such that they cannot be completed by internal staff. Staffing and consultant resources will also be managed within the appropriate budgeting parameters (see Section 4.1).

Sufficient internal staff resources are needed to plan evaluation activities, manage evaluation projects, review third party consultation studies / reports and conduct some evaluation analysis.

- Development of RFPs
- Working with purchasing to obtain quotes from qualified service providers
- Developing selection criteria for the proposals
- Managing the selection criteria
- Managing the evaluation projects
- Maintaining communications with interested parts of the organization (esp. EEC)

Evaluation staff will be involved in the program planning process to determine the major evaluation issues for each program and ensuring that sufficient evaluation resources are available.

Staff Resources for Measurement and Verification Activities:

Internal engineering expertise is required to develop technical measurement and verification process requirements, develop measurement and verification plans, inspect measurement and verification work being done by third parties, be able to conduct measurement and verification activities when necessary. Number of internal staff must be sufficient to manage base level work load, provide consistent project management, and must be managed relative to overall EEC budgeting requirements.

4.4 ROLE OF STAKEHOLDER ADVISORY GROUPS

Advisory Groups made up of key stakeholders external to the Companies have been established by FortisBC to provide insight and feedback on the Companies' portfolios of DSM activities. Advisory Group members are not expected to have a high level of expertise in EM&V and are not expected to provide input on individual evaluation or measurement and verification projects. FEI will make any final evaluation report summaries available to Advisory Group members if requested. Members will also be able to contact FortisBC staff for more detailed discussions/explanations if desired. A list of evaluation activities will also be included in the Companies' Annual Reports for their DSM programs. From time to time, the Companies may review EM&V issues and results with the Advisory Groups for discussion and feedback.

The companies submit evaluation plans through either their Revenue Requirements Application or other filings for approval by the BCUC. Any stakeholder can participate in the review of the evaluation plans through the BCUC's regulatory review process[10].

[10] Visit www.bcuc.com

Appendix E

FBC DSM 2017 ANNUAL REPORT

FORTIS BC™

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Vice President, Regulatory Affairs

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March 29, 2018

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

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

Dear Mr. Wruck:

Re: FortisBC Inc. (FBC)

Electricity Demand-Side Management (DSM) – 2017 Annual Report

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Attached please find the Electricity DSM Program 2017 Annual Report for FBC (the Annual Report).

Request for Confidentiality of Certain Information

FBC is also filing completed Monitoring and Evaluation Reports (the Evaluation Reports) separately as Confidential Appendix E and Confidential Appendix F of the Annual Report. FBC requests that the Evaluation Reports be filed on a confidential basis pursuant to Section 18 of the Commission's Rules of Practice regarding confidential documents established by Order G-1-16. The Evaluation Reports must be kept confidential on the basis that these reports contain customer-specific information that should not be disclosed to the public. In addition, the methodology and processes used in the reports are proprietary to the consultants hired by FBC. The publicly available Executive Summaries of the Evaluation Reports are provided in Appendices C and D.

If further information is required, please contact Sarah Wagner, Senior Regulatory Analyst, at (250) 469-6081.

Sincerely,

FORTISBC INC.

Original signed:

Diane Roy

Attachment

FortisBC Inc.

Electricity
Demand-Side Management Programs
2017 Annual Report

March 29, 2018

Table of Contents

List of Appendices

Index of Tables and Figures

1. REPORT OVERVIEW

This Demand-Side Management (DSM) Annual Report (the Report) provides highlights of FortisBC Inc.'s (FBC or the Company) DSM programs for the year ended December 31, 2017 and provides a summary of results achieved in 2017. The Report reviews the progress of FBC's DSM programs in meeting the approved 2017 DSM Plan[1] (Plan) by educating and incenting FBC's customers to conserve energy and improve the energy efficiency of their homes, buildings and businesses.

FBC and FortisBC Energy Inc. (FEI) DSM staff are largely integrated as the Conservation and Energy Management (C&EM) department, with a joint leadership team that combines program managers' responsibilities, wherever possible.

Section 1-3 includes summaries of how FBC's DSM programs met the requirements of the Demand-Side Measures Regulation (DSM Regulation) enacted under the *Utilities Commission Act* (UCA) in 2017. Section 1 contains a statement of financial results (Table 1-1), including Total Resource Cost (TRC) benefit/cost ratio cost-effectiveness test results for 2017. Sections 2 through 7 of the Report provide an overview of DSM program activities in 2017, by program area, including program-level comparisons of actual energy savings and costs to Plan.

Consistent with previous DSM Annual Reports, additional details on program results, cost-effectiveness test results, as well as historical DSM costs and energy savings are included in Appendix A and Appendix B, respectively. Two evaluation reports were completed in 2017; one for the Heat Pump Program and the other for the Custom Business Efficiency Program (the Evaluation Reports), the executive summaries for which are filed in Appendix C and Appendix D respectively. In accordance with Directive 21 of BCUC Order G-186-14, the full versions of the Evaluation Reports are provided in CONFIDENTIAL Appendix E and CONFIDENTIAL Appendix F.

1.1 *PORTFOLIO LEVEL RESULTS*

Table 1-1 provides an overview of FBC's 2017 energy savings, expenditures and TRC cost-effectiveness test results for all DSM programs, by program area (sector) and at the portfolio level. The Company achieved an overall portfolio TRC of 2.4 on DSM expenditures of $7.7 million, which were 18 percent higher than in 2016. Electricity savings totalled 27.8 GWh, a 22 percent increase over 2016 savings. As all programs passed the TRC, results for the modified TRC are not required.

FBC's 2017 DSM expenditures were one percent higher than the approved Plan. After accounting for $400,500 in co-funding received for the Energy Conservation Assistance Program and the Heat Pump Water Heater pilot, the 2017 net expenditure was $7.3 million or 96 percent of Plan. In accordance with past practise, additional detail and results for the TRC, Utility Cost Test (UCT),

[1] 2017 DSM Plan expenditures were accepted by the Commission pursuant to Order G-9-17.

the Ratepayer Impact Measure (RIM) cost effectiveness tests, and Levelized Costs are provided for the overall portfolio and each Program Area in Appendix A, Table A-1.

Table 1-1: DSM Portfolio Summary Results for 2017

	Annual Electricity Savings (MWh)		Utility Expenditures ($000s)		
Program Area	**2017 Approved Plan**	**2017 Actual**	**Total 2017 Actual**	**2017 Approved Plan**	**TRC B/C Ratio**
Residential Programs	7,755	10,154	1,363	1,557	4.0
Low Income Housing	2,739	693	529	1,161	1.4
Res'l & Low Income Total	**10,493**	**10,847**	**1,891**	**2,718**	**3.6**
Commercial Programs	13,666	16,115	4,023	3,131	2.2
Industrial Program	1,556	876	206	309	4.8
Programs Total	**25,715**	**27,838**	**6,120**	**6,158**	**2.7**
Portfolio Level Activities					
Planning & Evaluation			994	777	
Supporting Initiatives			595	674	
Total Portfolio	**25,715**	**27,838**	**7,709**	**7,610**	**2.4**
Less: Partner Co-funding			(401)		
Total after Co-funding	**25,715**	**27,838**	**7,309**	**7,610**	**2.4**

In 2017, FBC met the conditions of the British Columbia *Demand-Side Measures Regulation* (DSM Regulation), achieving a portfolio TRC value of 2.4. The Low Income program achieved a TRC of 1.3, after including the allowed 40 percent adder to benefits. The TRC test result (2.4 overall) was slightly higher than in 2016 (2.3 overall).

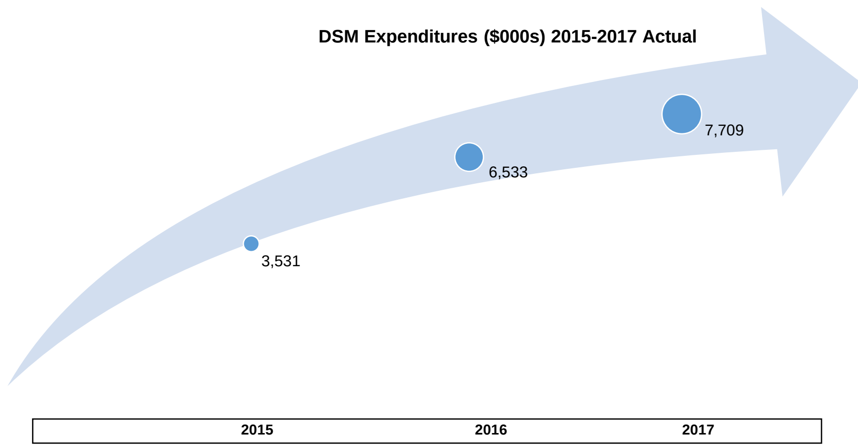
1.2 *MEETING APPROVED PLAN EXPENDITURE LEVELS*

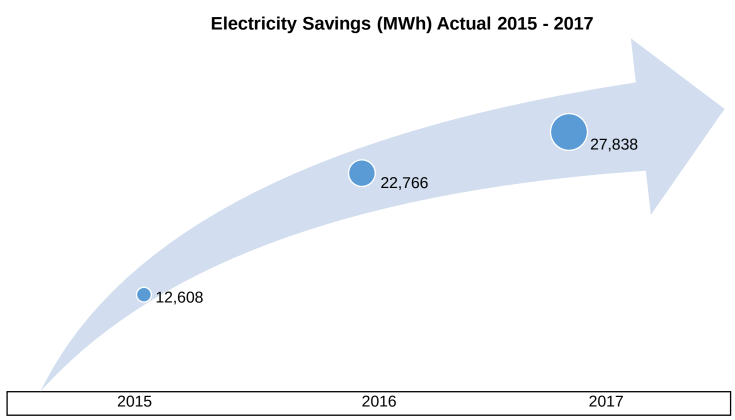
Actual 2017 DSM expenditures were one percent above the 2017 Plan levels accepted by the Commission as part of FBC's 2017 DSM Expenditure Application (2017 DSM Application). Actual 2017 expenditures of $7.7 million equal 101 percent of Plan expenditures and actual energy savings of 27.8 GWh equal 108 percent of Plan savings.

Since 2015, the Company has been rebuilding its DSM activities and has increased its results each year. Figure 1-2 shows the actual expenditures and savings for 2015 to 2017.

FBC achieved its 2017 Plan savings and expenditures, as indicated in Table 1-1. In addition, third party co-funding received from the British Columbia Ministry of Energy and Mines (MEM), British Columbia Hydro and Power Authority (BC Hydro) and Natural Resources Canada totalling $0.4 million reduced overall costs to FBC ratepayers, resulting in a net expenditure of $7.3 million.

Figure 1-2: FBC Expenditures and Savings (2015-2017)





1.3 *MEETING ADEQUACY REQUIREMENTS OF THE DEMAND-SIDE MEASURES REGULATION*

The adequacy requirements set out in the DSM Regulation at the time the 2017 DSM Plan was approved were as follows:

A public utility's plan portfolio is adequate for the purposes of Section 44.1 (8) c of the Act only if the plan portfolio includes all the following:

a) A demand-side measure intended specifically to assist residents of low-income households to reduce their energy consumption;

b) a demand-side measure intended specifically to improve the energy efficiency of rental accommodations;

c) An education program for students enrolled in schools in the public utility's service area; and

d) an education program for students enrolled in post-secondary institutions in the public utility's service area.

FBC notes its approved 2017 DSM Plan was in compliance with the adequacy requirements of the DSM Regulation, including BC Reg. 141/2014 amendments (effective July 10, 2014). As detailed in the Report, the Company met all the requirements for adequacy that were in place prior to the March 2017 amendment of the DSM Regulation.

Programs and incentives for low income customers, including Energy Savings Kits (ESK) and Energy Conservation Assistance Program (ECAP), are discussed in Section 3.

With regard to offerings to rental apartment buildings, a number of the Commercial Energy Efficiency programs are intended for use by owners of rental buildings, including the Rental Apartment Efficiency Program (RAP), detailed in Section 4.2.1. Tenants can also access ECAP and ESK offers, and other Residential Energy Efficiency programs are available to qualifying rental properties.

In terms of education programs, the Company funded a variety of initiatives for K-12 students, including BC Lions Energy Champion school assembly presentations, FortisBC Energy Leaders, and Energy is Awesome. The Company also funded post-secondary student engagement initiatives, including a program at Okanagan College and providing training grants (see Section 6.2.3).

1.4 *ADDRESSING BCUC DIRECTIVES*

There are no outstanding directives to be addressed in the Report; BCUC directives contained in Decision and Order G-186-14 have all been addressed in previous Annual DSM Reports.

1.5 *COLLABORATION & INTEGRATION*

The Company continues to collaborate and integrate energy efficiency programming with both FEI and BC Hydro, as well as with other entities such as governments and industry associations.

The Company recognizes that collaboration among utilities maximizes program efficacy and effectiveness. Collaborative activity is reported in the individual Program Area sections and program descriptions.

FBC, FEI and BC Hydro (the BC Utilities) also continue to experience additional benefits from collaboration efforts, including cost savings, streamlined application processes for customers, extended program reach and consistent and unified messaging, resulting in improved energy literacy among each utility's customers.

1.6 *PORTFOLIO SUMMARY*

The Company's DSM portfolio met the goal of cost effectiveness, with a TRC value of 2.4 in 2017. FBC is of the view that both energy savings accounted for in the portfolio and the resulting TRC are conservative. In addition to the direct energy benefits accounted for in the TRC, benefits from additional activities, such as Supporting Initiatives, play an important role in supporting the development and delivery of programs, while helping facilitate market transformation in British Columbia.

2. RESIDENTIAL PROGRAM AREA

2.1 *OVERVIEW*

The Residential Program Area achieved aggregate electricity savings of 10.2 GWh, and an overall TRC of 4.0. Approximately $1.4 million was invested in Residential energy efficiency measures in 2017, and 69 percent of these expenditures were in the form of incentives. The energy savings results from Residential programs were 131 percent of Plan, with the Lighting program contributing 80 percent of total Residential savings.

Residential programs address customers' major end-uses in residential detached dwellings, row-townhomes or mobile homes, and include retrofit and new home applications. Residential programs, in combination with education and outreach activities, play an important role in driving the culture of conservation in British Columbia.

Table 2-1 summarizes the actual expenditures for the Residential Program Area in 2017 compared to Plan, including incentive and non-incentive spending, annual and lifetime electric savings, as well as TRC cost-effectiveness test results.

Table 2-1: 2017 Residential Program Area Results Summary

	Annual Electricity Savings (MWh)			Utility Expenditures ($000s)			
Program Area	**2017 Approved Plan**	**2017 Actual**	**Lifetime Savings**	**Incentive Expenditure**	**Non-Incentive Expenditure**	**Total 2017 Actual**	**2017 Approved Plan**
Residential							
Home Renovation Rebate	364	187	6,082	66	129	196	348
Behavioural	3,097	20	56	4	1	5	200
Rental	508	295	4,091	42	35	77	206
Heat Pump Water Heaters	17	12	139	0	0	1	30
Appliances	126	494	7,727	240	98	337	133
Lighting	2,735	8,125	74,701	326	53	380	190
Heat Pumps	781	976	23,656	235	72	307	298
New Home Program	126	45	1,570	22	39	61	151
Residential Subtotal	**7,755**	**10,154**	**118,020**	**936**	**427**	**1,363**	**1,557**

2.2 *RESIDENTIAL PROGRAMS*

The highlights of the Residential programs are outlined below:

2.2.1 Home Renovation Rebate and Heat Pump Programs

The following activities were undertaken in the Home Renovation and Heat Pump programs in 2017:

- The Home Renovation Rebate (HRR), formerly called the Home Improvement Program, is a province wide program delivered and marketed in collaboration with BC Hydro and FEI, continued to gain momentum. By focusing on the most cost-effective retrofit measures and using a "menu" approach, the program provides incentives to customers for insulation and draft-proofing, bathroom fans, and space and water heating;

- A fall retail point of sale program was implemented in partnership with FEI and BC Hydro with RONA, Canadian Tire, and Home Depot. Instant rebates were offered on smart products, bathroom fans and thermostats. Bathroom fans were moved from HRR to the fall retail program to see if the uptake would be higher in a retail environment, and the results were positive;
- In partnership with FEI, BC Hydro and the MEM, funding was provided to support a Home Performance Stakeholder Council; and
- Heat pump rebates were offered through two channels: ductless heat pumps through the HRR program and central heat pump systems through a stand-alone program. A lower interest rate was introduced to the Company's long-standing air source heat pump loan offer for electrically-heated homes in 2016 and maintained throughout 2017. In addition, the heat pump tune up program attracted over 300 participants.

2.2.2 Appliance Program

The Appliance Retail Program continues to grow, encouraging retailers to carry top tier efficiency models for clothes washers, clothes dryers and refrigerators. By engaging retailers more consistently, the appliance program grew substantially with a 104 percent increase in kWh savings in 2017, and over 3,300 appliance rebates processed.

2.2.3 Residential Lighting Program

The Residential Lighting program offered point-of-sale rebates for ENERGY STAR labelled lighting products. Offered in collaboration with BC Hydro to provide a BC-wide offer to customers through lighting retailers across the BC market, the campaign ran for two months in the spring and one month in the fall in major retail stores.

The Residential Lighting program exceeded Plan savings by nearly 200 percent due to successful retail campaigns. Residential Lighting program costs were commensurate with savings at double the Plan amount. A number of changes in the rebate offering were implemented in 2017: a shorter offer period, the removal of A19 bulbs from the list of qualifying products, and switching to a percentage rather than a fixed rebate. These factors, as well as other market factors, led to savings from the 2017 Lighting program of 8.1 GWh, a six percent reduction from 2016 results.

2.2.4 New Home Program

The New Home program offers incentives for homes built to the ENERGY STAR New Home standard. 2017 saw a small increase in program participation, although the challenges central to 2016 remained. ENERGY STAR has high brand recognition, but stringent performance and prescriptive requirements have resulted in modest program participation by builders. The second tier of FBC's Residential Conservation Rate (RCR) is also a deterrent to builders/home owners choosing electric heat.

An internal review of this program is underway in order to identify improvements to increase participation, with plans to implement changes that align with the BC Energy Step Code.

2.2.5 Rental Apartment Program

There are three components to the Rental Apartment Program (RAP):

1. To provide direct install in-suite energy efficiency measures for occupants (renters) in multi-family rental properties;
2. To provide rental building owners and/or property/management companies with energy assessments recommending building level energy efficiency upgrades, such as common area lighting upgrades; and
3. To provide support in implementing the recommended upgrades and applying for rebates.

The program is offered jointly by FEI and FBC in the shared service territory (SST)[2] and by FEI outside the SST. A total of 44 buildings received in-suite installations in 2017 in the SST, with 3,557 individual measures installed, as shown in Table 2-2.

Table 2-2: 2017 RAP Installations

Installed Measure Type	# Units
CFL PAR 38, 23 W bulb	194
LED 16W bulb	77
LED 9.5 W bulb	3,286
Total measures intalled	3,557

2.2.6 Behavioural Programs

In 2017, FBC undertook a behavioural program to provide high usage customers with in-home displays. As an incentive for high usage customers who completed a survey of electricity use, 50 in-home displays were received for their homes. The program achieved measured savings, estimated at 20 MWh for these units.

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

[2] The Shared Service Territory is the overlapping service territories of FBC and FEI where both natural gas and electricity are supplied.

2.3 *RESIDENTIAL SUMMARY*

The Residential Program Area, including the Low Income program discussed in further detail in Section 3, realized 10.8 GWh of energy savings at an expenditure of $1.9 million, and achieved a TRC of 3.6. In 2017, Lighting remained the core Residential measure, delivering 75 percent of the overall Residential Program Area energy savings. With a TRC of 6.7, it was the most cost-effective program of the Residential portfolio.

3. LOW INCOME PROGRAM AREA

3.1 OVERVIEW

FBC worked collaboratively with FEI to deliver Low Income programs to customers in the SST.

Table 3-1 summarizes the planned and actual expenditures for the Low Income Program Area. In accordance with July 2014 amendments to Section 4(2)(b) of the DSM Regulation, the TRC of 1.3 for low income programs includes a 40 percent adder in the benefits, increasing the deemed cost effectiveness.

Table 3-1: 2016 Low Income Program Results Summary

	Annual Electricity Savings (MWh)			Utility Expenditures ($000s)			
Program Area	2017 Approved Plan	2017 Actual	Lifetime Savings	Incentive Expenditure	Non-Incentive Expenditure	Total 2017 Actual	2017 Approved Plan
Low Income Housing	2,739	693	7,171	409	119	529	1,161

Savings were 693 MWh for Low Income programs. Over 800 ECAP direct installations were completed in 2017, resulting in 440 MWh of energy savings. Additionally, 819 Energy Savings Kits (ESKs) were distributed, contributing savings of 253 MWh.

The following sections provide detail on the two Low Income programs delivered in 2017.

3.2 ENERGY SAVINGS KITS

ESKs were promoted and distributed at local food banks and other community events in the pre-heating season, as well as direct mailed to on-line applicants and Contact Centre referrals. In addition, the Company worked with FEI and BC Hydro to deliver a direct mail brochure through the British Columbia Ministry of Social Development's cheque run, and promoted the program through in-bill stuffers. In 2017, participation was in line with prior year results, although slightly lower than participation results in 2016.

3.3 ENERGY CONSERVATION ASSISTANCE PROGRAM

The Company delivered ECAP in the SST for eligible low income single and multi-family dwellings. The program's "basic" service level provided energy evaluations, consumer education, and the direct installation of energy efficiency measures including LED lighting, low-flow showerheads, faucet aerators and hot water pipe insulation at no cost. For homes that met the eligibility criteria for the "advanced" program level, ENERGY STAR refrigerators, high-efficiency furnaces, draft-proofing and insulation were also provided.

The ECAP program was promoted primarily through community-based social service organizations. Participation in 2017 was 24 percent lower than in 2016 due to 2016 results including installations for applications that were received beginning in November 2015, but not installed until the program was fully operational in February 2016.

3.4 *LOW INCOME SUMMARY*

The Low Income program area achieved savings of 693 MWh from $530,000 in expenditures. The overall TRC, including a 40 percent adder for benefits, was 1.3, up from 0.9 in 2016.

4. COMMERCIAL PROGRAM AREA

4.1 OVERVIEW

Commercial DSM programs encourage commercial customers (including institutions, government etc.) to reduce overall consumption of electricity and associated energy costs. The Commercial programs produced aggregate electricity savings of 16.1 GWh and achieved an overall TRC of 2.2 in 2017. Actual Commercial program expenditures totaled $4.0 million, 69 percent of which was in the form of incentives.

Table 4-1 summarizes Plan and actual expenditures for the Commercial programs, including incentive and non-incentive spending, annual and lifetime savings, and the TRC cost-effectiveness test results.

Table 4-1: 2017 Commercial Program Results Summary

	Annual Electricity Savings (MWh)			Utility Expenditures ($000s)			
Program Area	**2017 Approved Plan**	**2017 Actual**	**Lifetime Savings**	**Incentive Expenditure**	**Non-Incentive Expenditure**	**Total 2017 Actual**	**2017 Approved Plan**
Commercial							
Lighting	10,592	12,580	224,139	2,222	527	2,749	2,322
Sm Business Direct Install	0	2,634	56,547	430	432	862	-
Building Improvement	2,931	605	10,242	104	267	371	784
Irrigation	144	59	1,170	10	3	12	25
MURB New Construction	0	237	3,723	25	3	29	
Commercial Total	**13,666**	**16,115**	**295,822**	**2,791**	**1,232**	**4,023**	**3,131**

The Commercial sector recorded savings of 16.1 GWh, or 118 percent of Plan. Approximately 94 percent of these savings were realized through the commercial lighting programs, including Commercial Product Rebate (CPR) program, Business Direct Install (BDI) program and custom lighting projects incented through the Custom Business Efficiency program (CBEP) rebates. An example of a commercial lighting project was the replacement of high-pressure sodium exterior lighting with LEDs at the Kelowna International Airport, which contributed 127 MWh of energy savings.

Building and Process Improvement (BIP) energy savings were 0.6 GWh or 21 percent of Plan. An example of a BIP project was the installation of a high-efficiency refrigeration system at a local grocery store, which contributed 138 MWh of energy savings.

Commercial sector costs in 2017 amounted to $4.0 million or 128 percent of Plan; a 72 percent increase over 2016. The largest cost component of Commercial programs was the Lighting program paid through CPR, BDI and CBEP.

The following sections provide detail on the key Commercial DSM programs offered in 2017.

4.2 COMMERCIAL PRODUCT REBATE AND BUSINESS DIRECT INSTALLATION

- The CPR program offers prescribed rebates for commercial lighting, HVAC, refrigeration, commercial kitchen appliances, irrigation and other electric energy efficiency measures. The program was offered through point-of-sale rebates at lighting wholesalers and directly to customers. A third party study was conducted to expand CPR offers and several new lighting, HVAC, kitchen and refrigeration measures were added. The new offers will be launched in early 2018.
- The BDI program was launched in April 2016 and provides point-of-sale rebates for the direct installation of lighting, HVAC, refrigeration, plug load and other end use measures to small and medium businesses. The BDI implementer contract term ended in December 2017. BDI rebates will be incorporated in the CPR program and the electrical contractor benefits will be transitioned to the FortisBC Trade Ally Network (TAN) in 2018;
- In partnership with FEI, FBC offers the Rental Apartment Efficiency Program (RAP) that specifically addresses the rental market by providing direct in-suite installations of hot water and LED lighting measures, energy assessments and implementation support for deeper energy efficiency retrofits at the building-wide level (see Section 2.2.5); and
- To support customers in MURBs, FBC developed the MURB New Construction program jointly with FEI to encourage building energy efficiency above code. The MURB New Construction program provides prescribed rebates for energy efficient lighting, controls, electric HVAC, natural gas HVAC, natural gas hot water and natural gas fireplace measures.

4.3 CUSTOM BUSINESS EFFICIENCY PROGRAM (CBEP)

- CBEP provides custom rebates for larger, more complex energy efficiency retrofits and new construction projects in both the Commercial and Industrial sectors;
- FBC and FEI offer a joint new construction program to encourage energy efficient electric and natural gas measures to be installed in large new construction projects. The program allows new building projects over 85,000 square feet to access subsidized energy modelling and provide custom rebates for both electric and natural gas energy conservation measures; and
- FBC and FEI have a joint retrofit program to encourage energy efficient electric and natural gas retrofits in existing buildings. The energy efficiency electric measures are primarily focussed on deeper building and process retrofit energy conservation measures. The program allows existing buildings to access a subsidized energy assessment and then provide custom rebates for both electric and natural gas energy conservation measures.

4.4 COMMERCIAL SUMMARY

The Commercial program area activity in 2017 achieved 16.1 GWh of annual electricity savings, almost doubling 2016 results, and achieved a TRC of 2.2, an increase from the 2016 TRC of 1.5. The program is experiencing the rapid adoption of LED lighting, supported by the downward cost curve in LED lighting products.

5. INDUSTRIAL PROGRAM AREA

5.1 OVERVIEW

The Industrial DSM programs continued to encourage industrial customers to consume electricity more efficiently in 2017. The Industrial programs achieved an overall TRC of 4.8, with electricity savings of 0.9 GWh. Actual Industrial expenditures in 2017 totalled $0.2 million, of which 70 percent was incentive spending.

Table 5-1 summarizes the plan and actual expenditures for the Industrial Program Area in 2017, including incentive and non-incentive spending, annual and lifetime electricity savings, and TRC cost-effectiveness test results.

Table 5-1: 2017 Industrial Program Results Summary

	Annual Electricity Savings (MWh)			Utility Expenditures ($000s)			
Program Area	**2017 Approved Plan**	**2017 Actual**	**Lifetime Savings**	**Incentive Expenditure**	**Non-Incentive Expenditure**	**Total 2017 Actual**	**2017 Approved Plan**
Industrial							
Industrial Efficiency	1,556	876	13,980	145	61	206	309
Industrial Total	**1,556**	**876**	**13,980**	**145**	**61**	**206**	**309**

The Industrial Efficiency program achieved savings of 0.9 GWh, or 56 percent of the 1.6 GWh Plan for 2017 and a decrease over 2016 savings of 2.1 GWh.

The Industrial sector is characterized by large “lumpy” projects that generally occur less frequently and take much longer to complete, so the realization of energy savings can shift to a following year. In 2017, delays were associated with two medium sized industrial energy efficiency projects and the cancellation of a sawmill modernization energy efficiency project.

Industrial sector costs incurred totaled $0.2 million for 2017, or 67 percent of Plan. An example of an industrial energy efficiency project was a compressed air upgrade for a large winery that contributed to 138 MWh of energy savings.

5.2 INDUSTRIAL PROGRAMS

- The Custom Business Efficiency program (CBEP) provides custom rebates for larger, more complex energy efficiency retrofits, including, but not limited to, lighting, compressed air, hydraulics, industrial controls, fans and pumps;
- The Industrial Optimization Program (IOP) provides industrial customers with electricity usage in excess of 3 GWh electricity per year two different energy assessment offers
    - The Plant Wide Audit: a high level, whole facility audit to identify energy efficiency and both electric and natural gas conservation measures;

- The Feasibility Study: a detailed engineering study of a specific process or system to fully investigate opportunities to use electricity and natural gas more efficiently. In 2017, the first IOP studies was completed at a local wood pellet mill.

5.3 *INDUSTRIAL SUMMARY*

In 2017, the Industrial energy savings and program costs were below Plan at 876 MWh and $206 thousand due to project delays and a cancellation. Overall, the Industrial program area achieved a 4.8 TRC for 2017.

6. SUPPORTING INITIATIVES

6.1 *OVERVIEW*

Supporting initiatives support the goals of conservation and energy management in a variety of ways, from funding and supporting educational opportunities in schools, to promoting energy conservation at community events.

To maximize internal efficiencies and minimize duplicate messaging, FBC worked collaboratively with FEI for all initiatives except for a limited number of electricity-only outreach events. Budgets and other resources were coordinated to provide school and community outreach, retail campaigns, communications pieces and various event materials. The Company also supported various training seminars and educational workshops in collaboration with the Canadian Home Builders' Association and other industry associations.

The Community Energy Planning program, described in further detail in section 6.2, was fully subscribed and will result in community or institutional strategic energy plans that will promote energy efficiency into the future.

Supporting Initiative activities are not incentive-based programs, therefore the Company has not attributed any direct savings to them. Supporting Initiatives costs are included at the portfolio level and incorporated into the overall portfolio cost-effectiveness results..

Plan expenditures for 2017 were $0.7 million and actual spending was $0.6 million. Expenditures on Supporting Initiatives were 12 percent below Plan because a First Nation energy plan was delayed, and a post-secondary behavioural campaign was cancelled by the participant due to internal restructuring.

Table 6-1 summarizes the Plan and actual expenditures for Supporting Initiatives in 2017.

Table 6-1: 2017 Supporting Initiatives Results Summary

	Utility Expenditures ($000s)			
Program Area	**Incentive Expenditure**	**Non-Incentive Expenditure**	**Total 2017 Actual**	**2017 Approved Plan**
Supporting Initiatives	10	585	595	674

The following sections provide detail on FBC's Supporting Initiatives activity in 2017.

6.2 *COMMUNITY ENERGY PLANNING*

The Company continues to offer strategic Community Energy Planning financial assistance to local governments, including First Nations, and publically-funded institutions (up to 50 percent of project costs to a maximum of $20 thousand per participant) to facilitate future energy efficiency activities. Only one local government applied to access the funds in 2017.

6.3 *EDUCATION PROGRAMS (ELEMENTARY AND SECONDARY)*

The focus for 2017 was the development and launch of the elementary school curriculum-based Energy Leaders program, which started its pilot phase in late 2016. The program, accessed through an on-line portal, was fully launched in the fall of 2017.

The following programs were continued:

- Energy is Awesome, an interactive presentation focused on energy conservation and safety; and
- BC Lions Energy Champions program.

6.4 *EDUCATION PROGRAMS (POST-SECONDARY), INCLUDING TRADES TRAINING*

The Company partnered with and supported several university and college trade training programs that provided real life/living lab learning opportunities, as well as support for post-college upgrade training. These included:

- Support for Okanagan College for curriculum enhancement to include more efficiency construction techniques and the purchase of blower door equipment to better illustrate air-tightness;
- Support for the University of British Columbia Okanagan (UBCO) and Okanagan College Wilden Living Lab project, which saw two identically designed homes constructed side-by-side, one built to the current building code and the other to an EnerGuide rating of 47 GJ – less than half the energy usage of a typical new home. The homes will be monitored and analysed by UBCO for energy use over the next three years;
- Sponsorship of Illumination Engineering Society Fundamentals of Lighting course, and grants for electricians and local contractors to participate; and
- Grant support for Certified Energy Manager (CEM) training.

6.5 *COMMUNITY OUTREACH*

Opportunities to communicate directly with customers in less formal, community focused venues are important. In 2017, the Company engaged in the following outreach activities:

- Junior hockey game sponsorship: promotion of conservation in public venues;
- A new initiative, in collaboration with FEI, was successfully piloted with small businesses in the SST. The focus was face-to-face efficiency education, and through this pilot 371 small businesses were visited in 2017. This will become an ongoing offering in 2018;

- To support residential conservation and energy literacy, FortisBC's Street Team and Ambassadors attended 93 community events in the SST last year, including educational seminars, home shows and community events, such as the Rock Creek Fall Fair;
- Attendance and seminar presentations were undertaken at residential home shows, retail building supply and hardware stores; and commercial trade shows; and
- FortisBC's electronic newsletter, Energy Moment (previously known as the Conserver Club).

The Company, in collaboration with FEI, partnered with selected local governments to provide direct community engagement and marketing to residents and energy rebate program education for government officials and community organizations (i.e., Chambers of Commerce, community social service organizations).

6.6 *SECTOR SUPPORT*

To help promote energy efficiency and rebate programs, the Company supported several large institutions and harder to reach communities and stakeholders with resources and educational opportunities. This included:

- The Company co-sponsored two Energy Specialist positions (City of Kelowna and Interior Health Authority), in partnership with FEI, to promote both natural gas and electricity energy efficiency projects. Energy Specialists serve as an in-house customer resource that supports the development and execution of energy efficiency projects to increase participation in energy efficiency programs;
- The Company provided funds to the Regional District of Central Kootenay and the City of Kelowna for a Community Senior Energy Advisor to promote residential energy efficiency and the C&EM rebate programs at the community level; and
- FBC supported and provided education to trade allies (e.g. contractors) to promote energy efficiency products and C&EM rebate programs to their customers.

7. PLANNING AND EVALUATION

7.1 OVERVIEW

The BC Utilities (including Pacific Northern Gas) dual-fuel Conservation Potential Review (BC CPR) undertook additional scope services during 2017 that built on the base services Technical/Economic potential study. The additional work included three components: Market, Demand Response and Fuel-Switching (Electrification) potential. The latter will include an estimate of electric vehicle (EV) potential. These will be completed in 2018.

Members of the DSM Advisory Committee (DSMAC) were invited to a joint Energy Efficiency and Conservation Advisory Group (EECAG) meeting in late November 2017 to provide feedback on FortisBC's multi-year DSM expenditure plan filings anticipated in 2018.

FBC continued to operate its Monitoring and Evaluation (M&E) activities in 2017 in accordance with the DSM Monitoring and Evaluation Plan 2013-15[3], as amended and extended for 2017[4]. Evaluation activities are undertaken at different stages of the programs' lifecycles, when appropriate. The evaluation activities undertaken in 2017 and presented in Table 7-1 reflect the characteristics of the individual programs in the market and the level of studies required to provide program feedback.

7.2 PROGRAM EVALUATION ACTIVITIES

Primary types of Evaluation, Measurement and Verification (EM&V) activities include the following:

- Process evaluations, where surveys and interviews of participants and trade allies are used to assess customer satisfaction and program success;
- Impact evaluations, to measure the achieved energy savings attributable from the program, including free-ridership and spillover[5] impacts; and
- Measurement & Verification (M&V) activities, to confirm project specific energy savings associated with energy conservation measures. Secondary evaluation findings of market effects may be revealed through interviews of market players, such as trade allies.

FBC's evaluation activities for 2017 continued to focus on identifying energy savings, assessing participant awareness and satisfaction, barriers to participation, the effectiveness of education initiatives and conducting industry research regarding best practices. EM&V activities were focused on identifying and verifying project and measure level savings assumptions and

[3] FBC Application for 2014-2018 Performance Based Ratemaking Plan, Appendix H3.
[4] FBC Application for Demand Side Management (DSM) Expenditures for 2017, s.6.1 and Appendix A5.
[5] Free-ridership refers to participants who would have participated in the absence of the program and spillover refers to additional reductions in energy consumption or demand that are due to program influences that are not directly associated with program participation. Reference: National Renewable Energy Laboratory, https://www.nrel.gov/docs/fy17osti/68578.pdf

understanding any issues associated with equipment installation in the field. M&V activities associated with specific projects, conducted by third party engineering consultants to verify installed measures and savings thereof, are included in the project costs and not in the portfolio level EM&V costs.

Table 7-1: 2017 DSM Program Planning, Evaluation and Research Activities

Evaluation Name	Program Area	Type of Evaluation	Evaluation Partnership	Evaluation Status
Heat Pump Program	Residential	Process & Impact	None	Participant and contractor surveys for free-ridership and spillover. Process review. Review of other utilities' programs. Completed March 2018 by Research Into Action
Energy Conservation Assistance Program (ECAP) - Ongoing Feedback Survey	Low Income	Process	FEI & BC Hydro	Ongoing survey with program participants to gather frequent and ongoing feedback on customer experience, satisfaction with the program and its program evaluators.
Energy Conservation Assistance Program (ECAP)	Low Income	Evaluation Study	FEI & BC Hydro	Ongoing Quality Assurance to ensure products are installed according to program policies and procedures.
Energy Conservation Assistance Program (ECAP) - Overall Program Evaluation 2017	Low Income	Process & Impact	FEI	Participant survey and monthly consumption usage conducted for the program. Expected completion by Q2 2018
Rental Apartment Efficiency Program (RAP) - Evaluation 2016	Residential	Process	FEI	Building owner and Tenant survey for program evaluation with 2015 and 2016 program participants. Completed December 2016 by Cohesium Research.
Rental Apartment Efficiency Program (RAP) - Evaluation 2017	Residential	Process	FEI	Building owner and Tenant survey for program evaluation with 2017 program participants. Expected completion by Q1 2018
Commercial Custom Program	Commercial	Process & Impact	None	Participant and contractor surveys. On-site visits to ten participant sites. Completed March 2018 by Evergreen Economics
Smart Learning Thermostat Pilot	Innovative Technologies	Measurement & Verification	FEI	Gauging customer acceptance and energy savings associated with smart learning thermostats. Expected completion Q3 2019
Review of Net-to-Gross Assumptions (FEI & FBC Energy Efficiency Programs)	C&EM Portfolio	Evaluation Study	FEI	Review of net-to-gross (NTG) methods, data sources, and assumption used by FortisBC to ensure alignment with the industry best practices. Completed Decmber 2017 by Sampson Research
Contractor Research Survey	Residential	Process	FEI	Survey with program participants and non-participants within the Contractor community. Completed May 2017 by Participant Research and Sentis Research Inc.
Energy Specialist Program - Evaluation 2017	Commercial	Process & Impact	FEI	The evaluation study includes program and industry stakeholder surveys and an energy savings audit on a subset of completed 2017 projects. Expected completion by Q2 2018.

7.3 *PORTFOLIO EXPENDITURES*

Formerly known as Planning & Evaluation (P&E), the actual Portfolio expenditures for 2017 were $1.0 million, or 128 percent of Plan. However, after accounting for the $208 thousand in co-funding received, from MEM, BC Hydro and Natural Resources Canada for the Heat Pump Water Heater Pilot project, net Portfolio expenditures were $0.8 million or 101 percent of Plan. Costs comprise largely of staffing costs and consultants' fees for the two comprehensive evaluation studies undertaken. Non-program area specific costs, such as telephone and tracking system upgrades, are also reported herein.

7.4 *EVALUATION REPORTS*

Two evaluation studies were largely completed in 2017, one for Residential Heat Pumps and the other for Custom Commercial projects. These had been scheduled for 2016, but were delayed due to increased due-diligence of vendors for privacy policy and technical security compliance.

FBC requests that the Evaluation Reports be filed on a confidential basis pursuant to Section 18 of the Commission's Rules of Practice regarding confidential documents established by Order G-1-16. The Evaluation Reports must be kept confidential on the basis that these reports contain customer-specific information that should not be disclosed to the public. In addition, the methodology and processes used in the reports are proprietary to the consultants hired by FBC.

The executive summary of the evaluation study conducted on the Residential Heat Pump Program by a third-party research company, Research Into Action, is included in Appendix C. The full report[6] is provided separately in Confidential Appendix E.

The Heat Pump study's high level findings were an energy savings realization rate of 102 percent and an overall program-level weighted net-to-gross ratio (NTGR) of 84 percent. Loan participants had a significantly lower free-ridership rate of 15 percent, compared to rebate participants at 44 percent.

The executive summary of the evaluation study conducted on the Custom Business Efficiency Program by Evergreen Economics, is included in Appendix D. The full report is provided separately in Confidential Appendix F.

The CBEP study's high level findings were an energy savings realization rate of 100 percent, a program-level weighted NTGR of 69 percent, a measure-level NTGR of 59 percent for lighting and 76 percent for non-lighting measures.

[6] Order G-186-14, Directive 21

Appendix A

DSM PROGRAMS COST AND SAVINGS SUMMARY REPORT

Table A-1: FBC DSM Report for Year Ended December 31, 2017

	Annual Electricity Savings (MWh)		(MWh)	Utility Expenditures ($000s)				Cost Effectiveness Results			
Program Area	**2017 Approved Plan**	**2017 Actual**	**Lifetime Savings**	**Incentive Expenditure**	**Non-Incentive Expenditure**	**Total 2017 Actual**	**2017 Approved Plan**	**TRC B/C Ratio**	**Calc UTC**	**Calc RIM**	**Levelized cost (¢/kWh)**
Residential											
Home Renovation Rebate	364	187	6,082	66	129	196	348	1.8	1.7	0.6	7.6
Behavioural	3,097	20	56	4	1	5	200	1.1	1.1	0.5	0.0
Rental	508	295	4,091	42	35	77	206	6.7	5.4	0.9	0.1
Heat Pump Water Heaters	17	12	139	0	0	1	30	1.2	42.1	1.5	17.1
Appliances	126	494	7,727	240	98	337	133	2.2	2.9	1.0	9.8
Lighting	2,735	8,125	74,701	326	53	380	190	6.0	23.5	0.8	59.5
Heat Pumps	781	976	23,656	235	72	307	298	1.9	4.8	0.8	7.2
New Home Program	126	45	1,570	22	39	61	151	2.1	1.4	0.6	6.5
Residential Subtotal	**7,755**	**10,154**	**118,020**	**936**	**427**	**1,363**	**1,557**	**4.0**	**9.0**	**0.8**	**2.5**
Low Income Housing	2,739	693	7,171	409	119	529	1,161	1.4	1.3	0.5	927.2
Res'l & Low Income Total	**10,493**	**10,847**	**125,191**	**1,345**	**546**	**1,891**	**2,718**	**3.6**	**6.8**	**0.8**	**2.9**
Commercial											
Lighting	10,592	12,580	224,139	2,222	527	2,749	2,322	2.2	5.1	0.8	468.9
Sm Business Direct Install	0	2,634	56,547	430	432	862	-	3.3	3.7	0.7	25.3
Building Improvement	2,931	605	10,242	104	267	371	784	1.3	1.6	0.6	2.1
Irrigation	144	59	1,170	10	3	12	25	7.6	12.8	1.4	0.6
MURB New Construction	0	237	3,723	25	3	29		2.3	10.2	0.8	0.1
Commercial Total	**13,666**	**16,115**	**295,822**	**2,791**	**1,232**	**4,023**	**3,131**	**2.2**	**4.5**	**0.8**	**6.4**
Industrial											
Industrial Efficiency	1,556	876	13,980	145	61	206	309	4.8	5.2	0.8	2.6
Industrial Total	**1,556**	**876**	**13,980**	**145**	**61**	**206**	**309**	**4.8**	**5.2**	**0.8**	**2.6**
Programs Total	**25,715**	**27,838**	**434,993**	**4,281**	**1,839**	**6,120**	**6,158**	**2.7**	**5.3**	**0.8**	**4.6**
Portfolio Level Activities											
Planning & Evaluation					994	994	777				
Supporting Initiatives				10	585	595	674				
Total Portfolio	**25,715**	**27,838**	**434,993**	**4,292**	**3,418**	**7,709**	**7,610**	**2.4**	**4.2**	**0.8**	**4.6**
Less: Partner Co-funding				(193)	(208)	(401)					
Total after Co-funding	**25,715**	**27,838**	**434,993**	**4,099**	**3,210**	**7,309**	**7,610**	**2.4**	**4.4**	**0.8**	**5.1**

Appendix B

HISTORICAL SUMMARY OF DSM COST AND ENERGY SAVINGS RESULTS

Table B-1: Historical FBC DSM Costs and Energy Savings 2012-2017

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
		2012 (Actual)							2013 (Actual)						
		Spend ($000s)			Energy Savings (MWh)			TRC	Spend ($000s)			Energy Savings (MWh)			TRC
		Planned	Actual	Variance	Planned	Actual	Variance	(B/C)	Planned	Actual	Variance	Planned	Actual	Variance	(B/C)
1	**Residential**														
2	Home Improvements	1,719	637	1,082	7,620	4,656	(2,964)	1.7	1,961	725	1,236	8,680	5,222	(3,458)	1.7
3	Building Envelope[1]														
4	Heat Pumps	703	636	67	3,397	2,161	(1,236)	1.0	698	532	166	3,397	2,100	(1,297)	1.3
5	Residential Lighting	328	337	(9)	2,530	2,599	69	1.8	313	473	(160)	2,467	3,300	833	1.4
6	New Home Program	43	314	(271)	90	1,040	950	1.4	45	782	(737)	93	3,000	2,907	1.9
7	Appliances[1]	247	332	(85)	690	1,248	558		267	241	26	739	578	(161)	
8	Electronics[1]														
9	Water Heating[1]														
10	Low Income	677	308	369	1,774	1,054	(720)	1.3	660	415	245	1,570	2,000	(430)	1.6
11	Behavioural[1]														
12	*Residential Total*	**3,717**	**2,564**	**1,153**	**16,101**	**12,758**	**(3,343)**	**1.5**	**3,944**	**3,168**	**776**	**16,946**	**16,200**	**(1,606)**	**1.6**
13	**Commercial**														
14	Lighting	1,157	2,152	(995)	7,390	14,256	6,866	2.2	1,170	1,235	(65)	7,140	7,600	460	2.0
15	Building and Process Improvements	659	612	47	3,410	1,959	(1,451)	1.3	738	594	144	3,730	2,600	(1,130)	1.6
16	Computers														
17	Municipal (Water Handling)	383	255	128	2,580	1,677	(903)	2.6	177	80	97	1,110	700	(410)	1.4
18	Irrigation[2]														
19	*Commercial Total*	**2,199**	**3,019**	**(820)**	**13,380**	**17,892**	**4,512**	**2.0**	**2,085**	**1,909**	**176**	**11,980**	**10,900**	**(1,080)**	**1.8**
20	**Industrial**														
21	Compressed Air														
23	EMIS	27	10	17	190	-	(190)	2.0	41	17	24	290	-	(290)	-
22	Industrial Efficiencies	323	163	160	2,290	937	(1,353)	-	323	307	16	2,290	2,500	210	1.0
24	*Industrial Total*	**350**	**173**	**177**	**2,480**	**937**	**(1,543)**	**1.9**	**364**	**324**	**40**	**2,580**	**2,500**	**(80)**	**1.0**
25	**Programs Total**	**6,266**	**5,756**	**510**	**31,961**	**31,587**	**(374)**	**1.8**	**6,393**	**5,401**	**992**	**31,506**	**29,600**	**(2,766)**	**1.9**
26	Supporting Initiatives	725	816	(91)	-	-	-	-	725	706	19	-	-	-	-
27	Planning & Evaluation	740	728	12	-	-	-	-	760	748	12	-	-	-	-
28	**Total**	**7,731**	**7,300**	**431**	**31,961**	**31,587**	**(374)**	**1.6**	**7,878**	**6,855**	**1,023**	**31,506**	**29,600**	**(2,766)**	**1.6**

[1] These programs were included in Home Improvements program
[2] Irrigation was included in Municipal (Water Handling)
[3] Benefits calculated using RS3808 applicable at the time

Table B-2: Historical FBC DSM Costs and Energy Savings 2012-2016 (cont'd)

		1	2	3	4	5	6	7	8						
		2014 (Actual)							2015 (Actual)						
		Spend ($000s)			Energy Savings (MWh)			TRC	Spend ($000s)			Energy Savings (MWh)			TRC
		Planned	Actual	Variance	Planned	Actual	Variance	(B/C)	Planned	Actual	Variance	Planned	Actual	Variance	(B/C)
1	**Residential**														
2	Home Improvements	295	391	(96)	1,881	1,299	582	1.5	884	199	685	3,106	231	2,875	1.7
3	Heat Pumps	158	252	(94)	553	865	(312)	1.6	302	182	120	1,618	569	1,049	1.5
4	Residential Lighting	176	291	(115)	2,136	3,411	(1,275)	1.5	193	198	(5)	1,569	4,144	(2,575)	5.3
5	New Home Program	67	254	(187)	98	733	(635)	2.7	390	111	279	1,179	356	823	1.1
6	Appliances[1]	-	-	-	-	-	-		96	71	25	288	52	236	1.2
7	Water Heating	99	3	96	425	92	333		387	2	385	850	5	845	1.5
8	Low Income	242	502	(260)	707	2,286	(1,579)	1.9	824	287	537	2,598	282	2,316	1.3
9	Behavioural[1]			-			-		85	-	85	888	-	888	0.0
10	*Residential Total*	**1,037**	**1,694**	**(657)**	**5,800**	**8,686**	**(2,886)**	**1.7**	**3,160**	**1,050**	**2,110**	**12,096**	**5,639**	**6,457**	**2.9**
11	**Commercial**										-			-	
12	Lighting	510	646	(136)	3,359	3,353	6	2.0	1,485	735	750	7,445	4,089	3,356	2.0
13	Building and Process Improvements	592	533	59	2,641	1,926	715	1.4	897	543	354	3,832	1,606	2,226	1.6
14	Municipal (Water Handling)	-	5	(5)	-	-	-		79	36	43	759	187	572	2.3
15	Irrigation	32	-	32	200	-	200	0.0	69	9	60	490	-	490	0.0
16	*Commercial Total*	**1,134**	**1,184**	**(50)**	**6,200**	**5,279**	**921**	**1.6**	**2,530**	**1,324**	**1,206**	**12,526**	**5,882**	**6,644**	**1.8**
17	**Industrial**														
18	Compressed Air[3]														
19	Industrial Efficiencies	148	188	(40)	800	614	1,121	1.2	202	226	(24)	1,537	1,087	450	2.0
20	*Industrial Total*	**148**	**188**	**(40)**	**800**	**614**	**2,041**	**1.2**	**202**	**226**	**(24)**	**1,537**	**1,087**	**450**	**2.0**
21	**Programs Total**							**2.0**							**2.2**
22	Supporting Initiatives	190	207	(17)					675	346	329				0.0
23	Planning & Evaluation	492	579	(87)					725	585	140				0.0
24	Recoveries from 2013		(378)	378							-				
25	**Total**	**3,001**	**3,473**	**(472)**	**12,800**	**14,580**	**75**	**1.6**	**7,292**	**3,531**	**3,761**	**26,159**	**12,608**	**13,551**	**2.0**

[1] In 2014, these programs were included in Home Improvements progr

[2] In 2014, Compressed Air was included in Industrial Efficiencies.

[3] In 2015, Computers was added to Process Improvements and had no Spending or Savings.

Table B-3: Historical FBC DSM Costs and Energy Savings 2012-2016 (cont'd)

		2016 Actual						
		Spend ($000s)			Energy Savings (MWh)			TRC
1	**Residential**	Planned	Actual	Variance	Planned	Actual	Variance	(B/C)
2	Home Improvement Program	884	225	659	3,106	243	2,863	1.6
3	Behavioural	106	79	27	1,048	587	461	4.1
4	Rental	-	137	(137)	576	840	(264)	4.5
5	Watersavers	430	72	358	948	21	927	2.3
6	Appliances	96	245	(149)	288	242	45	1.6
7	Lighting	189	360	(171)	1,547	8,607	(7,059)	10.7
8	Heat Pumps	302	249	53	1,618	753	865	1.6
9	New Home Program	390	39	351	1,179	31	1,148	1.4
10	Low Income Housing	952	1,111	(159)	2,598	1,214	1,385	0.9
11	*Residential Total*	**3,348**	**2,518**	**830**	**12,908**	**12,538**	**370**	**4.0**
12	**Commercial**			-			-	
13	Lighting	1,519	1,192	327	7,616	5,694	1,922	1.6
14	Sm Business Direct Install	-	556	(556)	-	1,139	(1,139)	1.6
15	Building Improvement	842	574	268	3,452	1,234	2,218	1.0
16	Computers	55	-	55	378	-	378	
17	Municipal (WWTP)	79	4	75	759	-	759	0.0
18	Irrigation	69	13	56	490	61	429	2.1
19	*Commercial Total*	**2,564**	**2,339**	**225**	**12,695**	**8,128**	**4,566**	**1.5**
20	**Industrial**			-			-	
21	Industrial Efficiency	209	300	(91)	1,585	2,099	(514)	6.9
22	*Industrial Total*	209	300	(91)	1,585	2,099	(514)	6.9
23	**Programs Total**	**6,122**	**5,158**	**964**	**27,188**	**22,766**	**4,422**	**2.6**
24	Portfolio Level Activities			-			-	
25	P&E, M&E, Dev	735	718	17			-	
26	Supporting Initiatives	675	657.3	17.68			0	
27	**Total**	**7,532**	**6,533**	**998**	**27,188**	**22,766**	**4,422**	**2.3**

Appendix C

RESIDENTIAL HEAT PUMPS PROGRAM EXECUTIVE SUMMARY

Final Report

Evaluation of the FortisBC Residential Heat Pump Program

March 27, 2018

Funded By:

FORTIS BC™

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&

sbw
ENERGY • WATER • EFFICIENCY

Bob Tingleff

Executive Summary

FortisBC commissioned this study to gain a deeper understanding of the effectiveness of its residential heat pump offerings in driving uptake of heat pumps and shifting the market from electric resistance heating to heat pump technologies.[1] Presently, FortisBC offers a $1,200 rebate for a central air source heat pump (ASHP), $800 rebate for a ductless ASHP, or a loan of up to $6,500 at a 1.9% interest rate for either central or ductless ASHP. We refer to these residential heat pump offerings collectively as the "Heat Pump Program."

Research Into Action and SBW, the evaluation team, conducted several tasks as part of this evaluation:

- Assessed savings for the two measures (central and ductless ASHP)
- Estimated free-ridership (FR) and spillover (SO) and net-to-gross (NTG) ratio
- Reviewed program tracking data and documentation
- Interviewed program staff about goals, program processes, and program delivery challenges
- Surveyed trade allies and participants on program influence and processes

The team estimated savings for the two heat pump measures using residential energy simulation software. Results derived with this software have been calibrated to utility bills in the U.S. Pacific Northwest (PNW) region. The calibration adjustments were applied to the results found for the FortisBC Heat Pump Program.

Note inputs to the savings simulations were based on data collected as part of the program implementation, data gathered in a phone survey of program participants, and data provided by FortisBC personnel. These data included parameters such as home size, type of home, efficiency of installed heat pumps, and prevalence of Heating Ventilation and Air Conditioning (HVAC) system types in homes in FortisBC territory. Where inputs specific to FortisBC program participants were not available, values used by programs in the PNW were used.

We also estimated FR and SO based on data from the participant and trade ally surveys and calculated NTG ratio with the formula NTG = 1 – FR + SO. We calculated both FR and SO values for central and ductless ASHP and for the program as a whole. We weighted the measure-level mean values by the proportion of participants who received rebates versus loans, and we weighted the program-level mean values by the proportion of program savings that central and ductless ASHP generated.

SO estimates included estimations of both participant and nonparticipant SO. We estimated the participant SO from the participant survey and nonparticipant SO from the trade ally survey data.

1 Excluding heat pump water heater offerings.

We surveyed 77 participants and 15 trade allies. The 15 trade allies represented 53% of all installations completed in 2016-2017. Below we present a summary of the key findings, conclusions, and recommendations from this study.

Key Findings, Conclusions, and Recommendations

Conclusion 1: **This study's estimate of the ductless ASHP savings value was higher than the savings value used by the program in 2017** (Table ES-1)**.** Compared to the savings values used by the program in 2017, the study's estimate of the ductless ASHP savings value was higher while the estimate of the central ASHP savings value was lower. Since a large majority (74%) of the installed units in 2016 and 2017 were ductless ASHPs, the overall realization rate (the study-estimated savings as a percentage of the program claimed savings) was 102%.

Table ES-1: Calibrated Simulation Estimation of Savings Compared to Program Savings Values

	kWh Savings per Year per Ton		Realization Rate	
Measure	Estimated and Calibrated Savings	FortisBC 2017 Program Energy Savings [a]	Percentage of Participants (by Measure)	Program (Weighted by Participation %)
Central ASHP	1309	1700	26%	102%
Ductless ASHP	2406	2200	74%	

[a] Reported by FortisBC staff. Savings are 4,400 per Ductless ASHP, with an average of 2 tons per unit.

The savings calibration adjustment based on comparison of simulation output to utility bills had a large impact on the per-ton savings estimate shown in Table ES-1. The calibration study conducted in the PNW found that occupant behavior reduced actual energy use significantly compared with that predicted by the simulation software, especially in poorly insulated homes where energy consumption would be the highest. Occupant behavior may differ in FortisBC territory. To improve on the estimates of savings found here, we ***recommend*** a study that measures actual energy consumption.

The program-level FR was 0.36, participant SO was 0.02, and nonparticipant SO was .18. Thus, the NTG ratio was 1 - .36 + .02 + .18 = .84.

Conclusion 2: **Generating more loan than rebate applications will help lower FR at the program level.** FR is substantially lower for loan than rebate participants (Table ES-2). The program-level FR is 0.361.[2]

[2] The program-level free-ridership is the savings weighted mean of the measure-level free-ridership scores.

Table ES-2: FR Scores by Participant Type

Measure	Count	Mean FR Score	Confidence/ Precision
Loan	20	0.150	85/12
Rebate	57	0.442	90/10

To generate more loan applications, we offer two ***recommendations:***

1. Reach out to contractors to encourage them to promote FortisBC loans since very few contractors reported discussing FortisBC loan offers with their customers. However, since contractors often do not like to deal with loan paperwork, provide them with the information on loan offers but do not ask them to help customers with that paperwork.
2. Increase the focus on the loan options in program marketing campaigns. The loan participants most commonly noted hearing about the loans from their family, friends, or other acquaintances (45% of all responses). A smaller proportion reported hearing about the loans from channels FortisBC uses to promote the heat pump incentives: website (15%), bill inserts (5%), and contractors (20%).

Conclusion 3: **Program is influencing trade allies to sell qualifying equipment outside of the program.** We asked trade allies to report on program-qualifying and program-influenced heat pump measures sold for which no incentives or program financing were provided. From this data, we were able to estimate the nonparticipant SO. The prior evaluation assessed participant SO only. Our findings show a much higher nonparticipant than participant SO (Table ES-3).

Table ES-3: Spillover

Type	Data Source	SO
Participant SO	Participant Survey	0.02
Nonparticipant SO	Trade Ally Survey	0.18

We ***recommend*** FortisBC measures the nonparticipant SO in future evaluations.

Conclusion 4: **Saving money should not be the sole message conveyed when promoting heat pumps and program incentives.** Surveyed participants were less satisfied with bill savings than with heat pump reliability, comfort from it, and ease of operation. Additionally, the nonparticipant survey conducted by Illumina Research Partners[3] revealed that high-usage customers were skeptical that the ASHP will save them money if they installed one. We ***recommend*** program staff include and/or highlight messages around comfort, ease of operation, and reliability of ASHPs in program and/or marketing collateral. The vast majority (90% or more) of customers were highly satisfied with these non-energy benefits.

[3] *FortisBC Heat Pump Potential: Pumping Up Potential for Electricity Conservation*. Prepared for FortisBC by Illumina Research Partners, June 2, 2017. FortisBC proprietary research document.

Conclusion 5: **Current rebates, although reasonable, could be further optimized**. While current participants indicated that rebate levels were adequate – and even suggested they might have bought heat pumps at lower rebate levels, feedback from surveyed contractors and nonparticipants[4] suggests that current incentive levels may not be sufficient to drive a large increase in participation.[5] Since staff are considering restructuring rebate offers, we ***recommend*** exploring tiered rebates that depend upon factors such as efficiency level or whether the heat pump is certified to operate in very cold climates. Tiered rebates would reward (i.e., be higher for) customers who installed more efficient equipment and are the most common type of rebates offered by many heat pump programs we reviewed during this evaluation.

Conclusion 6: **Promotion of program offerings via multiple channels generates confusion among customers.** FortisBC customers receive rebates for ductless ASHPs through the Home Renovation Rebate Program, while central ASHPs are incented through another program. Loan and ductless ASHP rebate applications are submitted via mail, while central ASHP rebate applications are submitted online. Ductless ASHP rebate submissions are processed by a third-party, while central ASHP loan submissions and rebates are processed internally. This complexity appears to generate confusion among customers: staff noted customers who mistakenly apply for ductless ASHP rebates online are confused when their application is rejected. Ductless ASHP rebate must be submitted via mail to a third-party implementer. However, whether this potential confusion and requirement to resubmit reduces the number of applications is unclear. We ***recommend*** FortisBC investigate this impact by tracking the number of such customers who resubmit to assess the relative frequency with which such customers drop out of the application process. Further, since FortisBC staff must spend time explaining the process and helping such customers resubmit applications through the correct channel, we recommend that FortisBC consider *s*treamlining these processes to reduce administrative costs.

4 Ibid.

5 The nonparticipant study reported that the current central ASHP rebate is sufficient for "only" 35% of customers and the current ductless rebate is sufficient for "only" 30%. Note that these percentages translate to around 50,000 customers, which is many multiples of the total number of rebates provided to date.

Appendix D

CUSTOM BUSINESS EFFICIENCY PROGRAM EXECUTIVE SUMMARY

EVERGREEN
ECONOMICS

Evaluation of the FortisBC Custom Business Efficiency Program (CBEP)

Submitted by Evergreen Economics

Executive Summary

March 28, 2018

Table of Contents

1 Executive Summary

1.1 Introduction

This report presents the impact and process evaluation results for the FortisBC Custom Business Efficiency Program (CBEP) covering participants that completed projects from November 2014 through July 2017.

This program provides custom rebates for larger, more complex energy efficiency retrofits and new construction projects for medium to large customers in both the Commercial and Industrial sectors. Completed projects include lighting upgrades, industrial compressed air upgrades and municipal water projects. Other qualifying projects include measures such as HVAC upgrades, hydraulics, industrial controls, fans and pumps. Energy savings are calculated with the assistance of Technical Advisors on an individual project basis based on the eligible measures. For CBEP projects where the estimated rebate amount is greater than $10,000, the rebate is paid in two installments. The first payment is equal to one-half of the total estimated rebate amount, as determined at the time the project is completed. The second payment is paid after the project savings have been verified and is equal to the total rebate amount associated with the verified savings, minus the first installment payment.

The Evergreen Economics evaluation team that conducted the research consists of the following firms:

- Evergreen Economics (prime contractor)
- Michaels Energy
- Phil Willems / PWP
- Sentis Research

The evaluation relied on several analysis methods to derive gross and net impacts:

- **Engineering analysis.** The Evergreen team completed both desk reviews (n=37) and site visits (n=9) for participating CBEP customers. Reviews focused on the appropriateness of assumptions and savings algorithms that were used in calculating energy savings, along with a verification that measures were installed in participants' facilities.
- **Participant phone surveys.** A phone survey was conducted on a sample of program participants (n=20). These surveys were used primarily to collect feedback on the program experience as part of the process evaluation and estimate self-reported free ridership.

- **Net-to-gross analysis.** The evaluation team estimated net impact savings for CBEP using the battery of questions in the phone survey focused on what equipment would have been installed if the FortisBC CBEP had not been available. A program net-to-gross ratio was calculated based on the evaluation team's free ridership scoring system.
- **Trade ally interviews.** Interviews were conducted with contacts provided by FortisBC (n=3) to evaluate the effectiveness of the program's design and delivery and better understand contractors' experience with the program.
- **FortisBC staff interviews**. Interviews were conducted with key FortisBC staff members (n=3) to identify the overall processes and effectiveness of CBEP and inform the other research tasks.

1.2 Impact Evaluation Results

The impact evaluation portion of the FortisBC CBEP evaluation consisted of three main research tasks:

- **Desk reviews of project documentation.** The evaluation team's engineers reviewed the project documentation for 37 CBEP projects to help determine the appropriateness of assumptions and savings algorithms that were used in calculating energy savings.
- **Project site visits.** Site visits were conducted on available participants to understand the equipment installed through the program, determine installation rates and help aid the savings claim validation.
- **Self-reported participant free ridership.** Results from the participant phone survey were used to estimate participant free ridership and the subsequent weighted net-to-gross ratios to determine program net impacts.

1.2.1 Engineering Review of Savings Values – Desk Reviews

The evaluation team carefully examined the complete set of documentation for each project during desk reviews. During project file reviews, we verified all key characteristics of the sampled projects, including:

1. **Engineering Equations.** Savings were calculated using engineering models that must be consistent with sound engineering fundamentals. The evaluation team scrutinized each equation to verify that it was fundamentally consistent and arithmetically accurate.
2. **Technical Assumptions.** An engineering equation can be correct, but the result still inappropriate if the inputs into equations are not reasonable. We traced the sources of assumptions through calculation files and supporting documentation such as

invoices, equipment specifications, data trends, codes and standards, and written project descriptions.

3. **Baseline Used.** Proper baselines are an essential part of any program impact evaluation. We reviewed the project documentation to determine if the selected baseline was appropriate for the technology and application.
4. **Holistic Results.** The overall savings were given a final review to confirm that measure savings as a portion of total building consumption were reasonable. Were the savings proportional to what was expected for the measure? If facility usage histories were available, were the project savings relative to facility usage reasonable?

Desk reviews were completed for 37 projects, which represented 4,099,239 kWh in energy savings and 1,060.5 kW in demand savings. The desk reviews included a review of the project documentation in addition to determining the appropriateness of assumptions and savings algorithms that were used to calculate energy savings.

A review of the project documentation and savings analyses showed that key operating parameters and equipment quantities used in the savings analyses were consistent with the information provided in the project documentation.

No adjustments were made to the claimed savings based on the desk reviews. The savings for the projects evaluated through a desk review are shown below in Table 1. The projects in the desk review sample accounted for approximately 36 percent of the overall program kWh savings (11,430,613).

Table 1: Summary of Savings - Desk Reviews

	kW	kWh
Claimed	1,060.5	4,099,239
Ex Post	1,060.5	4,099,239
Realization Rate	100.0%	100.0%

1.2.2 Engineering Review of Savings Values – Site Visits

Once desk reviews were completed, the evaluation team selected another nine projects for follow-up site visits. The selected projects constituted the largest projects in the sample. The site visits focused on verifying the following information with customers:

- **Equipment Installation:** During the site visit, the evaluation team verified any new equipment that had been installed. Additionally, relevant existing equipment was also verified to be consistent with the energy calculations. Equipment specifications, make and model numbers, and physical descriptions were also verified as appropriate.

- **Equipment Operation:** The customer was interviewed regarding the operation of pertinent equipment. If data were collected by the customer, they were reviewed during the site visit. Operational information was compared to what FortisBC staff used in the *ex ante* calculations.
- **Baseline Conditions:** The customer was also interviewed about the baseline equipment or conditions for the project. This could include what equipment was removed, changes to equipment operation, or facility conditions that were adjusted.

The evaluation team completed site visits in order to gain a better understanding of the equipment installed through the program. The information gathered during site visits was used to determine installation rates and to aid in validating the savings claims for a sample of the projects that were completed over the study period (November 2014 – July 2017). Site visits were completed at four facilities to verify the completion of nine projects. These projects accounted for 487.1 kW in demand savings and 3,301,098 kWh in energy savings, representing 47 percent of the overall sample savings and 29 percent of the overall population savings. The evaluated measures included air compressor upgrades, variable speed drives, and LED light fixtures.

All of the equipment was found to be installed and operating as expected. The realization rates for each of the projects are shown in Table 2.

Table 2: Summary of Savings - Site Visits

	Claimed Savings		Evaluated Savings		Realization Rates	
Project Number	**kW**	**kWh**	**kW**	**kWh**	**kW**	**kWh**
ME3 - c	169.00	1,277,858	169.00	1,277,858	100%	100%
ME3 - d	89.30	782,648	89.30	782,648	100%	100%
ME3 - a	81.70	392,591	81.70	392,591	100%	100%
ME4	24.92	213,446	24.92	213,446	100%	100%
ME1	27.64	192,125	27.64	192,125	100%	100%
ME2	21.25	187,194	21.25	187,194	100%	100%
ME3 - b	31.80	132,261	31.80	132,261	100%	100%
ME3 - e	33.80	77,099	33.80	77,099	100%	100%
ME4	7.60	45,876	7.60	45,876	100%	100%
Total	**487.01**	**3,301,098**	**487.01**	**3,301,098**	**100%**	**100%**

The desk reviews and site visits showed that the project-specific inputs were appropriate and representative of equipment operation for each project. The evaluation estimated 1,547.5 kW in demand savings and 7,400,337 in energy savings, resulting in realization rates of 100 percent for both demand and energy savings.

1.2.3 Net Impact Analysis

In addition to the gross impact analysis, a separate net impact analysis was completed as part of the CBEP evaluation. The net impact analysis consisted of using a phone survey to estimate a free ridership rate that reflects the portion of gross savings that likely would have occurred even if the program were not available.

The net impact analysis relied on a self-report method that is based on a series of participant phone survey responses. In general, the self-report method uses responses to a series of carefully constructed survey questions to learn what participants would have done in the absence of the utility's program. The goal is to ask enough questions to paint an adequate picture of the influence of the program activities (rebates and other program assistance) within the confines of what can reasonably be asked during a phone survey.

With the self-report approach, specific researchable questions that were explored included the following:

- What were the circumstances under which the customer decided to implement the project (i.e., new construction, retrofit/early replacement, replace-on-burnout)?
- To what extent did the program accelerate installation of high efficiency measures?
- What were the primary influences on the customer's decision to purchase and install the high efficiency equipment?
- How important was the program rebate on the decision to choose high efficiency equipment?
- How would the project have changed if the rebate had not been available (e.g., would less efficient equipment have been installed, would the project have been delayed, etc.)?
- Were there other program or utility interactions that affected the decision to choose high efficiency equipment (e.g., was there an energy audit done, has the customer participated before, is there an established relationship with a utility account rep, was the installation contractor trained by the program)?

The method for estimating free ridership (and ultimately the net-to-gross ratio) is based on the 2017 Illinois Statewide Technical Reference Manual (TRM).[1] The general framework is presented here and was applied to the participant survey results for the FortisBC CBEP.

The net-to-gross method divides free ridership into several primary components:

- A ***Program Component*** series of questions that asks about the influence of specific program activities (rebate, customer account rep, contractor recommendations, other assistance offered) on the decision to install energy efficient equipment;
- A ***Program Influence*** question, where the respondent is asked directly to provide a rating of how influential the overall program was on their decision to install high efficiency equipment, and;
- A ***No-Program*** component, based on the participant's intention to carry out the energy-efficient project without program funds or due to influences outside of the program.

Each component is assessed using survey responses that rate the influence of various factors on the respondent's equipment choice. Since opposing biases potentially affect the main components, the *No-Program* component typically indicates higher free ridership than the *Program Component/Influence* questions. Therefore, combining these opposing influences helps mitigate the potential biases. This framework also relies on multiple questions that are crosschecked with other questions for consistency. This prevents any single survey question from having an excessive influence on the overall free ridership score.

Once the self-report algorithm is used to calculate free ridership, the total net-to-gross ratio (NTGR) is calculated using the following formula:

$$\text{NTGR} = (1 - \text{Free Ridership Rate})$$

The NTGR was calculated at the program level, and (if possible) at the measure level (lighting versus non-lighting) for larger measure groups if there was an adequate amount of data available. Finally, we also conducted sensitivity analyses using alterative weighting and scoring schemes to test the stability of the estimated NTGR.

Using the mean value across all three free ridership input scores, the evaluation team estimated individual free ridership scores for all participants. As shown in Table 3, these individual scores were then averaged across the participants to estimate measure-level (lighting versus non-lighting) and program-level free ridership values. The resulting net-

[1] The full Illinois TRM can be found at http://www.ilsag.info/il_trm_version_6.html

to-gross values were then weighted based on project savings for a program total of 0.69. The non-lighting net-to-gross value was estimated to be 0.76 compared to the lighting net-to-gross value of 0.59, indicating a higher level of free ridership among participants that completed lighting projects.

Table 3: Free Ridership and Net-to-Gross Ratio

Measure Type	Unweighted Free Ridership Score	Unweighted Net-to-Gross Ratio	Weighted Net-to-Gross Ratio
Lighting (n=11)	0.34	0.66	0.59
Non-lighting (n=9)	0.20	0.80	0.76
Total (n=20)	0.28	0.72	0.69

The participant phone survey did include questions about any additional projects the participants had completed since participating in CBEP, which potentially could provide evidence of program spillover. Results from the phone survey were very limited, however, as only two participants provided information on additional efficiency upgrades, with little context on how these were influenced by the program. Given the very small sample and limited information, we did not attempt to quantify participant spillover from these results.

1.2.4 Combined Impact Evaluation Results

Savings for CBEP were calculated using each of the analysis components discussed above and are summarized in Table 4 for both energy (kWh) and demand (kW). The gross realization rate is based solely on the engineering adjustments as applied to the current participant population. The weighted net-to-gross ratio is the result of applying the sample net-to-gross ratios outlined previously to the participant population. To calculate the final savings for the program, the *ex ante* savings were multiplied by the gross realization rate to determine gross annual savings. This value was then multiplied by the weighted net-to-gross ratio determined from the phone survey data to obtain net annual savings. The final realization rate was obtained by dividing the net annual savings value by the original *ex ante* savings total.

Table 4: Summary of Gross and Net Realized Savings[2]

	Ex Ante Electrical kWh Savings	Gross Realization Rate (%)	Gross Annual Savings (kWh)	Net-to-Gross Ratio (Weighted)	Net Annual Savings (kWh)	Final Realization Rate
Energy (kWh)	11,430,613	100%	11,430,613	0.69	7,887,123	69.0%
Demand (kW)	1,656	100%	1,656	0.69	1,143	69.0%

1.3 Process Evaluation

To supplement the impact analysis, the evaluation team also conducted a process evaluation of the FortisBC CBEP. The process evaluation included three primary analysis components:

- **In-depth Interviews with program staff (n=3).** Three key CBEP program staff were interviewed over the phone to provide insight on the program scope and processes and to guide the remaining analysis components.
- **In-depth interviews with contractors and trade allies (n=3).** Interviews with participating contractors and trade allies focused on evaluating their experience with CBEP and identifying ways to improve the program moving forward.
- **Participant phone survey (n=20).** A phone survey was conducted with a representative sample of the participant sample that completed projects between 2014 and 2017.

1.3.1 Summary of Staff Interview Findings and Recommendations

Overall, the staff interviews indicate that the program is effectively reaching out to commercial and some industrial customers. While there are known challenges, program managers have taken or are planning to take steps to address concerns regarding the predominance of lighting projects, bottlenecks in application and rebate processing, and the two-stage rebate process that increases uncertainty for customers and limits the program's ability to influence equipment selection decision. Concerns remain, however, regarding CBEP's outreach to trade allies and the difficulty program staff have working with the system used to track applications.

A more detailed summary of the staff interview findings is presented in Section 4.2 of this report.

[2] Savings based on project database provided by FortisBC with 67 completed and verified projects.

1.3.2 Summary of Trade Ally Findings and Recommendations

The results of our limited interviews indicate a surprisingly low level of involvement with and awareness of CBEP among 17 companies identified as trade allies by FortisBC. Even though we reached out to the specific contact provided by FortisBC or spoke with individuals we were referred to by that contact, only a few trade allies were aware of any involvement with projects completed through CBEP. While trade allies who had completed applications for the program generally considered the paperwork and other administrative requirements to be reasonable, those who were aware of the program but had not participated perceived it to be complicated and cumbersome, and they were not certain of what kinds or sizes of projects would be eligible for the program.

For most trade allies, the Business Direct Install (BDI) program was one with which they had more experience and found much easier to use and sell to their customers. The Commercial Products Program is seen as less generous in the level of rebates provided but easier to participate in than CBEP.

Both these results and specific suggestions from some respondents indicate that better communication with trade allies is needed to explain the details of CBEP, including eligibility requirements and the participation process. In addition, several trade allies pointed out that customers are relatively uninformed regarding energy efficiency generally and FortisBC programs in particular. A more focused outreach program to address these concerns should be manageable for the limited number of trade allies involved.

A more detailed summary of the staff interview findings is presented in Section 4.3 of this report.

1.3.3 Summary of Participant Survey Findings and Recommendations

The participant survey was designed to probe more in-depth on participants' experiences with CBEP and included questions on the following topics:

- Participant demographics
- Program awareness and participation process
- Program rebates
- Program satisfaction
- Project decision making
- Participant attitudes towards energy efficiency

Key findings across each of these categories include:

- Overall, CBEP participants covered a wide range of business types including schools (n=2), food retailers (n=2), municipal office buildings (n=2), and manufacturing facilities (n=2). Other businesses included aircraft engine facilities, low income apartments, an electrical utility, and a sawmill.
- Participants noted they learned about CBEP from a variety of sources. The most common sources included FortisBC technical advisors (25%), distributors (15%), word of mouth (15%), and from co-workers with previous experience with FortisBC programs (15%). All five of the participants who first learned of the program through a FortisBC technical advisor indicated the process went well and the technical advisor did a good job of explaining the program and the necessary participation steps.
- Approximately 60 percent of participants said the Technical Advisors were very or extremely influential in their decision. Additionally, 45 percent of participants noted their contractors were very or extremely influential while 60 percent of participants added that outside consultants were not at all or not very influential in their decision.
- Satisfaction was relatively high across all program aspects, with over 50 percent of participants indicating they were somewhat or completely satisfied with all parts of the program. Participants noted especially high levels of satisfaction with the application requirements for the program and communications with FortisBC and the overall service provided by FortisBC, with over 65 percent of participants saying they were completely satisfied with each of those aspects (71%, 67% and 65%, respectively).

1.4 Conclusions and Recommendations

Based on the key findings from the research tasks outlined above, the evaluation team identified the following recommendations for CBEP.

Recommendation 1: Calculate demand savings during peak demand periods given that peak demand savings were claimed inconsistently based on a review of the savings analysis. There can be significant differences between demand reduction and demand savings during peak periods due to variable equipment operation. For example, lighting projects simply claim the demand reduction due to installing efficient LED light fixtures while several other projects claim peak demand savings as the peak power reading based on metered data. If the lights or other equipment are off during the peak demand periods, no peak demand savings should be claimed.

Recommendation 2: HVAC interactive effects should be considered when lighting projects are completed in conditioned spaces. Currently, lighting projects do not take into account the location of the installations and the potential effects the projects may have on other pieces of equipment such as the HVAC requirements. HVAC interactive effects account for the reduced cooling load required to be provided by the air conditioning equipment.

Recommendation 3: Continue to monitor the implications that shifting lighting projects to the Commercial Products Program has on custom projects that include non-lighting measures as well. Given the large percentage of lighting projects in CBEP (66%), the decision to move lighting projects to the Commercial Products Program will significantly reduce potential program savings for CBEP. While this shift will allow CBEP to devote more time and resources to other custom projects, it may also impact large-scale custom projects that involve lighting and non-lighting measures as the rapid payback from lighting projects plays a significant role in justifying the return on investment (ROI). If potential participants elect not to pursue these custom projects because of the difficulty pursuing incentives through two distinct programs, the CBEP program may experience a loss in potential savings from non-lighting measures.

Recommendation 4: Consider an adjustment to the two-stage (50-50) rebate payment process such as a 75-25 split or an increase to the threshold for two-stage payment projects.[3] Both staff and participants acknowledged that the evenly split two-stage payment process typically means only the initial part of the payment can be used to offset the costs of the project. This lesser payment can also influence the purchase decision and may dissuade potential customers from pursuing additional energy efficient solutions. Only 47 percent of survey participants noted they were completely satisfied with the length of time it took to receive their rebate.

Recommendation 5: Increase engagement with both existing and potential trade allies. The evaluation found that there is relatively limited interaction between program staff and trade allies despite the amount of customer engagement the contractors and other trade allies have with participants. For example, of the provided trade ally contact list used for interview recruitment, over 50 percent of contacts were relatively unaware of CBEP and had little knowledge of any past involvement with the program. Increasing communication can help drive program participation—from both a trade ally and commercial customer perspective—and ensure trade allies are aware of program updates, administrative requirements of the program and project statuses for existing projects through the program.

Recommendation 6: Continue to leverage relationships with Technical Advisors, and provide additional resources—such as more allocated time and marketing efforts—for them to help drive participation. Approximately 25 percent of survey participants indicated they learned about CBEP from their Technical Advisor, which was the most

[3] Based on staff interview feedback, both of these solutions have been discussed internally already by FortisBC but were not implemented at the time of the interviews and evaluation

common source mentioned. Additionally, 60 percent of survey participants noted that the Technical Advisor was very or extremely influential in their decisions to install high efficiency equipment through CBEP. Given their level of expertise and knowledge of the program, Technical Advisors can remain a primary driver in raising customer awareness of CBEP and encouraging large-scale custom projects.

Appendix E

EVALUATION STUDY
RESIDENTIAL HEAT PUMPS PROGRAM

FILED CONFIDENTIALLY

Appendix F

EVALUATION STUDY
CUSTOM BUSINESS EFFICIENCY PROGRAM

FILED CONFIDENTIALLY