COMPLETE RESPONSES TO INTERROGATORIES FROM THE SASKATCHEWAN RATE REVIEW PANEL

[2022 and 2023 Rate Application]

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2022 AND 2023 RATE APPLICATION
SRRP INTERROGATORIES

SRRP Q1 Reference: Application

When were the revenue and expenditure forecasts used in the application prepared? Please provide the date of the business plan that forms the basis of the application and identify the date of any updates to that business plan included in the application.

Response:

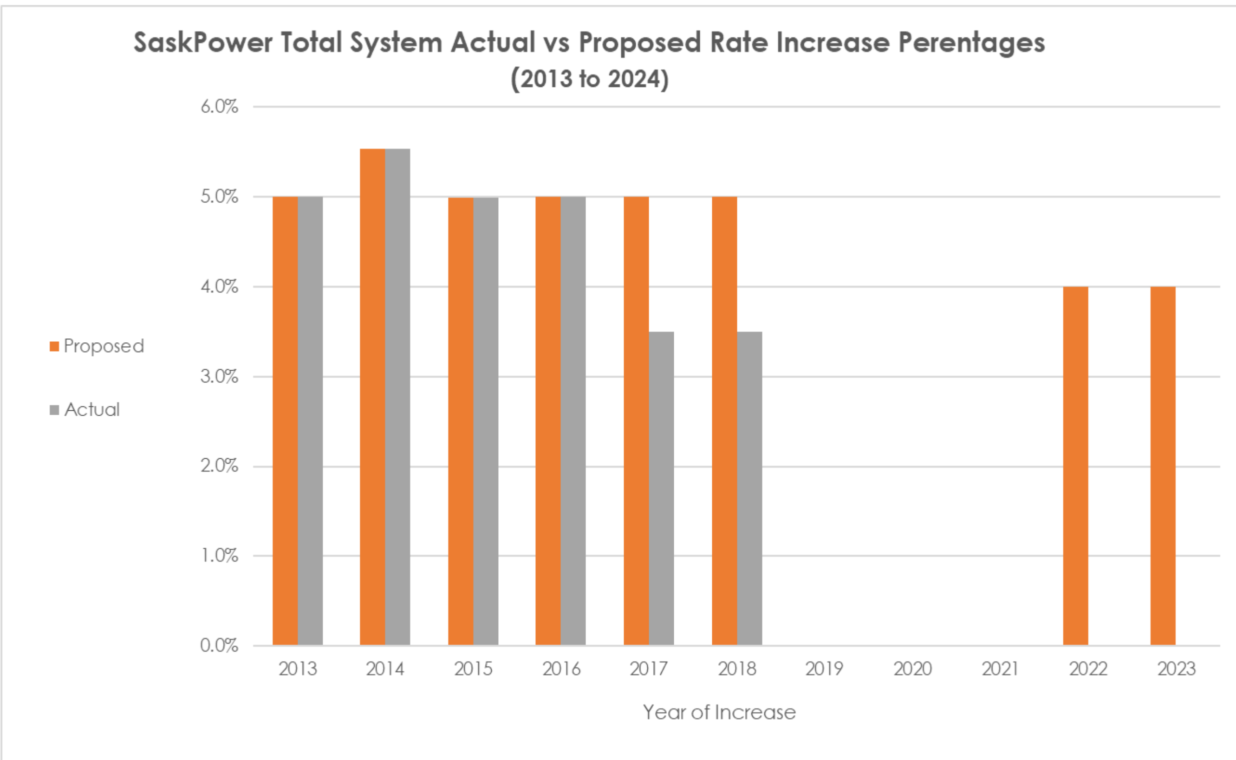
The fuel and purchased power and revenue amounts were based on the Fiscal 2022 Q1 Load Forecast, which was finalized on June 30, 2021. All other expense categories were based on the 10-year 2022-23 Rate Application Business Plan update, dated January 14, 2022. This update follows the original 2022-23 Business Plan which was finalized December 17, 2021.

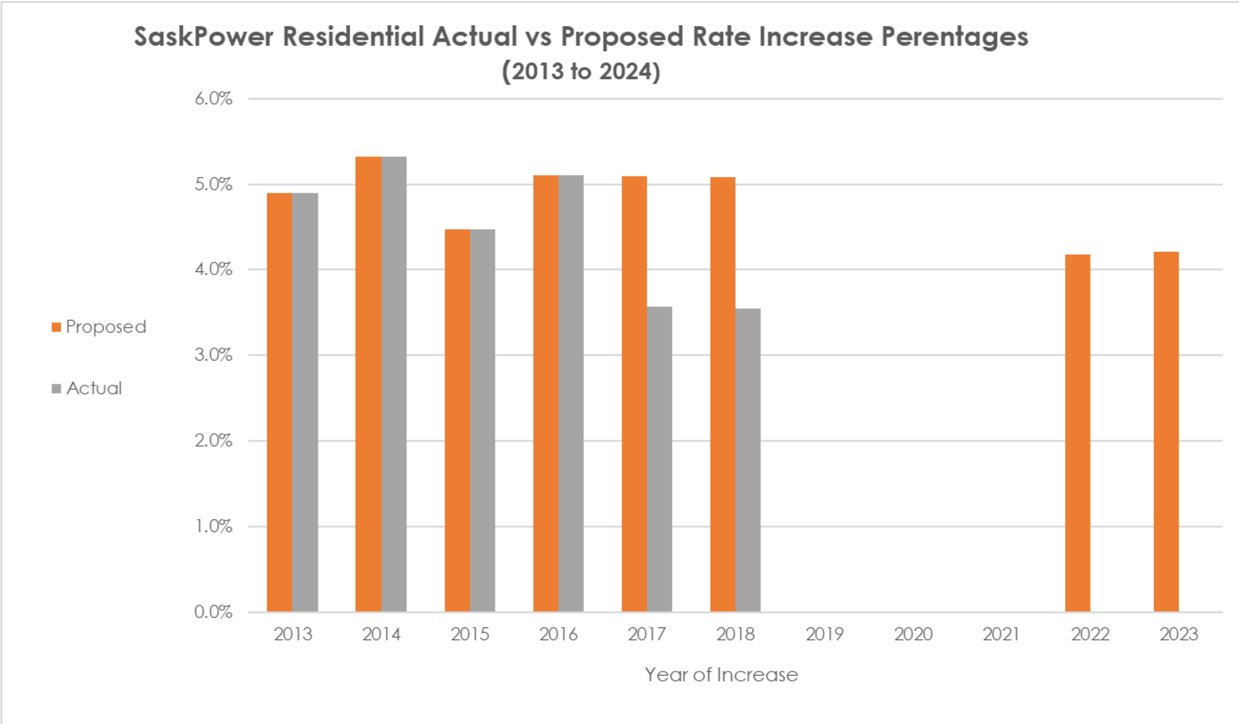
SRRP Q2 Reference: Application

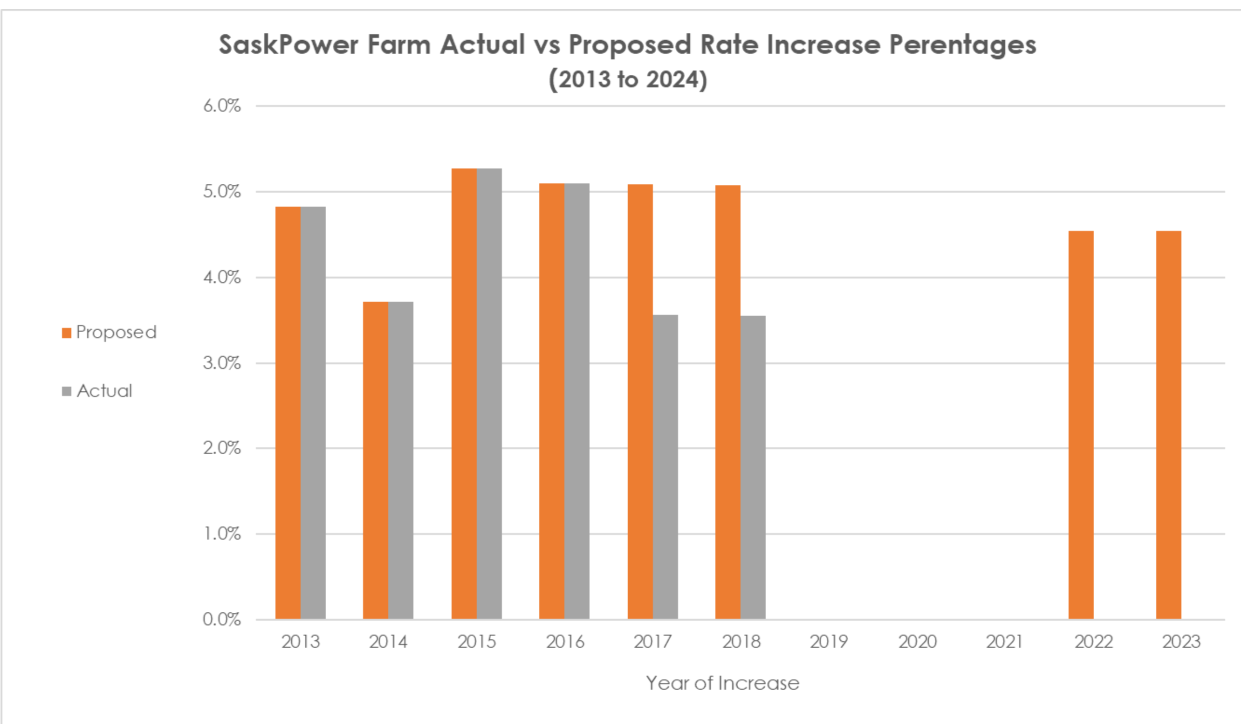
Please provide a graph which illustrates the actual and proposed percentage increases for each major customer group from 2013 through 2023/24.

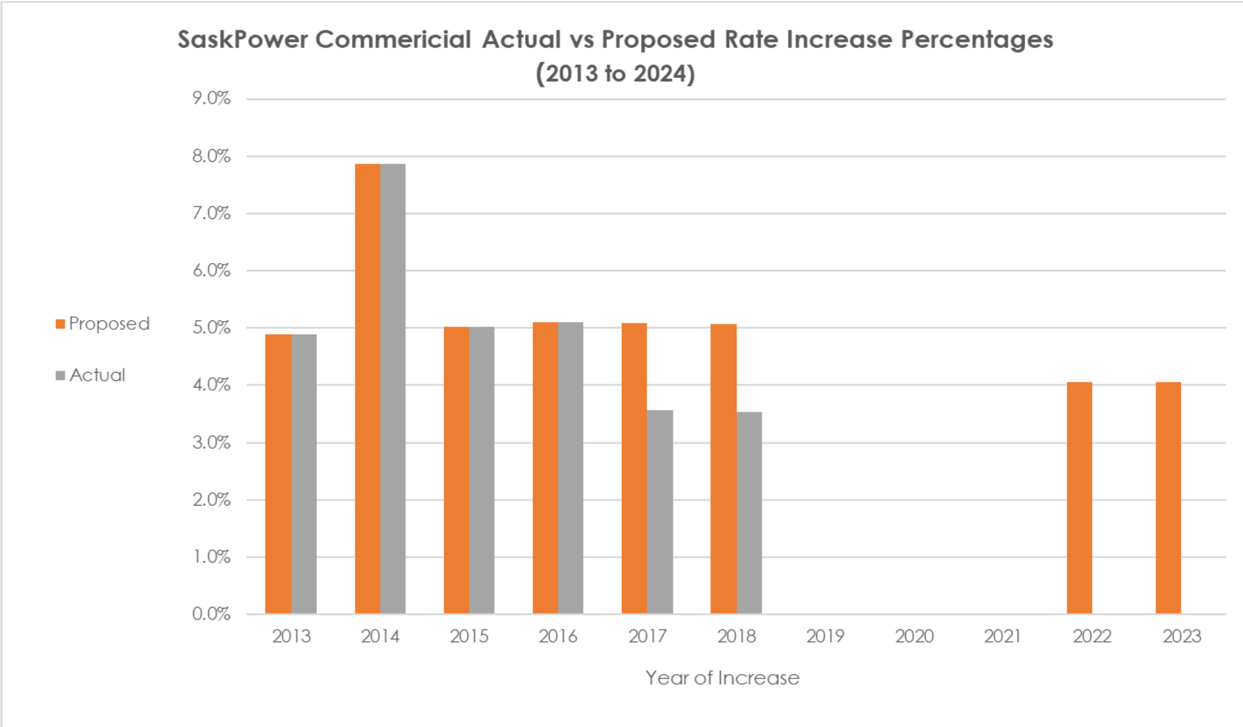
Response:

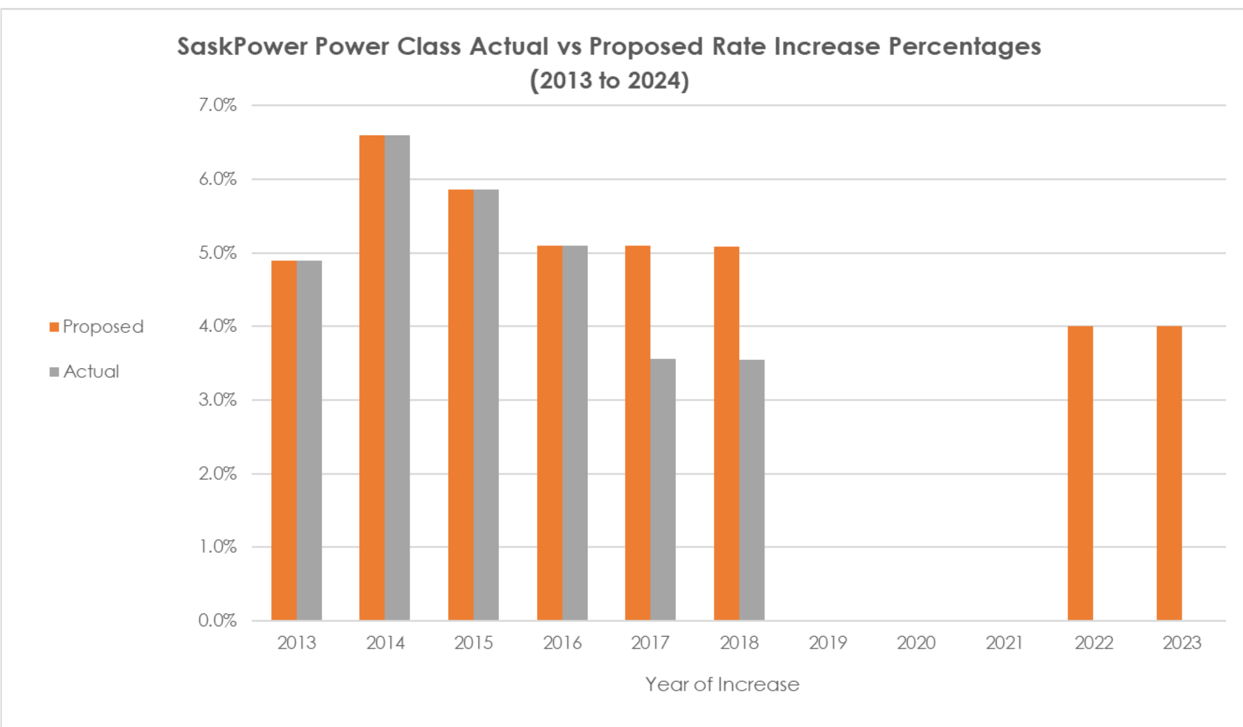
Please see the graphs below:

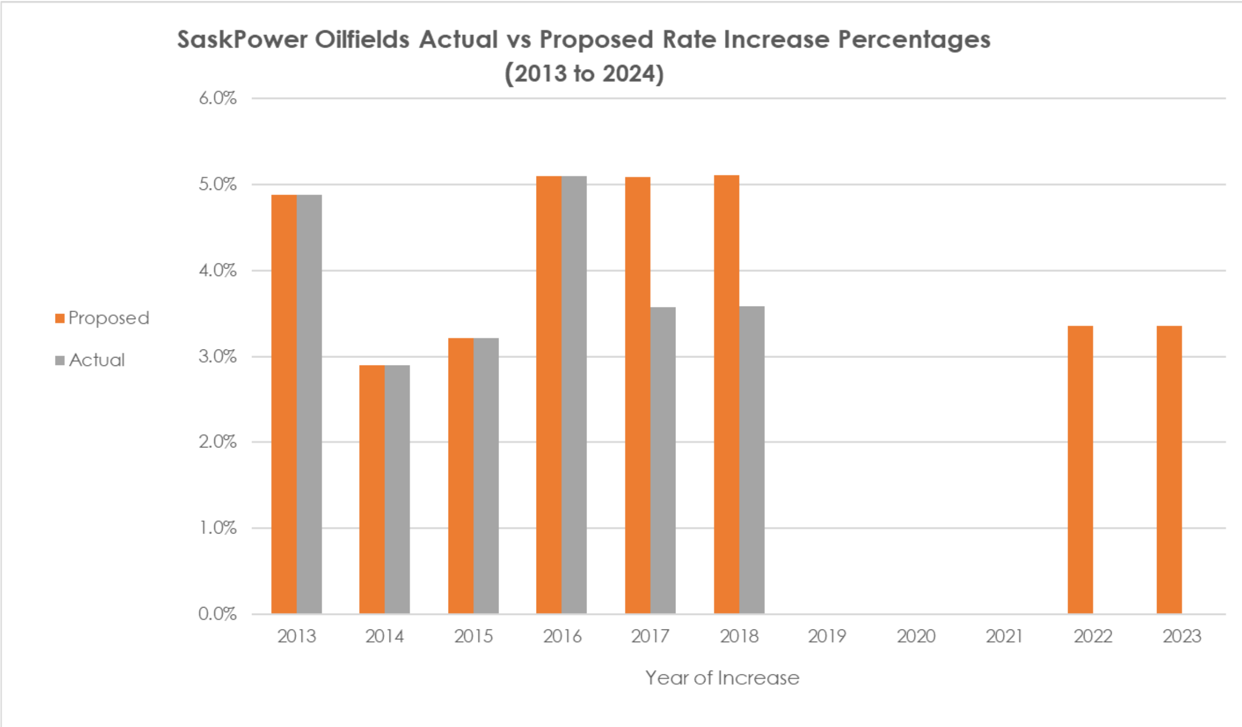


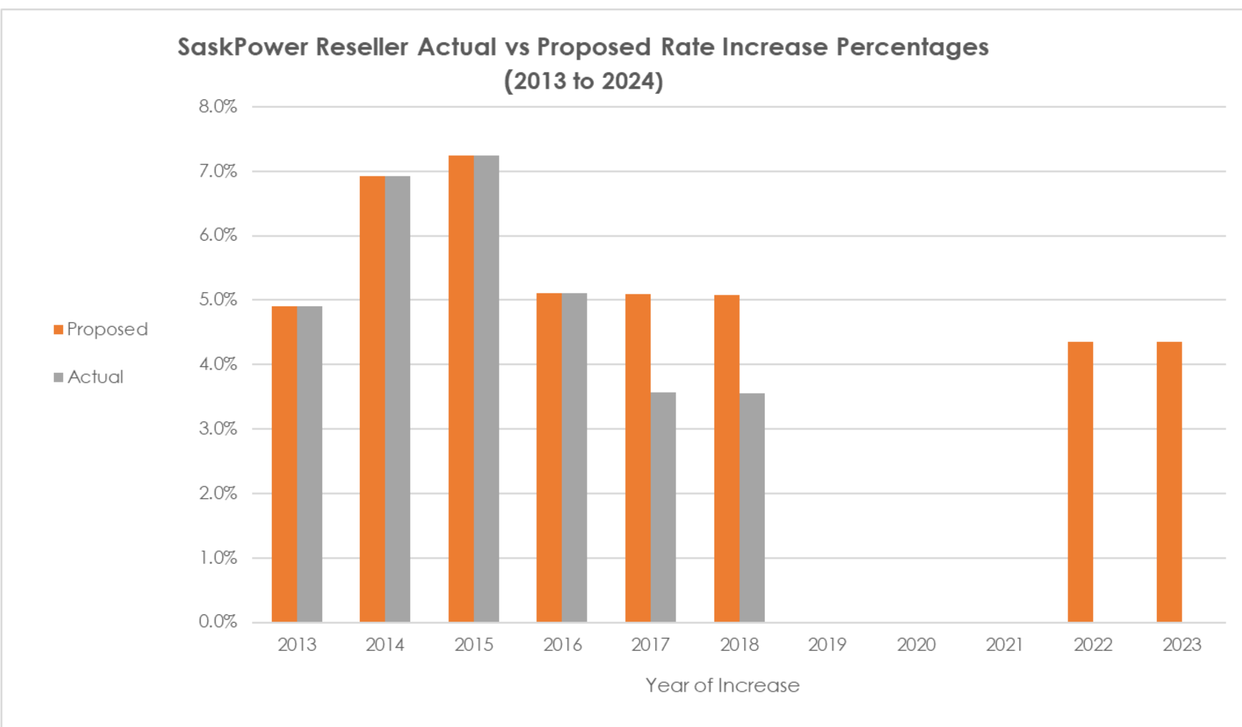

SaskPower Residential Actual vs Proposed Rate Increase Perentages
(2013 to 2024)
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
Proposed
Actual
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year of Increase


SaskPower Farm Actual vs Proposed Rate Increase Perentages
(2013 to 2024)
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
Proposed
Actual
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year of Increase


SaskPower Commericial Actual vs Proposed Rate Increase Percentages
(2013 to 2024)
9.0%
8.0%
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
Proposed
Actual
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year of Increase


SaskPower Power Class Actual vs Proposed Rate Increase Percentages
(2013 to 2024)
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
Proposed
Actual
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year of Increase


SaskPower Oilfields Actual vs Proposed Rate Increase Percentages
(2013 to 2024)
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
Proposed
Actual
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year of Increase


SaskPower Reseller Actual vs Proposed Rate Increase Percentages
(2013 to 2024)
8.0%
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
Proposed
Actual
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
Year of Increase

SRRP Q3 Reference: Application

Please provide a schedule showing SaskPower's total domestic electricity sales revenue; operating income; return on equity, debt to equity ratio, revenue lift and percentage rate increase for 2022/23 and 2023/24 assuming each of the following potential rate scenarios:

i. Confirmation of the 4% average rate increases effective September 1, 2022 and April 1, 2023 as applied for;
ii. Confirmation of 3% average rate increases effective September 1, 2022 and April 1, 2023;
iii. Confirmation of 2% average rate increases effective September 1, 2022 and April 1, 2023;
iv. Confirmation of a single rate increase of 4% effective September 1, 2022 and no rate increase effective April 1, 2023;
v. No rate increases in 2022/23 or 2023/24;
vi. Equal percentage rate increases effective September 1, 2022 and April 1, 2023 that achieve the long-term target ROE of 8.5% in the 2023/24 fiscal year.

Response:
The following table includes a breakdown of the impact of the six rate increase scenarios indicated above:

	i.		ii.		iii.	
	2022-23	2023-24	2022-23	2023-24	2022-23	2023-24
Saskatchewan sales (incl. rate increase)	$ 2,639.1	$ 2,792.8	$ 2,624.0	$ 2,739.4	$ 2,609.1	$ 2,686.4
Net income	$ 32.6	$ 108.9	$ 17.4	$ 54.9	$ 2.5	$ 1.9
Return on equity	1.1%	3.8%	0.6%	1.9%	0.1%	0.1%
Per cent debt ratio	72.9%	72.8%	73.0%	73.2%	73.1%	73.7%
Cumulative revenue lift	$ 60.2	$ 210.7	$ 45.1	$ 157.3	$ 30.1	$ 104.3
Rate increase	4.0%	4.0%	3.0%	3.0%	2.0%	2.0%

	iv.		v.		vi.	
	2022-23	2023-24	2022-23	2023-24	2022-23	2023-24
Saskatchewan sales (incl. rate increase)	$ 2,639.1	$ 2,582.1	$ 2,579.0	$ 2,582.1	$ 2,678.8	$ 2,936.0
Net income	$ 32.6	$ 1.6	$ (27.4)	$ (103.4)	$ 72.2	$ 252.8
Return on equity	1.1%	0.1%	-1.0%	-3.8%	2.5%	8.5%
Per cent debt ratio	72.9%	73.5%	73.4%	74.9%	72.7%	71.6%
Cumulative revenue lift	$ 60.2	$ 103.3	$ -	$ -	$ 99.8	$ 353.9
Rate increase	4.0%	0.0%	0.0%	0.0%	6.6%	6.6%

SRRP Q4 Reference: Covid-19 Impacts

a) Please discuss any incremental costs and savings to SaskPower as a result of the Covid-19 pandemic, including but not limited to:
   i. Transitioning to remote work
   ii. Personal protective equipment purchases
   iii. Reduced travel costs

b) What proportion of the workforce does SaskPower anticipate will continue to work remotely either part-time or full-time going forward?

c) Did SaskPower observe any productivity changes as a result of remote work? Please discuss measures taken by SaskPower to maintain productivity during remote work.

Response:

a)

i.) Transitioning to remote work costs were minimal.

ii.) Personal protective equipment purchases resulting from the Covid-19 pandemic totalled approximately $1.7 million over the past two years. This includes items such as masks, sanitization stations, additional and on demand cleaning, disinfectant, face shields and gloves. Some items, such as sanitization stations and disinfectant will likely continue to be provided in the future.

iii.) Travel related costs were down approximately $5.2 million, or 42% from budget in 2020-21, largely due to the impacts of the Covid-19 pandemic. As a result of this variance, SaskPower reduced its travel budget by $3.7 million in 2021-22 and assumes modest inflationary increases to this category in future year budgets.

b) After a staggered return to the workplace in the summer of 2021, SaskPower developed a remote work policy pilot that ran from September to December 2021. Approximately one third of SaskPower's employees participated in the pilot, either on a regular or ad hoc basis. SaskPower anticipates that a similar number of employees will continue to express interest in a work from home arrangement under a new remote work policy that is expected to be rolled out in April 2022.

c) SaskPower did not experience any significant changes in productivity as a result of employees participating in some form of remote work. The policy only applied to employees where it was operationally and economically feasible to work remotely. Also, the employee's remote work location was required to meet all health and safety criteria at the employee's cost. Regular communication with co-workers and managers was also required, and the remote arrangement could be terminated at any time if the policy was not being upheld by the employee.

SRRP Q5 Reference: Application

Please provide a continuity schedule of Plant in Service and Total Property, Plant and Equipment by function (generation, transmission, distribution, general) for the three most recent actual years and forecasts for 2022/23 and 2023/24.

Response:

Please see the table below showing total Plant in Service for the three most recent actual years and forecasts for 2022-23 and 2023-24:

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SaskPower Plant in Service by Function
(in $ Millions)

	Actual			Forecast	
PLANT IN SERVICE	**2018-19**	**2019-20**	**2020-21**	**2022-23**	**2023-24**
Power Production					
Power Production - SaskPower Units	$6,681.0	$6,787.3	$7,586.7	$7,752.8	$7,866.0
Power Production - PPA	$1,233.2	$1,243.3	$1,017.1	$1,039.5	$1,039.5
Coal Reserves	$57.2	$72.5	$70.2	$73.3	$76.6
Shand Greenhouse	$5.5	$5.5	$5.5	$5.6	$5.6
Total	**$7,976.9**	**$8,108.6**	**$8,679.5**	**$8,871.2**	**$8,987.7**
Transmission					
Grid Lines	$929.6	$1,015.3	$1,333.4	$1,493.8	$1,593.2
Area Lines	$601.1	$670.1	$696.2	$779.9	$831.8
230kv Lines	$203.2	$217.6	$247.5	$277.3	$295.7
138kv Lines	$263.0	$270.7	$220.3	$246.8	$263.3
72kv Bus	$35.9	$36.8	$40.4	$45.3	$48.3
Common & Spares	$225.3	$239.5	$259.5	$290.7	$310.0
Total	**$2,258.1**	**$2,450.0**	**$2,797.4**	**$3,133.8**	**$3,342.3**
Distribution					
Mobile and Area Substations	$360.2	$369.8	$397.2	$440.4	$456.0
25kV Lines (Urban & Rural Combined)	$1,142.1	$1,212.0	$1,252.5	$1,388.8	$1,437.8
14.4kV Distribution Urban	$404.5	$426.0	$452.2	$501.4	$519.2
14.4kV Distribution Rural	$753.4	$793.4	$842.2	$933.8	$966.8
Distribution Transformers	$457.3	$507.7	$534.2	$592.3	$613.2
Urban Residential Services	$136.5	$152.3	$164.2	$226.0	$251.3
Rural Residential Services	$71.2	$74.3	$78.7	$97.9	$105.3
Urban Commercial Services	$190.6	$199.8	$210.4	$270.1	$293.6
Rural Commercial Services	$100.5	$110.2	$123.0	$168.5	$187.1
Farm Services	$13.2	$14.7	$16.5	$22.2	$24.5
Oilfield Services	$178.8	$168.7	$177.3	$216.3	$231.1
Streetlights	$92.2	$98.0	$103.3	$113.2	$116.8
Meters	$82.1	$87.9	$95.2	$156.7	$213.9
Instrument Transformers	$16.8	$17.0	$17.6	$18.9	$19.5
Total	**$3,999.4**	**$4,231.8**	**$4,464.4**	**$5,146.5**	**$5,436.1**
General					
Unused Land	$2.3	$2.3	$2.3	$2.3	$2.3
Right of Use Land	$0.0	$0.0	$7.2	$9.8	$10.7
Buildings	$245.4	$256.4	$282.2	$381.5	$416.5
Right of Use Buildings	$0.0	$0.0	$13.8	$18.7	$20.4
Office Furniture & Equipment	$36.9	$38.4	$42.0	$56.8	$62.0
Vehicles & Equipment	$187.3	$191.0	$196.9	$224.2	$238.2
Computer Development & Equipment	$129.7	$139.0	$155.0	$597.7	$625.8
Communication, Protection & Control	$169.7	$173.1	$174.0	$178.4	$178.4
Tools & Equipment	$31.4	$32.6	$33.2	$44.9	$49.1
Total	**$802.7**	**$832.8**	**$906.8**	**$1,514.4**	**$1,603.5**
TOTAL PLANT IN SERVICE	**$15,037.1**	**$15,623.2**	**$16,848.1**	**$18,665.8**	**$19,369.7**

SRRP Q6 Reference: Payments to the Province

a) For the period of 2018/19 through 2023/24 please provide a table itemizing all actual or forecast payments to the Province of Saskatchewan including water rentals, corporate capital taxes, coal royalties, dividends and any other payments to the Province.
b) SaskPower states that the application is based on the principle that "…SaskPower must set rates that will collect sufficient revenue to recover all reasonable costs and to provide a return to the shareholder." Please discuss if "a return to the shareholder" means solely a dividend or if some other meaning is intended.

Response:

a) The following table summarizes the payments made to the Province of Saskatchewan related to 2018-19 through 2020-21 and forecasted amounts for 2021-22 through 2023-24:

Payments to the Province

(in millions)	Actual **2018-19**	Actual **2019-20**	Actual **2020-21**	Forecast **2021-22**	Business Plan **2022-23**	Business Plan **2023-24**
Water rentals	$ 21	$ 23	$ 26	$ 17	$ 22	$ 23
Corporate capital tax	46	48	49	51	50	51
Grants-in-lieu	25	26	26	27	28	30
Coal royalties	7	7	9	9	6	6
Dividends	20	20	48	3	10	33
Total	$ 119	$ 124	$ 158	$ 107	$ 116	$ 143

b) "A return to the shareholder" doesn't solely refer to the dividend. It refers to SaskPower's long-term return on equity target of 8.5%.

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2022 AND 2023 RATE APPLICATION
SRRP INTERROGATORIES

SRRP Q7 Reference: Corporate Risks

a) Please update the response to the Round 1 SRRP Q7 from the 2018 rate application indicating what SaskPower considers to be the largest business or financial risks it faces (e.g. natural gas prices; interest rates; sales growth or decline) and provide an estimate of the potential upper and lower range of effects of these risks on operating income and return on equity in 2022/23 and 2023/24.
b) Does SaskPower consider potential changes to environmental regulations including the federal carbon charge to be a material business or financial risk? Please discuss why or why not.

Response:

a) As part of SaskPower's strategic planning process, we have identified major challenges to our business which introduce a variety of risks and uncertainties that could impact the achievement of our financial, operational, and public safety objectives. The following risk factors represent challenges SaskPower considers the most significant in the short to medium term:

- Environmental regulation
- Financial sustainability
- Infrastructure & reliability
- Stakeholder expectations & Indigenous engagement
- Security
- Safety of employees & contactors
- Project delivery
- Industry disruption
- Workforce management
- Security & optimization of energy supply

The business or financial risks that could have a significant impact on operating income and/or return on equity in the short term, including 2022-23 and 2023-24, are discussed below with alignment to our top corporate risk profile identified.

Capital expenditures | Project Delivery/Financial Sustainability/Environmental Regulation
SaskPower has identified the need to invest significant amounts of capital in long-term projects to ensure continuing reliability; maintain, upgrade and expand infrastructure; and meet environmental requirements. New regulations, stakeholder expectations, and financial constraints are placing increasing demands on SaskPower and are all competing for operating and capital resources.

SaskPower's Business Plan assumes capital expenditures of over $1.0 billion in 2022-23 and $0.9 billion in 2023-24. A $100 million change in the capital budget is estimated to have a $7 million impact on net income.

Rate increase | Financial Sustainability/Stakeholder Expectations & Indigenous Engagement
SaskPower's Business Plan assumes a rate increase of 4.0% effective September 1, 2022, and 4.0% effective April 1, 2023. The rate increase is subject to review by the Saskatchewan Rate Review Panel with final approval by Cabinet.

Each 1% change in the recommended rate increase is estimated to have a $26 million impact on SaskPower's net income in both 2022-23 and 2023-24.

Saskatchewan electricity sales volumes | Financial Sustainability/Industry Disruption
SaskPower is forecasting Saskatchewan electricity sales growth of 0.1% in 2022-23, resulting in total annual electricity sales of 23,628 GWh. In 2023-24, the Corporation is forecasting a contraction in sales of 0.2%, resulting in a total annual sales volume of 23,587 GWh. However, actual sales volumes are subject to several variables, including economic conditions, number of customers and weather.

The impact of a change in the sales volumes forecast will differ by customer class. For example, the financial impact of a 100 GWh change in sales volumes to the Residential customer class is forecast to have a $14 million impact on SaskPower's net income. A 100 GWh change in Power customer class sales is estimated to have a $4 million impact on SaskPower's financial results. These estimates were calculated before applying the impact of the proposed rate increases.

Natural gas prices | Financial Sustainability/Energy Supply/Environmental Regulation
SaskPower uses a diversified fleet of generation and fuel sources to produce electricity in Saskatchewan. This includes natural gas, coal, hydro, wind, solar, waste heat, flare gas and imports. Natural gas generation is forecast to provide between 38% to 41% of the Corporation's electrical needs in 2022-23 and 2023-24, which serves as SaskPower's largest generation source in terms of percentage of electricity supplied. SaskPower is forecasting to consume 81.0 million gigajoules (GJ) of natural gas in 2022-23 and 79.8 million GJ in 2023-24.

Natural gas prices are subject to significant volatility due to fluctuations in the market price. To mitigate that risk, the Corporation has hedges in place to fix the price of natural gas on up to 80% of its forecasted natural gas purchases in the coming calendar year.

The estimated impact to SaskPower's fuel and purchased power costs of a $1/GJ change in the price of natural gas is $48 million in 2022-23 and $49 million in 2023-24.

Hydro volumes | Financial Sustainability/Energy Supply
Hydro generation is forecast to provide approximately 14% of SaskPower's generation needs in 2022-23 and 2023-24. Hydro generation is the least expensive marginal cost source of electricity in SaskPower's fleet. When hydro generation is lower than expected, it must be replaced by other, more expensive sources of electricity, such as natural gas or imports.

The actual amount of hydro generation is largely dependent on water levels in the rivers that feed SaskPower's hydro generation facilities. A 10% change in the level of hydro generation is estimated to have a $10 million impact on SaskPower's fuel and purchased power budget in 2022-23 and $9 million in 2023-24.

The following sensitivity analysis provides some additional information on the financial impact of changes in the Corporation's planning assumptions.

Business Plan sensitivity analysis

Item	Assumptions 2022-23	Assumptions 2023-24	Sensitivity analysis	Net income impact 2022-23	Net income impact 2023-24
Revenue					
Rate increase (%)	4.0%	4.0%	1% change in annualized rate increase assumption	$ 26	$ 26
Sask Sales Growth (%)	0.1%	-0.2%	100 GWh change in power customer consumption	4	4
			100 GWh change in residential customer consumption	14	14
			0% load growth	(2)	1
			2% reduction in domestic sales	(38)	(38)
Fuel and purchased power					
Natural gas price ($/GJ)	$ 4.01	$ 3.80	$1/GJ change in natural gas price assumption	48	49
Hydro generation (GWh)	3,646.3	3,644.3	10% change in hydro generation assumption	10	9
Coal generation (GWh)	7,031.1	7,015.7	10% change in coal generation assumption	17	24
Capital					
Capital spending ($ millions)	$ 1,053	$ 906	$100 million change in capital budget	7	7
Short-term interest rates	0.9%	1.3%	1% change in short-term interest rates	8	9
Long-term interest rates	3.2%	3.4%	1% change in long-term interest rate assumption	5	4

b)

Yes, environmental regulation is a material business and financial risk. In SaskPower's 2020-21 Annual Report environmental regulation was listed as a top 10 risk for SaskPower.

Our industry is challenged by changing regulations resulting in the phase-out of conventional coal generation, including emissions performance requirements for natural gas generation and the implementation of a price on carbon that is gradually increasing from its current $50 per tonne of carbon dioxide emissions above the established thresholds to an expected $170 per tonne by 2030. Current federal regulations require the phase-out of conventional coal-fired generation by 2030. The federal government has also enacted new emissions performance standards for new natural gas generation. In Addition, the Corporation is also subject to extensive provincial and municipal environmental regulations. Failure to comply with these regulations could result in fines or other penalties.

SRRP Q8 Reference: Carbon Charges

a) Please provide a detailed calculation showing how SaskPower has estimated the forecasted carbon charges for 2022/23 and 2023/24. Please describe any assumptions or estimates used in preparing the forecast of carbon charges including the assumed carbon tax per tonne.
b) Please provide a detailed calculation showing how SaskPower calculated the current carbon charge rider for each rate class. Please describe any assumption or estimates used in preparing the forecast of carbon charge riders.
c) Please provide a detailed calculation showing how SaskPower has estimated the forecasted carbon charge revenues for 2022/23 and 2023/24. Please ensure that the schedule shows the forecasted carbon charge rider (cents per kWh) assumed for each year.
d) Please describe in detail how SaskPower considers the impact of the federal carbon tax when making decisions related to the dispatch of generation options.
e) With reference to page 35 of SaskPower's 2020-21 annual report, please elaborate on the meaning of the statement that "the Federal Carbon Tax Variance Account, which is not included in SaskPower's financial statements…". Does SaskPower consider the account to be a notional account with no impact on SaskPower's statement of financial position?

Response:

a) Forecasted carbon tonnes and charges are as follows:

Fiscal Year	CO_2 Tonnes	Taxable CO_2 Tonnes	CO_2 Tax ($)
2022/23	11,673,520	2,854,435	154,367,812
2023/24	11,640,107	3,210,792	222,502,829

- CO_2 tonnes are estimated by using forecasted generation and unit emission intensities.
- Taxable CO_2 tonnes are estimated by factoring in the allowable carbon thresholds which are as follows:

	Allowable Threshold (tonnes CO_2/MWh)	
Calendar Year	**Gas Unit**	**Coal Unit**
2022	370	594
2023	370	566
2024	370	538

*SaskPower gas units coming online after 2023-24 are subject to a declining allowable threshold

- The CO_2 tax calculation utilizes the following federal rates:

Calendar Year	CO_2 Tax Rate ($/tonne CO_2)
2022	50
2023	65
2024	80

b) For SaskPower, emissions are taxed based on the output of each generation facility (i.e., the carbon tax is paid on a portion of the emissions, and that portion varies case by case for each of SaskPower's generating units), and must therefore account for the following when determining the amount of annual carbon expense to recover from customers:
   1. Annual changes to the system load forecast, including changes in how much each customer class is expected to consume.
   2. Annual changes to the federal government's emission thresholds on each of our carbon dioxide emitting generating units.
   3. Annual changes in our generating mix (i.e., how we predict we will run our units for a given year including additions/retirements of generating facilities, predictions of river flow to forecast hydro generation, etc.).
   4. Annual adjustments due to any previous surplus/deficits of the Federal Carbon Tax Variance Account (FCTVA) which is impacted by all the factors above (e.g., what we forecasted relative to what occurred).

Each one of these factors affect the amount of carbon expense we are expected to recover each year. Once we have determined the annual amount of carbon expense based on the above factors, we assess how much is to be recovered by each customer class based on their forecasted energy requirements (which includes an allocation of system losses) and then calculates the riders by dividing that allocated expense by their forecasted energy sales for the year. This is illustrated in the example below:

2021 Calendar Carbon Tax Rate Rider
(Based on 2020 Q3 Calendar Load Forecast)

Annual Federal Carbon Levy Estimate	$	157.9	(A)
less: FCTVA surplus	$	(14.7)	(B)
Revised Federal Carbon Levy Estimate	**$**	**143.2**	**(C)**

(D) Customer Class	(E) Sales (MW.h)	(F) Losses & Corporate Use (MW.h)	(G) = (E+F) Total Electricity (MW.h)	(H) (%)	(I) = (C*H) Amount of Carbon Tax Paid ($millions)	(J) = (I/E) Rate Rider ($/MWh)
Residential	3,154,318	266,521	3,420,839	14.1%	20.2	$ 6.393
Farm	1,313,570	103,161	1,416,731	5.8%	8.4	$ 6.357
Commercial	3,721,586	303,934	4,025,521	16.6%	23.7	$ 6.376
Power Class	10,512,475	303,499	10,815,975	44.5%	63.8	$ 6.065
Oilfields	2,891,562	227,980	3,119,541	12.8%	18.4	$ 6.359
Resellers	1,145,131	28,086	1,173,217	4.8%	6.9	$ 6.039
Total Sask Sales	22,738,643	1,233,181	23,971,824	98.7%	141.3	$ 6.214
Exports	302,881	15,638	318,519	1.3%	1.9	$ 6.199
Total System Sales	23,041,524	1,248,819	24,290,343	100.0%	143.2	$ 6.214

c) Please see the table below showing how SaskPower has estimated the forecasted carbon charge revenues for 2022-23 and 2023-24:

	2023F			2024F		
Customer Class	**Energy (GWh)**	**Implied Carbon Riders ($/MWh)**	**Carbon Revenue ($millions)**	**Energy (GWh)**	**Implied Carbon Riders ($/MWh)**	**Carbon Revenue ($millions)**
Residential	3,227.8	$ 6.3	$ 20.3	3,245.6	$ 8.2	$ 26.8
Farm	1,341.8	$ 6.2	$ 8.3	1,341.5	$ 8.1	$ 10.9
Commercial	3,701.4	$ 6.3	$ 23.4	3,733.5	$ 8.3	$ 30.9
Power Class	10,283.4	$ 5.9	$ 61.0	10,107.8	$ 7.8	$ 78.6
Oilfields	3,901.9	$ 6.3	$ 24.5	3,984.8	$ 8.2	$ 32.6
Reseller	1,171.3	$ 5.9	$ 6.9	1,174.3	$ 7.8	$ 9.1
Exports	503.2	$ 6.0	$ 3.0	1,132.8	$ 7.8	$ 8.9
Total	**24,130.8**	**$ 6.1**	**$ 147.5**	**24,720.3**	**$ 8.0**	**$ 197.7**

d) The federal carbon tax is considered as a variable cost. The federal carbon tax cost is converted into a $/MWh cost for each individual unit. The units are then dispatched as before based on individual unit total variable cost including carbon tax.

e) The Federal Carbon Tax Variance Account (FCTVA) as described on page 35 in the SaskPower 2020-21 Annual Report accumulates the differences between the federal carbon charge revenue collected from customers and the federal carbon tax owing/paid to the federal government. In accordance with current International Financial Reporting Standards (IFRS), SaskPower is not permitted to adopt rate regulated accounting practices and as such does not have any rate regulated assets or liabilities recorded on its statement of financial position. Therefore, these timing differences accumulated in the FCTVA are not recorded and have no impact on SaskPower's statement of financial position. The over/under collected balances are either recovered from or refunded to customers as part of future federal carbon charge rates.

SRRP Q9 Reference: Bad Debt

a) Please provide a schedule showing SaskPower's bad debt expense for the five most recent actual years and forecasts for 2021/22 through 2023/24.
b) Please discuss if, in SaskPower's view, bad debt expense increased as a result of the Covid-19 pandemic?
c) Please discuss whether the changes SaskPower made to its collections policies and procedures during the Covid-19 pandemic discussed in section 3.3 of the application are still in place. Please also discuss any other changes to collections policies and procedures in addition to those discussed in section 3.3 of the application.

Response:

a)

Bad debt

	Actual	Actual	Actual	Actual	Actual	Forecast	Business Plan	Business Plan
(in millions)	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
Bad debt expense	$ 6	$ 5	$ 5	$ 9	$ 7	$ 1	$ 5	$ 5

b) In 2019-20, SaskPower increased its allowance for doubtful accounts by $4 million as a provision for the impact of COVID-19 on collectability.

As a result of the financial relief program implemented, SaskPower experienced an increase in the aging and balance of its customer receivables as at March 31, 2021. Consequently, SaskPower increased its allowance for doubtful accounts provision for 2020-21 as well.

SaskPower saw a significant decrease in bad debt expense during 2021-22, due to the partial reversal of credit losses previously allowed for as the collectability of payments from customer improves. As at February 28, 2022, our company's bad debt expense was forecasted to be $4 million below budget for the year ended March 31, 2022.

The full impact of potential credit losses due to customer non-payment is not known at this time. SaskPower continues to monitor customer accounts and work with customers on payment arrangements.

c) SaskPower implemented initiatives to help ease the financial burden of the pandemic on its customers. In March 2020, SaskPower and other Crown utilities started a program to waive interest on outstanding bills for six months. Once the six-month period was over, SaskPower offered an interest-free program to pay outstanding balances over 12 equal monthly payments. In addition, SaskPower paused disconnecting customers for non-payment and implemented a temporary stop on active collections. Crown Investments Corporation (CIC) approved the resumption of disconnections on April 1, 2021, and by September 30, 2021, the majority of customers had paid their payment plans in full.

The provincial government also provided relief through the Saskatchewan Economic Recovery Rebate. The rebate provided a 10% rebate on energy consumption, demand and basic monthly charges from December 1, 2020, to November 30, 2021. This rebate program was fully funded by the Government of Saskatchewan and did not impact SaskPower's financial statements. The program concluded on November 30, 2021. As of January 31, 2022, the Government of Saskatchewan provided $262 million of relief to SaskPower customers through this program.

Also, a one-time relief program for eligible community rinks was introduced. Rinks could receive relief on the demand charges from March to September 2021, resulting in savings of approximately $1,600 per month for rinks still in operation and approximately $330 for rinks after they were shut down for the season. This program concluded in September 2021.

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2022 AND 2023 RATE APPLICATION
SRRP INTERROGATORIES

SRRP Q10 Reference: Financial Indicators

With reference to the financial indicators on page 32 of the application, please discuss whether SaskPower has targets for all of these indicators and how they are used for business planning.

Response:

Targets

SaskPower's annual business plan, which is approved by SaskPower's Board of Directors and Crown Investments Corporation's (CIC) Board of Directors, forms the basis for annual targets (or budgets) for the financial indicators on page 32 of the application (net income, return on equity (ROE), per cent debt ratio, EBITDA interest coverage ratio (ICR), and dividend declared).

While SaskPower does not target a specific amount of net income, our company does have long-term targets for our ROE (8.5%) and per cent debt ratio (60-75%) that are re-approved annually by SaskPower's Board of Directors and CIC's Board of Directors as part of our corporate balanced scorecard. SaskPower does have a long-term ICR target (2.5) that has been approved by our company's Executive, while our annual declared dividend is based on the dividend rate directed to it by CIC.

These indicators are considered in decisions regarding how to balance the costs to operate, maintain and renew or replace our aging infrastructure with the need to impose constraints on expenses and capital investments and how best to finance capital investments.

SRRP Q11 Reference: Financial Indicators

Please provide a schedule that shows the calculation of SaskPower's actual and forecasted interest coverage ratio for each of the years in the table on page 32 of the application.

Response:

Interest coverage ratio

	Actual 2018-19	Actual 2019-20	Actual 2020-21	Forecast 2021-22	Business Plan 2022-23	Business Plan 2023-24
Net income	$ 197	$ 205	$ 160	$ 10	$ 33	$ 109
Finance charges	416	431	426	398	370	366
Add back:						
Debt retirement fund earnings	17	23	23	17	17	18
Interest income	3	2	2	1	2	2
Depreciation and amortization	553	572	595	614	604	607
Earnings before interest, tax, depreciation & amortization (EBITDA)	**1,186**	**1,233**	**1,206**	**1,040**	**1,026**	**1,102**
Interest on long-term debt	277	297	291	278	251	258
Interest on short-term debt	17	13	4	1	6	11
Interest on finance lease	165	155	149	137	138	131
Other interest and charges	1	1	1	-	1	1
Gross interest expense	**$ 460**	**$ 466**	**$ 445**	**$ 416**	**$ 396**	**$ 401**
Interest coverage ratio (EBITDA)	**2.6**	**2.6**	**2.7**	**2.5**	**2.6**	**2.7**

Note: a discrepancy was noted in debt retirement fund earnings in 2019-20 and has been updated in the table above.

SRRP Q12 Reference: Financial Indicators

Please explain how the dividend declared is determined for each actual and forecast year shown in the table on page 32 of the application.

Response:

SaskPower is required to pay dividends as per the Crown Investment Corporation (CIC) Subsidiary Crown Dividend Policy. As per the CIC Dividend Policy the annual dividend amount is to be determined by the CIC Board of Directors during its annual review of the Crown Performance Management and Capital Allocation Plans.

CIC determined that the dividend rate for 2018-19 and 2019-20 would be 10% of net income and for 2020-21and 2021-22 would be 30% of net income. For 2022-23 and 2023-24 the dividend was calculated at the same rate as 2020-21and 2021-22.

SRRP Q13 Reference: Finance Expense

Have there have been any changes to SaskPower's debt strategy with respect to how much short-term versus long-term debt SaskPower takes on and the mixture of floating rate debt versus fixed rate debt SaskPower considers to be optimal since the response to the Round 1 SRRP Q12 from the 2018 GRA proceeding? If so, please provide a summary of the changes and an explanation of the rationale for the changes.

Response:

SaskPower's Board approval to target 15% in floating rate debt as a percentage of total debt equivalent obligations, which includes capital leases, has not changed.

SaskPower had been managing to a target of 10% floating rate debt but reduced the short-term debt component starting in early 2020 to reduce funding risk, which increased due to Covid-19. SaskPower has recently increased that percentage back to 10%, which it will continue to target.

SRRP Q14 Reference: Finance Expense

a) Please provide a schedule showing all long term debt (including any long-term lease obligations) including the date of issue, date of maturity, effective interest rate, coupon rate, par value, unamortized premium, and outstanding amount.
b) Please provide a schedule showing SaskPower's debt in relation to the total debt of the Province of Saskatchewan for each of the last three years.

Response:

a) Please refer to the table below for details on SaskPower's finance lease liabilities as at March 31, 2021:

Finance lease liabilities

		Actual
(in millions)		2020-21
Total future minimum lease payments	$	2,177
Less: future finance charges on leases		(1,195)
Present value of lease liabilities	$	982

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2022 AND 2023 RATE APPLICATION
SRRP INTERROGATORIES

Please refer to the table below for details on SaskPower's long-term debt as at March 31, 2021:

Long-term debt

Date of issue	Date of maturity	Effective interest rate (%)	Coupon rate (%)	Par value	Unamortized premiums (discounts)	Outstanding amount
February 4, 1992	February 4, 2022	9.27	9.60	$ 240	$ 1	$ 241
July 21, 1992	July 15, 2022	10.06	8.94	256	-	256
April 1, 2020	April 1, 2023	Floating	CDOR[1]	150	-	150
April 8, 2020	June 3, 2024	1.79	3.20	200	9	209
May 30, 1995	May 30, 2025	8.82	8.75	100	-	100
July 27, 2020	September 2, 2025	0.93	0.80	100	(1)	99
June 14, 2019	December 2, 2028	2.34	3.05	175	9	184
June 25, 2020	June 2, 2030	1.53	2.20	100	6	106
August 8, 2001	September 5, 2031	6.49	6.40	200	(1)	199
January 15, 2003	September 5, 2031	5.91	6.40	100	4	104
May 12, 2003	September 5, 2033	5.90	5.80	100	(1)	99
January 14, 2004	September 5, 2033	5.68	5.80	200	2	202
October 5, 2004	September 5, 2035	5.50	5.60	200	2	202
February 15, 2005	March 5, 2037	5.09	5.00	150	(1)	149
May 6, 2005	March 5, 2037	5.07	5.00	150	(1)	149
February 24, 2006	March 5, 2037	4.71	5.00	100	3	103
March 6, 2007	June 1, 2040	4.49	4.75	100	3	103
April 2, 2008	June 1, 2040	4.67	4.75	250	2	252
December 19, 2008	June 1, 2040	4.71	4.71	100	-	100
September 8, 2010	June 1, 2040	4.27	4.75	200	12	212
November 15, 2012	February 3, 2042	3.22	3.40	200	5	205
February 28, 2013	February 3, 2042	3.54	3.40	200	(4)	196
October 9, 2013	June 2, 2045	3.97	3.90	400	(4)	396
January 17, 2014	June 2, 2045	3.95	3.90	200	(1)	199
October 9, 2014	June 2, 2045	3.43	3.90	200	15	215
February 13, 2015	June 2, 2045	2.73	3.90	200	41	241
June 2, 2015	December 2, 2046	3.15	2.75	200	(14)	186
October 26, 2015	December 2, 2046	3.43	2.75	200	(23)	177
January 28, 2016	December 2, 2046	3.34	2.75	200	(20)	180
July 19, 2016	December 2, 2046	2.85	2.75	150	(3)	147
October 20, 2016	December 2, 2046	3.00	2.75	200	(9)	191
January 24, 2017	June 2, 2048	3.35	3.30	200	(2)	198
August 15, 2018	June 2, 2050	3.18	3.10	200	(3)	197
April 2, 2019	June 2, 2050	2.81	3.10	150	9	159
March 13, 2014	March 5, 2054	3.76	3.75	100	-	100
May 12, 2014	March 5, 2054	3.71	3.75	175	1	176
August 29, 2017	March 5, 2054	3.19	3.75	150	17	167
September 19, 2018	June 2, 2058	3.13	2.95	200	(8)	192
				$ 6,696	**$ 45**	**$ 6,741**

1. The coupon rate for this floating rate note is the three-month Canadian Dealer Offer Rate (CDOR) plus a margin of 48 basis points.

b) The table below show SaskPower's debt in relation to the Province of Saskatchewan's debt.

SaskPower debt to provincial debt

(in millions)	2018-19	2019-20	2020-21	2021-22
SaskPower debt	$ 7.0	$ 7.3	$ 7.0	$ 7.2
Provincial debt	22.0	23.8	25.9	29.6
Percentage of debt	32%	31%	27%	24%

Note: The 2021/22 numbers provided are the forecast for March 31, 2022.

SRRP Q15 Reference: Finance Expense

For each year of the ten most recent actual years please provide a schedule showing the forecasted short-term and long-term interest rates for new debt from the prior year's business plan (i.e. the last business plan prepared before the start of each fiscal year) and the actual short-term and long-term interest rates for new debt.

Response:

The following table provides the budgeted versus actual rates for each of SaskPower's long-term debt issues and short-term advances back to 2012.

Interest rates

	12 months **2012**	12 months **2013**	12 months **2014**	15 months **2015-16**	12 months **2016-17**
Short-term					
Business Plan forecast	1.10%	1.20%	1.10%	1.20%	0.80%
Actual range	0.91-1.10%	0.55-1.10%	0.83-1.05%	0.37-1.05%	0.37-0.65%
Long-term					
Business Plan forecast	4.10%	3.40%	3.70%	4.20%	3.10%
Actual floating rate notes	•	0.64-1.17%	0.62-1.15%	•	•
Actual coupon rate	3.40%	3.40-3.90%	3.75-3.90%	2.75-3.90%	2.75-3.30%
Actual effective rate	3.22%	3.54-3.97%	3.43-3.95%	2.73-3.43%	2.85-3.35%

	12 months **2017-18**	12 months **2018-19**	12 months **2019-20**	15 months **2020-21**	12 months **2021-22**
Short-term					
Business Plan forecast	0.80%	1.60%	2.30%	1.40%	0.50%
Actual range	0.50-1.43%	1.19-1.99%	0.75-1.85%	0.15-0.44%	0.09-0.68%
Long-term					
Business Plan forecast	3.30%	3.70%	3.70%	2.60%	2.20%
Actual floating rate notes	•	•	•	0.92-1.71%	•
Actual coupon rate	3.75%	2.95-3.10%	3.05-3.10%	0.80-3.20%	•
Actual effective rate	3.19%	3.13-3.18%	2.34-2.81%	0.93-1.79%	•

• No new borrowings of this type were issued during the year.

SRRP Q16 Reference: Finance Expense

Please provide a schedule showing details of the total finance charges for the five most recent actual years and forecasts for 2021/22 through 2023/24 including interest on long-term debt, interest on short-term debt, leases, interest capitalized, debt retirement fund earnings, and other finance charges.

Response:

The following table summarizes actual finance charges for the 2016-17 through 2020-21 fiscal years as well as forecasted finance charges for the 2021-22 through 2023-24 fiscal years.

Finance charges

	Actual **2016-17**	Actual **2017-18**	Actual **2018-19**	Actual **2019-20**
Interest on long-term debt	$ 257	$ 269	$ 277	$ 299
Interest on lease liabilities	166	160	165	155
Interest on short-term advances	6	8	17	13
Interest on employee benefit plans	11	10	6	10
Interest on provisions	5	5	6	5
Interest capitalized	(15)	(21)	(36)	(25)
Amortization of debt premiums/discounts	(1)	(1)	(1)	(2)
Amortization of bond forward agreements	-	1	1	-
Other interest and charges	-	1	1	1
Finance expense	**429**	**432**	**436**	**456**
Debt retirement fund earnings	(13)	(13)	(17)	(23)
Debt retirement fund realized market value gain	-	-	-	-
Interest income	-	(2)	(3)	(2)
Finance income	**(13)**	**(15)**	**(20)**	**(25)**
TOTAL FINANCE CHARGES	**$ 416**	**$ 417**	**$ 416**	**$ 431**

(continued on the following page)

Finance charges (continued)

	Actual 2020-21	Forecast 2021-22	Business Plan 2022-23	Business Plan 2023-24
Interest on long-term debt	$ 296	$ 284	$ 257	$ 264
Interest on lease liabilities	149	137	138	131
Interest on short-term advances	4	1	6	11
Interest on employee benefit plans	10	9	7	7
Interest on provisions	6	7	7	7
Interest capitalized	(10)	(16)	(21)	(29)
Amortization of debt premiums/discounts	(5)	(6)	(6)	(6)
Amortization of bond forward agreements	-	-	-	-
Other interest and charges	1	-	1	1
Finance expense	**451**	**416**	**389**	**386**
Debt retirement fund earnings	(21)	(17)	(17)	(18)
Debt retirement fund realized market value gain	(2)	-	-	-
Interest income	(2)	(1)	(2)	(2)
Finance income	**(25)**	**(18)**	**(19)**	**(20)**
TOTAL FINANCE CHARGES	**$ 426**	**$ 398**	**$ 370**	**$ 366**

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2022 AND 2023 RATE APPLICATION
SRRP INTERROGATORIES

SRRP Q17 Reference: Finance Expense

Please provide details with respect to the sinking fund requirements for long-term debt and discuss whether there have been any recent changes to the provincial government's sinking fund requirements for new debt.

Response:

There have been no changes to the provincial government's sinking fund requirements for new debt.

For borrowings with a term of 10 years and longer, a payment of at least 1% of the outstanding principal amount of that borrowing must be made into a sinking fund each year, up to and including the year of maturity.

SRRP Q18 Reference: Finance Expense

a) Please provide details of the actual and forecasted sinking fund balances, earnings, contributions, and average returns for the five most recent actual years and forecasts for 2021/22 through 2023/24.
b) Has SaskPower evaluated what the difference in finance expenses would have been if the sinking fund or debt retirement payments had instead been able to be used to pay down debt principle? If so, please provide any such analysis.

Response:

a) The following continuity schedule includes actual sinking fund balances for 2016-17 through 2020-21and forecasted amounts for 2021-22 through 2023-24:

Finance charges

(in millions)	Actual **2016-17**	Actual **2017-18**	Actual **2018-19**	Actual **2019-20**
Opening balance	$ 533	$ 590	$ 658	$ 748
Instalments	48	52	56	60
Redemptions	-	-	-	-
Earnings	13	13	17	23
Realized market value gains	-	-	-	-
Unrealized market value losses	(4)	3	17	17
Ending balance	$ 590	$ 658	$ 748	$ 848
Return	**2.3%**	**2.1%**	**2.4%**	**2.9%**

(in millions)	Actual **2020-21**	Forecast **2021-22**	Business Plan **2022-23**	Business Plan **2023-24**
Opening balance	$ 848	$ 865	$ 789	$ 786
Instalments	62	63	60	63
Redemptions	(42)	(166)	(80)	-
Earnings	21	17	17	18
Realized market value gains	2	-	-	-
Unrealized market value losses	(26)	10	-	-
Ending balance	$ 865	$ 789	$ 786	$ 867
Return	**2.5%**	**2.1%**	**2.2%**	**2.2%**

b) SaskPower reviewed the potential impact in February 2020. SaskPower is borrowing to satisfy the debt retirement fund ("DRF") requirements. The money raised is invested in high grade bonds.

The DRF includes cash deposits, Government of Canada bonds and provincial bonds such as Ontario or BC that have lower yields than Saskatchewan bonds. Depending on the portfolio mix, this can result in a cost of approximately 0.15% (based on a 10 year term).

Investment	**Approximate Credit Spread Versus Saskatchewan (December 2019)***	**DRF Balance (December 2019)**
Bank Deposits	(0.15%)	$260 million
Federal Bonds	(0.73%)	$310 million
Saskatchewan Bonds	-	$365 million
Provincial Bonds	(0.05%)	$1.5 billion
Total	**Approximately (0.15%)**	**$2.4 billion**

* As an example, (0.73%) means the Federal Bond yield is lower than the Saskatchewan yield. If the Saskatchewan bond rate was 2.30% (borrow at this rate) the Federal Bond rate would be 1.57% (invest at this rate).

On average, the DRF invests for a shorter time horizon than SaskPower borrows. This difference means SaskPower could be borrowing for 30 years to invest in shorter term bonds which normally have a lower yield.

The potential cost will vary with the composition of the DRF's holdings, the term of SaskPower's borrowing and the interest rate credit and term spreads observed in the market. The DRF reduces refinancing risk and the DRF is viewed positively by bond rating agencies. Costs incurred through the DRF are potentially offset by lower borrowing costs (lower credit spread) on new debt issuances due to the positive impact the DRF has on the Province of Saskatchewan's credit rating.

SRRP Q19 Reference: Depreciation and MFR Tab 8

a) Please confirm that the most recent external depreciation study is from 2018 and provide the proposed timing for the next external depreciation study.
b) Would SaskPower consider commissioning a version of the next external depreciation study that could be made public?
c) Did SaskPower accept and implement all of the proposed changes to average service life estimates recommended by the external consultant? If not, please explain which recommendations were not accepted and why.
d) With reference to the statement in MFR tab 8 that "The equivalency agreement between the Saskatchewan Ministry of Environment and Environment and Climate Change Canada has been signed and ratified. This would formally stand-down the coal regulation from applying in Saskatchewan, leaving the regulation of SaskPower emissions with the Saskatchewan Ministry of Environment." Please:
    i. Provide a copy of the ratified equivalency agreement.
    ii. Discuss and quantify the impact of the equivalency agreement for SaskPower's depreciation rates and fuel expense, if any.
e) Please elaborate on the reason for the $2.625 million impact on depreciation expense related to the Shand unit 1, the $1.550 million impact on depreciation expense related to the Boundary dam unit 6 and the $1.176 million impact on depreciation related to the Shand common property groups if the anticipated retirement dates for these property groups has not changed.
f) Please provide a table that quantifies the impact of any and all changes SaskPower has made to its depreciation rates by depreciable property group since the time of the last rate application.
g) Please describe SaskPower's process for reviewing and revising its depreciation rates between external depreciation studies.
h) Please confirm if SaskPower's auditor has reviewed and accepted all changes to SaskPower's depreciation rates for financial reporting purposes.
i) With reference to section 7.2.3.1 of the Application, please explain the types of assets that are included in the finance lease depreciation line of the table.
j) Please discuss how SaskPower's depreciation study or depreciation rates address provisions for net salvage and/or gains or losses on disposal.

Response:

a) It is recommended that a formal depreciation study be completed every five years. An external consultant was engaged to complete the 2017-18 depreciation study and it is planned to complete another external review in 2022-2023.
b) SaskPower will investigate, with the successful external consultant, the possibility of preparing a report that can be made public.
c) Yes, all changes recommended by the external consultant were implemented.
d) i) The ratified equivalency agreement follows.
ii) The equivalency agreement between the Saskatchewan Ministry of Environment and Environment and Climate Change Canada has been signed and ratified. This formally

stands down the coal regulation from applying in Saskatchewan, leaving the regulation of SaskPower emissions with the Saskatchewan Ministry of Environment. As such, the final retirement dates of the coal generation unit assets have been revised based on the life expectancy of these assets as determined through discussions with Asset Management and the most recent supply plan. This shift to increased renewable generation through the use of independent power producers (IPP's) will cause SaskPower's fuel expense to increase.

e) The increases are driven by capital expenditures required to maintain safe and reliable operation of the coal generation units. Depreciation of the coal generation unit assets is adjusted to ensure all capital additions are fully depreciated by the expected retirement date.

f)

	Estimated Annual Impact (000's)		
Depreciable Property Group	**2018-19**	**2019-20**	**2020-21**
Power Production			
Coal	$ 5,265	$ 6,024	$ 6,499
Gas	7,212	6,223	549
Wind		(1,764)	
Other	-	(780)	11
Communication Protection & Control (CP&C)			(175)
Buildings	395	-	-
	$ 12,872	**$ 9,703**	**$ 6,884**

g) On an annual basis, SaskPower's Finance Department reviews its depreciation rates with internal personnel from various operating areas to determine whether any changes to the estimated useful lives are required based on manufacturers' guidance, past experience and future expectations regarding the potential for technical obsolescence. In addition, depreciation rates are adjusted each year for coal facility assets based on the Corporation's most recent supply plan.

h) SaskPower's external auditor has audited our annual financial statement results and has provided us with an unqualified audit opinion.

i) Included in finance leased assets are Purchase Power Agreements related to natural gas-fired facilities (Meridian Cogeneration Station, Spy Hill Generating Station and the North Battleford Generating Station) where SaskPower has the exclusive right to the use of production. Also included in these amounts are land and building leases with a term greater than one year.

j) Where deemed a salvage value is appropriate for a group of assets the annual rate is adjusted to account for any salvage value at the end of asset life. SaskPower' policy is to calculate depreciation on a straight-line basis over the life of the estimated average service life of the asset therefore any loss on retirement of an asset is recorded as an expense when incurred.

AN AGREEMENT ON THE EQUIVALENCY OF
FEDERAL AND SASKATCHEWAN REGULATIONS
FOR THE CONTROL OF GREENHOUSE GAS EMISSIONS FROM ELECTRICITY
PRODUCERS IN SASKATCHEWAN, 2020

BETWEEN

THE GOVERNMENT OF CANADA
AS REPRESENTED BY THE MINISTER OF THE ENVIRONMENT
("CANADA")

AND

THE GOVERNMENT OF SASKATCHEWAN
AS REPRESENTED BY THE MINISTER OF THE ENVIRONMENT
("SASKATCHEWAN")

WHEREAS Canada and Saskatchewan ("the Parties") are parties to the Canada-Saskatchewan Agreement in Principle with respect to an equivalency agreement for Canada's *Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations* (*Coal-Fired Electricity Regulations*), dated November 22, 2016;

AND WHEREAS Saskatchewan promulgated the *Management and Reduction of Greenhouse Gases (General and Electricity Producer) Regulations (MRGG Regulations)*, made under section 84 of *the Management and Reduction of Greenhouse Gases Act*, on January 1st, 2018, which limit greenhouse emissions from the electricity generating sector in Saskatchewan for the period January 1, 2018 to December 31, 2029 to 175 Mt CO_2e;

AND WHEREAS SaskPower commenced operation of carbon capture and storage (CCS) at Boundary Dam unit 3 in 2014, in advance of the emission intensity performance standard of the *Coal-fired Electricity Regulations* for the unit which starts applying in 2020;

AND WHEREAS for the purposes of determining equivalency, the impact of the federal *Coal-fired Electricity Regulations* was modeled based on the regulated requirements, which include a 420 t CO_2/GWh emission intensity performance standard applied to coal-fired electricity generating units that operate beyond the end of their useful life. The total modelled emissions from the electricity generating sector in Saskatchewan for the period of January 1, 2018 to December 31, 2029 are 176.7 Mt CO_2e;

AND WHEREAS section 10 of the *Canadian Environmental Protection Act, 1999 (CEPA)* sets out provisions on equivalency and allows the Minister of the Environment to agree in writing with a provincial government that there are in force by or under the laws applicable to the jurisdiction of the government provisions that are equivalent to a regulation made under subsection 93(1) of the *CEPA*, and provisions that are similar to sections 17 to 20 of the *CEPA* for the investigation of alleged offences under environmental legislation of that jurisdiction;

NOW THEREFORE, the Parties agree:

1.0 DEFINITIONS

"*CEPA*" means the *Canadian Environmental Protection Act, 1999*, S.C. 1999, c. 33;

"*MRGG Act*" means Saskatchewan's *the Management and Reduction of Greenhouse Gases Act*, S.S. 2010, c. M-2.01.;

"*MRGG Regulations*" means Saskatchewan's *the Management and Reduction of Greenhouse Gases (General and Electricity Producer) Regulations*, January 1st, 2018;

"*Coal-fired Electricity Regulations*" means the *Reduction of Carbon Dioxide Emissions from Coal-fired Generation of Electricity Regulations, DORS/2012-167.*

2.0 EQUIVALENCY

2.1 Provisions that are in force by or under the laws of Saskatchewan, and in particular the *MRGG Act* and the *MRGG Regulations* are equivalent to the provisions of the *CEPA* and the *Coal-fired Electricity Regulations*, for the purposes of Section 10 of the *CEPA*, by reason of the fact that the following criteria have been met:

A. Greenhouse Gas Emissions Levels

The effect on greenhouse gas emissions levels of the limits, determined in tonnes of carbon dioxide equivalent, that are applicable under the *MRGG Act* and the *MRGG Regulations* are assessed to be, for the calendar years 2018 to 2029, equivalent to the effect on greenhouse gas emissions levels of the limits imposed under the *CEPA* and the *Coal-fired Electricity Regulations.*

B. Resident's Request for Investigations

Sections 62.1 and 62.2 of the *MRGG Act* provide a mechanism similar to that provided in sections 17 to 20 of the *CEPA* whereby an alleged offence will be investigated on the application of a resident, and a report shall be made by the provincial Minister of the Environment to the applicant outlining the progress of the investigation and the action, if any, that is or will be taken.

C. Sanctions and Enforcement Programs

The penalty and enforcement provisions of the *MRGG Act* are equivalent to the penalty and enforcement provisions in the *CEPA*.

3.0 INFORMATION-SHARING

3.1 The Parties will share information upon request respecting the administration of this Agreement in order to meet each Minister's respective reporting obligations to Parliament or to the people of Saskatchewan, as the case may be.

3.2 For the administration of this Agreement, Saskatchewan will provide to Canada on an annual basis as a minimum:

(a) written notification of any relevant proposed and actual amendments to the *MRGG Act* or the *MRGG Regulations*;

(b) reports on the quantity of electricity generated by each fossil fuel-fired electricity unit in Saskatchewan;

(c) reports on the quantity of CO_2, and of total GHG emissions (in CO_2e) released from each electricity generating unit in Saskatchewan;

(d) reports on the performance of Boundary Dam unit 3 carbon capture and storage in Saskatchewan;

(e) returns and other compliance period reports required under section 19 of the *MRGG Act*;

(f) any auditing reports produced for the purposes of the *MRGG Act* concerning the *MRGG Regulations*;

(g) copies of any orders issued, amended, or renewed under the *MRGG Act* concerning the *MRGG Regulations*; and

(h) annual statistics on enforcement actions by Saskatchewan concerning the *MRGG Regulations*.

3.3 For the administration of this Agreement, Canada will provide to Saskatchewan, upon request, written notification of relevant proposed and actual amendments to the *CEPA* or the *Coal-fired Electricity Regulations*.

4.0 CONDITIONS

4.1 As part of this Agreement, it is recognized that the *MRGG Regulations* include the following mandatory greenhouse gas emissions limits for the electricity sector in Saskatchewan for the years 2018 to 2029:

(a) for the calendar years 2018 to 2019, not greater than 33.5 Mt of carbon dioxide equivalent; and

(b) for the calendar years 2020 to 2024, not greater than 77 Mt (or 82 Mt if a carbon capture and storage system is installed at Boundary Dam units 4 & 5) of carbon dioxide equivalent; and

(c) for the calendar years 2025 to 2029, not greater than 64.5 Mt of carbon dioxide equivalent.

4.2 Following the signature of this agreement, the Governor in Council will be authorized to make an order declaring that the provisions of the *Coal-fired Electricity Regulations* do not apply in Saskatchewan.

4.3 Saskatchewan confirms that, for the purposes of this Agreement and for complying with the *MRGG Regulations*, electricity producers will not be authorized to:

- use credits other than performance credits for electricity producers whose actual emissions for a compliance period were less than the emissions level prescribed for that emitter;
- use any tonnes of CO_2e allocated as a result of investment in a pre-certified investment;
- use any tonnes of CO_2e allocated with respect to early action;
- deduct any amount of CO_2e, allowed at the Minister's discretion, when calculating their greenhouse gas emissions;
- make compliance payments, such as payments to Saskatchewan Technology Fund Corp.

4.4 Saskatchewan agrees to meet a commitment to have at least 40% of the provinces' electricity generation capacity be from non-emitting energy sources by 2030. Saskatchewan agrees to meet this target with milestones for the range of percentages of the provinces' electricity generation capacity that is from non-emitting sources of a minimum of:

- 26 - 30% by December 31, 2021; and
- 30 - 34% by December 31, 2024; and
- 34 - 40% by December 31, 2027; and
- 40 - 50% by December 31, 2030.

4.5 The Parties acknowledge that this Agreement is without prejudice to the form of any future agreement between the Parties on electricity.

5.0 ENTRY INTO FORCE AND CONDITIONS FOR RENEWAL

5.1 This Agreement comes into force on January 1, 2020.

5.2 This Agreement terminates on December 31, 2024. This Agreement may be renewed in its current form such that any renewal expires no later than December 31, 2029. This Agreement may be terminated earlier by either Party giving the other at least three months' notice.

6.0 AMENDMENT

6.1 The Parties may amend this Agreement from time to time pursuant to the requirements under section 10 of the *CEPA*.

02 MAI 2019
Date

HER MAJESTY THE QUEEN IN RIGHT OF CANADA

HON. CATHERINE McKENNA
Minister of the Environment

May 3/19
Date

HER MAJESTY THE QUEEN IN RIGHT OF SASKATCHEWAN

HON. DUSTIN DUNCAN
Minister of the Environment

SRRP Q20 Reference: Decommissioning and Disposal of Assets

a) Please discuss how SaskPower plans for the decommissioning and disposal of assets, in particular generation assets.
b) Are decommissioning requirements considered when selecting new generation resources? Please discuss.
c) Please discuss how SaskPower addresses refurbishment, reuse, or recycling of materials during decommissioning. In particular, are some types of generation assets more easily reused or recycled than other types of generation assets?

Response:

a)

SaskPower has a 5-year cycle to review all decommissioning and reclamation plans for the generation facilities excluding the hydroelectric facilities as they are assumed to remain in service indefinitely. In conjunction with this, effective January 1st, 2020, the Ministry of Environment (MEnv) brought in regulations stating that all facilities that have an Industrial Waste Work (IWW) permit associated with the facility require a Decommissioning and Reclamation (D&R) plan be submitted and approved by the MEnv. The D&R plans are to be reviewed and updated at a minimum of every 5 years or sooner if warranted by major changes to the facility and operations. SaskPower has received approval from the MEnv for D&R plans for six generation sites that require an IWW permit (Chinook, Queen Elizabeth, Boundary Dam, Shand, Poplar River Power Station and Cory Cogeneration).

These plans are currently at a high level and the work to refine and better define the work scope needed during the decommissioning and reclamation process has already begun. The environmental reclamation costs are anticipated to be one of the larger risks to the cost estimates for the decommissioning and reclamation plan. SaskPower will continue to monitor and manage site conditions and possible contamination through work required under the existing IWW permit. Nearer to the time of decommissioning, SaskPower will undertake additional site assessment activities to refine the remedial planning for the facility. Additional options for ongoing assessment and delineation will be explored in the interim.

The estimated cost used to define the required Asset Retirement Obligation (ARO) funding is a class 4 estimate per ASTM E2516-11 Standard Classification for Cost Estimate Classification System. SaskPower has established provisions to decommission coal, natural gas, cogeneration and wind generation facilities. The fair value of the estimated decommissioning cost is recorded as a provision with an offsetting amount capitalized and included as part of property plant and equipment. The provisions are increased periodically for the passage of time by calculating interest expense. The offsetting capitalized asset retirement costs are depreciated over the estimated useful life of the related asset. The calculations of fair value are based on detailed studies that take into account various assumptions regarding the anticipated future cash flows including the method and timing of decommissioning and estimates of future inflation rates.

Decommissioning provisions are periodically reviewed and any changes in the estimated timing and amount of future cash flows as well as changes in discount rate are recognized as an increase or decrease in the carrying amount of the obligation and related asset.

b)

Decommissioning requirements are considered from a cost and risk perspective. Cost assessment includes inputs of total capital cost, annual cash flow percentages, construction time, interest rates and discount rates which results in outputs of the required annual expenditures and the salvage value at the end of the study period. Project approvals are made in consideration of a risk assessment, risk and the ability to mitigate risk play a role in in the decision to proceed for projects that require special consideration upon decommissioning.

c)

SaskPower addresses each generating station on a case-by-case basis to determine what building materials and equipment will be scrapped (metal and copper recycling) or salvaged (retained for resale or kept as spares for another generating station).

Scrap materials will generally comprise of all steel building structures, tin siding and roofing from buildings, copper electrical cables, steel and copper piping and other scrapped metal equipment from within the power plant and other buildings at site. These scrapped materials will be hauled to the nearest metal recycler and SaskPower will be reimbursed based on scrap weight and the current market price for scrap metal.

At the onset of the decommissioning and reclamation execution, equipment is reviewed to determine if it has salvage value, either resale or to be retained as a spare at another SaskPower generating station. Typically, transformers will be the most common piece of equipment which would have salvage value to SaskPower since they are a more generic type of equipment which can be used in numerous applications. Equipment such as pumps, fans, and compressors may be salvageable, but not likely since they are designed and sized for more specific applications within the generating station. Turbines and generators are highly unlikely to have any salvage value since they will be old technology, at the end of their useful life at the time of decommissioning, and may have some unique/specific designs to suit a given generating station. Regardless of the type of equipment, age and condition will be a determining factor in deciding whether a piece of equipment is salvageable.

SRRP Q21 Reference: Export Revenues and Electricity Trading

a) Please provide a break-out of export revenues and electricity trading revenues for each of the last five actual years and forecasts for 2021/22, 2022/23 and 2023/24.
b) Please describe the activities that lead to each of the export revenues and electricity trading revenues.
c) Please describe the types of export sales (long-term contract, short-term contract, spot market sales) SaskPower makes and provide details of SaskPower's current export transmission rights.
d) Please describe in detail how SaskPower prepares its export revenue forecasts and provide an explanation for the decrease in export revenues in 2022/23 relative to 2020/21 and 2021/22 actuals. Please describe any differences between the export revenue forecast methodology and the electricity trading revenue forecast methodology.
e) Please provide SaskPower's actual export sales for the last 10 years compared to forecasts from the prior year's business plan (i.e. the last business plan prepared prior to the start of the fiscal year).
f) Please provide an estimate of the proportion of SaskPower's export sales to Alberta compared to other jurisdictions in terms of both volume and revenue.
g) Please discuss whether SaskPower believes adding renewable generation will affect its export sales, both in terms of volume of export sales and also volatility in export sales forecasts.
h) Please indicate if there are any fixed costs associated with pursuing exports and/or electricity trading activities and if so, quantify any fixed amounts.
i) Please provide an illustrative sample of a trading transaction that shows how SaskPower calculates the revenue from the transaction (showing both volumes and prices); the costs of the transaction (including both direct costs and the share of any fixed costs related to trading); and the net revenues from the transaction.

Response:

a)

Export revenues and electricity trading

	Actual	Actual	Actual	Actual	Actual	Forecast	usiness Plan	usiness Plan
(in millions)	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**	**2022-23**	**2023-24**
Exports	$ 5	$ 10	$ 30	$ 20	$ 54	$ 87	$ 41	$ 59
Electricity trading	$ (3)	$ (3)	$ -	$ -	$ (1)	$ -	$ -	$ -

b)

Traders are charged with monitoring external energy and transmission markets on a 24/7 basis. At the same time, they are also monitoring SaskPower's marginal price and energy position. In doing so they essentially develop an hourly near term price projection or forecast for external markets and internal position. When the evaluation of all these variables points to a profitable export opportunity, traders will if required, reserve the necessary transmission service and carry out the necessary steps to offer and schedule the energy to external markets.

c)

SaskPower participates in several organized deregulated markets. The organized markets are called Independent System Operators ("ISO") or Regional TransmissionOrganizations ("RTO"):

<u>ISO</u>
Alberta Electric System Operator ("AESO") -Alberta

<u>RTO</u>
Southwest Power Pool ("SPP") - Midwestern US including North and South Dakota
Midcontinent Independent System Operator ("MISO") - Midwestern states and provincesincluding Manitoba and Minnesota

SaskPower may also engage in bi-lateral transactions with counterparties in the AESO, MISO and SPP footprints.

SaskPower's export sales are almost always spot market transactions, but SaskPower has occasionally entered single month export transactions. As at March 2022, SaskPower has not entered into any short-term or long-term export contracts.

SaskPower has firm transmission rights on export paths within Saskatchewan:

1. 153 MW to AESO
2. 150 MW to SPP (US)
3. 185 MW to Manitoba

d)
SaskPower's export revenue forecast is prepared in conjunction with the development of the annual Fuel and Purchased Power budget. SaskPower uses an optimized dispatch model to forecast fuel and purchased power costs, accounting for a variety of factors including system load, import requirements, and commodity prices. The model initiates export transactions where energy is available and projected market conditions indicate profit potential.

The average projected export price for 2022/23 is $80.68/MWh. The decrease in export revenues in 2022/23 relative to 2020/21 and 2021/22 is attributable to higher average export prices in 2021/22 (~$110/MWh YTD), coupled with export revenues related to the Texas winter storm event of February 2021.

The export revenue forecast methodology is designed to project the revenues for export of electrical energy generated within Saskatchewan while the electricity trading revenue forecast methodology is designed to project the revenues created from proprietary trading transactions performed by NorthPoint.

e)

Export revenue

(in millions)	Actual Revenue	Business Plan Budget
2020-21	$ 54	$ 26
2019-20	20	28
2018-19	30	12
2017-18	10	10
2016-17	5	17
2015-16*	9	21
2014	7	27
2013	62	27
2012	49	8
2011	40	15

*15-month period (fiscal year-end changed from December to March)

f)

Of the 781 GWh of export sales projected for 2021-22, 717GWh are projected to be exported to Alberta, representing $82 million of the total $87 million in forecasted export sales.

Over time Alberta has been the most lucrative market for SaskPower. Export opportunity and profit are dependent on the availability of SaskPower surplus energy but more significantly a function of the external market price over which SaskPower has no control. In some years export profit to the US has been higher than Alberta.

g)

The addition of more renewables in Saskatchewan will undoubtedly make more supply available when the wind is blowing, so exports should increase during those times. However, the overall ability to export comes down to having surplus energy so if load growth keeps pace with renewables growth and overall supply, exports will stay roughly the same over time. The markets around us all have significant levels of wind penetration and have already seen volatility increase for that reason. SaskPower believes that to maintain system reliability, the tools available to manage the variability of wind and solar must also increase. Currently our view is that renewable supply is coming on faster than tools, like energy storage, to manage the variability but we see storage catching up. So future market volatility may go down. SaskPower currently forecasts an average price that then uses historical volatility to create hourly price shapes.

h)

SaskPower does not currently assign any fixed costs to pursue export or trading opportunity. We do not own any external transmission positions. Trading staff and equipment are in place to manage and optimize SaskPower generation and transmission assets in the operational time frame to serve SaskPower load commitments. The tools, skills, market enabling and knowledge in surrounding markets are all required to economically serve SaskPower load. These same tools, skills and market intelligence are leveraged to capture export and trading opportunity when time and market conditions permit.

i)

Export Net Profit Sample Calculation

SaskPower sells 50 MWh to the buyer at a price of $70 per MWh. The delivery point is the Saskatchewan border.

Assuming transmission losses are 2%, SaskPower needs to generate 51 MWh to deliver 50 MWh to the border.

Costs

Energy: 50 MWh x $40 per MWh (incremental cost of supply unit)= $2,000. Note incremental costs consist of incremental fuel and OM&A.

Transmission: no charge within the Saskatchewan system and no external transmission charges because the buyer took delivery at the Saskatchewan border

Transmission Losses: I MWh x $40 per MWh (incremental cost of supply unit) = $40

Total Cost: $2,000 + $0 + $40 = $2,040

Revenue

50 MWh x $70 per MWh = $3,500

Net Profit Margin on the Trading Transaction

$3,500 - $2,040 = **$1,460**

Fixed costs are not allocated to individual transactions.

SRRP Q22 Reference: Other Revenue

a) With reference to the statement in section 7.1.3 that "other revenue is expected to decline slightly as a result of the transfer of SaskPower's Gas & Electrical Inspections Division to the Technical Safety Authority of Saskatchewan" please discuss:
   i. The reason for this transfer.
   ii. Whether there are any offsetting reductions in operations and maintenance expenses as a result of the transfer and if so, please quantify these reductions for 2022/23 and 2023/24.

Response:

a)
   i. SaskPower's Gas & Electrical Inspections division was transferred to the Technical Safety Authority of Saskatchewan (TSASK) effective January 31, 2021, as part of a government initiative to consolidate several inspection and licensing functions within a single regulatory body.

   ii. Reductions to SaskPower's OM&A expenses related to the transfer of the Gas & Electrical Inspections division to TSASK are approximately $15 million per year for 2022-23 and 2023-24.

SRRP Q23 Reference: Other Revenue

Please explain how SaskPower forecasts customer contribution revenues in the test years and provide an explanation for the difference in forecasted contributions between 2022/23 and 2023/24.

Response:

Customer contributions are funds received related to the cost of service extensions. These contributions are recognized immediately in profit or loss as other revenue when the related property, plant and equipment is available for use.

Distribution customer connects are based on historic averages of actual customer contribution revenue received by SaskPower with consideration given to forecasted load growth.

Transmission customer connects are based on a combination of:

- Forecasted capital projects for which customers or independent power producers are responsible to pay for a portion of the costs,
- Meetings with Key Account Managers regarding updates received from customers on any anticipated changes in their short- and long-term energy requirements (this includes expansions or speculative load); and
- Historic averages of actual customer contribution revenue received by SaskPower.

The difference in forecasted contributions between 2022-23 and 2023-24 relates to the expected completion of various large transmission projects in 2023-24.

SRRP Q24 Reference: Other Revenue

a) Please discuss how the CO2 sales revenue forecasts are prepared.
b) Please provide an explanation for the absence of CO2 sales revenues in 2021/22.

Response:

A. CO_2 sales revenue forecasts are prepared in accordance with contractual obligations of the off taker. The forecast does not assume SaskPower captures and sells the maximum amount of CO_2 and factors in average expected facility availability targets.

B. The absence of CO_2 revenues in 2021-22 was a result of unforeseen outages caused by the back-to-back failures of major components in the plant. The components' failures were both exclusive events and unpredictable in nature. SaskPower was unable to meet its contractual obligations for CO_2 deliveries because of the outages, thus lowering net CO_2 revenues for the 2021-22 fiscal year.

SRRP Q25 Reference: Other Revenue

Please provide a detailed breakout of Miscellaneous Revenue for the five most recent actual years and forecasts for 2022/23 and 2023/24. Please provide an explanation for the decreased revenue in 2022/23 and 2023/24 compared to 2021/22.

Response:

The following table provides a detailed schedule for Miscellaneous Revenue for the 2016-17 through 2020-21 years as well as forecasted amount for 2021-22 through 2023-24.

Miscellaneous Revenue

(in imllions)	Actual 2016-17	Actual 2017-18	Actual 2018-19	Actual 2019-20	Actual 2020-21	Forecast 2021-22	Business Plan 2022-23	Business Plan 2023-24
Late payment charges	$ 5	$ 5	$ 6	$ 5	$ 4	$ 7	$ 6	$ 6
Joint use charge	4	4	5	5	5	7	5	5
Custom work	4	5	5	4	3	4	4	4
Connect fees	1	1	3	3	2	3	2	2
Meter reading	2	2	2	2	2	2	2	2
Transmission tariff revenue	-	-	-	1	-	-	-	-
Other revenue	4	3	3	9	2	2	2	1
Fly ash	6	7	7	10	8	10	9	10
Renewable energy credits	-	-	-	-	-	1	1	1
Equity investment income (loss)	1	2	3	(1)	-	-	-	-
Miscellaneous revenue	$ 27	$ 29	$ 34	$ 38	$ 26	$ 36	$ 31	$ 31

The decrease in revenue in 2022-23 and 2023-24 compared to 2021-22 is mainly due to:

- lower joint use revenue due to retroactive contract adjustments made in 2021-22,
- reduced late payment charges due to customers returning to pre-COVID payment habits in 2021-22, and
- fluctuations in fly ash revenue driven by coal-fired generation levels.

SRRP Q26 Reference: Business Plan

Please provide a description of SaskPower's annual business planning cycle including inputs required, review and approval processes, and the typical timing of updates.

Response:

The following is a summary of SaskPower's typical business planning cycle:

April to June (Q1)

- The Q1 load forecast is finalized, and the Supply Plan is updated to reflect new load forecast assumptions.
- Detailed capital plans are updated, preliminary capital targets and OM&A budgets are prepared, and new initiative requests or funding shortfalls are identified.
- Preliminary revenue and expense budgets are developed.
- Rate increase scenarios are developed based on preliminary targets and budgets.
- SaskPower's Executive review rate increase options and approve a Rate Strategy.
- SaskPower's Audit & Finance Committee and Board of Directors review and approve the Rate Strategy for use in the Business Plan and Rate Application.

July to September (Q2)

- Detailed capital plans are updated, and any additional new initiative requests or funding shortfalls are prioritized by SaskPower's Executive.
- Revenue and expenses are updated to reflect any changes in assumptions (i.e., natural gas prices).
- All other preliminary budget assumptions used in developing the rate strategy are reviewed and revised where necessary.
- SaskPower's Executive reviews and provides feedback on the preliminary Business Plan.

October to December (Q3)

- The preliminary Business Plan is updated to incorporate the most recent current year forecast (as at September 30) as well as the Executive's feedback during the preliminary review.
- SaskPower's Executive and Audit & Finance Committee review and approve the Business Plan.
- Business Units update detailed capital plans based on the approved capital targets.
- SaskPower's Board of Directors reviews and approves the Business Plan, which is subsequently provided to the Crown Investments Corporation (CIC).

January to March (Q4)

- Crown Investments Corporation of Saskatchewan reviews and approves SaskPower's Business Plan.

- The Government of Saskatchewan Ministry of Finance consolidates SaskPower's financial results as part of the Province's financial reporting package.

Note: Typically, the approved Rate Strategy is used in developing SaskPower's Rate Application.

Due to the timing of the 2022 and 2023 Rate Application, a revised version of the 2022-23 Business Plan submitted to CIC, at the beginning of December 2021, has been used.

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SRRP Q27 Reference: Business Plan

a) Please discuss how SaskPower develops its forecasted annual rate increases included in the business plan and why the forecast rate varies by year.
b) Please provide a table that shows the cumulative percentage rate increase, the cumulative percentage carbon charge increase, and the combined cumulative percentage rate increase and carbon charge increase forecast for each year of the business plan.

Response:

a) SaskPower developed its annual rate increase requirements with an objective to return to the achievement of its 8.5% return on equity target within the next five years, combined with an annual rate increase cap of the lower of 4.0% and the rate increase percentage that achieves a return on equity of 8.5% for the applicable year. Annual rate increases vary by year due to this annual rate increase cap.

b) Please see the table below for details on the cumulative percentage rate increase and the cumulative percentage carbon charge increase.

Business Plan

	Business Plan **2022-23**	Business Plan **2023-24**
Cumulative rate increase	4.0%	8.0%
Cumulative carbon charge increase*	0.0%	0.5%
Total cumulative increase	4.0%	8.5%

* The cumulative system average impact of the Federal Carbon Tax is 5.7% as at March 31, 2022.

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2022 AND 2023 RATE APPLICATION
SRRP INTERROGATORIES

SRRP Q28 Reference: Generation expense

For each of the last three actuals years, plus forecasts for 2021/22 through 2023/24, please provide the total cost of generation broken out into:

i. Fuel and purchased power expense
ii. Operations and maintenance expense
iii. Finance expense
iv. Depreciation expenses
v. Return on equity
vi. Other

Response:

The information requested is included in the table below:

Generation expense

(in millions)	Actual 2018-19	Actual 2019-20	Actual 2020-21	Forecast 2021-22	Business Plan 2022-23	Business Plan 2023-24
Fuel and purchased power	$ 691	$ 669	$ 715	$ 886	$ 902	$ 952
Federal carbon charge	19	68	92	176	154	223
Operating, maintenance and administration[1]	264	276	260	264	270	264
Depreciation	309	308	317	325	306	304
Finance charges[2]	277	291	288	266	254	249
Taxes[1]	21	22	22	24	23	24
Other expenses[1]	7	8	8	9	6	8
Total generation expense	$ 1,588	$ 1,642	$ 1,702	$ 1,950	$ 1,915	$ 2,024

1. The expenses presented in the above table exclude shared costs that are cannot be directly allocated to generation activities (i.e., costs for supporting business units such as human resources and safety, finance and business performance, etc.). OM&A consists of business unit costs for power production and purchased power agreements; taxes consist of an allocation of corporate capital tax; and other expenses includes amounts related to losses on asset retirements and costs of disposal.
2. Finance charges have been calculated based on the relative proportion of the asset acquisition value.

Note that a return on equity for generation has not been broken out as SaskPower's entire asset base is considered to be one cash-generating unit.

SRRP Q29 Reference: Fuel and Purchased Power (F&PP)

a) Please discuss if there have been any changes to the methods SaskPower uses to prepare its fuel and purchased power forecasts since the response to SRRP Round 1 question 39 from the 2018 rate application. If so, please explain any changes.
b) Please provide a table showing the total GWh of generation for each of the last three actual years plus forecasts for 2021/22 through 2023/24 for:
   i. SaskPower's own generation
   ii. Purchased power within Saskatchewan
   iii. Imports from outside Saskatchewan

Response:

a) There has been no material change to the methodology employed since the response to SRRP Round 1 question 39 from the 2018 rate application. For clarity, projected grid scale photo-voltaic generation would also be included in SaskPower's projected cumulative must-run generation.

b) Please see the table below for actual generation supplied (in GWh) for 2018-19 through 2020-21 and forecasted generation for 2021-22 through 2023-24:

Fuel and purchased power - generation supplied

(in GWh)	Actual **2018-19**	Actual **2019-20**	Actual **2020-21**	Forecast **2021-22**	Business Plan **2022-23**	Business Plan **2023-24**
SaskPower-owned generation[1]	20,588	20,142	19,511	19,744	17,776	17,512
Purchased power within Saskatchewan	4,699	4,613	4,494	5,360	6,413	7,137
Imports from outside Saskatchewan	490	278	629	725	1,751	1,964
Gross electricity supplied	25,777	25,033	24,634	25,829	25,940	26,613

1. Cory Cogeneration Station has been included with SaskPower-owned generation in all years of the above table for comparative purposes; however, prior to July 11, 2019, this facility was classified as a Power Purchase Agreement (PPA) under the joint venture agreement between the Corporation's subsidiary, SaskPower International, and ATCO Power Canada Ltd. SaskPower International purchased the remaining ownership interest in the Cory Cogeneration Station Joint Venture on July 11, 2019, thereby dissolving the joint venture and terminating the PPA.

SRRP Q30 Reference: Fuel and Purchased Power (F&PP)

a) Please identify any actual or forecast energy volumes subject to "Take or Pay" (TOP) obligations under the PPAs (in total) for each of the three most recent actual years and forecasts for 2021/22 through 2023/24.
b) Please discuss whether SPC has been required to pay for unused energy because of TOP provisions and indicate whether any such costs are forecast to be incurred in 2021/22 through 2023/24.

Response:

a)

All of SaskPower's PPAs are subject to Take or Pay obligations for SaskPower.

PPA energy volumes

(In GWhs)	Actual **2018-19**	Actual **2019-20**	Actual **2020-21**	Forecast **2021-22**	Business Plan **2022-23**	Business Plan **2023-24**
Energy volumes	4,844	4,756	5,034	6,014	8,117	9,056

b) There are circumstances where SaskPower may need to pay for energy rather than receive it, for system security reasons. These decisions are made by SaskPower and not the Independent Power Producer (IPP) and are further defined by each of the respective PPAs.

SRRP Q31 Reference: Fuel and Purchased Power (F&PP)

To the extent possible without requiring the disclosure of confidential information, please provide the average power price for generation owned by SPC and separately, the average purchase price for PPAs by fuel type, and explain any differences in unit costs.

Response:

Table 1 outlines the unit costs for each applicable fuel type for Power Purchase Agreements (PPAs) and SaskPower and is based on the twelve month period ending March 31, 2021.

The fuel cost for PPA gas-fired generation is lower than SaskPower's gas-fired fleet because one of the major PPA units is a fuel-efficient cogeneration facility and two other PPA units use a relatively new technology, which is more efficient than the older units in SaskPower's fleet.

The fuel cost for wind PPAs is higher than SaskPower's wind because the PPA price includes capital recovery and O&M costs, whereas SaskPower's price only reflects fuel.

SaskPower does not have any PPAs with coal facilities; however, it does have long-term import PPA agreements with Manitoba Hydro.

The PPA "Other" category includes green technologies, such as heat recovery, flare gas, and landfill gas-fired generation. SaskPower does not have any comparable facilities.

	Hydro ($/MWh)	Coal ($/MWh)	Gas ($/MWh)	Wind ($/MWh)	Imports ($/MWh)	Other ($/MWh)
SaskPower	$6	$32	$34	$0	N/A	N/A
PPAs	N//A	N/A	$22	$107	$98	$96

SRRP Q32 Reference: Natural Gas

Please describe SaskPower's natural gas procurement processes including details on any firm contracted transmission and/or storage volumes for the three most recent actual years and forecasts for 2021/22 through 2023/24.

Response:

SaskPower secures natural gas for the short to long-term generation needs to meet the gas-fired generation and storage requirements. SaskPower contracts enough market access and storage to ensure it can meet the supply of natural gas during a firm hydro year, which is a 1 in 50 low flow year. In addition, SaskPower secures enough market access and storage to ensure that all the natural gas-fired facilities can reach full load during on-peak hours.

The rest of the response contains commercially sensitive information and cannot be released publicly. A copy of the full response has been provided to the Saskatchewan Rate Review Panel for their review.

SRRP Q33 Reference: Natural Gas

Please describe any changes to SaskPower's or NorthPoint's procedures, Risk Management Policies, and/or Risk Management Manuals related to procurement and pricing of Natural Gas supplies, including Storage and hedging since the last rate application.

Response:

SaskPower removed the natural gas price hedging element of the Long-Term Natural Gas Exposure Management Policy in December 2019. No price hedge transactions on natural gas have been executed since December 2019.

SaskPower made other minor adjustments to policies related to the procurement of natural gas. These changes were made to provide clarity and are administrative in nature.

SRRP Q34 Reference: Natural Gas

Please provide a table showing natural gas purchases within Saskatchewan and outside Saskatchewan including total volumes, average unit costs, and total natural gas expenses for each of the three most recent actual years and forecasts for 2021/22 through 2023/24.

Response:

	Gas Purchased in Saskatchewan			Gas Purchased Outside Saskatchewan		
Fiscal Year	**Volume (Million GJs)**	**Total Cost ($ Millions)**	**$/GJ**	**Volume (Million GJs)**	**Total Cost ($ Millions)**	**$/GJ**
2018-19	17	36	$ 2.19	48	145	$ 2.99
2019-20	13	32	$ 2.45	50	138	$ 2.79
2020-21	14	44	$ 3.10	43	142	$ 3.31
2021-22*	13	54	$ 4.27	50	193	$ 3.85
2022-23*	10	28	$ 2.66	42	129	$ 3.09
2023-24*	10	27	$ 2.69	40	117	$ 2.91

*** Forecasted volume and cost**

SRRP Q35 Reference: Natural Gas

a) Please provide a schedule showing actual natural gas hedged volumes for the five most recent actual years and currently hedged volumes for 2021/22 through 2023/24. Please summarize the types of financial instruments used each year and indicate the overall annual cost of hedged volumes in aggregate and on a unit basis.
b) Please provide an estimate of the impact of SaskPower's hedging activities on natural gas costs for each of the five most recent actual years. Please also provide a discussion on the net cost or benefit to ratepayers of the hedging program over the past five years.

Response:

a) The following schedule shows the total physical and financial fixed-price transactions by fiscal year:

Fiscal Year	Volume (GJ Millions)	Notional Value (Millions)	Unit Value ($/GJ)
2016/17	52	$ 195	$ 3.73
2017/18	47	$ 182	$ 3.92
2018/19	42	$ 172	$ 4.06
2019/20	46	$ 176	$ 3.87
2020/21	41	$ 149	$ 3.64
2021/22	36	$ 134	$ 3.69
2022/23	29	$ 110	$ 3.79
2023/24	25	$ 86	$ 3.49

b) When comparing the transactions to the settled market prices over the five most recent actual years, the estimated mark-to-market net impact is a net cost of approximately $352 million.

	GJ (Millions)	Notional Value (Millions)
2017/18	47	$ 87
2018/19	42	$ 109
2019/20	46	$ 103
2020/21	41	$ 55
2021/22	36	$ (2)
Total		$ 352

The volumes secured address a security of supply objective, which is approximately half of total volume exposure per year. The transactions also stabilize a portion of the natural gas costs, which otherwise would have been open to market movements.

In a declining market price environment, the settlement value is negative. However, this negative value is offset by the open exposure where natural gas was purchased at a lower market price. In these circumstances, SaskPower's total portfolio cost of gas will be lower than projected.

SRRP Q36 Reference: Natural Gas

a) Please provide a schedule that shows SaskPower's natural gas fuel efficiency ratio (i.e. the kW.h generated per unit of natural gas) for each of the three most recent actual years and forecasts for 2021/22 through 2023/24. Please comment on any material variances between years.
b) Please discuss if the fuel efficiency ratios vary materially across plants and if so, why?
c) Please describe how SaskPower prepares its forecasts of natural gas fuel efficiencies.

Response:

a) SaskPower Natural Gas Fuel Efficiency Ratio:

Fiscal Year	MWh/GJ
2018/19	0.102
2019/20	0.109
2020/21	0.116
2021/22	0.112
2022/23	0.125
2023/24	0.126

- 2022-23 & 2023-24 have a higher fuel efficiency ratio because additional renewables are reducing the use of less efficient natural gas units and therefore improving the overall efficiency.

b) There can be material differences across plants based mostly on technology. Gas units with similar technology could see efficiency differences due to the age of the unit and the technological advances made over time. The structure of the gas generation plants also has an impact on efficiency with simple cycle gas turbines consuming more natural gas per MWh of electrical energy produced compared to a combined cycle plant.

c) The dispatch of gas units is based on the lowest variable incremental cost units being dispatched to meet SaskPower's energy and ancillary service requirements. The gas unit calculation of variable incremental costs is based on the projected natural gas commodity price, heating values of the gas supplied, heat rate of the natural gas generation, and the variable Operation and Maintenance cost of the unit or plant. The natural gas fuel efficiency is a result of this process.

2022 AND 2023 RATE APPLICATION
SRRP INTERROGATORIES

SRRP Q37 Reference: Natural Gas

Please provide a schedule showing the average cost of transmission and storage per GJ for the three most recent actual years and forecasts for 2021/22 through 2023/24.

Response:

SaskPower contracts firm transportation service with TransGas for the purpose of transporting gas into and within Saskatchewan. SaskPower pays the tariff rates posted by TransGas. The table below displays the average cost of transportation (transport into Saskatchewan and within Saskatchewan).

SaskPower contracts storage capacity and withdrawal capability with TransGas. The average cost is in the table below. Both transportation and storage unit costs are relative to consumption and assume an 8% rate increase for 2022/23 and 2023/24.

	Average Transportation Cost ($/GJ)	Average Storage Cost ($/GJ)
2018-19	$ 0.60	$ 0.09
2019-20	$ 0.81	$ 0.10
2020-21	$ 0.85	$ 0.11
2021-22	$ 0.83	$ 0.10
2022-23	$ 0.89	$ 0.11
2023-24	$ 0.97	$ 0.12

SRRP Q38 Reference: Coal

Please provide the average heat values for coal generation for each of the past three actual years and forecasts for 2021/22 through 2023/24.

Response:

Coronach area

Year		2019	2020	2021	2022	2023
Heat Value	MJ/Mg	13,138	13,197	13,159	13,344	13,238

Estevan area

Year		2019	2020	2021	2022	2023
Heat Value	MJ/Mg	15,642	15,536	15,466	15,844	15,945

Information is provided on a calendar year basis.

SRRP Q39 Reference: Hydro

Please provide an update on the status of the Tazi Twé project, including whether SaskPower anticipates it may become an economic project in the future.

Response:

In 2017 the decision was made to defer the Tazi Twé project indefinitely. The decision was based on a 2016 decline in the load forecast for northern Saskatchewan driven by a softening of market conditions for uranium resulting in a scaling back of mining activity. Under current load forecasts, load in the far north can be served by existing infrastructure, imports or wheeling through Manitoba. The development of Tazi Twé would result in excess energy in SaskPower's far north grid. SaskPower will continue to review options for far north generation and if forecasted loads increase significantly the project could be reconsidered.

SRRP Q40 Reference: Hydro

Please provide a schedule showing the actual and forecasted water rental rates for the three most recent years of actuals and forecasts for 2021/22 through 2023/24.

Response:

The following table contains the water rental fee rate paid or forecasted to be paid in fiscal years 2018/19 through 2023/24.

Year	Water Rental Fee ($/MWh)
Fiscal 2018/19	5.68
Fiscal 2019/20	5.83
Fiscal 2020/21	5.92
Fiscal 2021/22	6.01
Fiscal 2022/23	6.10
Fiscal 2023/24	6.19

SRRP Q41 Reference: Hydro

Please provide any updates on the expected flow conditions for 2022/23 based on recent snowfall or other conditions since the business plan supporting the rate application was prepared.

Response:

There are hydrological factors which could provide either above or below median flow on the Saskatchewan and Churchill River system this year. There is a greater chance of above median flows however it is too early to assign a high degree of confidence to this. Median flow conditions are still projected as the expected flow conditions for planning purposes.

SRRP Q42 Reference: Hydro

a) Please confirm which 40 years of data are used for forecasting hydro availability.
b) Please discuss whether SaskPower has prepared an analysis of the potential effects of climate change on future hydro generation and if so, provide a summary of the analysis.

Response:

a) The current data set being used is 1970-2009 adjusted for the current level of Alberta development.

b) SaskPower has reviewed many climate change projections but has not performed any analysis of climate change impacts on hydro generation.

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SRRP Q43 Reference: Wind

a) Please provide a schedule showing actual and forecasted monthly wind generation in GWh and wind capacity factors for wind facilities for the last three actual years and forecasts for 2021/22 through 2023/24.

b) What proportion of the 385 MW of wind generation to be added in 2021/22 as described on page 24 of the application will be SaskPower owned wind generation versus purchased power?

Response:

a)

Forecast and Actual Wind Energy by Month (GWh)										
	2018-2019		2019-2020		2020-2021		2021-2022		2022-2023	2023-2024
Month	Business Plan	Actual	Business Plan	Actual	Business Plan	Actual	Rate Application	Actual	Forecast	Forecast
Apr	66.5	41.6	72.6	68.7	75.3	75.3	82.3	82.3	206.5	202.9
May	68.8	51.3	76.4	52.6	68.2	68.2	83.7	83.7	182.5	179.5
June	54	42.3	61.7	53.0	51.5	58.3	85.6	85.5	139.5	135.8
July	48.6	44.4	54.6	50.4	43.3	54.9	71.2	71.2	121.0	118.9
Aug	50.2	36.1	57.4	55.7	49.2	58.0	95.6	95.5	137.6	135.4
Sept	58.9	45.8	64.2	53.6	65.1	74.2	115.1	115.3	175.3	173.0
Oct	69.1	62.8	74.7	82.4	85.4	80.8	139.0	141.1	227.1	225.7
Nov	68.2	38.9	75.2	69.8	94.1	84.2	165.0	168.4	255.3	255.3
Dec	75.6	77.9	84.7	77.8	93.4	95.2	180.5	169.7	255.1	339.9
Jan	78	86.2	84.4	87.7	105.1	93.9	287.3	184.2	283.6	377.6
Feb	65.1	47.5	71.5	81.7	130.8	80.3	186.4	212.7	183.7	253.2
Mar	69.5	84.9	78.4	81.5	155.4	89.3	222.3		218.8	288.0
Total	772.5	659.7	855.8	815.0	1,016.8	912.6	1,714.0	1,409.4	2,386.2	2,685.1

Forecast and Actual Wind Capacity Factor by Month										
	2018-2019		2019-2020		2020-2021#		2021-2022#		2022-2023	2023-2024
Month	Business Plan	Actual	Business Plan	Actual	Business Plan	Actual	Rate Application	Actual	Forecast	Forecast
Apr	42%	25%	42%	42%	42%	46%	47%	47%	46%	45%
May	42%	31%	42%	29%	42%	38%	46%	46%	39%	39%
June	34%	26%	35%	30%	35%	32%	48%	48%	31%	30%
July	29%	27%	30%	28%	30%	31%	48%	48%	26%	26%
Aug	30%	22%	32%	31%	32%	32%	40%	40%	30%	29%
Sept	37%	28%	37%	30%	37%	41%	55%	55%	39%	38%
Oct	42%	38%	41%	46%	42%	45%	42%	42%	49%	48%
Nov	43%	24%	43%	39%	43%	47%	51%	51%	57%	57%
Dec	46%	47%	47%	43%	47%	53%	51%	51%	55%	55%
Jan	47%	52%	47%	49%	47%	52%	56%	54%	61%	61%
Feb	44%	29%	44%	46%	44%	45%	41%	46%	44%	44%
Mar	42%	52%	43%	45%	45%	50%	44%		47%	47%
Total	40%	34%	40%	38%	40%	36%	41%	42%	44%	45%

Fiscal year 21 and 22 Capacity Factor calculated without impacts from facilities prior to reaching commercial operations.

b)

None of the new wind additions are SaskPower-owned. All of the wind generation added in 2021-2022 is owned and operated by the private sector and the wind energy is purchased by SaskPower.

SRRP Q44 Reference: Purchase Power Agreements

a) Does SaskPower have any site restoration or site remediation obligations related to its purchase power agreements? Please discuss how any such obligations are addressed with purchase power agreements.
b) Does SaskPower require that the operators of facilities with purchase power agreements undertake site remediation and site restoration when the facility reaches its end of life? Please discuss any such requirements and how they are incorporated into purchase power agreements.

Response:

a)

SaskPower does not define any specific site restoration or site remediation requirements in our agreements. The Power Purchase Agreement obligates the Independent Power Producer to satisfy any requirements or regulations pertaining to end of life obligations put in place by the Saskatchewan government, the local RM or the landowners in which the Independent Power Producer leases the land for their project.

b)

The Power Purchase Agreement includes the following regarding Decommissioning of the facility:

Supplier retains sole responsibility for the decommissioning of the Supplier's Facilities and the remediation of the Site and all associated costs and expenses. Supplier's obligations and liabilities pursuant to this Section shall survive termination or expiration of this Agreement.

In addition to the above, SaskPower excludes any transfer of risk related to changes in laws or regulations pertaining to decommissioning. There are no other obligations related to decommissioning in the Power Purchase Agreement.

SRRP Q45 Reference: Imports

a) Please provide a schedule showing actual and forecasted import volumes and average prices separately for firm import contracts and spot market or short-term contracts for each of the last four actual years and forecasts for 2021/22 through 2023/24.
b) Please discuss any current plans SaskPower has to increase import capabilities from other jurisdictions.

Response:

This response contains commercially sensitive information and cannot be released publicly. A copy of the full response was provided to the Saskatchewan Rate Review Panel for their review.

SRRP Q46 Reference: Other

a) Please provide an explanation for the increase in other fuel and purchased power expense and volumes for 2022/23 and 2023/24 compared to prior years.
b) Please provide a breakdown of the increased volumes in each year from 2021/22 through 2023/24 that relate to solar versus other types of generation.

Response:

a) Other fuel and purchased power includes additional generation sources such as solar (both utility-scale solar and through our Power Generation Partners Program), waste heat, biomass and flare gas. SaskPower is increasing its investment in renewable or low-emitting generation sources to meet provincial and federal emissions regulations.

b) A breakdown of other fuel and purchased power volumes (including solar versus other types of generation) by fiscal year is provided below:

Fuel and purchased power - other

(in GWh)	Actual **2020-21**	Forecast **2021-22**	Business Plan **2022-23**	Business Plan **2023-24**
Solar	-	19.5	85.7	101.5
Power Generation Partner Program*	1.1	2.0	163.6	394.5
Other	117.3	140.1	326.7	527.7
Total other	**118.3**	**161.6**	**576.0**	**1,023.7**

*The Power Generation Partner Program is comprised mostly of solar generation projects but also contains some flare gas projects.

SRRP Q47 Reference: Operating, Maintenance and Administration (OM&A)

a) Please provide an update to the response to Round 1 SRRP Q68 from the 2018 rate application adding any actual year results available since 2016/17.
b) Please provide an explanation for any material variances between forecasts and actuals in the information provided in the response to part (a).

Response:

a) The following table shows both the actual and forecasted OM&A spend, customer accounts and the average OM&A per customer account for the years 2017-18 through 2020-21.

OM&A per customer account

	Actual **2017-18**	Actual **2018-19**	Actual **2019-20**	Actual **2020-21**
OM&A (millions)	$ 680	$ 708	$ 705	$ 700
Total of customer accounts	532,719	537,714	540,727	545,179
OM&A per customer account	$ 1,276	$ 1,317	$ 1,304	$ 1,284

	Forecast **2017-18**	Forecast **2018-19**	Forecast **2019-20**	Forecast **2020-21**
OM&A (millions)	$ 689	$ 701	$ 715	$ 701
Total of customer accounts	532,928	538,793	544,969	545,824
OM&A per customer account	$ 1,293	$ 1,301	$ 1,313	$ 1,284

b) **2017-18:** There was a favourable variance of $9 million driven by workforce efficiency efforts, lower costs related to purchased power agreements and deferrals of technology projects into 2018-19.

2018-19: There was an unfavourable variance of $7 million driven by greater emergency maintenance required because of damage incurred during storms and the advancement of generation unit overhauls originally scheduled for 2019-20.

2019-20: There was a favourable variance of $10 million driven by workforce efficiency efforts and lower costs for generation unit overhauls.

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2022 AND 2023 RATE APPLICATION
SRRP INTERROGATORIES

SRRP Q48 Reference: Operating, Maintenance and Administration (OM&A)

Please provide a breakout of SaskPower's OM&A spending by business unit for each of the five most recent years of actuals and forecasts for 2021/22 through 2023/24.

Response:

The following table provides OM&A actuals by business units for the 2016-17 through 2020-21 years and forecasts for 2021-22 through 2023-24:

Operating, Maintenance & Administration - by Business Unit

(in millions)	Actual **2016-17**	Actual **2017-18**	Actual **2018-19**	Actual **2019-20**	Actual **2020-21**	Forecast **2021-22**	Business Plan **2022-23**	Business Plan **2023-24**
President/Board	$ 1	$ 2	$ 2	$ 3	$ 3	$ 3	$ 3	$ 3
Power Production	216	220	229	257	249	253	259	253
Distribution & Customer Service	158	158	162	159	161	171	173	176
Asset Management, Planning & Sustainability	52	56	49	49	58	68	76	87
Finance & Business Performance	16	16	16	16	17	16	17	18
Transmission & Industrial Services	71	68	75	73	77	86	90	91
Corporate & Regulatory Affairs	36	41	42	36	31	18	20	21
Technology & Security	80	83	87	84	94	98	105	110
Human Resources	21	21	22	21	21	22	23	24
Supply Chain	48	50	53	47	48	50	49	50
Corporate workforce savings	-	-	-	-	-	-	(1)	(3)
Total core	699	715	737	745	759	785	815	833
Customer programs	18	15	16	9	5	6	9	9
Insurance expense	5	4	5	8	8	11	15	17
Bad debt expense	6	5	5	9	7	1	5	5
HR programs	4	2	3	6	2	3	3	3
Other expense	(2)	2	-	-	-	(10)	2	2
Contingency	-	-	-	-	-	-	(18)	(11)
PPA - OM&A	27	24	35	19	11	11	11	11
Total non-core	58	52	64	51	33	22	27	36
OM&A before labour credits	757	767	801	796	792	807	841	866
Labour credits	(82)	(87)	(93)	(91)	(92)	(97)	(101)	(101)
	$ 675	$ 680	$ 708	$ 705	$ 700	$ 710	$ 740	$ 765

SRRP Q49 Reference: Operating, Maintenance and Administration (OM&A)

Please provide the actual overhaul spending for the three most recent years and forecasts for 2021/22 through 2023/24.

Response:

Overhaul Spending

(in millions)	Actual **2018-19**	Actual **2019-20**	Actual **2020-21**	Forecast **2021-22**	Business Plan **2022-23**	Business Plan **2023-24**
Overhaul Spending	$ 45	$ 66	$ 49	$ 52	$ 58	$ 49

SRRP Q50 Reference: Operating, Maintenance and Administration (OM&A)

Please provide the actual vacancy rates for the three most recent years and forecasts for 2021/22 through 2023/24.

Response:

The following table summarizes the vacancy rate in Permanent Full-time Equivalents as of March 31 of each year. A 3% vacancy rate is assumed for business planning purposes.

FTE vacancy rate

	Actual **2018-19**	Actual **2019-20**	Actual **2020-21**	Forecast **2021-22**	Business Plan **2022-23**	Business Plan **2023-24**
Permanent FTE vacancy	3.9%	4.5%	2.8%	2.4%	3.0%	3.0%

SRRP Q51 Reference: Operating, Maintenance and Administration (OM&A)

a) Please indicate when the current collective agreements are set to expire and provide an update on the status of any negotiations for future collective agreements.
b) With reference to the response to Pre-ask 7 (c) (i) (MFR tab 24) please provide the breakdown of FTEs between employees covered by collective agreements and those excluded from collective agreements.
c) With reference to the response to Pre-ask 7 (c) (v) please explain what labour credits are and how SaskPower prepares forecasts of labour credits.

Response:

a)

The IBEW Local 2067 and UNIFOR LOCAL 649 collective bargaining agreements will both expire December 31, 2022. Negotiations will most likely begin early 2023.

b)

FTE complement

	Actual **2018-19**	Actual **2019-20**	Actual **2020-21**	Forecast **2021-22**	Business Plan **2022-23**	Business Plan **2023-24**
Total FTEs	3,337.3	3,300.4	3,241.1	3,315.9	3,377.0	3,377.0
Employees not covered by collective agreements	1,230.0	1,218.0	1,225.0	1,226.0	1,240.0	1,240.0
Employees covered by collective agreements	2,107.3	2,082.4	2,016.1	2,089.9	2,137.0	2,137.0

c)

Labour credits are primarily driven by the amount of time SaskPower employees spend working on capital projects. As all employee salaries are initially included in the OM&A budget, any time spent working on a capital project is applied to the cost of the project itself, with the offsetting credit being applied against the OM&A budget.

Forecasts are based on discussions with operational areas as to the work being carried out and are also based on a trend / historical analysis.

SRRP Q52 Reference: Operating, Maintenance and Administration (OM&A)

a) With reference to the response to Pre-ask 8 (MFR tab 24) please discuss how SaskPower selects the recipients of its donations and sponsorships.
b) Please confirm donations and sponsorships are included in the total OM&A figures in the table on page 26 of the application.

Response:

a) SaskPower's Community Partnership and Investment Policy has been provided in this response.

b) A budget for donations and sponsorships is included in the total OM&A figures in the table on page 26 of the application.

COMMUNITY PARTNERSHIPS & INVESTMENT POLICY

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Division	Corporate & Regulatory Affairs
Policy Title	Community Partnerships & Investment Policy
Issue Date	3/11/2021
Revision Frequency	5 years

POLICY STATEMENT

Purpose:

SaskPower's strategic plan requires us to gain social licence and public trust as we rebuild lines, add new generation and support provincial growth. This policy outlines SaskPower's commitment to align our Community Partnerships & Investment program to the company's strategic direction while also making a real difference with our community partners.

Our Community Partnerships & Investment program encompasses community investment, employee volunteering, sponsorship, community relations, stakeholder relations, CIC provincial projects and executive support. Of these categories, community investment is the primary focus of this policy.

APPLICABILITY

Applies to:	This policy applies to all SaskPower officers and employees partnering with or sponsoring non-profit or charitable organizations on behalf of SaskPower.

REQUIREMENTS

Responsibilities:

SaskPower seeks to ensure in all community investment:

- All Community Investment opportunities are of mutual benefit to SaskPower and Saskatchewan communities

- Our audiences easily make the connection from our community activities to SaskPower's business and message
- Our audiences associate SaskPower with specific sponsorships and community initiatives, unprompted
- Our program is considered industry best practice and benchmarked by other professional organizations

ELIGIBILITY for community investment:

SaskPower's Community Investment program is focused on education programming. By educating our audiences about behaviour change, we align to SaskPower's business priorities and leave a lasting mark in our communities:

- Workforce excellence — building our next generation of employees
- Safety — keeping our customers safe around electricity
- Conservation and efficiency — creating a community of customers who find ways to save power and protect our environment

Targeted demographics align to business needs:

- Indigenous
- Gender and diversity
- Youth
- Broad provincial representation

Through the broad Community Partnerships & Investment program funds are also set aside for planned activities in the following categories:

- Executive support. Visibility of SaskPower's executive team is important to SaskPower's reputation. A portion of our annual sponsorship budget will be reserved for these activities, at the discretion of the President.
- Crown alignment. Through CIC, each Crown contributes to major initiatives deemed worthy of a united Crown presence.
- Stakeholders. The purpose of our stakeholder initiatives is to build business relationships in communities across the province. We find speaking and engagement opportunities with relevant organizations aligned to our messages and designed to enhance our relationships with community leaders.
- Promotional items. In order to be present at smaller community events, we distribute promotional items at a grassroots fundraising level. Any Saskatchewan organization raising money for a Saskatchewan non-profit or charity project or event will be eligible for a promotional item to assist in their efforts once per fiscal year.

Conditions:

The following are ineligible for funding under this policy (unless approved by the President & CEO):

- Out-of-province organizations
- Individuals
- Political organizations and political parties
- Advocacy groups
- Organizations that discriminate on the basis of ethnic origin, gender, sexuality, colour, language, national or social origin, economic status, religion, political or other contentiously held beliefs
- Religious organizations and churches (unless providing community services and activities without promoting religious or other contentiously held beliefs)
- Travel, accommodation, meal expenses, field trips or tours
- Organizations that rely upon SaskPower as the sole funder for their operations
- Organizations seeking investment for capital projects
- Organizations without a tax-registered number or non-profit society number
- For-profit community endeavors
- Donation of electricity or electrical services

Groups that meet eligibility requirements may be denied funding due to budget constraints.

Governance:

- All sponsorships are reviewed annually to ensure objectives of both parties are met.
- All applications must be completed online.
- All SaskPower donations are managed out of the corporation's Community Partnerships & Investment group within Corporate Relations & Communications.
- Sponsorship opportunities are reviewed, and decisions made in consultation with business units to ensure strategic corporate needs are met.
- Employees involved in decisions affecting sponsorship must declare if they volunteer with an organization to whom sponsorship dollars are to be allocated.

RESOURCES

Related Policies:

Code of Conduct Policy

Indigenous Relations Policy

Appendix

n/a

Ownership & Inquiries

Position Owner	Consultant
Business Department	Corporate Relations & Communications
Contact Person	Verna Williamson
Approved by	Board of Directors
Date	3/11/2021
Contact Information	306.566.3575

Document History

Revised by	Revision Purpose	Date
Board of Directors	Overhauled three existing policies into one CP&I policy reflecting corporate strategic direction	12/13/2013
Board of Directors	Changed title of policy and clarified language regarding restrictions	12/15/2015
Board of Directors	Added Code of Conduct language to governance section	3/11/2021

SRRP Q53 Reference: Operating, Maintenance and Administration (OM&A)

Please summarize SaskPower's overtime policies and describe how SaskPower forecasts overtime.

Response:

Due to the unique working requirements for each of SaskPower's operating areas (Power Production, Transmission and Distribution)the primary drivers of overtime requirements vary by area. As a result, overtime is managed at the Business Unit level and is a component of each area's overall OM&A budget. Variances between actual and budgeted overtime costs are driven primarily by emergency maintenance that results from storm activity and unplanned outages. While SaskPower makes every effort to do this during regular working hours, we also attempt to restore power as quickly as possible, regardless of when the outage occurs.

Overtime costs are reviewed on a monthly basis at the Business Unit level and forecasts are updated to reflect year-to-date activity and projections for the remainder of the year.

Overtime is forecasted based on discussions with operational areas as well as trend / historical analysis.

SRRP Q54 Reference: Operating, Maintenance and Administration (OM&A)

Does SaskPower have bonus or at-risk pay incentive structures for any employees? If so, please provide a summary of any such programs.

Response:

Yes, SaskPower has a Salary Holdback Program. The Crown Investments Corporation (CIC) Out-of-Scope Salary Holdback Policy includes the following guidelines:

Employee Eligibility

- Employees must achieve a minimum of a "Fully Satisfactory/Meets Expectations" (or equivalent) performance rating on their annual individual objectives. Employees who are new to a role (minimum of 6 months in the role) and are assessed as developing as expected in the role are considered eligible.
- Employees are eligible to receive a payment regardless of the position of their base salary within their assigned salary range.
- Employees must have been active in an eligible position for a minimum of six months of the program year to be eligible for a salary holdback payment and be deemed a permanent employee (e.g. successfully completed an initial probation in an out-of-scope position with the employer, in cases where out-of- scope probationary periods are applicable). Salary holdback payments for periods of eligible employment of less than one year will be prorated.

Targets

- Salary holdback targets must be stretch goals and directly linked to corporate balanced scorecard targets. Targets and measures must be objective, quantifiable and within the influence of out-of-scope employees.
- Salary holdback targets may be more challenging than balanced scorecard targets and cannot be less than the balanced scorecard target.
- Crown corporations are to consider historical, actual trends and actual results, as well as industry sector trends and competitor performance benchmarks in setting stretch targets. For example, if the historical pattern indicates results that have consistently exceeded targets, the Crown corporation board should make the target more challenging.
- Conversely, if a target has not been met and management recommends a lower target for the subsequent year, was the initial result an anomaly or an indicator of a fundamental change OR is the corporation measuring the right thing? Targets are not to be lowered to merely allow staff to achieve them.

SRRP Q55 Reference: OM&A – Nuclear SMR research

a) Please provide a schedule showing the costs related to SMR research included in total OM&A for each of the last three actual years and forecasts for 2021/22 through 2023/24.
b) Please provide a copy (by attachment or weblink) of the MOU with Ontario, New Brunswick and Alberta or a summary of the content of the MOU that can be made public.
c) Please provide a copy of the SMR Action Plan.

Response:

a)

SaskPower's feasibility work related to SMR research was completed in 2016. Between then and prior to 2020, no significant costs were incurred that were tracked against SMR research. In 2020, conditions were appropriate for SaskPower to advance into the planning and development phase for nuclear power from SMRs.

SMR planning and project development

(in millions)	Actual **2020-21**	Forecast **2021-22**	Business Plan **2022-23**	Business Plan **2023-24**
SMR Consortium	$ 0.4	$ 4.1	$ 7.1	$ 12.2

It should be noted that the SMR Project Development Group budget is $14.8 million in 2022-23 and $28.5 million in 2023-24. The numbers included in the table above assume that SaskPower's SMR project costs for these two fiscal years will be reduced by federal funding which is the subject of ongoing negotiations. If it is determined that no federal funding is available, these figures will be adjusted accordingly and updated in the mid-application update.

b)

The Interprovincial MOU follows.

c)

Canada's SMR Plan follows.

COLLABORATION MEMORANDUM OF UNDERSTANDING

THIS COLLABORATION MEMORANDUM OF UNDERSTANDING ("MOU") is made as of December 1 2019 (the **"Effective Date")** with the addition of Alberta as of April 14, 2021.

BETWEEN:

THE PROVINCE OF NEW BRUNSWICK,

- and -

THE PROVINCE OF ONTARIO,

- and -

THE PROVINCE OF SASKATCHEWAN,

- and -

THE PROVINCE OF ALBERTA,

The Provinces of New Brunswick, Ontario, Saskatchewan and Alberta are hereinafter referred to as the "Parties".

WHEREAS Nuclear is a cost-effective, reliable and non-carbon emitting form of energy;

AND WHEREAS Small Modular Reactor (SMR) technology is the next generation of innovative, versatile and scalable nuclear reactors that promise to further enhance the safety, economic and environmental benefits of nuclear energy;

AND WHEREAS the Parties were instrumental in the development of *"A Call to Action: A Canadian Roadmap for Small Modular Reactors"*, referred to as the "Canadian SMR Roadmap (found at: http://smrroadmap.ca/);

AND WHEREAS Canada is a "Tier 1" nuclear nation with a full-spectrum nuclear industry that has a limited window of opportunity to lock in the significant strategic, economic and environmental benefits in this area of high-tech innovation by becoming one of the first-movers on SMR deployment;

AND WHEREAS the Parties are home to most of Canada's world-renowned nuclear industry and/or are interested in the introduction of SMRs in their respective territories.

AND WHEREAS the Parties recognize the competitive structure of Alberta's electricity generation market and broader energy sector, where private investors select the technologies that will be deployed in their facilities;

NOW THEREFORE, in consideration of the mutual covenants contained herein, the Parties hereby agree as follows:

PURPOSE AND SCOPE OF MOU

1.0 **Non-Binding MOU.** This MOU is intended to constitute an expression and mutual understanding of the Parties' willingness to work collaboratively in support of the development and deployment of SMR's. None of the Parties intend this MOU will create any legally binding or enforceable rights or obligations, with the exception of **Sections 4.1, 5.1, 5.2, 5.8** (the **"Binding Provisions"),** which are binding and enforceable.

COMMITMENTS OF THE PARTIES

2.0 **Commitments.** The Parties commit to the following:

(a) To work co-operatively to advance the development and deployment of SMRs to address the needs of New Brunswick, Ontario, Saskatchewan and Alberta with regards to addressing climate change, regional energy demand, economic development (e.g., supply chain, fuel manufacture, skilled employment and export opportunities) and research and innovation opportunities;

(b) To work co-operatively to address key issues for SMR deployment including technological readiness, regulatory frameworks, economics and financing, nuclear waste management and public and Indigenous engagement.

(c) To work co-operatively to positively influence the federal government to provide a clear unambiguous statement that nuclear energy is a clean technology and is required as part of the climate change solution;

(d) To work co-operatively to positively influence the federal government to provide support for SMRs identified in the Canadian SMR Roadmap and as requested by the Chief Executive Officers (CEOs) of Ontario Power Generation (OPG), Bruce Power, New Brunswick Power Corporation (NB Power) and SaskPower;

(e) To work co-operatively to positively influence the federal government to make changes as necessary to facilitate the introduction of SMRs.

(f) To work co-operatively to inform the public along economic and environmental benefits of nuclear energy and SMRs; and

(g) To work co-operatively to engage with other interested provinces and territories to explore the potential for SMR deployment in their jurisdictions.

3.0 PROCEDURAL FRAMEWORK

3.1 The Parties direct their respective ministries ("Energy Ministries") to undertake the following:

(a) The three Energy Ministries will hold a winter meeting in the January 2020 – March 2020 timeframe ("Winter Meeting") to discuss strategies that will best advance the development and deployment of SMRs, including engagement with the nuclear regulator, nuclear operators, supply chain companies, academic and research experts, technology vendors and the Federal Government.

(b) By Summer 2020, informed by the Winter Meeting, the three Energy Ministries in cooperation with the respective CEOs of OPG, Bruce Power, NB Power and SaskPower will prepare a feasibility report, including a business case for the development and deployment of SMRs in their jurisdictions.

(c) By Fall 2020, the Energy Ministries of New Brunswick, Ontario, Saskatchewan and Alberta will develop a strategic plan for deployment of SMRs, including market opportunities across Canada and globally, based on the outcomes of the Winter Meeting, and report back to their respective Premiers on next steps.

4.0 TERM AND TERMINATION

4.1 The term of this MOU commences on the Effective Date and will terminate upon the first to occur of:

(a) termination by mutual written agreement of the Parties;

(b) 18 months after the Effective Date, unless extended by mutual written agreement of the Parties.

5.0 MISCELLANEOUS

5.1 **Intellectual Property**. No licence or other rights of or in the intellectual property of any Party are granted by any Party in connection with this MOU.

5.2 **Assignment.** Neither this MOU nor any of the rights, entitlements, duties or obligations arising from it may be assigned in whole or in part by any Party without the prior written consent of the other Parties.

5.3 **Notices.** Any notice given by a Party to another Party or the other Parties shall be in writing and (a) delivered personally, or (b) sent by facsimile or other similar means of electronic communication to the other Party or Parties at the following respective address:

If to the Province of New Brunswick:

Department of Natural Resources and Energy Development
Hugh John Flemming Forestry Centre
1350 Regent Street Fredericton, NB E3C 2G6
Attention: Hon. Mike Holland
Minister of Natural Resources and Energy Development
Facsimile No: (506) 444-4367
E-mail: Mike.Holland@gnb.ca

If to the Province of Ontario:

Ministry of Energy, Northern Development and Mines
77 Grenville Street, 10th Floor
Toronto, Ontario M7A 1B3
Attention: Hon. Greg Rickford
Minister of Energy, Northern Development and Mines and Minister of Indigenous Affairs
Facsimile No: (416) 325-9620
E-mail: Greg.Rickford@ontario.ca

If to the Province of Saskatchewan

Minister of Environment, Minister responsible for SaskPower
Room 348, Legislative Building
2405 Legislative Drive, Regina, SK, Canada, S4S 0B3
Attention: Hon. Dustin Duncan
Minister of Environment, Minister responsible for SaskPower
Facsimile No. (306) 787-1669
E-mail: env.minister@gov.sk.ca

If to the Province of Alberta:

Minister of Energy
324 Legislature Building
10800 - 97 Avenue, Edmonton, Alberta, T5K 2B6
Attention: Hon. Sonya Savage
Minister of Energy
Facsimile No. 780 644-1222
E-mail: minister.energy@gov.ab.ca

Any such notice so given shall be deemed conclusively to have been given and received when so personally delivered or sent by facsimile or other electronic communication. A Party may from time to time change its address hereinbefore set forth by notice to the other Parties in accordance with this Section.

5.4 **Publicity.** This MOU will be made public at the Council of the Federation meeting on December 2, 2019; with additional announcements to follow in the event that additional parties join this MOU.

5.5 **Certain Rules of Interpretation.** In this MOU, (i) words importing the singular include the plural and vice versa (ii) headings are for convenience of reference only and shall not affect the construction or interpretation of this MOU, and (iii) unless otherwise indicated, references to a Section or Schedule followed by a number or letter refer to the specified Section or Schedule of this MOU.

5.6 **Entire Agreement/Amendment.** This MOU is the entire agreement between the Parties and supersedes all prior communications, understandings, negotiations and agreements, whether oral or written, express or implied, with respect to the subject matter hereof. This MOU may not be modified, varied or amended except as agreed in writing signed by the Parties.

5.7 **Governing Law.** This MOU is governed by and shall be construed in accordance with the laws of the Province of Ontario, Province of New Brunswick, Province of Saskatchewan, Province of Alberta and the laws of Canada applicable therein, without regard to conflict of laws rules.

5.8 **Successors and Assigns.** This MOU Is binding upon and ensures to the benefit of the Parties and their respective successors and permitted assigns.

5.9 **Counterparts and Electronic Delivery.** This MOU may be executed in counterparts, each of which will be deemed an original and all of which together will constitute one in the same instrument. Executed signature pages delivered by facsimile or electronic mail will be deemed for all purposes to be original counterparts of this MOU.

IN WITNESS WHEREOF this MOU has been executed by the Parties as of the Effective Date:

FOR THE PROVINCE OF NEW BRUNSWICK

Blaine M. Higgs

___

Hon. Blaine Higgs

Premier

FOR THE PROVINCE OF ONTARIO

___

Hon. Doug Ford

Premier

FOR THE PROVINCE OF SASKATCHEWAN

___

Hon. Scott Moe

Premier

FOR THE PROVINCE OF ALBERTA

___

Hon. Jason Kenney

Premier

A Call to Action:

A Canadian Roadmap for Small Modular Reactors

A Call to Action:

A Canadian Roadmap for Small Modular Reactors

November 2018

This report was prepared by the Canadian Small Modular Reactor (SMR) Roadmap Steering Committee. The Steering Committee is a group of Canadian provincial governments, territorial governments, and power utilities interested in the potential for development, demonstration, and deployment of SMRs in Canada. The findings and recommendations of this report reflect the views of the voting members of the Steering Committee. Natural Resources Canada supports the Steering Committee in a convening role and participates as a non-voting member. Atomic Energy of Canada Limited participates in the SMR Roadmap Steering Committee as a non-voting member.

Recommended Citation:

> Canadian Small Modular Reactor Roadmap Steering Committee (2018). *A Call to Action: A Canadian Roadmap for Small Modular Reactors*. Ottawa, Ontario, Canada.

Voting Members

Non-voting Members

Executive Summary: A Call to Action

Nuclear energy in Canada is a strategic asset. Canada is a Tier 1 nuclear nation, with a full-spectrum industry that we leverage for significant economic, geopolitical, and social and environmental benefits.

A Roadmap for Small Modular Reactors (SMRs) is our answer to the question: "What's next?" It is the result of a 10-month effort that was unlike any other initiative the sector has ever undertaken. Through the SMR Roadmap, representatives from industry, governments, utilities and enabling partners have come together to chart a vision for the next wave of nuclear innovation. This vision was informed by expert analysis as well as dialogues across the country, including initial engagement with Northern and Indigenous communities and organizations.

The opportunity

Why did we do this? Because SMRs could help Canadians achieve a low-carbon future. And with SMRs, we could witness the emergence of a new industrial subsector that will create jobs and economic opportunities across Canada. Because SMRs can help Canadians achieve a low carbon future. Because Canada is well-positioned to lead.

Markets around the globe are signalling a need for smaller, simpler, and cheaper nuclear energy in a world that will need to aggressively pursue low-carbon and clean energy technologies to meet climate change goals.

SMRs respond to these needs: they are smaller nuclear reactors that involve lower capital investment and modular designs to control costs; they can compete with other low-cost forms of electricity generation; they incorporate enhanced safety features; and they could enable new applications, such as hybrid nuclear-renewable energy systems, low-carbon heat and power for industry, and offset diesel use in remote communities and mine sites.

First-movers in this area of high-tech innovation will lock in significant benefits. For Canada, this could mean anchoring jobs, Intellectual Property, and supply chains here; positioning Canada as a policy leader and international standard-setter for strategic influence; and delivering on our climate change and clean energy commitments while opening opportunities for regional development, and enabling a constructive dialogue with northern and Indigenous communities on remote energy issues.

And Canada has what we need to seize this opportunity: a ramped-up supply chain leveraging the Province of Ontario's $26 billion investment in nuclear reactor refurbishments; leadership in nuclear science and technology—bolstered by a federal investment of $1.2 billion in infrastructure at Canadian Nuclear Laboratories and investments by New Brunswick to establish an SMR nuclear research cluster; and a regulatory approach that is open to innovation.

The approach

Through *Generation Energy*—a national dialogue on Canada's energy future - the federal government heard that a pan-Canadian approach to SMRs would reduce uncertainty and help guide decisions by investors and policymakers, and inform decisions by regulators. Leveraging its convening power, the federal government, challenged all interested provinces, territories, and power utilities from across the country to co-create a Roadmap for SMRs. This involved expert analysis, extensive engagement with industry and end users, and initial engagement with Indigenous communities and organizations.

Over 10 months, more than 180 individuals representing 55 organizations across 10 sectors and subsectors were engaged in workshops and Indigenous engagement sessions. Five expert groups comprising 18 organizations looked at questions related to technology; economics and finance; Indigenous and public engagement; waste management; and regulatory readiness. All told, the Roadmap comprehensively addressed key areas of analysis surrounding SMR deployment in Canada.

The vision

What emerged is a collective vision statement for bringing this innovative technology to fruition in Canada:

Small Modular Reactors as a source of safe, clean, affordable energy, opening opportunities for a resilient, low-carbon future and capturing benefits for Canada and Canadians.

The path forward

Throughout the process, it has become clear that success will rely on strategic partnerships – across the sector and internationally. No single organization can do this alone. What also emerged is a concrete set of recommendations across four thematic pillars to guide future actions needed by governments, industry, and other nuclear stakeholders to capitalize on Canada's SMR opportunity. These include:

Pillar 1: Demonstration and Deployment

Priority Recommendations:

Funding for SMR demonstration projects. The federal government and provincial governments interested in SMRs should provide funding to cost-share with industry in one or more SMR demonstration projects for advanced reactor designs.

Risk-sharing measures for first commercial SMRs. Federal and provincial governments should implement measures to share risk with private investors to incentivize first commercial deployment of SMRs in Canada, with the potential of exporting SMR technologies and related innovations developed in Canada to international markets.

Pillar 2: Policy, Legislation, and Regulation

Priority Recommendations:

Federal impact assessment. The federal government should work to align the modernization of Canada's federal impact assessment process with other initiatives to develop and deploy SMRs.

Nuclear liability. The federal government should review liability regulations under the *Nuclear Liability and Compensation Act*, in order to ensure that nuclear liability limits for SMRs are aligned with the risks they pose, using a graded scale based on risk-informed criteria.

Regulatory efficiency and nuclear security. The Canadian Nuclear Safety Commission (CNSC) should engage with industry, public, and Indigenous representatives on amendments to the *Nuclear Security Regulations* to ensure a graded approach based on risk-informed criteria.

Waste management.

- **Used fuel.** SMR technology vendors should engage with Canada's Nuclear Waste Management Organization (NWMO) to ensure that planning for NWMO's deep geological repository is well-informed by the technical specifications of these novel technologies.
- **Low- and intermediate-level waste.** Canada's Radioactive Waste Leadership Forum should take steps to ensure consideration of SMR waste streams in its integrated radioactive waste management plan.
- **Demonstration projects.** The federal government should consider risk-sharing in some of the costs of management and disposal of radioactive waste.

Pillar 3: Capacity, Engagement, and Public Confidence

Priority Recommendations:

Indigenous engagement. Building on the constructive dialogues that were launched under the Roadmap, federal, provincial and territorial governments and utilities interested in SMRs should continue with meaningful, two-way engagement with Indigenous peoples and communities on the subject of SMRs, well in advance of specific project proposals.

Pillar 4: International Partnerships and Markets

Priority Recommendations:

International enabling frameworks. The federal government, with support from industry, labs, and academia, should continue strong and effective international engagement on SMRs. In particular, to influence the development of international enabling frameworks for these technologies.

Alongside these priority recommendations, the Roadmap identified additional, detailed recommendations for essential enablers in Canada. These comprehensive recommendations for actions by all essential enablers are set out in Annex A.

The time to act

Early-mover advantage will be critical to capturing global market share. Demonstration projects and early deployments in Canada will be important to anchor benefits—science and technology, intellectual property, supply chain, jobs—in Canada. All other major nuclear nations are making strategic investments in order to position their domestic industries to capitalize on the opportunity. Early action on demonstration and deployment in Canada will be important to keep innovation opportunities and investment from moving abroad.

From Roadmap to Action

What's next? The Roadmap is our answer: it sets out priority recommendations for early action, as well as comprehensive recommendations for all essential enablers, which we call "Team Canada." It calls for essential enablers to respond to the recommendations with commitments for concrete action.

Three next steps for turning the Roadmap into action:

Step 1. Essential enablers to take early action on priority recommendations.

Step 2. Team Canada to respond to comprehensive recommendations with commitments for further concrete action in a Canadian SMR Action Plan.

Step 3. Industry and governments to co-create Canada's Nuclear Energy Advisory Council consisting of senior executives and Ministers to review progress annually and discuss ongoing strategic priorities for the future.

This Roadmap is not the end of the road, it is the beginning. It is a call to action for Canada.

And the future looks bright.

Table of Contents

1. Why an SMR Roadmap — The opportunity and key considerations

To understand why we undertook this SMR Roadmap, we need to understand the context for nuclear energy in Canada.

Nuclear energy in Canada is a strategic asset. Canada is a Tier 1 nuclear nation[1], with a full-spectrum industry that we leverage for significant economic, geopolitical, and social and environmental benefits.

The nuclear sector contributes $6 billion to the economy annually[2], providing 30,000 direct jobs[3]. Our longstanding leadership in nuclear science and technology is a beachhead for strategic international engagement with key partners and it maintains Canada's influence at strategic, multilateral tables on issues affecting Canada's foreign policy and national security.

Nuclear energy is also an important part of Canada's non-emitting energy mix and will play an important role in achieving Canada's low-carbon future. All told, nuclear energy provides 15% of Canada's electricity supply (approximately 60% in Ontario and 33% in New Brunswick) and avoids over 50 million tonnes of carbon dioxide every year in Canada—that's equal to nearly a quarter of Canada's greenhouse gas reduction target under the Paris Agreement[4]. Canada is the second largest producer of uranium in the world, and our exports avoid over 500 million tonnes of carbon dioxide emissions the world over.

And the future for nuclear in Canada looks bright, with the Province of Ontario investing $26 billion to refurbish the province's nuclear reactors—investments that will sustain and grow the sector into the next decade. At Chalk River Laboratories, the federal government is investing $1.2 billion to revitalize the birthplace of Canada's nuclear sector and the centre of Canadian leadership in nuclear science and technology for the past 60 years. In Atlantic Canada, New Brunswick has invested $10 million—with an additional $10 million matched from industry—to establish an SMR nuclear research cluster in the province.

Canada has:

- Longstanding leadership in nuclear science and technology.
- A full-spectrum industry with a supply chain primed for growth.
- Revitalized labs with new capabilities for research and innovation.

All this begs the question: What's next?

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[1] Tier 1 nuclear countries are often defined as those with full-spectrum nuclear capabilities (research reactors, power reactors, fuel manufacturing capabilities, R&D, etc.). Other Tier 1 countries include US, France, UK, Russia, and China.
[2] GDP contribution based on data from Statistics Canada's Environmental and Clean Technology Products Economic Account (2017) with uranium sector data from Natural Resources Canada (2018).
[3] Employment estimates from Canadian Manufacturers and Exporters (2012).
[4] See https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

Small Modular Reactors, or SMRs, could be the answer.

In Canada and around the world, markets are signalling a need for smaller, simpler, and cheaper nuclear energy. At the same time, demand for nuclear energy is poised to grow with global action on climate change: the International Energy Agency projects that nuclear energy will need to double globally within 20 years to meet a 2-degree Celsius climate target.[5]

> *The International Energy Agency projects that* ***nuclear energy will need to double*** *within 20 years to meet a 2-degree Celsius climate target.*

SMRs are not the same nuclear reactors we have seen in the last half-century. They are innovative technologies that promise to help enable the clean energy transition, with designs that are:

- **Smaller**, with a lower up-front capital investment than traditional nuclear power plants;
- **Simpler**, involving modular designs and a fleet-based approach to control costs and shorten project schedules;
- **Cheaper** to compete with alternatives, enabling new applications such as hybrid nuclear-renewable energy systems, with SMRs serving as a dynamic, load-following source of energy, paired with variable renewables on a decentralized grid.

Many SMR designs also offer enhancements to further improve safety, performance, and prevention of accidents.

With SMRs, we could witness the emergence of a new industrial subsector, and first-movers in this market will lock in significant economic, geopolitical, and social and environmental benefits in this area of high-tech innovation with substantial export potential.

For Canada, this could mean:

- Anchoring domestic and global research and development at Canadian Nuclear Laboratories through SMR demonstration projects, accruing benefits from Intellectual Property and positioning Canada as a world-class hub for innovation on SMRs;
- Securing the position of Canada’s supply chain in global markets to fortify manufacturing, expert nuclear services, and jobs in Canada;
- Maintaining Canada’s influence at strategic, multilateral tables on issues affecting Canada’s foreign policy and national security;
- Demonstrating regulatory excellence internationally and influencing the development and enhancement of international regulatory guidance on SMRs; and
- Attracting inclusive, diverse, global talent and next-generation leadership to Canadian universities and organizations—building the future pipeline of innovators and professionals needed to ensure a strong and safe nuclear sector in Canada.

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[5] International Energy Agency (2017) *World Energy Outlook*, Paris, France.

The federal government used its convening power to bring together provinces, territories, and utilities because Canada has a narrow window to lead in the emerging domestic and global market for SMRs.

Competitors are moving quickly with significant investments, and the lead time for development of SMR technologies and the timing of key decisions mean that the time to act is now. Decisions made by industry and governments in the next year will determine whether Canada will lead or cede the emerging global SMR market.

Through innovative, collaborative national, sub-national, and industry leadership, this SMR Roadmap addresses all the relevant considerations for enabling the development and commercialization of SMRs in Canada: regulation, liability, waste management, economics, Indigenous and public engagement, and technology assessment.

In essence, this Roadmap lays the groundwork for the co-creation of an SMR action plan for Canada: a plan involving all the essential enabling partners of this technology.

Decisions ***in the next year*** *will determine whether Canada will* ***lead or cede*** *the emerging global SMR market.*

What's next?
The Roadmap is our answer.

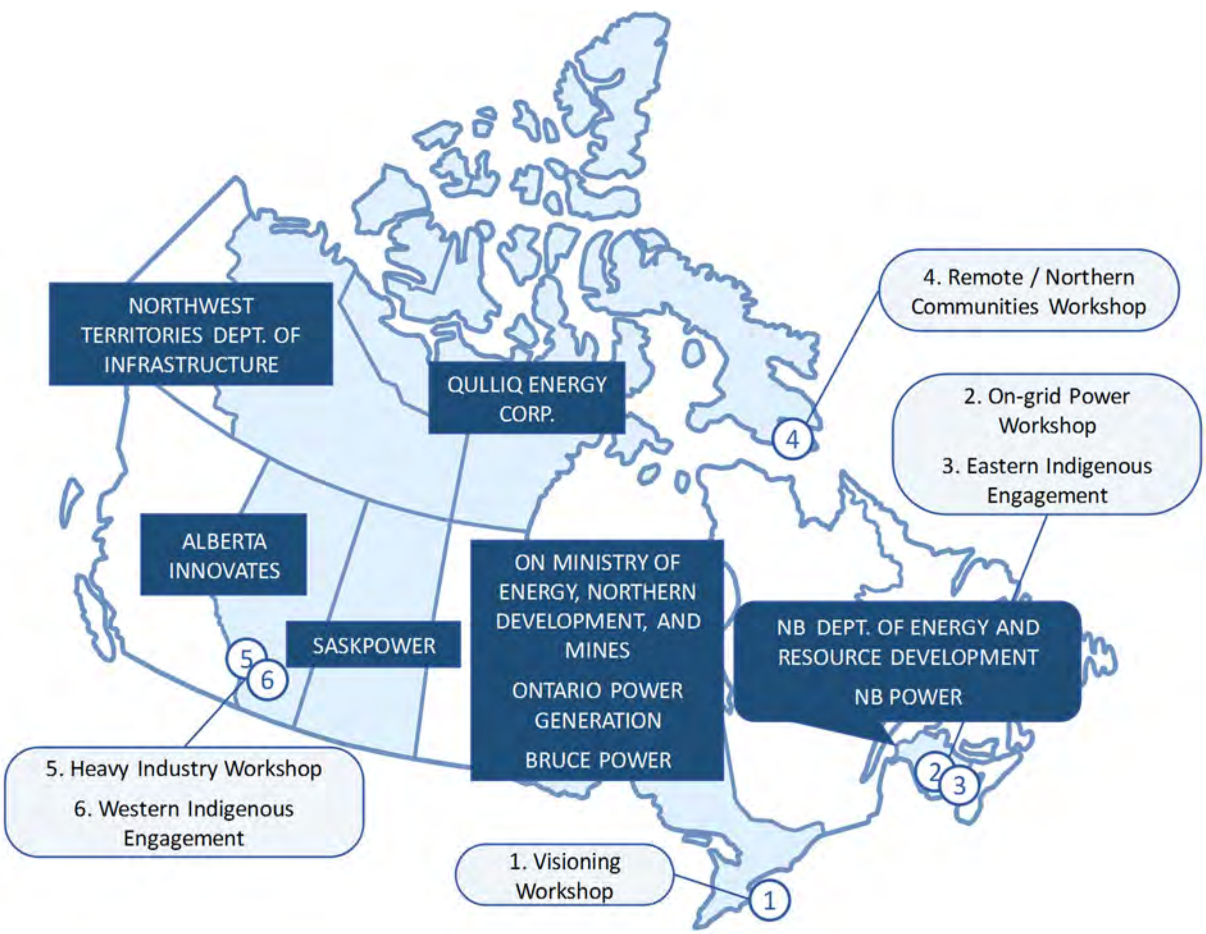
2. What We Did — A collaborative national approach

With an eye to the opportunity set out earlier, key enablers from across Canada's nuclear sector came together to undertake a pan-Canadian SMR Roadmap: an example of innovative, collaborative leadership to co-create a common vision for SMRs and lay the foundation for Canada's success in this field.

The Roadmap was built with a collaborative, national approach, both with respect to its leadership and engagement. All interested provinces, territories, and power utilities from across Canada were invited to join the Steering Committee, ensuring that a range of interests and potential applications were considered.

SMR ROADMAP STEERING COMMITTEE

- Natural Resources Canada *(Chair, non-voting)*
- Alberta Innovates
- Bruce Power
- New Brunswick Department of Energy and Resource Development
- New Brunswick Power
- Northwest Territories Department of Infrastructure
- Ontario Ministry of Energy, Northern Development and Mines
- Ontario Power Generation
- Qulliq Energy Corporation
- SaskPower
- Atomic Energy of Canada Limited *(non-voting)*



Leveraging the convening power of the federal government, Natural Resources Canada served as the Chair of the Steering Committee and participated as a non-voting member. Atomic Energy of Canada Limited (AECL) also participated on the Steering Committee as a non-voting member. The CNA served as the Secretariat for the Roadmap.

Work under the Roadmap took a number of tracks, involving **extensive engagement** with industry and other stakeholders through technical workshops; **initial dialogues** with Indigenous communities and organizations; and **expert analysis** by five working groups to address the key questions around SMR deployment.

Extensive engagement with industry and end users

The Roadmap held technical sessions in different regions across Canada to gain perspective on the unique realities and needs of industries and end users, dealing with potential on-grid, off-grid, and heavy industry applications for SMRs.

In sum, over 130 individuals representing 40 organizations across 10 sectors and subsectors participated. These included: federal departments and agencies; provincial and territorial governments; laboratories and academia; labour unions; supply chain and industry; and a range of potential end users, including utilities, and extractive and heavy industries.

Initial dialogue with Indigenous communities and organizations

At the outset of the SMR Roadmap process, the Steering Committee identified engagement with Indigenous groups in Canada as an essential component of the process and committed to beginning a constructive and respectful conversation with Indigenous peoples about their interests, priorities and concerns related to SMR development. The objective was to begin a dialogue on SMRs, with the understanding that more engagement will be necessary before any SMR proposals could be considered.

Over 50 individuals from 14 Indigenous organizations and communities participated in Indigenous engagement sessions, which took place in New Brunswick, Alberta and Nunavut, and focused on national, regional and sub-regional organizations.

Expert analysis

Five expert working groups reporting to the Steering Committee were created to address key areas of analysis for SMR deployment. These comprised 18 organizations, each with unique expertise to bring to bear.

WORKING GROUP	MANDATE AND KEY ACTIVITIES	MEMBERS
Technology	Mandate: Identify SMR technology categories that could meet stakeholder requirements with regard to: size, energy output, technology readiness, deployment timelines, geographical considerations, and supply chain, among others. Key Activities: ▪ Analysis of technology categories against Canadian SMR end-user requirements ▪ Identification of gaps in research and development for preferred technology categories	▪ Alberta Energy ▪ Atomic Energy of Canada Limited ▪ Bruce Power ▪ Canadian Nuclear Laboratories ▪ JMH Technology Consulting ▪ Natural Resources Canada ▪ New Brunswick Power ▪ Ontario Ministry of Energy, Northern Development and Mines ▪ Ontario Power Generation ▪ SaskPower ▪ Canadian Nuclear Safety Commission
Economics and Finance	Mandate: Produce cost estimates for SMR technologies for profitability and break-even analysis. Key Activities: ▪ Literature review and/or meta analysis of available literature, data, and methodological approaches for conducting cost estimates ▪ Develop consensus on methodological approach to be used ▪ Sensitivity analysis with alternative financing and policy scenarios	▪ Alberta Innovates ▪ Canadian Nuclear Association ▪ Canadian Nuclear Laboratories ▪ MZConsulting ▪ Natural Resources Canada ▪ Ontario Ministry of Energy, Northern Development and Mines ▪ Ontario Power Generation ▪ SaskPower
Indigenous and Public Engagement	Mandate: Identify current trends in public opinion on nuclear energy and SMRs, and outline best practices for Indigenous and public engagement in SMRs. Support and provide advice on the Roadmap's direct Indigenous engagement undertaken through sessions across Canada. Key Activities: ▪ Literature review on public opinion and on public engagement in nuclear projects, in particular SMRs ▪ New analysis of public opinion research raw data, where possible, and proposals for new outreach and engagement ▪ Identification of Indigenous and public engagement best practices for Canadian SMR applications	Indigenous engagement advisors from: ▪ Alberta Energy ▪ Atomic Energy of Canada Limited ▪ Bruce Power ▪ Canadian Nuclear Association ▪ Canadian Nuclear Laboratories ▪ Natural Resources Canada ▪ New Brunswick Power ▪ Nuclear Waste Management Organization ▪ Ontario Ministry of Energy, Northern Development and Mines ▪ Ontario Power Generation ▪ Qulliq Energy Corporation ▪ SaskPower ▪ Canadian Nuclear Safety Commission

WORKING GROUP	MANDATE AND KEY ACTIVITIES	MEMBERS
Waste Management	Mandate: Identify waste disposal and storage considerations for Canadian SMR applications Key Activities: ■ Review Canada's waste management framework (policies, legislation, and regulations) for SMR readiness and identify any gaps ■ Analysis of waste streams, short- and long-term waste transportation, disposal and storage requirements, and decommissioning considerations ■ Identification of gaps in research and development for SMR waste	■ Atomic Energy of Canada Limited ■ Canadian Nuclear Laboratories ■ Natural Resources Canada ■ New Brunswick Power ■ Nuclear Waste Management Organization ■ Ontario Ministry of Energy, Northern Development and Mines ■ Ontario Power Generation ■ Canadian Nuclear Safety Commission
Regulatory Readiness	Mandate: Identify barriers and challenges to the deployment of SMRs under current regulatory regime Key Activities: ■ Comprehensive review of federal, provincial, and territorial legislation and regulations for SMR readiness ■ Analysis of the current Canadian regulatory regime for SMR deployment ■ Identification of gaps in regulatory regime, and proposed way forward	■ Atomic Energy of Canada Limited ■ Bruce Power ■ Canadian Nuclear Laboratories ■ CANDU Owners Group ■ Environment and Climate Change Canada ■ Natural Resources Canada ■ New Brunswick Power ■ Ontario Power Generation ■ Canadian Nuclear Safety Commission

The Roadmap also took advantage of analyses from a variety of sources. It unfolded in close coordination with various parallel initiatives on SMRs, and benefited from their work:

- CNSC's workshop on graded approach and consultations on SMR licensing issues, such as its discussion paper on SMR regulatory strategy, approaches, and challenges, and subsequent public report and presentations.
- Canadian Nuclear Laboratories' Request for Expressions of Interest (RFEOI) and Invitation for Applications to assess and pursue viable options for SMR demonstration projects in Canada.
- CANDU Owners Group (COG) SMR Technology Forum, engagement with nuclear operators and vendors to review SMR licensing pathways in Canada.
- The Roadmap also built on the work of Canadian industry stakeholders, such as the Canadian Nuclear Association's 2017 "*Vision 2050: Canada's Nuclear Advantage.*"

Other key initiatives that unfolded in parallel included CNSC's efforts to ensure regulatory readiness for SMRs in Canada, CNSC's pre-licensing engagement with SMR vendors, and Vendor Design Reviews.

Key Questions and Areas of Analysis Addressed by the Roadmap

All told, through extensive engagement with industry and other stakeholders, initial dialogue with Indigenous communities and organizations, and expert analysis, the Roadmap addressed key areas of analysis surrounding SMR deployment, such as:

- **Stakeholder and Indigenous engagement**, with a focus on demand-side, community and end-user requirements
- **Economic analysis,** including market valuation, costing, and financial models
- **International strategies** to understand Canada's niche and the role of global partnerships
- **Regulatory readiness**, enabling frameworks, and transportation policy
- **Waste management** and long-term storage liabilities
- **Social and environmental factors**, including gender-based analysis, strategic environmental assessments, carbon pricing and climate change
- **Technology assessments**, advantages, disadvantages, and risks

3. What We Heard — Engagement across Canada

3.1 Visioning

The Roadmap kicked off with a visioning exercise held in March 2018, in Mississauga, Ontario, with 30 participants from 16 organizations.

The main objectives of the Visioning Session were to:

- Ensure the proper focus, structure, content, and participation for the Roadmap;
- Begin to map out the stakeholder universe;
- Inform the activities of the five Roadmap working groups;
- Set the foundation for the subsequent Roadmap workshops; and
- Begin to identify the key elements and key considerations for an SMR vision for Canada.

The Visioning Session included a series of presentations and roundtable discussions, which led to a fulsome discussion of what a shared vision for Canadian leadership on SMRs could look like.

There was consensus on a number of preliminary points, which formed the basis for discussion:

- There are at least **three potential applications** for SMRs in Canada: on-grid, heavy industry, and remote communities. Each of these has different energy demands and it is not likely that a single design could meet all of these needs.
- **A fleet approach is desirable**, involving a relatively small number of designs. By taking advantage of project experience and common supply chains, it would help keep costs down and shorten construction schedules for future projects. Coordination of procurement approaches across jurisdictions could help enable a fleet approach.
- Governments are both **stakeholders and potential customers**: they will play an important role in bringing SMRs to fruition, but could also purchase SMRs, for example, to power government sites in remote locations.
- There are a **range of pathways and options for demonstration**, including a variety of different models of public and private cooperation.

VISIONING SESSION PARTICIPANTS

- Alberta Innovates
- Atomic Energy of Canada Limited
- Bruce Power
- Canadian Nuclear Laboratories
- Inuit Tapiriit Kanatami *(observer)*
- JMH Technology Consulting
- MIRARCO Mining Innovation
- Mitacs
- Natural Resources Canada
- New Brunswick Department of Energy and Resource Development
- New Brunswick Power
- Nuclear Waste Management Organization
- Ontario Ministry of Energy, Northern Development and Mines
- Ontario Power Generation
- Qulliq Energy Corporation
- SaskPower
- Suncor Energy

As the discussion continued, key elements of a shared vision began to emerge:

- Participants saw a future involving **Canadian leadership in the demonstration and deployment of SMRs** domestically and as a key player on the export market, capturing economic, geopolitical, social and environmental benefits for Canada. It was agreed that Canada has a significant opportunity in SMRs and that quick action will be necessary to seize it.
- SMR demonstration and deployment could **help create jobs and bolster energy security** while building a robust domestic supply chain and seizing export opportunities, supporting economic development in Ontario and Atlantic Canada and potentially extending to other regions over time.
- SMRs could serve as a beachhead for **strategic engagement with other countries**, while reinforcing Canada's traditional leadership role in multilateral nuclear engagement (e.g. International Atomic Energy Agency, Nuclear Energy Agency) and allowing us to continue to influence norms and frameworks. Canada's world-leading nuclear regulator, the CNSC, was also seen as a potential standard-setter.
- SMRs are the next step in building **on Canada's leadership in nuclear energy innovation** which has historically given Canada **strong and effective influence in international bodies dealing with nuclear and national security issues** such as respect to non-proliferation and safety.
- As a source of inexpensive, clean energy, SMRs could also **aid in meeting Canada's climate change objectives** by reducing reliance on fossil fuels for baseload electricity generation.

Participants agreed to move forward and continue to examine this opportunity, with an eye toward a number of the key considerations that had been identified. Each of these fell under broad themes that would continue to re-emerge throughout the Roadmap process.

Demonstration and deployment

- **First of a kind (FOAK) and so-called "N-th" of a kind (NOAK) issues:** What are the unique hurdles faced by a first project (i.e. FOAK), in terms of technology, financing, construction, and other issues? How can these be mitigated as we move forward with future projects that can incorporate learning and efficiencies to reduce project schedules and costs (i.e. NOAK)?
- **Economics and finance questions:** How competitive could SMRs be in comparison to other clean energy sources? What are the pathways to financing these projects? How can competitive procurements across jurisdictions and markets be coordinated to help realize the cost benefits of fleets?
- **Waste management considerations:** Given the range of potential applications and sitings, what work needs to be done to ensure resulting waste is appropriately managed?

Policy, legislation and regulations

- **Importance of regulatory certainty from all regulators that have a role in SMRs:** Is the existing regulatory framework robust enough for deployment of SMRs? Are there any unintentional barriers from the past focus on large reactor projects?

Capacity, engagement and public confidence

- **Engagement, capacity building, and public confidence:** Does Canada have the expertise to support a world-leading SMR industry? What steps are needed to sustain and grow Canada's capacity in nuclear innovation? Are Canadians open to discussing SMRs?

International partnerships and markets

- **Importance of strategic partnerships within Canada and internationally:** Who are the essential enablers, in Canada and abroad? What does partnership between them need to look like to realize these opportunities?
- **Size of domestic and international markets:** How big is the opportunity? Should Canada's focus be on domestic applications or are there more benefits on the global export market?

3.2 Indigenous Engagement

Indigenous engagement workshops took place in New Brunswick, Alberta, and Nunavut.

Indigenous peoples have their own backgrounds, views, interests and drivers. A range of views were expressed during these engagement sessions. That said, some common themes have started to emerge through the discussions:

- The importance of historical legacy and the need for respect and building trust.
- Priorities should be placed on building constructive relationships with Indigenous peoples, including in the form of business partnerships that allow for revenue sharing and economic development.
- Environmental stewardship and long-term effects are priorities: some characterized this as a “seven generations lens.” While this relates in part to global climate change, an equally important focus was on local effects such as on land, water, air and biodiversity.
- There were questions and concerns about nuclear safety, waste management, and transportation of materials, which were similar to those often expressed by the general public.
- Nuclear energy can be a challenging subject. While some participants were open to the option of SMRs, others were not. Many participants were skeptical of nuclear energy, and some participants who were open to the option acknowledged the challenge of discussing SMRs in their home communities.
- Indigenous youth have a role to play in Canada’s transition toward low-carbon energy, and priority should be placed on developing and supporting opportunities for Indigenous youth in the nuclear industry.

The SMR Roadmap Steering Committee understands that Indigenous participants provided initial, and not final, feedback on their views related to SMRs. As engagement continues, Indigenous peoples will have the opportunity to provide additional feedback.

New Brunswick First Nations

At the workshop held in Saint John, New Brunswick on April 18, 2018, there were 16 participants from seven communities and organizations.

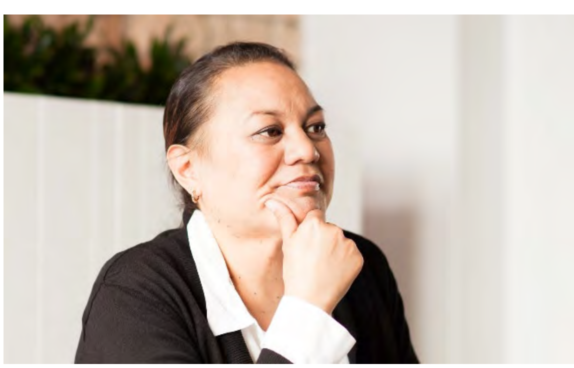
EASTERN INDIGENOUS ENGAGEMENT

- Kopit Lodge – Elsipogtog First Nation
- Mi'gmawe'l Tplu'taqnn Inc.
- Natural Resources Canada
- New Brunswick Department of Energy and Resource Development
- New Brunswick Power
- Ontario Power Generation
- Qulliq Energy Corporation

It was found that there is a high level of knowledge and experience with regard to nuclear energy in the region. Priorities were placed on reciprocity, revenue sharing, climate change mitigation, and keeping a small land footprint.

Some concerns were raised relating to the long-term management and transportation of waste. It was emphasized that SMRs must be safe, with a minimal impact on the environment, and confer appropriate benefits to Indigenous communities.

There was some interest in potential business opportunities, and some participants expressed interest in perhaps siting an SMR in a community and selling power back to the grid, but recognized that there would be challenges in ensuring community support for such a project.



Inuit Communities in Nunavut

The Northern and Remote Communities Workshop, held on May 10 and 11 in Iqaluit, Nunavut, had a focus on Inuit engagement. Nunavut has a unique context with its own challenges: it is entirely off-grid, reliant on diesel generation, and the majority of the population has Inuktitut as their mother tongue. Inuktitut is not widely spoken elsewhere and technical terms for some nuclear technology do not exist in that language.

NORTHERN AND REMOTE COMMUNITIES WORKSHOP PARTICIPANTS

- Atomic Energy of Canada Limited
- Bruce Power
- Canadian Nuclear Laboratories
- City of Iqaluit
- Canadian Nuclear Safety Commission
- Hamlet of Arctic Bay
- Hamlet of Clyde River
- Hamlet of Hall Beach
- Hamlet of Pangnirtung
- Member of Legislative Assembly for Iqaluit
- Natural Resources Canada
- Northwest Territories Department of Infrastructure
- Nunavut Department of Community and Government Services
- Nunavut Department of Environment – Climate Change Secretariat
- Nunavut Research Institute / Nunavut Arctic College
- Ontario Power Generation
- Qulliq Energy Corporation
- Yukon Research Centre / Yukon College
- Inuit Tapiriit Kanatami *(observer)*

As Nunavut is not a nuclear power jurisdiction, it was found that there was little familiarity with nuclear energy as a means to generate electricity. However, there is some prior Inuit experience with uranium exploration and development. Though not all participants were interested in the option of SMRs, others were open. Top of mind, participants noted the historical legacy of government and industry projects leaving behind harmful contaminants, and emphasized that this legacy is still impacting communities today. In this context, participants noted their concerns about the potential impact of nuclear power on land and wildlife, including traditional food sources.

Generally, there was an emphasis on the need for integrated, holistic energy planning on a community basis, considering all options in concert: renewables, SMRs, locally sourced natural gas, energy efficiency, storage, etc.

Particular emphasis was placed on the desire to enable engagement by Inuit on equal terms, rather than relying on information provided by outside organizations. Inuit participants expressed a desire to hire their own advisors who could provide them with impartial information and advice, and for capacity building to develop the skills and knowledge among Inuit to engage with outside organizations on issues related to SMRs. Some participants expressed interest in visiting Indigenous communities in Ontario, New Brunswick and Saskatchewan to learn from their experiences with nuclear and uranium mining, and with SMRs if and when they are deployed in the south of Canada.

Alberta and Saskatchewan First Nations

At the workshop held on June 18, 2018 in Calgary, Alberta, there were eight participants from seven communities and organizations.

WESTERN INDIGENOUS ENGAGEMENT

- Cote First Nation
- Federation of Sovereign Indigenous Nations
- First Nations Power Authority
- Prince Albert Grand Council
- Samson Cree Consultation Unit
- Saskatchewan First Nation Natural Resource Centre of Excellence
- Tsuut'ina Nation (elder)
- Alberta Energy
- Atomic Energy Canada Limited
- Natural Resources Canada
- Ontario Power Generation
- SaskPower

The high cost of power on reserve lands is a burden, and retaining capacity on reserve lands is a priority. Although Alberta and Saskatchewan are not presently nuclear power generating jurisdictions, groups were found to have a relatively high level of familiarity with nuclear energy because of their experience with the uranium mining sector in Saskatchewan. SMRs were seen as a potential clean energy option, but it was emphasized that there is a need to know the implications of potential worst case scenarios.

As with elsewhere, there was an emphasis on the need for business partnerships with First Nations, for which they have a strong capacity. A variety of potential models were discussed, including regional ownership models.

ONGOING ENGAGEMENT

Indigenous engagement that began under the SMR Roadmap was the beginning of a dialogue with Indigenous peoples on this subject. Members of the SMR Roadmap Steering Committee will build on this initial engagement to meet with interested groups and communities, including First Nations and Métis groups in Ontario, to encourage a meaningful, two-way dialogue on the potential for SMRs in Canada's clean energy mix.

3.3 On-Grid Applications

This was the first of three workshops focused on distinct markets and applications in Canada, which brought together relevant potential end users, demand-side stakeholders, and other key enablers.

ON-GRID APPLICATIONS WORKSHOP PARTICIPANTS

- Atomic Energy of Canada Limited
- Bruce Power
- Canadian Nuclear Laboratories
- Canadian Nuclear Safety Commission
- Canadian Nuclear Society
- Canadian Standards Association Group
- CANDU Owners Group
- IBEW-37 (labour union)
- Natural Resources Canada
- New Brunswick Department of Energy and Resource Development
- New Brunswick Power
- Nuclear Insurance Association of Canada
- Nuclear Waste Management Organization
- Ontario Ministry of Energy, Northern Development and Mines
- Ontario Power Generation
- Opportunities New Brunswick
- Organization of Canadian Nuclear Industries
- Power Workers Union
- Qulliq Energy Corporation
- SaskPower
- Suncor Energy
- University of New Brunswick

This workshop focused on on-grid applications for SMRs and brought together 42 participants from 22 organizations in Saint John, New Brunswick on April 19 and 20, 2018.

The workshop's objective was to have a collaborative discussion on technical requirements for on-grid SMRs, covering the following questions:

- What are the regional and national opportunities for on-grid power generation by SMRs?
- What characteristics are required for on-grid SMRs?
- What are the opportunities and risks for the Canadian supply chain?
- What policy levers and industry contributions would be necessary to support SMRs in this market?

There were a number of key takeaways from the workshop:

- **Different provinces are interested for different reasons**: New Brunswick and Saskatchewan have expressed interest in SMRs to help reduce emissions from electricity generation and reliance on fossil fuels, while Ontario may be interested in meeting demand in the longer-term, should the need arise.
  - The Province of New Brunswick has invested $10 million to support research and development of two advanced SMR technologies which, if successful, could lead to one or more commercial demonstration units at the Point Lepreau site in the 2030 timeframe.

- SMRs have a number of attributes of interest to potential users that set them apart from other options:
  - They are a reliable, **clean**, non-emitting source of energy, with costs that are predictable and competitive with other alternatives;
  - SMRs are scalable, fitting a number of different demand profiles, and are able to respond to growth in demand;
  - They are high-tech, create good, stable jobs (especially in Science, Technology, Engineering, and Math, or “STEM” fields), and have significant potential to contribute to Canada’s economy;
  - SMRs have the potential to replace economic activities lost when phasing out conventional coal-fired electricity generation;
  - They have **potential to complement variable renewables**, such as wind and solar, and to integrate with smart grids and energy parks. Rather than just competing with variable renewables, SMRs could **enable them**. They can support **grid modernization** (e.g. smart grid, load growth) and help replace existing aging infrastructure.
- There is a **need for appropriate risk-sharing between private and public partners** to support a demonstration project, which carries unique risks.
- It is **important to consider SMRs in a global context** where Canada is just one of many players: there is a global market, with global value chains and significant opportunities on the export market.
- Key enablers, especially industry, end users and investors, **consider regulatory clarity and certainty to be a key issue**. Given the timelines for SMR projects and large associated investments, they must have confidence in the process, including with respect to transparency, costs and timelines.
- Projects will require Indigenous and public **confidence and support**.
- **It is necessary to define a waste management strategy** that reduces/recycles waste, and that factors in all relevant costs (e.g. decommissioning, transportation, etc.).
- **Canada’s nuclear supply chain must be ready to pivot** to support a growing SMR industry, supporting a number of different designs. This includes considerations like supporting different fuel types and reactor systems, as well as managing different kinds of waste.
- **Life cycle research and development support** (i.e. through Canadian Nuclear Laboratories' work with the Canadian nuclear research ecosystems) will be a tremendous asset to Canada.

3.4 Northern and Remote Communities

On May 10 and 11, 2018, the Roadmap came to Iqaluit, Nunavut to engage with Northern and Indigenous groups on the potential for SMRs in off-grid communities, particularly as it relates to reducing reliance on aging diesel generators. Thirty people from 19 organizations participated.

The purpose of the workshop was to initiate preliminary discussions with participants from Nunavut and Northern communities about their future energy needs and explore whether nuclear energy from SMRs could be an option in addressing those needs. Some communities have explored the use of renewables to supplement their energy supply, but these are generally in the early stages. There is still ample time to consider other options as technology options mature. This was an opportunity to listen directly to Northern and Indigenous communities to hear their views and priorities and to share their perspectives.

With respect to current and future power generation, participants raised a number of points, including issues that SMRs could potentially alleviate:

- **Reliability:** Outages in the North are considered a liability and can be challenging to fix, particularly during winter storms. Further, there is also a limited window every summer to bring in the diesel needed for the year into Nunavut. Not receiving this diesel prior to winter would have a significant impact on reliability.
- **Demand Growth:** Population is increasing rapidly and the mining industry has increased operations in Nunavut in recent years. This has resulted in increased energy demands and stress on the current system.

NORTHERN AND REMOTE COMMUNITIES WORKSHOP PARTICIPANTS

- Atomic Energy of Canada Limited
- Bruce Power
- Canadian Nuclear Laboratories
- City of Iqaluit
- Canadian Nuclear Safety Commission
- Hamlet of Arctic Bay
- Hamlet of Clyde River
- Hamlet of Hall Beach
- Hamlet of Pangnirtung
- Member of Legislative Assembly for Iqaluit
- Natural Resources Canada
- Northwest Territories Department of Infrastructure
- Nunavut Department of Community and Government Services
- Nunavut Department of Environment – Climate Change Secretariat
- Nunavut Research Institute / Nunavut Arctic College
- Ontario Power Generation
- Qulliq Energy Corporation
- Yukon Research Centre / Yukon College
- Inuit Tapiriit Kanatami *(observer)*

- **Energy Conservation:** Currently, energy costs are highly subsidized for many in Nunavut. This has led to minimal economic incentives for Northerners to conserve energy.
- **Climate Change:** Northern communities see the impacts of climate change more directly than the rest of Canada, though any action taken by them would have little impact on climate change overall.
- **Potential Environmental Impacts:** The potential environmental impacts of any proposed energy project will need to be considered and scrutinized. Impacts of a potential accident, on the land, water, and wildlife is a major concern to Northerners. Fisheries make up one of the largest industries in the North, and wildlife such as seal, whale and caribou have always been, and are still, critical food sources to Inuit.

- **Ownership/Partnership:** In the past, investments made in the North, and resulting benefits, have left the area. Any new project or initiative should look for ways to ensure that Inuit have an ownership or partnership stake so that benefits remain in the region.

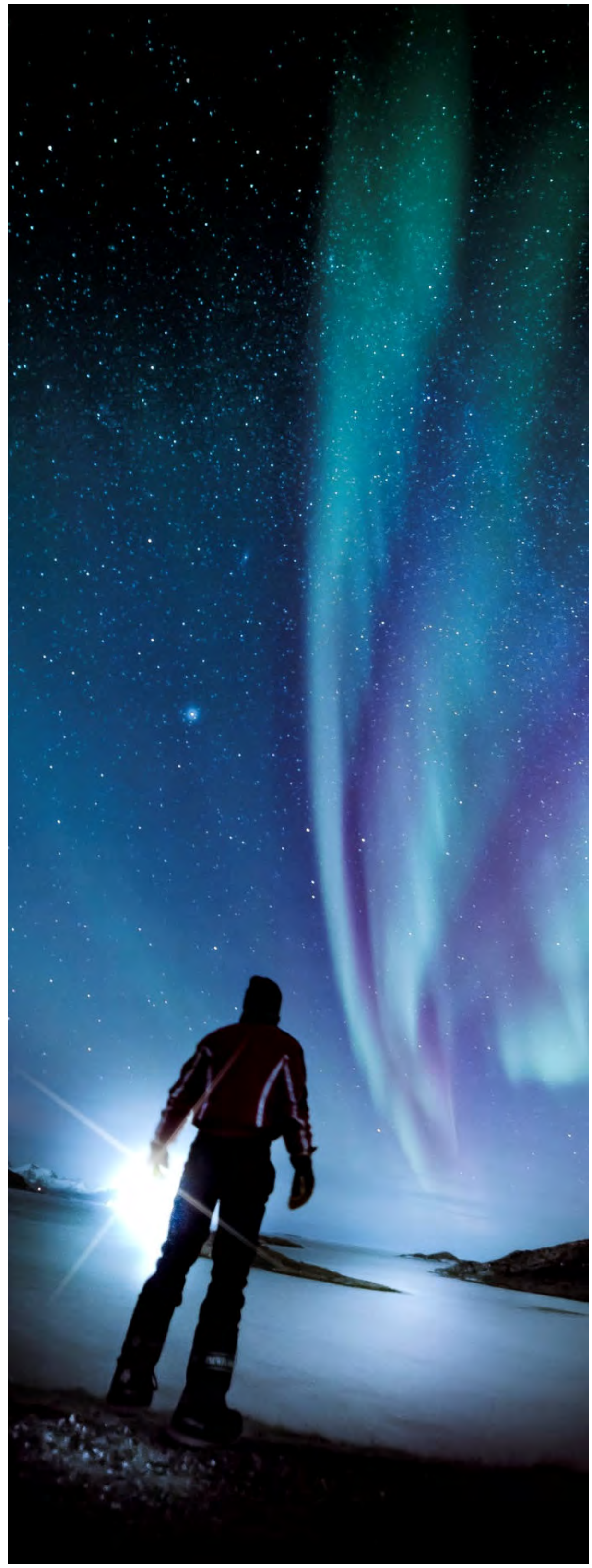
With respect to future engagement, the following guidance was provided by participants:

- **Preparation:** Participants need to prepare themselves prior to the engagement. In particular, Southerners should read the "*Truth and Reconciliation Commission of Canada: Calls to Action,"* before the meeting. Further, prepare clear, relevant and respectful materials and information, and translate those materials into Inuktitut. Also, be aware and respectful of historical context and legacy concerns.
- **Engage within the Communities:** Reach out to the Hamlets' councils and plan a visit directly with the communities. Be prepared to have a broader discussion about community priorities and energy needs, and present SMRs as a potential option. There may be apprehension about nuclear energy in some communities.
- **Holistic Community-based Energy Planning:** Support community-based energy planning discussions that put forward all options so communities can make informed decisions about their future energy mix.
- **Build Trust:** Building trust with Northerners would be the most critical factor in successful engagement. Look for ways to connect and partner with the communities, and have the right person who is fluent in Inuktitut speaking in the communities. Also, ensure the terminology and language being used is clear and honest.

There were a number of key takeaways from the session:

- Priorities in the North include: environmental issues (both local and climate change), preserving culture and social development, ensuring energy security, and reducing the cost of energy.
- The North has **unique challenges** not faced by other potential markets for SMRs:
  - Given its remoteness, logistics are a challenge. There is also a short shipping season;
  - Communities are small and distant from one another, and many are only connected by air;
  - The most common language is neither English nor French but Inuktitut, creating language barriers for outside organizations;
  - There is lower direct experience and familiarity with nuclear energy in the North than in existing nuclear jurisdictions. People living in Nunavut must be provided with adequate information and opportunities to ask questions before projects can be considered;
  - Historical context is key: it is important to build trusting, collaborative relationships with Northerners, especially in the spirit of reconciliation.

- While some communities are not interested in the prospect, **others may be interested** in continuing the discussion. Some have requested further engagement, capacity building and feasibility studies.
- Utilities and government departments and agencies (notably the Qulliq Energy Corporation and the Northwest Territories Department of Infrastructure) are looking at **all** options and are interested in continuing to engage.
- It is important to **keep all options on the table** for reducing reliance on diesel (SMRs, wind, solar, small hydro, etc.).
- While there is potential for deployment in the North, the most probable successful pathway would see demonstration and deployment in Southern Canada first.
  - However, **it is crucial not to postpone engagement with Northerners**. Any delay in engagement would risk decisions being made exclusively in the South without consideration of Northern priorities and needs.
  - There is a need to engage Northerners in decisions being made in the South, so that future options are relevant and applicable to Northern needs.



3.5 Heavy Industry Applications

The Roadmap then turned to discussion of potential heavy industry applications for SMRs, particularly in areas that presently rely heavily on heat and power from fossil fuel generation, such as mining, and oil and gas extraction. A Workshop was held in Calgary, Alberta on June 19 and 20, 2018, which included 60 participants from 40 diverse organizations.

Discussion at the workshop involved a wide range of topic areas including: current nuclear operations in Canada; potential SMR applications (i.e. mining, oil sands, on-grid); current SMR research and development activities; challenges to SMR deployment (i.e. economics, regulatory, waste); and how Canada's supply chain can support SMR design and deployment. The following are some of the common themes that surfaced from these discussions regarding the potential deployment of SMRs.

HEAVY INDUSTRY APPLICATIONS WORKSHOP PARTICIPANTS

ACADEMIA
- CESAR
- Saskatchewan Research Council
- University of Regina

FINANCE
- GH Enterprise Technology
- Gowling WLG
- MZConsulting

LABOUR
- Power Workers Union

MINING
- McEwen Mining
- MIRARCO

OIL & GAS
- Canadian Association of Petroleum Producers
- Canadian Oil Sands Innovation Alliance
- Conoco Phillips
- Imperial Oil
- PTAC
- Suncor Energy

NUCLEAR INDUSTRY
- Aecon
- Cameco Corporation
- Canadian Nuclear Association
- Canadian Nuclear Laboratories
- Hatch
- Organization of Canadian Nuclear Industries
- PCL
- SNC-Lavalin

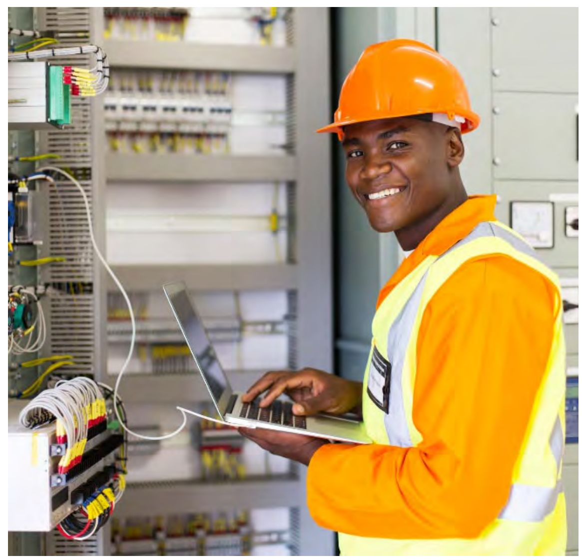
UTILITIES
- Alberta Electric System Operator
- ATCO Electric
- Bruce Power
- New Brunswick Power
- Ontario Power Generation
- SaskPower

GOVERNMENT
- Alberta Energy
- Alberta Environment and Parks
- Alberta Innovates
- Atomic Energy of Canada Limited
- Canadian Northern Economic Development Agency
- Canadian Nuclear Safety Commission
- Natural Resources Canada
- New Brunswick Department of Energy and Resource Development

OTHER
- Former CEO, AECL

Key takeaways were:

- **Heavy industry applications have common energy needs** regardless of the industry they serve: high quality steam and energy security including combined heat and power.
- Economically, there are two distinct sub-markets, each with unique demands:
  1. Off-grid/off-diesel, e.g. mining;
  2. On-grid/competing with gas, e.g. oil sands;
- **A successful demonstration project will be critical** as a proof of concept before industry can seriously consider the option.
- Most heavy industry stakeholders are not interested in developing nuclear expertise or operating SMRs themselves. Instead, they would prefer to partner with experienced nuclear operators or have an experienced operator license, build, operate, own, and sell combined heat and power **as a service**.
- There is **strong potential in the mining sector**, which has significant energy needs that are currently being met by diesel. There is a need for specific engagement in SMRs in this sector building on the Roadmap. The potential for SMR deployment in other industrial applications such as in the oil sands, will depend on carbon pricing initiatives, as these are currently serviced by natural gas.
- SMRs would be a long-term commitment and industry is sensitive to risk. **Regulatory clarity and manageable regulatory timelines** are key to promoting serious consideration of SMRs. It is also crucial to ensure that SMR planning and licensing timelines align with heavy industry planning timelines.



4. What We Learned — Key findings from expert working groups

4.1 Technology

The Technology Working Group examined the following lines of inquiry:

- What SMR technologies are being developed?
- Of these, which would bring most benefit to end-user needs in Canada, and which would enable Canada to capture the greatest value from emerging SMR supply chains?

First, the Working Group developed a set of requirements for three different potential end-user applications for SMRs in Canada: on-grid power generation; heat and power for heavy industry; and energy for remote and Northern communities. Second, Working Group members surveyed over 100 SMR designs to define six SMR technology categories. Finally, they evaluated what would be needed to deploy the six SMR technologies in each of the three end uses.

The Technology Working Group surveyed ***over 100 SMR designs****.*

The Working Group considered both the status and development of SMR technologies, and the development and deployment of actual SMR projects. Working Group members consulted literature, material from SMR developers, and their own expert knowledge. They also drew extensively from what we heard at engagement workshops, as well as interviews with domestic and international industry experts.

Key findings:

1 **SMRs are real and happening now: there are several project options for Canada to consider today.** SMR development has progressed to the point where several technologies are near demonstration readiness and some near deployment readiness. Projects that could meet end-user needs are ready to move forward in Canada. Other countries are moving quickly to deploy SMRs, with significant investments. In Canada, Canadian Nuclear Laboratories is taking steps to successfully demonstrate at least one SMR technology by 2026, while some other options could be ready for commercial deployment on a similar timeline.

2 **Demonstration of SMRs in Canada is critical for anchoring research, experience, knowledge, and therefore SMR supply chains, in Canada.** Demonstrating SMRs in Canada is a critical step for locking in significant research and intellectual property benefits at national labs, universities, and research organizations. Demonstration projects will yield the experience and knowledge required to

leverage our Tier 1 nuclear sector and to anchor SMR supply chains in Canada, capturing benefits from emerging SMR value chains for industrial development and global export opportunities.

3 **Canada has what it will take to succeed in the emerging SMR space.** Canada has differentiating capabilities at its national nuclear laboratories, universities, and research centres. We have the expertise and facilities to lead in developing SMR technologies. New areas of activity will need to be pursued, but these are within reach. All pathways to demonstration in Canada will leverage capabilities at Canadian Nuclear Laboratories—whether a demonstration project is sited there or not—as the labs have key personnel and facilities that do not exist elsewhere in Canada.

4 **There are many technologies with different risks and rewards for Canada.** The Technology Working Group surveyed over 100 SMR designs and found varying benefits and opportunities for Canada. Certain early-stage technologies may offer the greatest potential for Canada to capture value because the supporting supply chains are not yet established, and demonstrating these technologies would anchor research and development, and supply chain benefits in Canada. At the same time, these technologies have higher risks associated with their development. This range of opportunities may lend itself to a portfolio approach that advances both nearer-term, lower-risk designs, as well as more innovative, advanced designs. These would provide greater benefit to the domestic supply chain, but also carry a higher level of risk of missing the opportunity of becoming an early-mover on the global market.

5 **SMRs will most likely be deployed in a fleet approach.** Project proponents looking to deploy in Canada recognize the advantage of a fleet approach and are taking steps to enable this strategy whereby a large number of identical units would be deployed in multiple jurisdictions. An implication of this is that the design will need to be finalized and remain unchanged from unit to unit across the entire production run. Labs and supply chain partners will need to be ready to accommodate this new business model, which is a radically different approach in contrast to the traditional model of full scale nuclear power plants, where designs were often updated and changed between new build projects. The design, licensing, construction, and operational experience gained from first-of-a-kind demonstration projects and early deployment in Canada will be essential in enabling a standardized, fleet-based approach for SMR deployment.

6 **SMRs may require access to new types of fuel.** Although nearly all SMR designs will still run on uranium, they will use a grade of low-enriched uranium fuel, and fuel types that are different from the natural uranium fuel bundles currently used in Canadian nuclear reactors. While fuel for demonstration projects may be able to be sourced from the United States, both China and

Russia are positioning to lead in the commercial SMR fuel supply market. Canada may consider building domestic capabilities and developing strategic partnerships in this area. There could be a significant value added opportunity for Canada, with some of the activities anchored in Saskatchewan alongside the uranium mining sector. To realize this opportunity would require some targeted capacity building including, for example, in the area of advanced manufacturing. There may also be opportunities to reprocess used fuel from existing nuclear power plants in Canada, as some SMR designs plan to position themselves to run on reprocessed fuel.

7. **Canada's supply chain is well-positioned to capture value.** Canada has a robust supply chain that is primed for growth, leveraging the $26 billion refurbishment projects underway in Ontario. This is in contrast to some other countries, where supply chains have atrophied. At the same time, the ramped-up Canadian supply chain will need to retool to successfully transition to the new manufacturing and service needs of SMRs. Here, partnerships among federal, provincial, industry and academic actors will play a key role, and can benefit from existing programs.

4.2 Indigenous and Public Engagement

The Indigenous and Public Engagement Working Group addressed the following lines of inquiry, as a first step toward understanding Indigenous and public views on SMRs and nuclear energy more broadly:

- **Indigenous and public views**: reviewing and synthesizing existing literature and public opinion research, performing gap analyses, and developing recommendations.
- **Indigenous engagement best practices and lessons learned**: reviewing policies and practices across some relevant organizations (NWMO, CNSC, OPG [Hydro], Cameco, etc.), and identifying best practices and lessons learned, taking into account the "*Truth and Reconciliation Commission of Canada: Calls to Action"* and engagement guidelines published by Indigenous peoples.

At this time, existing public opinion surveys on public perceptions of SMRs are limited. The Working Group reviewed existing research relating to Indigenous and public perceptions of nuclear energy more broadly.

Public Confidence

Within the Canadian context, it is important to note regional differences in public opinion toward nuclear energy. There is a large cluster of support for nuclear power in Ontario and New Brunswick, perhaps because these provinces have a long history with it and have invested in nuclear research, education and innovation. It was also found that areas in close proximity to nuclear facilities have the highest support of all, potentially due to the economic benefits from nuclear energy in those areas and the knowledge and understanding of nuclear power that comes from living close to a nuclear facility. There is also higher-than-average support for nuclear energy in the province of Saskatchewan, potentially due to its status as the second largest exporter of uranium in the world. In other provinces where civil society, policy makers and regulators have less experience with nuclear power, public opinion is significantly less supportive.

Key findings from the review of existing public opinion research were:

1. Ontario, New Brunswick and Saskatchewan have the highest approval levels for nuclear energy, potentially due to their experience with nuclear power reactors and/or uranium mining.
2. People are most likely to be concerned about nuclear safety, waste and used fuel management, as well as perceived environmental risks. Nuclear energy is also perceived as an expensive form of power generation.
3. Individuals with higher levels of formal education are more likely than others to support nuclear power.
4. Men, particularly those with higher levels of income and formal education, are more likely than women to view nuclear power favourably.

Most people accept the positive aspects of nuclear power generation (e.g. non-emitting electricity generation) and nuclear medicine. However, unprompted, few will note these and many feel these benefits are outweighed by the unknowns around radiation exposure, long-term nuclear waste and used fuel management, or they conflate nuclear power with nuclear weapons.

These concerns often lead to assumptions about the risk of nuclear power. The nuclear industry must be prepared to clearly address any misunderstandings about nuclear power and previous incidents if they are to engage in constructive conversations about nuclear energy and SMRs. Speaking to Canada’s safety and operational record in nuclear operations, as well as the innovative “passive safety” features of proposed SMR technologies, could help to address concerns. Passive safety features are those that allow the unit to naturally shut down during an emergency; also referred to as “inherent” safety.

Engaging Indigenous Peoples

There have been few reports on Indigenous attitudes toward nuclear power. The Working Group considered two recent studies.

- ***The Nuclear Energy Sector: Overview of Saskatchewan Attitudes*** by the Nuclear Policy Research Initiative (NPRI) and the Social Science Research Laboratories (SSRL) at the University of Saskatchewan (2014).

NPRI conducted a survey of Saskatchewan residents, including Indigenous persons, to gain a better understanding of their attitudes related to the nuclear sector. The survey was administered as a 15-minute telephone survey with a fixed set of questions. The study found that Indigenous participants were more likely than other respondents to report a negative response when asked about their opinion regarding future nuclear developments, and to report a mainly or entirely negative overall impression of nuclear power. Indigenous respondents were also more likely to see greater levels of risk from nuclear power than other residents, and were more likely than others to report opposition to nuclear power generation in Saskatchewan.

- ***Northern Indigenous Peoples & the Prospects for Nuclear Energy*** by Dr. Ken Coates and the International Centre for Northern Governance and Development.
  More recently, in 2016, the University of Saskatchewan and the Fedoruk Centre for Nuclear Innovation conducted a study on the attitudes of Northern Indigenous peoples toward nuclear power. In contrast to the telephone survey methodology used by NPRI, the study focused on in-person interviews with community leaders in Northern Saskatchewan, Yukon and the Northwest Territories. Though participants expressed many real and substantial concerns, the study found considerable openness toward nuclear power and an interest in receiving more information on how it could be deployed in the North.

Key findings with respect to future Indigenous engagement were:

1. There is a need for more engagement to understand Indigenous views on nuclear power, covering more regions. Indigenous peoples are diverse, and communities may have different backgrounds, views, interests and drivers.
2. There is an important historical context, beyond nuclear power, which has included *many* mistakes and failures that have led to an erosion of trust. Much work is needed to rebuild trust.
3. Indigenous engagement is not a one-time checklist exercise. Authentic engagement can provide opportunities to strengthen mutually beneficial and respectful relationships with Indigenous peoples by ensuring Indigenous communities have agency to make decisions about their energy futures. Indigenous engagement activities must begin well in advance of project proposals and continue through the full life cycle of the project.
4. There are some good examples to follow, with which organizations should familiarize themselves before undertaking engagement:
   - The "*Truth and Reconciliation Commission of Canada: Calls to Action,*" the "*United Nations Declaration on the Rights of Indigenous Peoples,*" and engagement guidelines published by Indigenous peoples themselves.
   - Nuclear sector organizations with experience in this area, notably: the NWMO, CNSC, and utilities such as Qulliq Energy Corporation, NB Power, Ontario Power Generation, Bruce Power and SaskPower.

4.3 Waste Management

The Waste Management Working Group addressed the line of inquiry:

- Is Canada's current waste management framework sufficient for SMRs and, if not, what would need to be changed?

The Working Group convened technical experts, including waste owners, Canada's Nuclear Waste Management Organization, and the regulator to conduct a comprehensive review of the legislative framework, and waste management policy and practice in Canada. This included a series of table-top exercises to understand how Canada's framework would apply to the types of waste that would be produced by SMRs.

The Working Group differentiated its findings according to two classes of waste produced by SMRs: used fuel, and low- and intermediate-level waste. "Used fuel" is the used nuclear fuel that is removed from nuclear reactors after it has been used to produce energy. "Low- and intermediate-level waste" refers to all forms of radioactive waste, except used nuclear fuel; limited waste from the production of medical isotopes; and the waste from uranium mining and milling.

Key findings with respect to used fuel:

1. **Canada's existing legislative, policy, and technical framework is sound,** including the principles of the funding formula that the NWMO would use to charge waste owners for disposal of used fuel from SMRs. That said, there is uncertainty around the cost to new waste owners, especially where the waste type is significantly different than CANDU fuel. Costs will depend on: any modifications needed to the NWMO facility design, new packaging requirements, the normal transportation and disposal costs, as well as a proportional share of costs already incurred by the NWMO. The cost uncertainty presents a risk to the business case and economic viability of SMRs, and in the near term, affects the ability of SMR proponents to attract private-sector financing since full, life cycle costs are uncertain. As market forecasts and technology selection and design work become more certain, so too will projected waste management costs for used fuel.

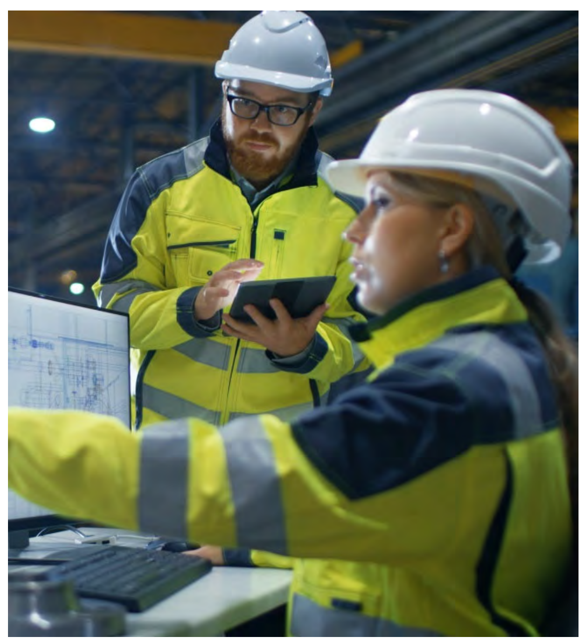
2. **Canada's technical solution for long-term disposal of used fuel waste is sufficiently flexible to accommodate new fuel types from SMRs.** Early engagement by proponents with the NWMO will be important to facilitate work that may be needed on the side of the proponent to demonstrate how new types of used fuel from SMRs can be accommodated in the proposed facility and/or to consider possible changes to the technical specifications of Canada's long-term disposal facility. As the design of the NWMO facilities matures, the ability to incorporate future changes to accommodate new SMR requirements will become reduced.

Key findings with respect to low- and intermediate-level waste:

1 **There is no legislative or regulatory gap for low- and intermediate-level waste.** In practice, these wastes are safely stored at existing facilities as there is currently no approved final disposal facility for these wastes in Canada. This situation may present challenges for the entry of new SMR operators as the need to establish waste storage facilities would add cost and long-term liability risk that may not be commercially viable. It may also present challenges for public acceptance of SMRs if there is no path for disposal of low- and intermediate-level wastes. To allow a competitive market for SMR operators, access to disposal facilities (and until available, storage facilities) is required.

2 **Currently, the most practical management practice for low- and intermediate-level waste from SMRs is safe storage at regulated sites.** Over time, however, storage costs will increase and eventually become a competitive disadvantage for SMRs in Canada, compared to other jurisdictions that have implemented mechanisms for safe disposal of these wastes. The lack of both storage and disposal options for small scale producers, including SMRs, presents an economic uncertainty that could present a barrier to some new market entrants.

3 **The ultimate solution is long-term disposal in a safe repository.** Industry does not yet have low- and intermediate-level waste disposal facilities available. The two major projects in the regulatory decision process do not presently contemplate receiving wastes from small volume producers (including SMRs). While technical requirements are well-elaborated, uncertainty in what it takes to get a repository approved in Canada with respect to the impact assessment and associated processes, will be reduced once one or both of these projects have been approved. Low- and intermediate-level wastes from SMRs are not characteristically different from those generated by existing nuclear power plants in Canada. Therefore, the need to finalize a plan for safe disposal already exists today. There are a number of different options that may be considered, and solutions for existing low- and intermediate-level waste could apply equally to incremental waste streams generated by SMRs.



4.4 Regulatory Readiness

The Regulatory Readiness Working Group considered the full range of existing regulatory and legislative processes, carrying out line-by-line analyses and tabletop exercises to evaluate how they might apply to SMR deployment. This review considered over 150 pieces of federal, provincial and territorial legislation and regulations, applicable codes and standards, as well as additional documents and comments from industry.

The Working Group focused their detailed review on federal legislation in order to provide the perspective of a pan-Canadian approach rather than a particular region of the country. The Working Group also leveraged the existing body of knowledge prepared by other Canadian organizations such as COG and the Canadian Standards Association (CSA) who have their own internal review processes concerning SMRs.

The Working Group had the following key findings:

1. **Canada's enabling framework is sound.** Existing regulatory and legislative processes are ready for SMR deployment in Canada, although some refinements would improve efficiencies.
2. On Canada's nuclear liability framework, the existing legislation is sound and current regulations assign liability limits to existing Canadian nuclear facilities based on the concepts of a graded approach, commensurate with risk. It is anticipated that some revisions to the regulations under the *Nuclear Liability and Compensation Act* will be required in order to apply these same concepts to small power reactors, thereby acknowledging the small size and low inherent risk of many SMR designs.
3. On nuclear security, the current regulations would require SMRs to incorporate security infrastructure comparable to today's operating full scale nuclear power plants. Industry stakeholders and the CNSC are already engaged in discussions about potential changes to these regulations to take a graded approach, commensurate with size and risk, while continuing to ensure appropriate security coverage is maintained.
4. Some additional refinements have been identified which would improve efficiencies in some existing regulatory control areas such as staff training and emergency response. Due to the consultation already undertaken to date by CNSC on the regulatory framework for SMRs, both industry and the CNSC are aware of and understand these refinement opportunities and are confident they can be resolved. This confidence is based on past experience whereby similar technical regulatory issues have been satisfactorily resolved in the past.

Existing regulatory and legislative processes are ***ready for SMR deployment*** *in Canada.*

SPECIAL ISSUE FOCUS: FEDERAL IMPACT ASSESSMENT

The *Impact Assessment Act*, currently before Parliament, is designed to modernize federal impact assessment processes for major projects, potentially including SMRs.

Canada is at a moment of opportunity. Small Modular Reactors could have substantial environmental and economic benefits, as outlined in this report. Governments and industry alike recognize that enhancements in legislation around protection of the environment are key to a successful long-term sustainable development strategy for Canada. The *Impact Assessment Act* addresses important improvements to how major projects are assessed and approved in Canada, and is recognized as a key federal initiative. Initiatives to enable SMRs and the *Impact Assessment Act* need to work together to provide these benefits.

Stakeholders made specific recommendations to the federal government through the consultation process for the *Impact Assessment Act* with the goal of ensuring the *Impact Assessment Act* and the Roadmap work together.

4.5 Economics and Finance

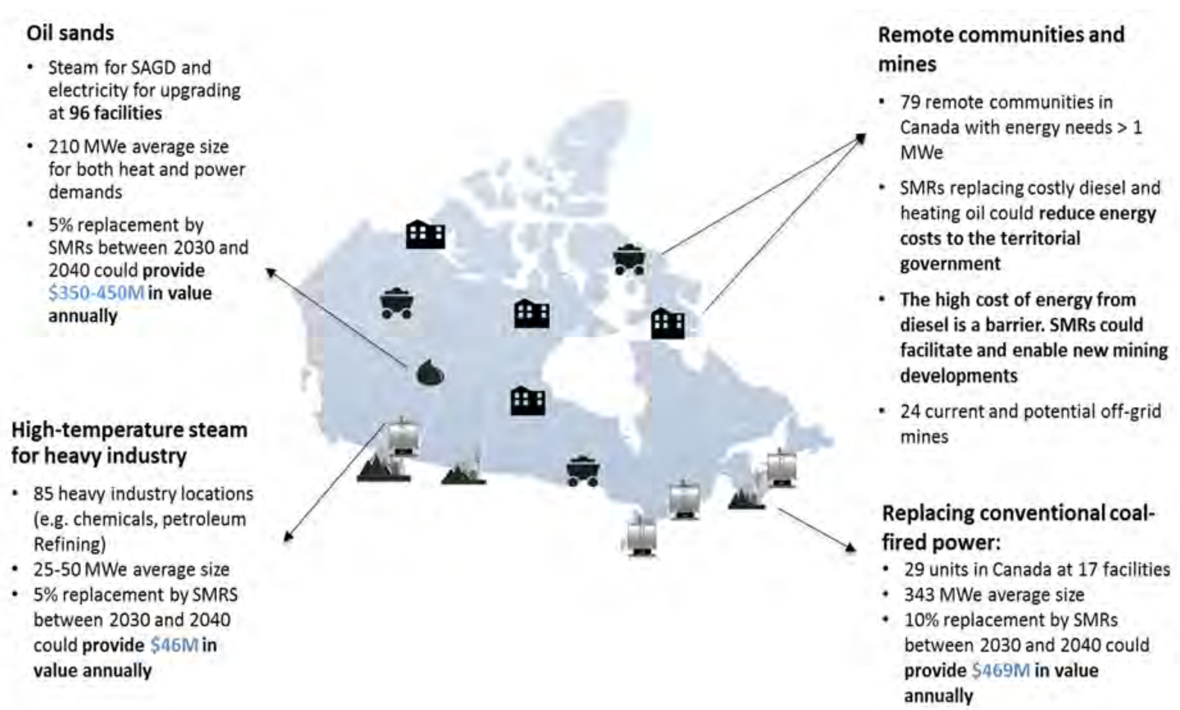
The Economics and Finance Working Group studied the market potential for SMRs, their competitiveness with other energy sources, as well as ways to overcome economic barriers to mass deployment. They reviewed existing literature, and undertook new analysis estimating cost competitiveness for on- and off-grid SMRs, with different sizes of SMRs, carbon pricing levels, technology readiness and discount rates.

They addressed the following questions:

1. What is the domestic market potential for SMRs, and what are the potential economic benefits?
2. Could SMRs be competitive with large nuclear power plants and other electricity generation options?
3. Which policy measures would be most effective in fostering a vibrant SMR industry? How can the costs of first-of-a-kind units be kept down, unlocking private investment?

The Working Group's key findings were:

1 **The domestic market potential is significant.** SMRs could be a key player in meeting Canada's commitment to phase out the use of conventional coal-fired power plants by 2030, and as Canada strives to secure 90% non-emitting electricity supply by 2030. They have other applications, such as providing non-emitting heat and power to oil sands facilities, remote communities, heavy industry plants and off-grid mines.



2 **SMRs meeting a fraction of this potential can provide significant economic benefits for Canada**, including up to 6,000 direct and indirect jobs per year between 2030 and 2040, and up to $10 billion in direct impacts and $9 billion in annual indirect impacts over the same timeframe. These are conservative estimates that do not take into account potential future uses of SMRs, such as powering greenhouses, desalination, and hydrogen production, all of which could increase their overall economic potential.

Additional information about these estimates is available in the full report of the Economics and Finance Working Group.

3 **SMRs can be a competitive option in terms of capital costs and electricity prices.**

The Working Group considered a range of on- and off-grid applications, with different sizes of SMRs, carbon pricing levels, technology readiness and discount rates. They found that SMRs can be competitive with alternatives including large nuclear power plants, diesel, natural gas, hydro, wind and solar.

SMRs have numerous advantages compared to large nuclear power plants, such as lower capital costs, modularity, economies of multiples, simpler designs, and potentially shorter construction schedules.

While many analysts expect natural gas prices to stay low over the next decade, an unexpected increase in prices would further strengthen the economic case for SMRs.

Figures 1 and 2 compare levelized cost of electricity from on-grid SMRs with:

a. *Natural gas*, which is expected to be a key source of low cost electricity for the next decade;

b. *Large hydro*, Canada's single largest source of electricity; and,

c. *Wind*, presently the fastest growing source of electricity in Canada.

Figures 1 and 2 compare levelized cost of electricity only, and do not reflect other systems and reliability costs, such as backup generation and storage costs. Solar, not included in Figures 1 and 2, would be more expensive than wind generation.

With the most favourable assumptions for on-grid SMRs, which include a 6% discount rate, NOAK costs, and more innovative technology, they are one of the least expensive options, potentially cheaper than large hydro plants and natural gas, even without a carbon price in place.

Even with the least favourable assumptions for on-grid SMRs, which include a higher discount rate, NOAK costs, and less innovative technology, they are competitive with large hydro plants, wind generation, and natural gas, assuming a carbon price is in place.

Moreover, while natural gas prices are expected to remain relatively low over the next decade, an unexpected increase in gas prices would further strengthen the economic case for SMRs.

The ranges of levelized costs of electricity for wind in Figures 1 and 2 reflect projects from various regions across North America. There are other salient reference points, however, including a specific recent experience in Alberta that saw an average price of $37 per MWh for wind projects selected in an auction for 600 MWe.

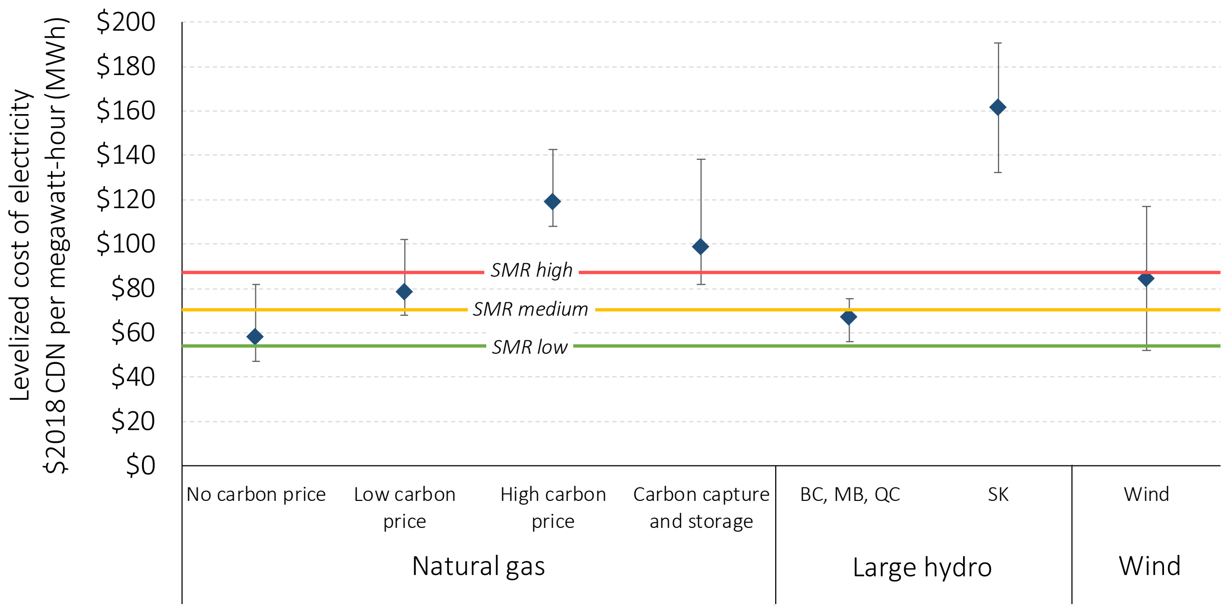


Figure 1. Comparison of levelized cost of electricity from on-grid SMRs with other options: Best case (6% discount rate, more innovative technology)

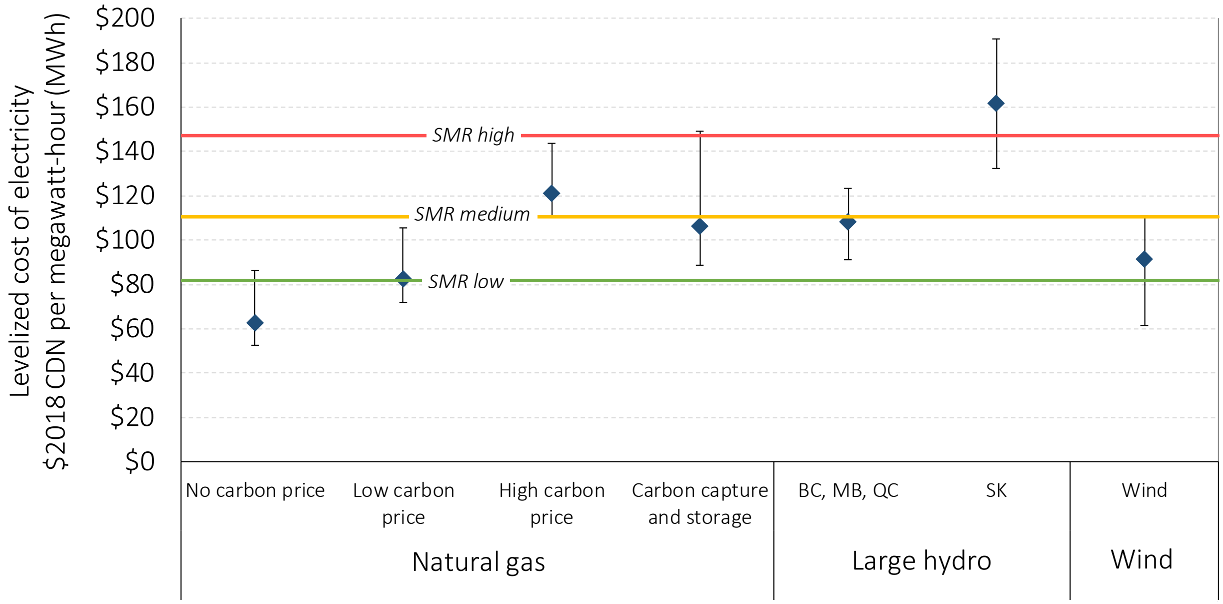


Figure 2. Comparison of levelized cost of electricity from on-grid SMRs with other options: Worst case (9% discount rate, less innovative technology)

Off-grid, where SMRs would compete against existing diesel generators, cost savings are highly sensitive to discount rate but would be substantial at sizes appropriate for mining sites (20 MWe) or small communities (10 MWe) (Figure 3).

In very small communities such as remote communities in Nunavut, a lower discount rate leads to a slight decrease in costs, while a discount rate of 9% would lead to slightly higher costs than diesel generators. Other benefits such as greater reliability and reduced emissions could offset this higher cost.

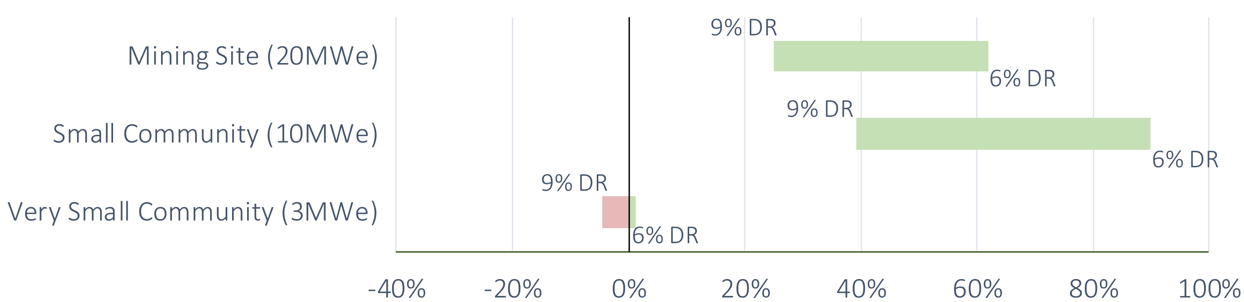


Figure 3. Cost advantage of SMRs over diesel: The difference between the levelized cost of electricity of diesel and SMR options, expressed as a percentage of the levelized cost of electricity of diesel in three remote/off-grid applications (shown for 6 and 9 percent discount rates).

4 While other drivers have significant impacts, **the cost of capital is the single most important driver in determining the competitiveness of SMRs.** As demonstrated in Figure 4, which shows the impact of different key economic drivers on SMRs' levelized cost of electricity, cost of capital is the most significant. A 3% reduction in the cost of capital on a 300 MWe first-of-a-kind SMR can reduce the levelized cost of electricity from $163/MWh to $124/MWh – an over 30% reduction.

Like any new, innovative technology, first-of-a-kind projects carry more risk and face higher costs. First-mover firms would absorb initial engineering costs, costs for R&D to build the licensing case, and costs for demonstration units to build the business case, from which other projects then benefit. Private actors would have little incentive to act first.

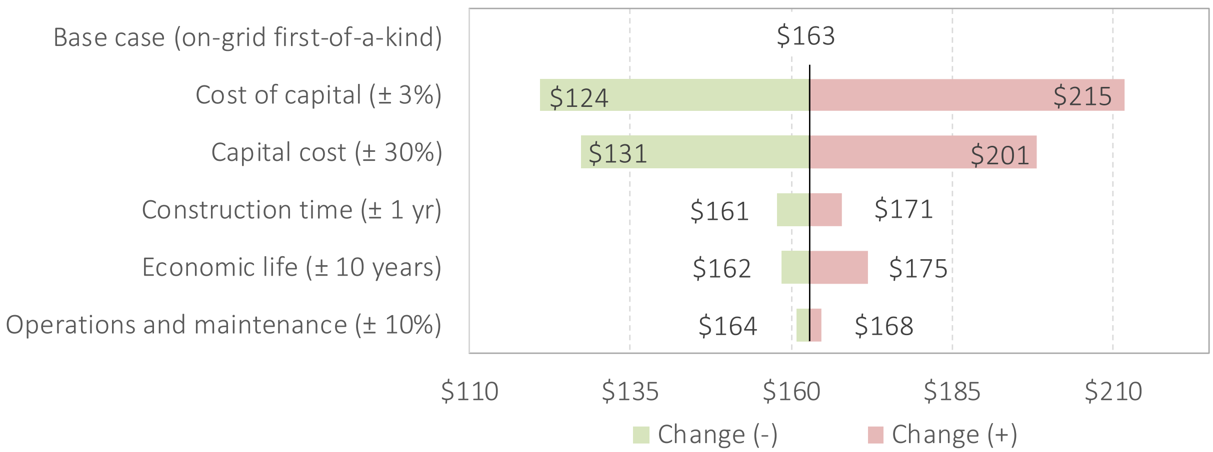


Figure 4. Sensitivity analysis: How levelized cost of electricity ($/MWh) for a first-of-a-kind SMR is affected by variations in cost of capital, capital costs, construction time, economic life, and costs of operations and maintenance.

5 **Federal and provincial governments have a role to play in sharing the risk and reducing the cost of capital.** Without government support, the private sector may not make the necessary investments to set the stage for an SMR industry in Canada. This risks forgoing benefits associated with being a first-mover market, such as supporting innovation, building expertise and reinforcing our robust supply chain.

Given the importance of the cost of capital in determining the competitiveness of SMRs, policy measures aimed at reducing the cost of capital were found to be most effective. In addition to policy levers aimed at reducing the cost of capital, other options—such as carbon emission credits, accelerated capital cost allowances, and grid reliability credits—were modelled, but found to be less effective than measures directed at reducing the cost of capital. Federal and provincial governments can reduce the cost of capital through a suite of policy levers that act across the life cycle of an investment:

a. Cost-sharing in the **development** phase. Government cost-sharing would reduce risks associated with development of earlier-stage, advanced SMR technologies, which are a critical barrier to bringing these technologies to market.

b. Loan guarantees in the **construction** phase. Due to the uncertainties surrounding first-of-a-kind SMR technology and project execution and operation, early projects would benefit from loan guarantees, resulting in lower financing costs.

c. Contracts for difference, power purchase agreements, or tax incentives to the generator in the **operating** phase of early projects. Long-term agreements with a credit-worthy counterparty at a competitive rate can lower the levelized cost of electricity of an SMR by decreasing its cost of capital, and provide revenue certainty for its production (e.g. a power purchase agreement at the market rate or contracts for difference).

As the technology matures, costs of individual units will decrease. Following the first one to two commercial units, SMR costs are expected to decline sufficiently that government risk-sharing would no longer be needed. Several factors will determine how quickly these costs decline: how many SMRs are built, construction experience, and the degree of standardization within SMR fleets.

One of the advantages of building a large nuclear power plant is that the operational, security, regulatory, and insurance costs can be spread over a larger revenue base. Accordingly, there may be a further role for government to create enabling frameworks for smaller SMRs in off-grid markets, taking a graded approach using risk-informed criteria so that the viability of SMRs—which are smaller and simpler, with enhanced safety—is not overwhelmed by disproportionate legislative or regulatory requirements.

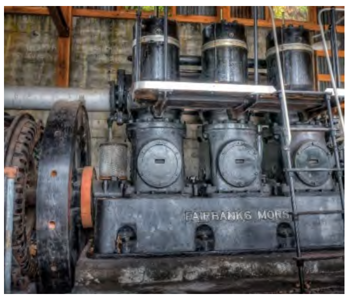
5. International Context

Replace coal-fired power generation

- SMRs can further transition the power sector away from coal
- Even in a 2-degree scenario IEA projects 1100GWe
- Potential market over $100B/year

Remote island nations and off-grid communities

- Large potential in over 70k communities
- $30B/year market



Heat and power for mines

- SMRs powering of new mines between now and 2040 could yield total global value of $3.5B/year market

Steam for heavy industry

- Potentially $12B per year global market. Joint project from Idaho NL and NREL identified 850 facilities where SMRs could provide steam for US heavy industry.

Diesel generator photo © Ken Lane (2015). Photo has been modified. For source and licence: https://www.flickr.com/photos/kenlane/23354939966.

5.1 Global Market Potential for SMRs

Alongside the domestic engagement and analysis undertaken by the Roadmap, there is a broader international context for SMR development and commercialization.

For the ***international*** market, the estimated total global export potential of SMRs is approximately **CDN$150 billion** per year for 2030 to 2040. This includes applications for electricity generation, remote mine sites, island nations, and off-grid communities. This estimate is based on conservative assumptions.

The global market for SMRs could be much larger if SMRs achieve widespread commercial success as the world moves forward to reduce and ultimately eliminate fossil fuel use for electricity generation.

While there remains work to be done to validate these initial estimates, capturing even a small share of these end use markets could amount to billions per year to Canada's economy.

5.2 What Are Other Countries Doing?

Other countries are also moving quickly to advance SMR technologies with programs and investments to support SMRs and advanced nuclear energy development at national labs, private sector companies, and state-owned enterprises:

- The **United States** has established a program to support SMR development, providing $755 million since 2012, including $336 million to a single developer. This funding has been granted incrementally, with more to come. The current Administration's support for nuclear energy shows, with a 20% increase in the US Department of Energy's (DoE) nuclear budget.
- The **United Kingdom** has previously announced an envelope of $423 million over five years for development of SMR technologies. In the past year, the UK has announced approximately $150 million for research and development for advanced SMR technologies, feasibility

projects, advanced manufacturing and construction, and a supply chain improvement program.

The UK has also announced a “Sector Deal,” whereby the government committed to: fund SMRs and nuclear innovation, consider new building financing options, and launch capacity building programs and supply chain support. In exchange, the UK’s nuclear industry has committed to: nuclear project cost reductions, domestic and international sales targets, and a gender diversity commitment to double the representation of women in the sector by 2030.

- **China** has nearly completed its first SMR, a high-temperature gas reactor, and is designing other advanced SMRs, such as a molten salt reactor and a floating SMR.
- **Russia** has just completed a floating barge SMR to access remote locations, and Russia’s state-owned nuclear company, Rosatom, claims to have an international order backlog exceeding $170 billion.
- **Korea** has designed an SMR for the export market, with Saudi Arabia already signing a purchase agreement with Korean firm KAERI.
- **Argentina** is nearing completion of a 25 MWe prototype.

Through the SMR Roadmap, we also heard that the likely path to commercialization will involve strategic partnerships and global value chains. This recognizes a growing trend toward a greater emphasis on private sector innovation, and the development of global supply chains for nuclear energy technologies.

Effective collaboration will require strong government-to-government relationships to enable nuclear energy trade and innovation, enabled by Nuclear Cooperation Agreements (NCAs), and multilateral engagement—not just in nuclear-only for a, such as the Nuclear Energy Agency and the International Atomic Energy Agency, but also at broader clean energy tables, such as the Clean Energy Ministerial and Mission Innovation.

6. Potential Benefits for Canada

Through the extensive engagement with industry and other stakeholders, initial dialogue with Indigenous communities and organizations, and expert analysis undertaken by the Roadmap, it became clear that SMRs are more than just a technology story.

The successful demonstration and commercialization of SMRs will require a broad support infrastructure of technical expertise, research facilities, manufacturing and service capabilities, operating experience, and highly qualified professionals. It will require enabling legislative, regulatory, and policy frameworks that can accommodate innovative technologies and new business models. And it will require a market "pull" from prospective end users to enable a range of different applications for SMRs—some of which are radically different than the current market for traditional nuclear power plants.

In other words, we heard that SMRs are a full-fledged innovation story, and a potential game-changer for the nuclear industry and Canada's natural resource sectors more broadly.

Canada could have a leading role in this international contest. A role that would unlock a range of benefits: economic, geopolitical, and social and environmental.

The complex and specialized nature of the elements required to bring SMRs to market means that first-movers will have significant competitive advantage: leverage to lock in or capture these benefits, with new entrants facing barriers to compete with first-to-market technologies.

Through the Roadmap, we identified the following potential benefits to Canada:

*SMRs are an innovation story and a **potential game-changer** for our nuclear industry and Canada's natural resource sectors more broadly.*

1 Economic benefits:

- **The creation of a new industrial subsector**: An estimated 6,000 new jobs supporting a high-skill labour force, and adding up to an estimated $10 billion to Canada's GDP between 2030 and 2040[6]. Capturing value from an emerging segment will sustain and grow Canada's nuclear workforce and supply chain, leveraging the Province of Ontario's $26 billion investment in nuclear reactor refurbishments. Essentially, this is to develop a new industrial subsector in Canada to respond to a clear market signal for smaller, simpler, and cheaper nuclear energy for multiple applications.

[6] These estimates are based on analysis by the Economics and Finance Working Group. Additional information about these estimates is available in the Working Group's full report.

- **Anchoring cutting edge research in Canada**: SMR demonstration projects to lock in research and intellectual property at Canadian Nuclear Laboratories, Canadian universities, and research organizations in critical areas of innovation such as materials science, fuel testing and qualification, advanced manufacturing, control systems, cybersecurity, and remote operation. Leveraging federal investments at Chalk River to attract private investment and the best and the brightest from around the world to a revitalized science campus, and a hub for SMR innovation.
- **Canada at the centre of a global export market**: Leading in deployment and operation of SMRs internationally, with Canadian power utilities as global SMR operators. Capitalizing on domestic supply chains, expertise, and operating experience to capture value in an emerging global market estimated at $150 billion per year by 2040.
- **Leadership in the mining sector**: Enhancing competitiveness in the mining sector with SMRs as a lower-cost source of low-carbon heat and power in remote frontier areas. Opening new opportunities for development in Canada, and leveraging the international footprint of Canada's mining sector to access global export markets for Canadian-supported SMR technologies.

2 Geopolitical benefits:

- **Global leadership in SMR policy expertise**: Nuclear energy has been a beachhead for strategic international engagement; Canadian leadership on SMRs would sustain this benefit into the future. Canada as a Tier 1 SMR nation, with a full-spectrum SMR industry and a successful enabling policy framework. Enhancing Canada's strong brand with a pathway to SMR commercialization, serving as a model to strengthen Canada's position in international relations with key partners and in strategic multilateral nuclear energy fora.
- **Canada as a key international leader on regulatory excellence**: Canada can influence SMR regulatory practices internationally to assist in building a strong enabling framework for SMR deployment globally.

3 Social and environmental benefits:

- **Meeting Canada's climate change commitments**: Deployment of SMRs in several markets to enable key milestones in Canada's pathway to a low-carbon future: The complete phase-out of conventional coal-fired electricity. Deep decarbonization of heavy and extractive industries while maintaining competitive advantage. And new opportunities for the radical transformation of the underpinning of our industrial base from one driven by fossil fuels to an economy powered by clean energy.

- **Unlocking regional growth opportunities**: Growing a pan-Canadian nuclear industry: In Atlantic Canada, with leadership on revolutionary molten salt SMR technology. In Saskatchewan, with new opportunities for uranium and fuel exports. And in Ontario, to provide advanced manufacturing and nuclear supply chain services to the world.
- **Constructive relationships and a positive energy dialogue**: Building on the opportunity for SMRs as an option in remote and Indigenous communities, there could be opportunities to develop best practices and engage in positive dialogue on broader remote energy issues, and development opportunities in communities interested in more information on the full range of options available.

Through the Roadmap, we heard that Canada is well-positioned to lead if we choose to seize the opportunity to capitalize on benefits for Canada. With a **supply chain and national laboratories primed for growth**, we can leverage the investments underway in Ontario and at Canadian Nuclear Laboratories. We have a strong international brand, an **independent regulator dedicated to safety and open to innovation**, and **viable sites for demonstration** of multiple SMR technologies.

We also heard that **Canada's time to lead is now**, given the lead times necessary for SMR technology development, the timing of key decisions regarding energy investments in different provinces, and the fact that the race is on. Other competitors are moving quickly to demonstrate and commercialize SMR technologies.

SMRs are an innovation story that will require strategic partnerships—in Canada and internationally. Achieving these potential benefits for Canada will require contributions from a host of essential enabling partners—everyone pulling together to put the different pieces in place.

This Roadmap starts with a Team Canada approach, involving actions from the essential enablers needed to realize the promise of SMRs in Canada.

7. Team Canada — Shared roles and responsibilities

Throughout the Roadmap, it has become clear that success will rely on strategic partnerships—across the sector and internationally. No single organization can do this alone.

As a result, there is a clear need for coordination and collaboration among all essential enabling partners in Canada. A truly national plan for action is needed to realize the historic opportunities associated with SMRs, bringing together key enablers, each with different resources, roles and responsibilities, from different jurisdictions. The Roadmap was built with this in mind: building the engagement, analysis, and recommendations needed to lay the groundwork for a *bottom-up* action plan with a common vision co-created and endorsed by all key enablers, rather than a top-down approach.

Canada is good at this. It is one of the few countries with capabilities that cover the full nuclear life cycle, from mining to plant construction to operation to waste management, and it is one of an even more select few that have been able to build the cross-sectoral consensus on a path forward that the Roadmap exemplifies. Our nuclear industry is a united front: a “Team Canada” approach where each partner builds on the strengths of the others, which has enabled tremendous success in international meetings and trade missions in recent years.

In nuclear energy and electricity generation, the federal government, provinces, territories and Indigenous peoples all have their own roles, responsibilities and jurisdictions. The federal government has jurisdiction over the regulation of all nuclear-related activities, including uranium mining and mills, nuclear power and nuclear waste management, as well as policies in the national interest, such as research and development. It also has a constitutional duty to consult Indigenous peoples when their rights may be affected by a federal decision.

Provinces and most territories have ownership over the natural resources and electrical grids within their boundaries, except on Indigenous lands and some federal lands. Provinces and territories set the pace and extent of resource development within their jurisdiction, including electricity resources and related infrastructure, transmission and distribution.

*A truly **national plan for action** is needed to realize the historic opportunities associated with SMRs **—bringing together key enablers**, each with different resources, roles and responsibilities, from different jurisdictions.*

Indigenous peoples and communities have Aboriginal and Treaty rights and a unique relationship with the land that must be respected. Recognizing the diversity of their backgrounds, views, interests and drivers, Indigenous peoples and communities should be engaged constructively from the outset of proposals that might affect them. Some Indigenous communities are also owners of clean energy projects on their lands and contribute generating capacity to local and regional electricity grids.

Federal, provincial and territorial governments will be key players in bringing SMRs to fruition, in consultation with Indigenous peoples and communities. This work must be done in concert with a range of other stakeholders who each bring key strengths to bear.

These players and their roles and responsibilities with respect to SMRs are diverse:

- **Federal Government:** The federal government, given its jurisdiction over nuclear energy and issues deemed to be in the national interest, can play a leadership role in enabling SMRs in Canada. It can help de-risk demonstration and first-commercial projects by providing clear signals of support, or through policy levers and programs. It can ensure that the federal legislative, regulatory, and policy framework is sound and ready for SMR deployment, while working with bilateral and multilateral partners to align international engagement and cooperation with Canadian priorities on SMRs. The federal government can also support and enable SMR research and development work to help advance designs through demonstration to commercial deployment stages.
- **Interested Provincial and Territorial Governments:** Given that provinces and territories generally have jurisdiction over electricity resources and related infrastructure, they will need to play a leadership role on any proposal to build SMRs and develop the infrastructure to support them. Like the federal government, they have significant policy levers at their disposal to help support SMR demonstration projects and ensure Canada's nuclear supply chain is prepared. Several of the options identified above also apply to provincial and territorial governments, which can partner with each other and with the federal government to advance SMRs.
- **Canadian Nuclear Safety Commission (CNSC):** The Canadian Nuclear Safety Commission regulates the use of nuclear energy and materials to protect health, safety, security and the environment; to implement Canada's international commitments on the peaceful use of nuclear energy; and to disseminate objective scientific, technical and regulatory information to the public. Any proposed project to build and operate an SMR would require licensing from the CNSC.
- **Atomic Energy of Canada Limited (AECL):** As a federal Crown corporation, AECL's mandate is to enable nuclear science and technology and fulfill the federal government's radioactive waste and decommissioning responsibilities. Its sites, managed and operated by Canadian Nuclear Laboratories under contract with AECL, are hubs of nuclear science and technology in Canada.

- **Canadian Nuclear Laboratories (CNL):** As Canada’s premier nuclear science and technology organization, Canadian Nuclear Laboratories serves Canada as an enabler of business innovation and technology transfer, and fosters the development of highly qualified personnel for the knowledge economy to come. Canadian Nuclear Laboratories is playing a leadership role through its Invitation for Demonstration process, where it is inviting SMR vendors and technology developers to apply to site a demonstration project.
- **Nuclear Waste Management Organization (NWMO):** Responsible for designing and implementing Canada's plan for the safe, long-term management of used nuclear fuel. The founding members are Ontario Power Generation, New Brunswick Power Corporation, and Hydro-Québec. These organizations, along with Atomic Energy of Canada Limited, are mandated to fund its operations.
- **Canadian Nuclear Association (CNA):** A non-profit organization established in 1960 that serves as the voice of the Canadian nuclear industry and promotes the development and growth of nuclear technologies for peaceful purposes. CNA provides industry leadership and coordination of advocacy and policy development with federal and provincial governments on issues of interest to Canada’s nuclear industry. CNA also plays a leading role raising public awareness of the many benefits of nuclear energy and technology.
- **CANDU Owners Group (COG):** COG is a private, non-profit organization primarily funded through voluntary contributions by utilities that operate CANDU nuclear power plants worldwide and Canadian Nuclear Laboratories with strong supplier participation. COG is a trusted nuclear industry leader comprised of highly skilled employees with extensive experience in many facets of CANDU nuclear technology and regulatory affairs. As an organization that manages collaborative projects and research and development for the nuclear industry, COG is uniquely positioned to support jointly funded work to enable SMR deployment in Canada. In the emerging space for SMRs, COG convenes the SMR Technology Forum, bringing together SMR technology vendors and SMR utilities to help chart a path forward on operational excellence.
- **Organization of Canadian Nuclear Industries (OCNI) and the Canadian Nuclear Supply Chain:** OCNI is an association of more than 200 leading Canadian suppliers to the nuclear industry in Canada and abroad. As its member companies collectively employ more than 12,000 highly skilled and specialized people who manufacture major equipment and components and provide engineering services and support to Canada’s nuclear sector, OCNI will play a key role in ensuring that supply chain companies are ready to meet the needs from emerging SMR value chains—in Canada and internationally—and to anchor supply chain benefits from an SMR industrial subsector in Canada.
- **Canadian Nuclear Industry:** Advances nuclear energy in Canada, with an annual economic impact of $6 billion and supporting 30,000 direct jobs across Canada.
- **Utilities and Owner/Operators:** Responsible for defining the overall project and plant requirements to meet end-user needs, and for establishing plant economic viability. The utility owner-operator will act as an informed customer, considering SMRs as a potential option, engaging with prospective vendors at an early stage, and building internal expertise to provide design, licensing and project oversight as the ultimate project licensee. They would also arrange to manage the resulting waste.

- **SMR Vendors and Technology Developers:** Potential SMR vendors are responsible for advancing SMR designs. They have a role in developing complete and technically sound designs, pursuing viable business models to bring these technologies to market, and engaging with the regulator to ensure their designs address Canadian regulatory requirements. Vendors must ensure that implications from novel features and fuel cycles—including waste management—are understood and contemplated by relevant stakeholders in Canada. Vendors also have a role in understanding how research, development, and supply chain capabilities in Canada can be leveraged to support technology development.
- **Universities and Colleges, Research Institutions, and Laboratories:** Provide an essential education and training role, ensuring that the industry's human capital and knowledge base are primed for leadership on SMRs and advanced reactor technologies. They could conduct early-stage research and advance international collaboration on topics relevant to development of advanced SMRs, addressing knowledge gaps and anticipating future industry needs.
- **End-User Industries:** As the demand side, potential users such as heavy industry define the need. For example, they identify the range of energy applications, such as power and industrial or district heating. This means that end users also need to be educated consumers, and able to evaluate and oversee projects.
- **Civil Society:** Civil society can play a role in enhancing transparency and accountability by contributing to increased public debate and awareness. Organizations such as labour unions, youth networks, women in STEM groups, technical societies, and other non-governmental organizations (NGOs), among others, bring important perspectives to bear in public discourse.

8. Priority Recommendations — The road forward

As we charted the path forward through the Roadmap, four thematic areas began to emerge as pillars for framing our recommendations:

PILLAR 1	PILLAR 2	PILLAR 3	PILLAR 4
Demonstration and deployment	Policy, legislation, and regulation	Capacity, engagement, and public confidence	International partnerships and markets

The Priority Recommendations in this section are the heart of the Roadmap.

Pillar 1. Demonstration and Deployment

- **Funding for SMR demonstration projects.** Federal and provincial governments interested in SMRs should provide funding to cost-share with industry in one or more SMR demonstration projects for advanced reactor designs. Demonstration projects are a critical step to advance these novel SMR technologies and business models that offer significant benefits to Canada and the Canadian nuclear supply chain.
- **Risk-sharing measures for first-commercial SMRs.** Federal and provincial governments should implement measures to share risk with private investors to incentivize first-commercial deployment of SMRs in Canada, with the potential of exporting SMR technologies and related innovations developed in Canada to international markets. Providing a clear path to deployment in Canada will build private sector confidence and help unlock near-term investments to support research and development of SMR technologies.

Pillar 2. Policy, Legislation, and Regulation

- **Federal impact assessment.** The federal government should work to align the modernization of Canada's federal impact assessment process with other initiatives to develop and deploy SMRs. This recognizes that SMRs could have substantial environmental and economic benefits that are fully aligned with the goals of improving how major projects are assessed and approved in Canada. Annex A includes specific recommendations on key aspects of the *Impact Assessment Act* and associated regulations that would ensure that efforts to deploy SMRs are not inadvertently inhibited, while also protecting the safety of Canadians and the environment.
- **Nuclear liability.** The federal government should review liability regulations under the *Nuclear Liability and Compensation Act* to ensure that nuclear liability limits for SMRs are aligned with the risks they pose, using a graded scale based on risk-informed criteria.
- **Regulatory efficiency and nuclear security.** The Canadian Nuclear Safety Commission should engage with industry, public, and Indigenous representatives on amendments to the

Nuclear Security Regulations to ensure a graded approach based on risk-informed criteria. This recognizes that, while the policy, legislative, and regulatory framework in Canada is sound and ready for the safe deployment of SMRs, there are efficiencies that could be pursued to provide further flexibility and clarity in SMR licensing and regulation.

- **Waste management.** Canada's existing legislative, policy, and technical framework for radioactive waste management is sound. On used fuel, SMR technology vendors should engage with Canada's Nuclear Waste Management Organization (NWMO) to ensure that planning for NWMO's deep geological repository is well-informed by the technical specifications of these novel technologies. On low- and intermediate-level waste, Canada's Radioactive Waste Leadership Forum should take steps to ensure consideration of SMR waste streams in its integrated radioactive waste management plan. On demonstration projects, the federal government should consider risk-sharing in some of the costs of management and disposal of low- and intermediate-level wastes.

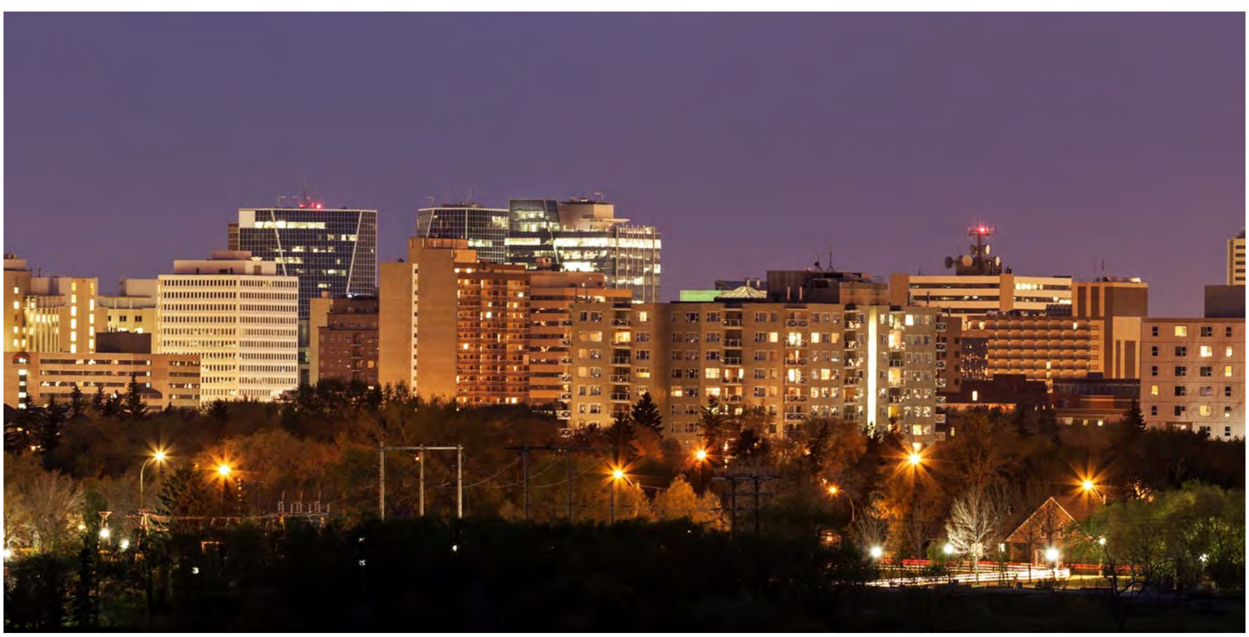
Pillar 3. Capacity, Engagement, and Public Confidence

- **Indigenous engagement.** Federal, provincial, and territorial governments, and utilities interested in SMRs, should continue and build on the initial dialogues with Indigenous groups that were started under the Roadmap. This should involve meaningful, two-way engagement with Indigenous peoples and communities on the subject of SMRs, well in advance of specific proposals.

Pillar 4. International Partnerships and Markets

- **International enabling frameworks.** The federal government, with support from industry, labs, and academia, should continue strong and effective international engagement in SMRs. In particular, position Canada as a leader, contributing policy and regulatory expertise to influence the development of international enabling frameworks for these technologies.

Alongside these priority recommendations, additional detailed recommendations are set out in Annex A.



The following next steps are critical to turning the Roadmap into action, capitalizing on its momentum, and realizing the promise of SMRs in Canada:

Step 1: **Take early action on priority recommendations.** Essential enablers that are identified in the priority recommendations above should take action now on these key activities.

Step 2: **Finalize an SMR action plan that responds to the recommendations in the Roadmap.** All essential enablers are called upon to review the recommendations of this report and make commitments for action that respond to the recommendations. Enablers should seize this opportunity to finalize a Canadian SMR Action Plan.

Step 3: **Implement the plan, report on progress, and pursue strategic priorities for future action.** Industry and governments to form a Nuclear Energy Advisory Council, composed of senior executives and ministers, which will meet annually to report on progress made on the SMR action plan and discuss strategic priorities for future action.

9. Conclusion — Strategic vision and next steps

There is a new reality for nuclear energy in Canada: this Roadmap is living proof.

Proof that the nuclear sector in Canada, once vertically integrated, is now one of collaborative leadership, with a range of essential enabling partners holding individual pieces to a larger puzzle.

But it's also proof that all the pieces do fit together.

This was a landmark, 10-month effort that was unlike any other initiative the sector has ever undertaken. Through the SMR Roadmap, the federal government, provinces, territories, utilities, Canada's nuclear sector, and enabling partners came together to chart a vision for this emerging area of nuclear innovation.

And we learned some very important things through the process.

First, **the opportunity is real**. SMRs are happening in order to respond to market forces for smaller, simpler, cheaper nuclear energy. And if successful, there will be a large global market for this technology, driven not just by climate change and clean energy policies but also by the imperatives of energy security and access.

Second, **Canada has what it needs to seize the opportunity** but the time for action is now. With refurbishments underway in Ontario and a revitalized nuclear science campus at Chalk River, we have a chance to leverage our longstanding leadership in nuclear energy to make this happen. And others are looking to Canada to lead, with a strong, independent regulator dedicated to safety and open to innovation, a solid brand and full-spectrum nuclear industry, and viable sites for demonstration. Demonstrating SMRs in Canada could lock in significant research and intellectual

property benefits at national labs, universities, and research organizations, and position Canada to leverage our Tier 1 nuclear sector for industrial development and global export opportunities. But competitors are also moving quickly in this space, and decisions over the next six to 12 months will be critical to capitalize on this opportunity.

Third, no single player can do it alone. **Strategic partnerships will be key to success**, across the sector in Canada and internationally. This is why we undertook the SMR Roadmap: to serve as the focal point for bringing together all essential enabling partners to chart the recommended path forward for how Canada can step up to lead on SMRs and their emerging global value chains.

But if it ends here, all we did was write a report.

The Roadmap is not an end, it is a beginning. And it starts with a Canadian vision for bringing this emerging, innovative technology to fruition:

SMRs as a source of safe, clean, affordable energy, opening opportunities for a resilient, low-carbon future and capturing benefits for Canada and Canadians.

WHY ACT NOW?

Early-mover advantage will be critical to capturing global market share. Demonstration projects in Canada will be important to anchor benefits—science and technology, intellectual property, supply chain, jobs—in Canada. All other major nuclear nations are making strategic investments in order to position their domestic industries to capitalize on the opportunity. Early action on demonstration and deployment in Canada will be important to keep innovation opportunities and investment from moving abroad.

What is at stake for Canada? A range of potential economic, geopolitical, and social and environmental benefits:

- New jobs, economic growth and innovation, with potential to capture significant value from domestic and international markets, anchored by an existing $6 billion industry that is a strategic asset for Canada.
- Policy leadership on SMRs, and Canada as an international standard-setter, strengthening our influence with key partners and at strategic, multilateral tables.
- Delivering on climate action, while opening opportunities for regional growth and opportunities across Canada, and enabling a positive dialogue with northern and Indigenous communities on remote energy issues.

The Roadmap is a call to action for Team Canada. Enablers must now leverage its momentum, respond to its recommendations, and take action. Essential enablers must act now on the priority recommendations. Enablers are also called upon to make commitments to finalize a comprehensive Canadian action plan on SMRs.

We've come a long way to start this journey. When the Roadmap began we didn't know where we would end up. But through collective leadership and collaboration, we now have a path forward.

And the future looks bright.

ANNEX A Detailed Recommendations — From Roadmap to Action

The Roadmap is a call to action. It is proposed that Team Canada respond to the recommendations in the Roadmap with concrete commitments for action.

This annex provides the full set of detailed recommendations for Canada's SMR Action Plan. They include the priority recommendations from Section 8 of the Roadmap, as well as additional insights and considerations.

Recommended Vision for Canada's SMR Action Plan:

SMRs as a source of safe, clean, affordable energy, opening opportunities for a resilient, low-carbon future and capturing benefits for Canada and Canadians.

Detailed Recommendations:

A-1 For the Federal Government

A-1-1 Demonstration and deployment

DEMONSTRATION AND DEPLOYMENT: **SMR demonstration projects**		**01**
RECOMMENDATION The federal government should provide funding to cost-share one or more SMR demonstration in Canada, leveraging investment from interested provinces, utilities, and the private sector.	EXPECTED RESULTS • One or more SMR demonstration constructed and in operation in Canada by 2026. • The technology-readiness of one or more SMR technologies is advanced to the pre-commercial stage. • Canada is positioned to capture research benefits and value for the domestic supply chain from the demonstration of these earlier-stage SMR technologies.	

DEMONSTRATION AND DEPLOYMENT: **Risk-sharing measures for first-commercial SMRs**	**02**
RECOMMENDATION The federal government should implement measures to share risk with private investors, incentivizing first-commercial deployment of SMRs in Canada, aimed at: • Reducing the cost of capital, for example with loan guarantees • Providing long-term price stability, for example through a Production Tax Credit • Reducing capital cost tax burden, for example through an Investment Tax Credit or extending Accelerated Cost of Capital Allowance provisions for renewable energy to nuclear energy projects	EXPECTED RESULTS • SMR developers see a clear path to deployment in Canada, building private sector confidence and unlocking near-term investment in SMR technologies. • First-commercial SMR deployment by 2030.

DEMONSTRATION AND DEPLOYMENT: **Waste management risk-sharing**	**03**
RECOMMENDATION The federal government should consider risk-sharing some of the life cycle costs of management and disposal of radioactive waste from demonstration projects.	EXPECTED RESULTS • Increased certainty regarding costs associated with long-term waste liabilities for demonstration projects.

A-1-2 Policy, legislation, & regulation

POLICY, LEGISLATION, & REGULATION: **Canada's SMR Action Plan**	**04**
RECOMMENDATION The federal government, with support from Team Canada enabling partners, should finalize Canada's Action Plan for SMR development, demonstration, and deployment in Canada and globally with subnational partners.	EXPECTED RESULTS • Public and private decisions are informed by a strategic, action-oriented plan. • The plan respects and builds on the respective roles and responsibilities of essential enabling partners and sets out timelines for action to maximize benefits to Canada.

POLICY, LEGISLATION, & REGULATION: **Nuclear Energy Advisory Council**	**05**
<u>RECOMMENDATION</u> The federal government should work with partners to co-create a Nuclear Energy Advisory Council (NEAC). • Through the Council, senior executives and ministers would meet annually to review progress on Canada's SMR Action Plan and discuss strategic priorities going forward. • Meetings could be held on the margins of the CNA's annual conference or the annual Energy and Mines Ministers' Conference (EMMC). • Two co-chairs: one rotating among industry representatives, the other rotating among the federal, provincial, and territorial governments interested in SMRs	<u>EXPECTED RESULTS</u> • Progress on development and commercialization of SMRs in Canada is advanced in a manner that respects shared roles, responsibilities, and jurisdictions—and leverages benefits to Canada and supports strategic partnerships. • Key decision makers have a venue for discussing progress and priorities for future action on nuclear innovation and nuclear energy matters broadly.

POLICY, LEGISLATION, & REGULATION: **Nuclear liability**	**06**
<u>RECOMMENDATION</u> The federal government should review nuclear installation classification in the regulations under the *Nuclear Liability and Compensation Act* to ensure that liability amounts for different SMR categories are aligned with the risks that they pose.	<u>EXPECTED RESULTS</u> • Regulations are clarified to support SMR applications, particularly for the smallest reactors in off-grid markets. • Based on their risk assessment, appropriate classes and liability amounts for different SMR categories will be made in the regulations under the *Nuclear Liability and Compensation Act*.

POLICY, LEGISLATION, & REGULATION:
Canada's proposed rules for impact assessment of major projects **07**

RECOMMENDATION

Governments and industry alike recognize that enhancements in legislation around protection of the environment are key to a successful long-term sustainable development strategy for Canada. Initiatives to enable SMRs and the new *Impact Assessment Act* should be mutually reinforcing.

The Canadian Environmental Assessment Agency sought public comments from February 8 to June 1, 2018 to help inform the approach to developing two regulations to support the federal government's proposed new *Impact Assessment Act*. Stakeholders have made specific recommendations to the federal government through this consultation process for the new proposed impact assessment legislation (i.e., Bill C-69) and regulations (e.g. the "Project List"). Many of the stakeholder organizations which participated in the preparation of the SMR Roadmap also took the opportunity to provide written comments and recommendations during this consultative period. A complete list of all submissions can be found on the Canadian Environmental Assessment Agency's website. Two examples of recommendations provided by SMR Roadmap participants are:

- *Bill C-69 should be implemented in a way that ensures the Act addresses the specific impact of a project rather than be used as a venue to debate a specific policy.*
- *Project applications to construct, operate, and decommission SMRs equal to or below an electric capacity of 300 MWe should be excluded from the Project List, on the basis of having a low risk for potential adverse environmental effects in areas of federal jurisdiction.*

EXPECTED RESULTS

- The new proposed *Impact Assessment Act* provides improved regulatory clarity and manageable regulatory timelines for project proponents and reduced project risk while maintaining strong environmental, health, social, and economic standards and protecting the well-being of Canadians.

POLICY, LEGISLATION, & REGULATION: **Fuel supply security**	**08**
RECOMMENDATION The federal government should convene stakeholders—including provinces, territories, Canadian fuel suppliers, and others as appropriate—to develop options and recommendations for addressing SMR fuel supply security.	EXPECTED RESULTS • Relevant decision makers and stakeholders develop a clear set of options, analysis, and a recommended approach for ensuring security of SMR fuel supply in Canada.

POLICY, LEGISLATION, & REGULATION: **Ensure clean energy programming is open to nuclear energy**	**09**
RECOMMENDATION The federal government should include nuclear energy in programs and policies that target the development of clean, non-emitting sources of energy. • For example, by applying a technology-neutral approach to clean energy funding programs; expanding renewable energy tax credits or production incentives to include nuclear energy.	EXPECTED RESULTS • Nuclear energy development is placed on equal footing, and included in federal government programming and policies in support of clean and non-emitting energy sources.

A-1-3 Capacity, engagement, & public confidence

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Indigenous engagement**	**10**
RECOMMENDATION Federal, provincial and territorial governments and utilities that are interested in SMRs, should conduct meaningful, two-way engagement with Indigenous peoples and communities on the subject of SMRs, well in advance of specific SMR project proposals.	EXPECTED RESULTS • Positive relationships are built with Indigenous groups. • Governments and industry have a greater understanding of Indigenous views, concerns, and priorities related to SMRs. • Indigenous groups have capacity to engage with governments and industry on SMRs.

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE:
Engagement and capacity building in remote communities — **11**

RECOMMENDATION

The federal government should support engagement and early feasibility studies in remote communities and jurisdictions who have indicated interest in SMRs through the Roadmap.

- Studies could address questions about technical and economic feasibility of SMRs, local ownership models, options for the management of radioactive waste, and emergency management planning and response.

EXPECTED RESULTS

- Trust and a positive dialogue on Northern and remote energy issues is built in communities interested in more information on SMRs.
- Northern and remote communities are better informed and have information on the full range of energy options available.
- Northern and remote communities have increased capacity to engage with SMR project developers to explore opportunities for local ownership models and partnerships.

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE:
Public and Indigenous views — **12**

RECOMMENDATION

Federal, provincial and territorial governments and utilities, interested in SMRs should undertake regional qualitative and quantitative research to assess the views, attitudes and understandings of Canadians, including Indigenous peoples in Canada, on all potential energy options, including nuclear energy and SMRs.

EXPECTED RESULTS

- Clear and reliable information on public and Indigenous views with respect to nuclear energy.

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE:
National SMR development research program — **13**

RECOMMENDATION

The federal government should establish an SMR development program that brings together AECL, Canadian Nuclear Laboratories, industry, universities, CANMET labs, and other research organizations to carry out focused research, linked to SMR demonstration projects.

EXPECTED RESULTS

- Capacity is built among the next generation leaders and workforce—including youth, women, and Indigenous people.
- Canada is able to capture additional research and development benefits by leveraging expertise in areas such as materials science, shared broadly among enabling research and development partners.

A-1-4 International partnerships & markets

INTERNATIONAL PARTNERSHIPS & MARKETS: **Global SMR market validation**	**14**
<u>RECOMMENDATION</u> The federal government should conduct a study to validate initial estimates of the global SMR market. • The study should repeat the rigour of the domestic SMR market analysis conducted under the Roadmap to explore specific end-use markets for SMRs in detail (e.g. extractive industries, small island states, etc.) and provide estimates on the potential value that Canada could capture from global supply chains.	<u>EXPECTED RESULTS</u> • Canadian stakeholders have information on the size and potential applications for SMRs globally, and the value that Canada could capture in global supply chains.

INTERNATIONAL PARTNERSHIPS & MARKETS: **International enabling frameworks for SMRs**	**15**
<u>RECOMMENDATION</u> The federal government should engage with key partners and strategic multilateral initiatives to develop international enabling frameworks for SMRs: regulation, transportation, liability, and waste management.	<u>EXPECTED RESULTS</u> • Viable pathways are developed to enable international deployment of SMRs—in both newcomer and existing nuclear countries. • Canada is strategically positioned to enable access to export markets for technologies with supply chains anchored domestically.

A-2 For Interested Provincial and Territorial Governments

A-2-1 Demonstration & Deployment

DEMONSTRATION & DEPLOYMENT: **SMR demonstration projects**		**16**
RECOMMENDATION Provincial governments should collaborate with the federal government on SMR demonstration projects, which may include providing funding to cost-share one or more SMR demonstrations in Canada, leveraging investment from the federal government and the private sector.	EXPECTED RESULTS • One or more demonstration SMRs constructed and operating in Canada by 2026. • The technology-readiness of one or more SMR technologies is advanced to the pre-commercial stage. • Canada is positioned to capture research benefits and value for the domestic supply chain from the demonstration of these earlier-stage SMR technologies.	

DEMONSTRATION & DEPLOYMENT: **Risk-sharing measures for first-commercial SMRs**		**17**
RECOMMENDATION Provinces to implement measures should share risk with private investors, incentivizing first-commercial deployment of SMRs in Canada, in coordination with federal risk-sharing provisions. • Provincial risk-sharing measures could include Power Purchase Agreements, feed-in tariffs, Clean Energy Credits, or tax measures.	EXPECTED RESULTS • SMR developers see a clear path to deployment in Canada, building private sector confidence and unlocking near-term investment in SMR technologies. • First-commercial SMR deployment projects are proposed for application to, or negotiation on, measures to share risk with governments by mid-2020s.	

A-2-2 Policy, Legislation & Regulation

POLICY, LEGISLATION & REGULATION: **Nuclear energy in climate change and clean energy planning**		**18**
RECOMMENDATION Provinces and territories that are interested in SMRs should develop public policy statements to explicitly include nuclear energy in climate change and clean energy planning and policies.	EXPECTED RESULTS • Climate change and clean energy policies are aligned with, and support, the development of innovative, low-carbon nuclear energy technologies across all interested provinces and territories in Canada.	

A-2-3 Capacity, Engagement & Public Confidence

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Indigenous engagement**	**19**
RECOMMENDATION Provincial and territorial governments that are interested in SMRs should conduct meaningful, two-way engagement with Indigenous peoples and communities on the subject of SMRs, well in advance of specific SMR project proposals.	EXPECTED RESULTS • Positive relationships are built with Indigenous groups. • Governments and industry have a greater understanding of Indigenous views, concerns, and priorities related to SMRs. • Indigenous groups have capacity to engage with governments and industry on SMRs.

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Retooling supply chains for global SMR value chains**	**20**
RECOMMENDATION Provinces should support Canadian industry to acquire, maintain, and augment the skills and capabilities needed to successfully transition and capture benefits from emerging global SMR value chains.	EXPECTED RESULTS • Canada's supply chain is well-positioned to lead in the development of global value chains for SMRs.

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Grade school and high school programming**	**21**
RECOMMENDATION With jurisdiction over education and curriculum development, provinces and territories are encouraged to include energy options such as nuclear energy, in grade and high school curriculum development to promote an informed understanding of all energy options in Canada.	EXPECTED RESULTS • Increased access to evidence-based information about all of Canada's non-emitting energy options.

A-3 For the Canadian Nuclear Safety Commission (CNSC)

A-3-1 Policy, Legislation & Regulation

POLICY, LEGISLATION & REGULATION: **Nuclear security**	**22**
RECOMMENDATION The CNSC should revise the *Nuclear Security Regulations* to cover high-level principles similar to other regulations and remove prescriptive requirements. A CNSC regulatory document (REGDOC) should then be produced providing necessary details and including the concept of a graded approach.	EXPECTED RESULTS • Revised Nuclear Security Regulations only cover high-level principles similar to other regulations and prescriptive requirements are removed. • New CNSC REGDOC produced providing necessary details and including the concept of a graded approach.

POLICY, LEGISLATION & REGULATION: **Regulatory efficiency**	**23**
RECOMMENDATION The legislative, regulatory, and standards framework in Canada is sound and ready for SMRs. To increase efficiencies in SMR regulation, the CNSC should consider regulatory refinements in existing regulatory documents (REGDOCS) based on a graded approach using risk-informed criteria. A typical example of such a refinement would be: • *Revise REGDOC 2.10.1 to eliminate the 10 MW thermal lower limit for application of the full suite of requirements in REGDOC 2.10.1. The need to apply the full suite of requirements should be based on risk-informed criteria, not an arbitrary low limit on reactor thermal power.*	EXPECTED RESULTS • Additional efficiencies are unlocked to provide further flexibility and clarity in SMR licensing and regulation.

A-3-2 Capacity, Engagement, & Public Confidence

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Public, community, and Indigenous engagement in SMRs**		**24**
RECOMMENDATION The CNSC should continue public, community, and Indigenous engagement in meaningful dialogues on a range of issues, such as the licensing process and waste. CNSC to continue to deliver on its mandate of disseminating objective scientific, technical, and regulatory information to the public.	EXPECTED RESULTS • The public and Indigenous communities continue to have full information on and active engagement in Canada's regulatory framework in relation to SMRs on a range of issues—including licensing and waste.	

A-3-3 International Partnerships & Markets

INTERNATIONAL PARTNERSHIPS & MARKETS: **International collaboration**		**25**
RECOMMENDATION The CNSC should continue international collaboration, providing Canadian leadership in key multilateral fora and with national regulators to provide leadership in the development of international enabling frameworks for the global deployment of SMRs.	EXPECTED RESULTS • Canada is well-positioned to influence and lead in the development of international enabling frameworks for global deployment of SMRs.	

A-4 For Atomic Energy of Canada Limited (AECL) and Canadian Nuclear Laboratories (CNL)

A-4-1 Demonstration & Deployment

DEMONSTRATION & DEPLOYMENT: **Site preparation for SMR demonstrations**	**26**
<u>RECOMMENDATION</u> AECL and CNL should prepare sites at federally owned laboratories for SMR demonstration projects.	<u>EXPECTED RESULTS</u> • The timeline for demonstration of SMR technology in Canada is accelerated based on enabling work in the areas of research and development and environmental assessment.

DEMONSTRATION & DEPLOYMENT: **Federal Nuclear Science and Technology Work Plan**	**27**
<u>RECOMMENDATION</u> AECL should continue to consider federal priorities around SMRs when assessing projects under the Federal Nuclear Science and Technology Work Plan for the federal role on SMR development and future deployment, informed by the outcomes of the SMR Roadmap.	<u>EXPECTED RESULTS</u> • Some early-stage SMR research is maintained in order to begin to build knowledge and expertise that will be needed should Canada choose to seriously pursue the SMR opportunity.

A-4-2 International Partnerships & Markets

DEMONSTRATION & DEPLOYMENT: **Invitation for SMR demonstrations**	**28**
<u>RECOMMENDATION</u> CNL should continue its Invitation for Demonstration related to SMR demonstration projects.	<u>EXPECTED RESULTS</u> • Canada benefits from first-mover advantage by constructing an SMR demonstration plant at one of its federally owned sites.

INTERNATIONAL PARTNERSHIPS & MARKETS: **International lab-to-lab collaboration**	**29**
RECOMMENDATION AECL and CNL should advance international collaboration on SMR research and development, with appropriate international partners, guided by but not limited to the strategic framework and findings of the SMR Roadmap. • Collaboration should prioritize opportunities to anchor Intellectual Property in Canada and undertake enabling work broadly.	EXPECTED RESULTS • Canada leverages international partnerships and science and technology collaboration in support of SMR development activities that benefit Canada.

A-5 For the Nuclear Waste Management Organization (NWMO)

A-5-1 Demonstration & Deployment

DEMONSTRATION & DEPLOYMENT: **Early engagement with SMR vendors on technical specifications and costs**		**30**
RECOMMENDATION NWMO to continue should offer early engagement with SMR proponents to ensure appropriate technical specifications for a safe disposal facility and compatible waste forms for SMRs that could be deployed in Canada.	EXPECTED RESULTS • The technical specifications for a safe disposal facility for used fuel fully accommodate used fuel types from SMRs that could be deployed in Canada. • SMR vendors are clear on the requirements for any conditioning of waste for acceptance at the used fuel waste facility. • Costs and funding requirements associated with fuel waste management are minimized through early engagement.	

A-5-2 Capacity, Engagement & Public Confidence

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Public and community engagement in used fuel from SMRs**		**31**
RECOMMENDATION NWMO should continue public, community, and Indigenous engagement in Canada's approach to the safe and long-term disposal of used fuel—including used fuel from SMRs.	EXPECTED RESULTS • Stakeholders continue to have full information and active engagement in Canada's approach to used fuel disposal.	

A-6 For the Canadian Nuclear Association (CNA)

A-6-1 Policy, Legislation & Regulation

POLICY, LEGISLATION, & REGULATION: **Nuclear Energy Advisory Council**	**32**
RECOMMENDATION CNA should help co-create and support Canada's Nuclear Energy Advisory Council (NEAC) with the federal government and Team Canada partners. • Through the Council, senior executives and ministers would meet annually to review progress on Canada's SMR Action Plan and discuss strategic priorities going forward. • Meetings could be held on the margins of the CNA's annual conference or the annual Energy and Mines Ministers' Conference (EMMC).	EXPECTED RESULTS • Progress on development and commercialization of SMRs in Canada is advanced in a manner that respects shared roles, responsibilities, and jurisdictions—and leverages benefits to Canada and supports strategic partnerships. • Key decision makers have a venue for discussing progress and priorities for future action on nuclear innovation and nuclear energy matters broadly.

A-6-2 Capacity, Engagement & Public Confidence

POLICY, LEGISLATION, & REGULATION: **Public awareness and confidence**	**33**
RECOMMENDATION CNA should increase its outreach to other clean energy industry associations, ensuring appropriate representation of nuclear energy in broader clean energy dialogues.	EXPECTED RESULTS • Increased awareness of the role of nuclear energy in Canada's clean energy mix.

A-6-3 International Partnerships & Markets

INTERNATIONAL PARTNERSHIPS & MARKETS: **Promoting industry leadership on the global stage**	**34**
RECOMMENDATION CNA should continue to support industry participation in a Team Canada approach to international conferences and multilateral initiatives, with an emphasis on nuclear innovation and SMRs: • Invite Canadian SMR companies to participate in industry delegations to the IAEA General Conference and other international events. • Contribute, and encourage SMR companies to make contributions, to the Nuclear Innovation: Clean Energy Future (NICE Future) initiative under the Clean Energy Ministerial.	EXPECTED RESULTS • Canada presents a unified and coordinated approach internationally, showcasing the full breadth of the sector and leadership in nuclear innovation.

A-7 For the CANDU Owners Group (COG)

A-7-1 Demonstration & Deployment

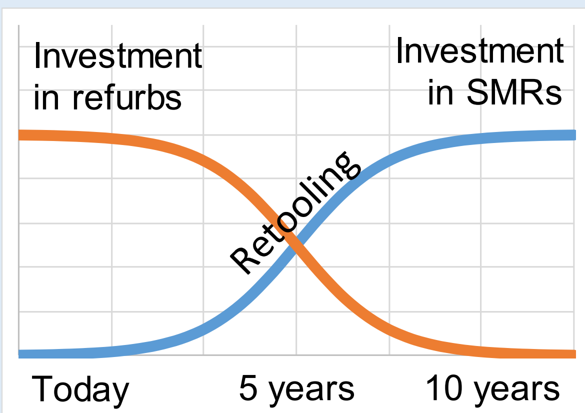
DEMONSTRATION & DEPLOYMENT **SMR Technology Forum**	**35**
RECOMMENDATION COG should continue convening the SMR Technology Forum, bringing together SMR technology vendors and SMR utilities for practical collaboration.	EXPECTED RESULTS • SMR vendors and SMR utilities have a forum to enable a broad range of collaborative activities, as needs arise.

A-7-2 Policy, Legislation & Regulation

POLICY, LEGISLATION, & REGULATION: **Radioactive Waste Leadership Forum**	**36**
RECOMMENDATION As the Secretariat of Canada's Radioactive Waste Leadership Forum, COG should take steps to include the federal government in the discussions toward an integrated radioactive waste management plan that will also consider SMR waste.	EXPECTED RESULTS • Consideration of the needs of smaller waste producers is encouraged, including from SMR proponents who may not yet be represented. • Ensure that plans continue to develop in a timely fashion and progress continues to be made toward identifying pathways for disposal of all radioactive wastes, including from SMRs.

A-8 For the Organization of Canadian Nuclear Industries (OCNI) and Canadian Nuclear Supply Chain

A-8-1 Demonstration & Deployment

DEMONSTRATION & DEPLOYMENT: **Supply chain transition strategy**		**37**
RECOMMENDATION OCNI should lead on the development of a transition strategy for retooling the already ramped-up Canadian nuclear supply chain to meet demand growth for SMRs. • Looking ahead to the successful conclusion of current refurbishment initiatives, this strategy would leverage Canada's supply chain—primed for growth from the refurbishments —and support it in pivoting to meet the needs of the growing market for SMRs. 	EXPECTED RESULTS • The Canadian nuclear supply chain, already ramped-up from the refurbishments in Ontario, is primed to pivot to a new emerging SMR subsector, leading in the development of global value chains and capturing benefits for Canada.	

A-9 For the Canadian Nuclear Industry

A-9-1 Demonstration & Deployment

DEMONSTRATION & DEPLOYMENT: **Initiatives to reduce SMR capital costs**	**38**
RECOMMENDATION Industry should develop and advance initiatives with a view to reducing SMR capital costs—for example, related to fleet economics (economies of multiples), advanced manufacturing, and 3-D printing. • Relevant actors include supply chain companies, Original Equipment Manufacturers (OEMs), Engineering Procurement and Construction companies (EPCs), utilities, owner-operators, national and commercial laboratories, and service providers.	EXPECTED RESULTS • Industry drives innovation and develops solutions to unlock efficiencies and savings that reduce the capital costs of SMR technologies, further enhancing their competitiveness and deployment potential.

A-9-2 Capacity, Engagement & Public Confidence

CAPACITY, ENGAGEMENT, AND PUBLIC CONFIDENCE: **Promoting diversity in the future SMR workforce**	**39**
RECOMMENDATION In transitioning and retooling toward the emergence of a new subsector on SMRs, industry should develop plans to ensure the SMR workforce of the future is diverse and representative—including women, youth, minorities, and Indigenous persons. • Participate in “Equal by 30” under the Clean Energy Ministerial, and other initiatives to promote a diverse and inclusive workforce.	EXPECTED RESULTS • The future SMR workforce is diverse and equitably recognizes contributions from women, youth, minorities, and Indigenous people.

A-10 For Utilities and Owner-Operators

A-10-1 Demonstration & Deployment

DEMONSTRATION AND DEPLOYMENT: **SMR demonstration projects**	**40**
RECOMMENDATION Interested utilities should engage in the demonstration of one or more SMRs in Canada to share risks; bring expertise, judgement, and credibility to project proposals and business plans; and potentially cost-share funding.	EXPECTED RESULTS • One or more demonstration SMR constructed and in operation in Canada by 2026. • The technology-readiness of one or more SMR technologies is advanced to the pre-commercial stage. • Canada is positioned to capture research benefits and value for the domestic supply chain from the demonstration of these earlier-stage SMR technologies. • Utility risk-sharing enhances commercial-readiness of the demonstration by bringing utility perspective as an eventual operator of SMR technologies.

DEMONSTRATION AND DEPLOYMENT: **Strategic partnerships and business models**	**41**
RECOMMENDATION Interested utilities should advance strategic partnerships, joint ventures, and consortia, as appropriate, to develop demonstration project proposals for different applications in Canada and on the export market. • These arrangements could bring other enablers (e.g. EPCs and the Canadian supply chain) and end users (e.g. mining customers) into the proposals, as appropriate—in addition to SMR technology vendors and developers.	EXPECTED RESULTS • Demonstration proposals have a clearer and more compelling path to commercialization, as project proposals represent the full breadth of essential enabling partners needed to bring SMRs to market. • Demonstration proposals represent more value by enabling greater sharing of operational experience and lessons learned among partners, with projects benefiting from the perspectives of multiple enabling partners.

DEMONSTRATION AND DEPLOYMENT: **Fleet deployment pathways**	**42**
RECOMMENDATION With an eye to longer-term deployment plans, interested utilities should lead on the development of a white paper setting out potential fleet deployment pathways. • This white paper would respond to what we heard through the Roadmap on the importance of a fleet-based approach for long-term deployment across domestic jurisdictions and markets to leverage benefits, such as economies of multiples and other synergies (e.g. common fuel types, training). • Paper to be presented to federal, provincial, and territorial ministers at EMMC 2019.	EXPECTED RESULTS • Key considerations for the transition to a fleet are identified. • Key enablers understand the pathways that could be undertaken to enable a fleet-based approach for SMR deployment in Canada.

A-10-2 Capacity, engagement, and public confidence

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Indigenous engagement**	**43**
RECOMMENDATION Utilities interested in SMRs should conduct meaningful, two-way engagement with Indigenous peoples and communities on the subject of SMRs, well in advance of specific SMR project proposals.	EXPECTED RESULTS • Positive relationships are built with Indigenous groups. • Governments and industry have a greater understanding of Indigenous views, concerns, and priorities related to SMRs. • Indigenous groups have capacity to engage with governments and industry on SMRs.

A-11 For Vendors and Technology Developers

A-11-1 Demonstration & Deployment

DEMONSTRATION AND DEPLOYMENT: **Engagement with the regulator**	**44**
<u>RECOMMENDATION</u> Engage with the CNSC at an early stage through pre-licensing process available: • Vendor Design Reviews (vendors) • Pre-licensing (four-step process – licensing applicants)	<u>EXPECTED RESULTS</u> • Early engagement facilitates efficient licensing procedures.

DEMONSTRATION & DEPLOYMENT: **Engagement with NWMO on fuel waste management specifications and costs**	**45**
<u>RECOMMENDATION</u> Engage with NWMO on appropriate technical specifications for a safe disposal facility and compatible waste forms for SMRs that could be deployed in Canada.	<u>EXPECTED RESULTS</u> • The technical specifications for a safe disposal facility for used fuel fully accommodate used fuel types from SMRs that could be deployed in Canada. • SMR vendors are clear on the requirements for any conditioning of waste for acceptance at the used fuel waste facility. • Costs and funding requirements associated with fuel waste management are minimized through early engagement.

DEMONSTRATION AND DEPLOYMENT: **Strategic partnerships and business models**	**46**
<u>RECOMMENDATION</u> Consider where you are planning to seek to site your project and what that means about the strategic partnerships you need to be developing. For example: • If you intend to seek to site your project on AECL-owned lands, engage with Canadian Nuclear Laboratories' Invitation for Applications process. • If you intend to seek to site your project at an already licensed site, start engaging directly with utilities.	<u>EXPECTED RESULTS</u> • Project proposals and business plans are strengthened by strategic partnerships with Canadian enablers.

DEMONSTRATION AND DEPLOYMENT: **Fleet deployment pathways**		47
RECOMMENDATION To maximize your chances of success in Canada, develop your business case with a view to benefits for Canada. Consider partnering with Canadian operators, Engineering, Procurement and Construction (EPC) firms, Original Equipment Manufacturers (OEMs), and the broader Canadian supply chain.	EXPECTED RESULTS • SMR projects leverage the vast array of Canadian expertise and competencies in the nuclear sector.	

A-12 For Universities and Colleges, Research Institutions, and Laboratories

A-12-1 Capacity, Engagement & Public Confidence

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Training programs and education curriculum**	**48**
<u>RECOMMENDATION</u> UNENE, universities, and colleges should lead in the following activities to ensure training and education programs are directed toward building the future SMR workforce: • Develop a pan-Canadian plan to re-orient technical training programs and educational curriculum with a view to SMRs. • Provide students with hands-on, practical experience through early-stage research and development programs. • Engage with universities and research organization around the globe to further international cooperation on nuclear science and technology, and attract international talent to Canada. • Bring nuclear examples to non-nuclear training programs and curriculum in areas, such as economics, accounting, marketing, policy and public administration, communications, etc.	<u>EXPECTED RESULTS</u> • The future nuclear workforce has the skills, abilities, and resources needed for industry to meet the demands of a new emerging SMR subsector in Canada. • The nuclear sector is strengthened by multidisciplinary perspectives and experience to develop new, innovative business models and solutions across technical, economic, and social issues.

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Diversity of next-generation nuclear talent**	**49**
<u>RECOMMENDATION</u> Universities, colleges, research institutions, and laboratories should promote and increase representation of women, youth, minorities, and Indigenous persons in the talent pipeline for the SMR workforce of the future.	<u>EXPECTED RESULTS</u> • Enrollment by women, minorities, and Indigenous persons in university and college programs in nuclear energy is increased. • The nuclear sector in Canada is able to draw from a diverse pool of highly skilled professionals that is fully representative of women, youth, minorities, and Indigenous persons.

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Dissemination of nuclear energy information to non-nuclear audiences**	**50**
RECOMMENDATION Universities, research institutions, laboratories, and colleges should increase dissemination of nuclear energy information to non-nuclear audiences (e.g. by engaging communications students) and showcase the diversity of people and types of work in the nuclear sector.	EXPECTED RESULTS • The public has a better understanding of the diversity and breadth of the nuclear sector, the people who work in it, and their passion, using nuclear science and technology, to improve the health, safety, and well-being of Canadians and their environment.

A-13 For End-User Industries

A-13-1 Demonstration & Deployment

DEMONSTRATION AND DEPLOYMENT: **Exploring SMRs in the Canadian Minerals and Metals Plan**		**51**
RECOMMENDATION The mining sector, in collaboration with NRCan, provinces and territories, utilities, and nuclear sector stakeholders, should explore the role for SMRs as a source of low-carbon heat and power for remote mining operations through the Canadian Minerals and Metals Plan.	EXPECTED RESULTS • The mining sector has a full understanding of the potential benefits of SMRs for the sector, potential challenges, and efforts underway to develop and demonstrate SMRs in Canada. • Efforts to develop SMR technologies are informed by the needs and end-use requirements of mining companies in design and development work. • Mining sector stakeholders and SMR proponents continue to engage in and explore potential business models and partnerships.	

DEMONSTRATION AND DEPLOYMENT: **Engagement with heavy industry**		**52**
RECOMMENDATION Heavy industry companies and organizations in oil and gas, oil sands, chemicals, and other heavy industry sectors should continue to engage in SMR development and deployment activities in Canada.	EXPECTED RESULTS • Canada's heavy industry sectors understand the potential applications and benefits for SMRs, potential challenges, and efforts underway in Canada. • The needs and end-user requirements of heavy industry are considered in the design and development of SMR technologies.	

A-14 For Civil Society

A-14-1 Capacity, Engagement & Public Confidence

CAPACITY, ENGAGEMENT & PUBLIC CONFIDENCE: **Engagement on SMRs**		**53**
RECOMMENDATION Civil society is invited to consider the Roadmap's key findings and recommendations. As industry and governments consider their options for responding to the Roadmap's recommendations, civil society and public perspectives will be sought.	EXPECTED RESULTS • Transparency, accountability, and evidence-based decision-making improves outcomes for Canadians and Canada.	

SRRP Q56 Reference: OM&A – Distribution system reliability

Please provide a schedule showing the number of positions and costs related to additional staff to support the distribution system reliability initiative included in total OM&A for each of the last three actual years and forecasts for 2021/22 through 2023/24.

Response:

The following table provides an overview of the additional resources that were added in 2021-22 to address the increased workload regarding distribution system reliability improvements. As these are net new positions, no costs were incurred prior to 2021-22.

OM&A - Distribution System Reliability

	Forecast **2021-22**	Business Plan **2022-23**	Business Plan **2023-24**
Total permananent FTE addidtions	16.0	16.0	16.0
Total temporary FTE additions	4.0	4.0	4.0
Total FTE additions	20.0	20.0	20.0

($ millions)	Forecast **2021-22**	Business Plan **2022-23**	Business Plan **2023-24**
Griosss Impact to OM&A	$ 1.2	$ 3.1	$ 3.2
Capital Credits	(0.6)	(1.5)	(1.6)
Total FTE additions	$ 0.6	$ 1.6	$ 1.6

Notes:

2021-22 - the new FTE hires were completed primarily in the second half of the year.

2023-24 - the temporary positions are expected to expire in 2023-24. Due to timing uncertainty the table relfects them being employed for the full year.

SRRP Q57 Reference: OM&A – Vegetation management

Please provide a schedule showing the costs related to vegetation management included in total OM&A for each of the last three actual years and forecasts for 2021/22 through 2023/24.

Response:

Vegetation Management

($ millions)	Actual **2018-19**	Actual **2019-20**	Actual **2020-21**	Forecast **2021-22**	Business Plan **2022-23**	Business Plan **2023-24**
Vegetation Management	12.1	11.2	18.0	21.7	27.2	32.2

SRRP Q58 Reference: OM&A – Inflation

a) Please provide the inflation rate assumed in preparing the OM&A forecasts for each of 2021/22 through 2023/24 and comment on whether or not SaskPower continues to believe that the inflation rate forecasts are reasonable.
b) Please provide an estimate of the increase on OM&A forecasts for 2022/23 and 2023/24 if inflation assumptions were increased to 3% each year.

Response:

a) SaskPower assumed an inflation rate of 2% when preparing the OM&A forecasts in the rate application. Recent global events are causing significant volatility to various input costs which will result in certain expenses increasing at a rate much higher than 2%.

   SaskPower continues to monitor these impacts and will incorporate any additional cost pressures into the mid-application update.

b) The following table shows the incremental impact of a 1% increase to inflation assumptions:

OM&A Inflationary Increase

($ millions)	Business Plan **2022-23**	Business Plan **2023-24**
1% Increase to Inflation	$ 6.6	$ 6.7

SRRP Q59 Reference: Information Technology

a) To assist the Panel in understanding changes in IT costs please provide, for each of the last three actuals years plus forecasts for 2021/22 through 2023/24, SaskPower's total IT related costs broken out into:
   i. Operations and maintenance expenses
   ii. Finance expenses
   iii. Depreciation expenses
   iv. Return on equity
   v. Other

b) Please describe SaskPower's approach to IT security, including how SaskPower develops and monitors its IT security policies and procedures and any recent updates to those policies and procedures.

Response:

a)

Technology and Security

(in millions)	Actual 2018-19	Actual 2019-20	Actual 2020-21	Forecast 2021-22	Business Plan 2022-23	Business Plan 2023-24
i. Operations and maintenance expense:	$ 87	$ 84	$ 94	$ 98	$ 104	$ 110
ii. Finance Expenses*	$ 13	$ 13	$ 13	$ 12	$ 11	$ 11
iii. Depreciation Computer Development & Equipment	$ 38	$ 40	$ 41	$ 40	$ 39	$ 33
iv. Return on Equity	N/A	N/A	N/A	N/A	N/A	N/A
v. Other	$ -	$ -	$ -	$ -	$ -	$ -

* Finance Expenses have been calculated based on % of Assets Aquisition Value

b) **Approach to IT Security**

SaskPower has a separate and distinct security department – Enterprise Security (ES) – responsible for Physical and Cyber security at SaskPower, and that reports up through the CIO and VP, Technology & Security. IT Security Policies and Standards are the responsibility of this group. SaskPower ES follows the National Institute of Standards and Technology (NIST) Cybersecurity framework, which is the predominant framework for Utilities.

Operationally, the ES department is finalizing an update to the SaskPower Security Policy Set for a planned approval request to the Board of Directors in 2022. This update builds on the policy work done by ES in 2019-20 with an external consulting organization. At that time ES brought in an outside expert team to assist SaskPower with improving its Security Standards and Policy to accommodate *enhancing* policy items related to technologies such as cloud computing, security testing of applications (penetration, structural, vulnerability), encryption, and modern information security and backup. The vendor was chosen for this work primarily due to their experience with doing similar work for other North American utilities.

SaskPower also uses external evaluators to regularly verify its security stance. Each of these assessments (or audits) considers standards, policy, and procedures in addition to personnel capabilities, technical fidelity, and improvements against previous assessments. SaskPower has had multiple recent assessments concerning security, including:

- 2020 - PricewaterhouseCoopers (PwC) Cyber Maturity Assessment
- 2021 - Midwest Reliability Organization (MRO) North American Electric Reliability Corporation (NERC) Critical Infrastructure Protection (CIP) Regulatory Audit
- 2021 - Crown Investment Corporation (CIC) sponsored Iron Spear Cyber Maturity Assessment of Crowns
- 2022 – SaskPower Internal Audit – Penetration Test (Internal/External)

These assessments are augmented by Project Lessons Learned and Incident Debrief sessions that collect what went well or not well in an IT project or incident; from a thwarted cyber attack to a data loss prevention (DLP) event, to a device misconfiguration. Each assessment is evaluated for change recommendations and each Audit provides recommendations for Management to develop action plans. Those action plans are then tracked and reported on by the SaskPower Internal Audit department to the Executive and Board of Directors.

Finally, Internal Audit facilitates an annual risk assessment process with Management which considers security risks and identifies processes and controls to mitigate.

SRRP Q60 Reference: Other Expenses

Please provide a break-out of SaskPower's Other expense category including Asset Disposals, Asset Retirements, Foreign exchange (if any), and Environmental Expenses for each of the five most recent actual years and forecasts for 2021/22 through 2023/24.

Response:

The following table provides a breakdown of actual other expenses for 2016-17 through 2020-21 and the forecasted amounts for 2021-22 through 2023-24:

Other expenses

(in millions)	Actual **2016-17**	Actual **2017-18**	Actual **2018-19**	Actual **2019-20**
Loss on asset retirements	$ 26	$ 49	$ 16	$ 20
Cost of asset disposals	6	5	8	11
Inventory variance adjustments	1	2	3	7
Environmental provisions	1	11	36	2
Other environmental costs	4	1	4	4
Settlement claims	-	-	-	-
Foreign exchange net losses	-	-	-	1
Gain on sale of equity accounted investments	-	-	-	(1)
	$ 38	$ 68	$ 67	$ 44

(in millions)	Actual **2020-21**	Forecast **2021-22**	Business Plan **2022-23**	Business Plan **2023-24**
Loss on asset retirements	$ 23	$ 23	$ 20	$ 24
Cost of asset disposals	9	9	1	9
Inventory variance adjustments	3	4	4	4
Environmental provisions	-	-	-	-
Other environmental costs	6	8	9	6
Settlement claims[1]	(37)	-	-	-
Foreign exchange net losses	-	-	-	-
Gain on sale of equity accounted investments	-	-	-	-
	$ 4	$ 44	$ 34	$ 43

1. During 2020-21, the Corporation received a favourable ruling from an arbitral panel in relation to a contractual dispute comprised of a $56 million cash award as well as $14 million in forgiven payables. The portion of the award allocated to property, plant and equipment was $32 million. The remaining $38 million awarded was received in the settlement claims amount shown above offsetting other claims.

SRRP Q61 Reference: Debt and Equity

a) Please confirm the current borrowing limit for SaskPower pursuant to the Power Corporation Act.
b) Please provide SaskPower's actual unused credit capacity at the most recent actual year and forecasts for 2021/22 through 2023/24.

Response:

a) Pursuant to the Power Corporation Act, SaskPower's total borrowing limit is $10 billion.
b) The table below shows the unused borrowing capacity for SaskPower:

(billions)	**2020/21**	**2021/22**	**2022/23**	**2023/24**
Total Borrowing Authority	$10.0	$10.0	$10.0	$10.0
Total Borrowings	$7.0	$7.2	$7.6	$7.9
Unused Borrowing Capacity	**$3.0**	**$2.8**	**$2.4**	**$2.1**

SRRP Q62 Reference: Debt and Equity

a) With reference to the response to Pre-Ask 11 please explain the nature of the equity advances shown in the tables.
b) Please discuss why the equity advances vary between actuals and forecasts.
c) Please confirm if SaskPower repaid a portion of the equity advances during this period and if so, please discuss the reasons for the repayment.

Response:

a) SaskPower does not have share capital. However, the Corporation has received advances from its parent, Crown Investments Corporation of Saskatchewan (CIC) to form its equity capitalization. The advances reflect an equity investment in the Corporation by CIC.

b) The variance between actual and forecasted equity advances is attributable to a $34 million repayment made in 2018-19 and a $33 million repayment made in 2019-20 that were not included in the 2018 rate application. These repayments were made at the direction of CIC.

c) SaskPower made a $34 million equity advances repayment in 2018-19 and a $33 million repayment in 2019-20. The equity advances represent CIC's ownership interest in SaskPower and are payable to CIC at their discretion.

SRRP Q63 Reference: Business Optimization

Please discuss if SaskPower has continued the Business Optimization program described in the 2018 rate application proceeding. If so, please provide an update on the program, if not, please discuss what programs or initiatives have replaced the Business Optimization program.

Response:

SaskPower's Business Optimization efforts concluded in 2018, and our company continues to benefit from the ongoing annual cost reductions achieved under this initiative.

Since this time, our company has shifted its focus to the following efforts:

Continuous improvement: evolving our employees' capabilities to make quality and continuous improvement part of their everyday work.

- Continuous improvement was added as a core competency for all staff.
- SaskPower has placed a priority on building on its continuous improvement, efficiency and quality mindset by developing continuous improvement practices and mindsets across all employee groups.
- SaskPower delivers a corporate Continuous Improvement training and support program. Teams across SaskPower learn to apply continuous improvement principles and practices to eliminate everyday waste and use a structured approach to make improvements. Training and coaching support from experienced practitioners is also provided to SaskPower teams to apply a structured problem-solving method to improve outcomes of larger processes and enhance customer experience.

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2022 AND 2023 RATE APPLICATION
SRRP INTERROGATORIES

Workforce efficiency planning:

- Review of vacated out-of-scope positions to identify opportunities where work can be reallocated amongst existing filled positions rather by filling the vacated position.
- SaskPower's long-term strategic workforce plan will focus on succession planning, skillset gap analysis, retention strategies, targeted recruitment for in-demand occupations and continuous improvement training. SaskPower also continues to partner with educational institutions and support apprenticeship programs.

Crown collaboration:

- Crown collaboration was added as a measure to SaskPower's Corporate Balanced Scorecard in 2021-22.
- Crown collaboration tracks combined cost savings for Crown corporations and participating Treasury Board Crowns, agencies and ministries achieved through joint initiatives and collaboration efforts, including:
  - Joint infrastructure installation
  - Line locating
  - Corporate Project Management Office – shared collaboration
  - Procurement – shared collaboration

SRRP Q64 Reference: Productivity and Efficiency

a) Please discuss how SaskPower budgets for and tracks productivity and efficiency improvements in its operating budgets.
b) Please provide any quantifiable information SaskPower maintains on tracking the long-term savings of productivity and efficiency programs.

Response:

a) Workforce efficiency planning is a key component in the development of SaskPower's operating budgets. In the 2022-23 Rate Application, SaskPower has budgeted for corporate workforce savings of approximately $4 million over the next two years, in addition to $29 million in other OM&A reductions.

OM &A savings

(in millions)		Business Plan **2022-23**		Business Plan **2023-24**
Corporate Workforce Savings	$	(1)	$	(3)
Contingency		(18)		(11)
Total OM&A savings	$	(19)	$	(14)

b) From 2015 through 2020-21, SaskPower has reduced its OM&A costs from budget by a total of $353 million and is projected to reach cumulative savings of $776 million by the end of 2023-24. These efficiency efforts contributed to four consecutive years without implementation of a rate increase (2018-19 through 2021-22).

OM&A savings

(in millions)	Actual **2015**	Actual **2016**	Actual **2016-17**	Actual **2017-18**	Actual **2018-19**	Actual **2019-20**	Actual **2020-21**	Forecast **2021-22**	Business Plan **2022-23**	Business Plan **2023-24**
Board-approved Business Plan	$ 672	$ 167	$ 702	$ 721	$ 748	$ 783	$ 821	$ 851	$ 882	$ 905
Actual/Forecast	634	159	675	680	708	705	700	710	740	765
OM&A budget reduction	$ 38	$ 8	$ 27	$ 41	$ 40	$ 78	$ 121	$ 141	$ 142	$ 140
Cumulative	$ 38	$ 46	$ 73	$ 114	$ 154	$ 232	$ 353	$ 494	$ 636	$ 776

SRRP Q65 Reference: Safety

a) Please provide the five most recent years of actual lost-time injury frequency rates, lost-time injury severity rates, and recordable injury frequency rates for SaskPower and peer CEA utilities.
b) Please provide an overview of how SaskPower's workplace safety programs and how SaskPower responds to changes in safety rates.

Response:

a)

Safety

	Actual 2016	Actual 2017	Actual 2018	Actual 2019	Actual 2020
Lost-time Injury Frequency Rate					
SaskPower	0.78	0.25	0.59	0.46	0.50
CEA Group 1* composite average	0.71	0.49	0.72	0.67	0.55
Lost-time Injury Severity Rate					
SaskPower	13.38	4.41	10.61	11.43	19.19
CEA Group 1* composite average	18.06	12.95	18.28	15.42	14.89
Recordable Injury Frequency Rate					
SaskPower	1.80	1.45	0.63	2.80	2.73
CEA Group 1* composite average	1.82	2.10	1.92	1.75	2.69

*CEA's Group 1 category is comprised of utilities that have more than 1,500 employees.

b) Our company places significant emphasis on the safety of its employees, contractors and the public. SaskPower's Safety Management System (SMS) is our overarching safety program and is aligned with ISO 45001. SMS includes the following tools and initiatives to assess, monitor and promote various aspects of safety within our operations:

- **Safety Absolutes & Constants:** Our corporate and divisional core safety requirements are part of conversations throughout business areas – Safety Absolutes only apply to employees in Safety Sensitive Positions while the remainder of employees adhere to Safety Constants.

- **Hazard/Aspect & Risk Assessment (HARA):** HARAs are used to proactively identify safety hazards and environmental aspects; evaluate risks; and apply multiple controls to eliminate or reduce the risk to within defined risk tolerance levels.

- **Good Catch Program:** This program focusses on the reporting of unsafe acts, unsafe conditions and near misses to proactively identify and address situations to prevent more severe incidents/injuries from occurring.
- **Learning**: Safety eLearning modules are included in every employee's annual required learning. In addition, SaskPower's Supervisor Essentials and Manager Essentials Programs include a section dedicated entirely to Safety.
- **Employee Goal Plans**: All Executive and out-of-scope employees are required to include a safety goal that supports the achievement of SaskPower's corporate safety goal – to improve employee, contractor, and public safety – in their annual Goal Plan.
- **Safety Moments:** SaskPower employees conduct Safety Moments, which are brief and concise chats about a specific safety topic or issue, prior to every meeting of five or more people.
- **Safety Days:** This annual event, held in both Saskatoon and Regina, provides an opportunity for Transmission and Distribution employees to renew their skills through training as well as to obtain other safety information that is relevant to their daily work.
- **ESMIS (Environment & Safety Management Information System):** ESMIS is SaskPower's comprehensive application for the reporting, investigation and tracking of safety incidents. It also provides employees with access to Safety Job Aids, Standard Operating Procedures, and SaskPower's SafetyNet portal for safety news and links.
- **ISNetWorld (ISN):** SaskPower uses this online contractor management database to communicate clear criteria on how contractor safety performance is evaluated and to meet record-keeping requirements related to health and safety.
- **Public Safety Campaign:** Public safety is one of the high priority safety objectives for SaskPower. On-going initiatives include power safety presentations, development of a high voltage display to be utilized for power safety presentations and consultations with farming groups regarding contacts with power infrastructure.

SaskPower uses its safety performance results to inform the development of new safety initiatives as well as changes to ongoing safety initiatives, such as the development of a Roadmap to Safety, which we immediately initiated in response to the tragedy in October 2020 when two of our powerline technicians lost their lives. This work builds on past process and procedure work completed as part of our earlier Safety Improvement Plan but emphasizes development of a more robust safety culture and addressing attitudes and approaches to our work. The roadmap focusses on five key improvement themes: visible leadership; proactive safety; human factors; technology; and measures and performance.

SRRP Q66 Reference: Capital Program

a) Please describe any changes to SaskPower's capital planning process since the time of the last rate application in particular with respect to:
   i. how project scopes and budgets are developed;
   ii. the approval process for SaskPower's capital plan;
   iii. how SaskPower paces and prioritizes its capital plans (for example, does SaskPower develop a high-level capital spending envelope and then prioritize projects within that envelope); and
   iv. how SaskPower manages and monitors the delivery of its capital projects including project reporting, variance analysis, and quality assurance in the delivery of each capital project.

Response:

i. Project scopes are defined by the Asset Management Teams to align the work with the priorities identified by our organization. Metrics related to reliability, age of infrastructure, risk to the system, customer needs, and cost to the business are all assessed to ensure the work that is defined meets the business needs of SaskPower and aligns with the strategic plan for our system.

Budgets for projects are managed through the Corporate Estimating Office by leveraging historical data, industry information, market analysis, and other key factors to assign an estimated value for the work.

ii. Each capital project is required to move through the Capital Project Authorization (CPA) process. This process standardizes the way information is collected, presented, and assessed to be considered as part of the capital portfolio plan. Built in workflow's match our governance model to ensure that the work is assessed at the appropriate level and that it aligns with the expectations of our organizations strategic plan.

The overall capital plan is projected over a 10 year forward looking period and is constantly reviewed and revised as priorities change with SaskPower. The 10-year plan used as the governing document for measuring the results of the efforts to manage and deliver over both a fiscal and multi-year period.

iii. SaskPower uses the 10 Year plan to define both the short- and long-term targets for capital spending. Projects and programs are prioritized and assessed on an ongoing basis to ensure that the portfolio being delivered is reflective of the business needs of our organization. The 10-year plan is updated as priorities change to reflect the most current plan for capital work.

The spending envelope for the capital plan is a living target and assessed each year based on business needs. From there the right projects are planned for the period and outliers are scheduled appropriately to maintain the integrity of the priority of the work.

iv. Projects utilize standardized reporting tools for documenting communicating project status. Visual metrics and near-real-time dashboards leverage project, program, and portfolio data to ensure it is available for business decisions.

Earned value metrics are utilized on most projects and are mandatory on any project with a capital expenditure in excess of $5M. There metrics and the thresholds assigned to them represent the current and projected future state of the project. This data is used to manage mitigative actions in projects that are forecasted to fall outside the acceptable tolerance levels of performance.

Quality management is mandatory on all projects and includes both the quality of the asset and the quality of the project delivery process. Each of these items defines the metrics necessary to meet the quality requirements of the project and is used to monitor and control the quality requirements throughout the lifecycle of the project.

SRRP Q67 Reference: Capital Program

Please expand the capital spending table provided on page 29 of the application to include the most recent five years of actual spending.

Response:

Capital spending

(in millions)	Actual **2016-17**	Actual **2017-18**	Actual **2018-19**	Actual **2019-20**	Actual **2020-21**	Forecast **2021-22**	Business Plan **2022-23**	Business Plan **2023-24**
Capital sustainment investment								
Generation	$ 166	$ 146	$ 124	$ 136	$ 125	$ 116	$ 97	$ 127
Transmission	89	110	64	60	42	104	103	98
Distribution	76	70	99	100	99	143	127	129
Other	84	54	55	78	100	95	92	71
Total sustainment investment	415	380	342	374	366	458	419	425
Growth & compliance investment								
Generation	179	325	83	25	100	299	234	177
Transmission	119	74	159	60	35	40	61	81
Distribution	21	26	27	12	14	15	15	15
Customer Connects	130	153	174	156	137	149	177	133
Total growth & compliance investment	449	578	443	253	286	503	487	406
Total strategic & other investments	22	38	48	69	41	56	147	75
Contingencay						(39)		
Power Grid Renewal Grant						(40)		
Total capital spending	$ 886	$ 996	$ 833	$ 696	$ 693	$ 938	$ 1,053	$ 906

SRRP Q68 Reference: Capital Program

With respect to the E.B. Campbell hydroelectric station life expansion please discuss:

i. How long the project is anticipated to extend the life of the facility?
ii. Whether the project will result in any improved generation efficiency at the facility.

Response:

The E.B. Campbell refurbishment currently underway is expected to extend the life of the facility by 50-60 years. The refurbishment project is expected to result in a 3.8% increase in efficiency over the original units (i.e. 3.8% more power can be generated from the same amount of water).

SRRP Q69 Reference: Capital Program

With reference to the rural rebuild and improvement program, please discuss how SaskPower identifies and prioritizes the lines to be replaced.

Response:

SaskPower identifies and prioritizes Rural Rebuild and improvement projects using the following process:

1. Wood pole inspections are executed within planned geographical territories on a ten-year cycle.
2. Wood pole condition data is geo-spatially plotted and a visual survey is conducted to identify and shortlist poor condition lines.
3. Shortlisted projects are analyzed and prioritized using the following weighted project scoring criterion:
    a. % of poles requiring maintenance (replace or stub)
    b. % of 10.7m (30FT) poles
    c. % of butt treat poles
    d. Connected kVA of load
    e. Quantity of customers / service points
    f. Reliability performance of circuit #1 – 5yr total trips
    g. Reliability performance of circuit #2 – 5yr customer hour durations
    h. Conductor type & operational efficiency gains
    i. Distribution operations input (access challenges, vegetation maintenance challenges, clearance concerns etc)
4. Projects are integrated into the 5-year plan based on asset risk classification and project rank score.

SRRP Q70 Reference: Capital Program

With reference to the $50 million provincial stimulus grant to enhance system reliability and build distribution capacity please discuss how the grant funding is allocated to different capital projects and in what years.

Response:

The Government of Saskatchewan approved a $50 million stimulus grant to SaskPower to protect system reliability and build distribution capacity. A significant portion of SaskPower's overhead and underground infrastructure moves towards a state where it requires renewal or replacement to continue providing reliable service to our customers.

The entire $50M stimulus grant has been allocated in 2021-22 towards communities most impacted by outages and system reliability over the last 5 years.

Work included upgrades to protection and equipment to improve reliability, wood pole replacement, and upgrading lines while moving them from fields to road allowances. The work will take place across the province in many different communities and rural areas, however, of note are the following regions, which over the past five years have been most significantly impacted by the frequency and duration of outages.

- Lumsden/Odessa area
- North Battleford rural area
- Meadow Lake/Buffalo Narrows Area
- Melville/Yorkton Area
- Prince Albert Rural Area
- Regina area
- Rosetown/Elrose/Beechy/Kyle Area

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2022 AND 2023 RATE APPLICATION
SRRP INTERROGATORIES

Work Complete throughout Fiscal Year 2021-2022 with the $50M Grant

Rural Rebuild & Improvement - Strategic Replacement of Aging Infrastructure	$16,000,000
Reliability Improvements - System Performance Focused Improvements	$2,800,000
Wood Pole Replacement - Proactive Update of Wood Pole Distribution System	$3,400,000
Cross-Arm Replacement - Proactive Update of Cross-Arms with Limited Remaining Life	$3,000,000
Farmyard Relocation - Burial of Conductors in Farmyards and Adjacent Work Areas	$1,500,000
Rural Economic Rebuild - Adding to Existing Facilities to Increase Capacity/Efficiency	$2,000,000
Apparatus Replacement (2-49ppm) - Replace Apparatus Beyond Expected Service	$3,300,000
Yorkton Area 138 kV Line/Station Updates - Improve System Reliability	$3,500,000
Weyburn/Assiniboia 72 kV Line Updates - Improve System Reliability	$3,500,000
Esterhazy/Tantallon 72 kV Line/Station Updates - Improve System Reliability	$1,000,000
Reliability and System Performance Improvements - Operations & Maintenance	$10,000,000
Total Investment	$50,000,000

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2022 AND 2023 RATE APPLICATION
SRRP INTERROGATORIES

SRRP Q71 Reference: Capital Program

With respect to the Great Plains power station, please discuss the specific features of the project that support the integration of renewable generation.

Response:

The addition of the Great Plains Power Station to the grid supports the integration of renewable generation in the following ways:

1. It provides firm capacity, stability and flexibility to the grid
2. High ramp rate provides better load following capability (Normal ramp rate is 13.4 MW/min, Fast ramp rate of 52MW/min)
3. Faster start-up time supports variable renewable integration (start-up time of GT ranges between 10 mins (fast) to 30 mins (normal))
4. Low turn-down ratio (ranges between 28% to 36% of the rated capacity, depending on the ambient temperature) provides large capacity range for unit operation

SRRP Q72 Reference: Capital Program

With respect to the smart meter deployment, will the smart meters enable SaskPower to implement demand billing options or rate structures for smaller customers? If not, please discuss what additional projects would be required to implement demand billing options for smaller customers and any timelines for such projects to be completed.

Response: Yes, smart meters will allow for demand billing options for other customer rate classes. Considerations regarding policy, rate design and system configurations would need to be made in order to provide those billing options.

SRRP Q73 Reference: Capital Program

Please discuss if SaskPower has any plans for new or expanded transmission interconnections with other jurisdictions in the next ten years.

Response:

Expanded Interconnections is a strategic priority for SaskPower to manage the imminent energy transition that will significantly impact the generation resources and load serving requirements for the province. SaskPower is exploring the expansion of its transmission interconnections with neighbouring systems to maintain operating flexibility, enhance resiliency and optimize resource development plans.

SRRP Q74 Reference: Capital Program

a) Please provide an update on SaskPower's logistics warehouse project, including forecast budget and timelines.
b) Please discuss if SaskPower anticipates any OM&A savings once the project is completed and in-service.

Response:

a) As part of a long-term strategy to bring Regina area employees together in fewer locations, SaskPower's Logistics Warehouse Complex (LWC) at the Global Transportation Hub is fully approved to proceed. A standard procurement competition was conducted in summer 2021 for a general construction contractor and the LWC Phase 1 contract was awarded to WESTRIDGEWRIGHT, A SASKATCHEWAN JOINT VENTURE. The construction will be in two phases. The initial phase ("Phase 1") of construction began in December 2021 and is expected to be complete in early 2024. The first phase of construction will cost about $100 million and is budgeted under our current approved capital program. The full cost of the complex is included in our capital budget. The final phase ("Phase 2") must still be fully designed and a construction contractor procured. Phase 2 construction is anticipated to start in 2024 with completion targeted in 2026.

b) The LWC project will replace current buildings that are nearing the end of their useful lives. If SaskPower continued to operate our current facilities, a large investment would be required to renovate and modernize these existing buildings. There are no direct OM&A facility savings anticipated with the new LWC complex however SaskPower will avoid investing funds on aging infrastructure.

SRRP Q75 Reference: Customer connects

a) Please provide SaskPower's customer connect spending by customer class for each of the last three actual years and forecasts for 2021/22 through 2023/24.
b) Please describe any updates or changes to SaskPower's customer connect policies since the time of the 2018 rate application.

Response:

a)

Customer connect spending by customer class

(in $ millions)	Actual **2018-19**	Actual **2019-20**	Actual **2020-21**	Forecast **2021-22**	Forecast **2022-23**	Forecast **2023-24**
Residential	$ 36	$ 29	$ 25	$ 30	$ 28	$ 27
Farm	25	23	29	27	27	27
Commercial	39	37	31	33	33	32
Oilfield	27	29	12	25	25	25
Total Distribution	127	118	97	115	113	111
Total Transmission	47	38	40	34	64	22
Total customer connect spending	$ 174	$ 156	$ 137	$ 149	$ 177	$ 133

b)

SaskPower's Distribution System Improvement Directive 97-05 was updated on December 1, 2020. System Improvement can be described as the required system reinforcement that may occur when a customer requests a new service or capacity increase. Prior to the policy change SaskPower absorbed all system improvement costs. The updated policy allows for a portion of required system improvement costs to be allocated to customers with individual load requests of 500kVA or more, or to customer sites with a cumulative load of 2000kVA or more. This change was made to improve the cost allocation for Distribution New Connect.

SRRP Q76 Reference: Load Forecasts

Please confirm that the application is based on the 2022 Q1 Load Forecast. If not confirmed, please provide the load forecast documents that the application is based on as well as any differences in assumptions, methods, or explanatory variables used.

Response:

SaskPower confirms that the submitted application is based on the 2022 (Fiscal) Q1 Load Forecast.

SRRP Q77 Reference: Load Forecasts

a) Please discuss any changes to assumptions, methodology, or explanatory variables used for the load forecasts and customer count forecasts for each major customer class since the previous rate application, including any changes affecting input data.
b) Please discuss any alternative assumptions, methods, and explanatory variables that were tested by SaskPower for the load forecasts or customer count forecasts and why these were not chosen for the final forecasts.
c) Please discuss what data was used to fit or train each SaskPower load forecast and customer count model and how accurate the models have been shown to fit testing data during validation.
d) Please provide the number of years worth of data that is used for the published SaskPower load forecasts and customer count forecasts.
e) Please discuss how SaskPower has considered the potential for electrification of vehicles or heating loads in developing its load forecasts and provide a table or figure illustrating SaskPower's current forecast of the impact of electrification of vehicle and heating loads on sales and demand peaks.

Response:

a) In 2018, SaskPower engaged the services of ICF Consulting to conduct a load forecast methodology review. This resulted in the adoption of the following recommendations to improve on the quality and accuracy of the forecast:
   1. Demand Side Management (DSM) data aligned with the end-use forecast:
      i. This involved identifying areas of overlap between the two forecasts and eliminating any duplicate provisions if any existed. The review revealed that there were no duplicates between the two data sets.
   2. Ensure consistency in End Use forecast:
      i. This was completed by using identical end use variables in the Farm and Residential forecasts as many end uses are similar. Calculations in the end use model were also standardized based on historical weather normalized use per customer calculations.
   3. Include feedback from expert consultant reports in the mass market forecast:
      i. An example of implementing this recommendation is using the Dunsky EV forecast for the vehicle forecast and subsequent energy.
   4. Include the price elasticity of electricity as a variable in its load forecasts:
      i. This recommendation was integrated into the mass market forecast.
   5. Include additional economic indicators beyond what has been provided by the government and SaskPower's software vendor:
      i. Some examples of this include multiple economic analysis around EVs such as Bloomberg battery price forecasts, and price parity with ICE vehicle forecasts from UBS Bank.

6. Develop relationships with counterparts from other utilities:
    i. This has helped to inform best practice on the load forecast. There were multiple conference calls in 2020 and 2021 where representatives from forecasting departments across Canada met to discuss various challenges and methodologies around topics such as Covid-19, EV forecasting, and PV forecasting.
7. Include the EV forecast methodology in the load forecast report:
    i. This section was built in the report and has since been improved on every year. Contact with other utilities on their EV Forecasting models has resulted in a deeper awareness of various methodologies across Canadian utilities.
8. Establish behind-the-meter solar accounting process with the DSM team:
    i. As model complexity increased, SaskPower increased collaboration between work groups to verify data and build various models.

Further internal methodology changes Include:

9. Scenario analysis mechanisms:
    i. SaskPower has begun to analyze what-if scenarios for new end uses with the potential to add or subtract load. Scenarios analyzed include greater or lesser uptake for PVs, EVs, and electric heat. SaskPower also performs sensitivity analyses on economic factors including increased or decreased oil production, 1% change in population expectation, 1% change in income, 1% change in the price of electricity as well as a 1° Celsius change in weather.
10. Enhanced EV forecasting:
    i. The EV forecast now includes the make, model, and year of all existing PHEVs and BEVs. Electrical efficiency obtained for each unique vehicle is used to model historic energy use as shown in the NR Can Fuel Efficiency Guide, providing insight into the growth of different segments of EVs in the province by manufacturer and vehicle type.
    ii. SaskPower obtains average distance travelled by a typical Saskatchewan resident from a Transport Canada survey which is used to model daily kilometres. This data, when coupled with the efficiency data provides SaskPower with the average daily KWhs for that model, make, and year of vehicle.
    iii. A vehicle quantity forecast is produced in two parts. First the historical vehicles are increased into the future by the manufacturer growth rate. This is used to index expected vehicles with the growth rate assumed in the Dunsky report. This vehicle quantity forecast is then multiplied by the KWh/day rating to provide an energy forecast.
11. Battery Storage & Backup:
    i. It is expected that battery backup will become more prevalent as battery costs decrease in price. Residential net metering customers will be the first to obtain these units as they seek to use their power production internally rather

than sell it to SaskPower at a reduced rate. SaskPower expects to see a reduction in energy provided in the future to these customers as they can store energy to be used later.

b) Alternative Assumptions Tested:

1. SaskPower was previously using a centered moving average to smooth weather data for use in the mass market models. This did not give the resolution needed to be able to use the elasticities that would influence electrical consumption. This was revised to use unsmoothed economic data to include more elasticities in the forecast.
2. A change was made in the residential forecast to use non-farm households as an economic driver, rather than population. Non-farm households produced both good model statistics as well as a reasonable customer forecast while population was not a good fit in terms of model stats or reasonability.
3. The residential UPC model was changed from using stock lighting data from iTron to an adjusted lighting data that matches weather normalized UPC historically. Historical lighting trends in Saskatchewan have been different than what is seen in the west-north-central region of America. Adoption of new lighting such as CFLs and LEDs have historically lagged in America in general.
4. The population forecast is no longer used to forecast commercial customers – rather the internal residential customer forecast is used. The commercial customer forecast growth was too aggressive using the population variable while the residential customer forecast produced more reasonable results.
5. Streetlight energy use was changed from using the number of residential households to the number of residential customers as an input.
6. Streetlight customers are now modeled using the commercial customer forecast rather than household counts. Commercial customer expectations produce an appropriate growth rate.

c) Model Validation:

1. SaskPower uses MetrixND and MetrixLT from iTron to create mass market forecast models. The software allows a forecaster to rapidly create models and test them against the historic data. Model stats are easily accessible and calculated automatically by the software. Adding or removing variables from the models is very straightforward, allowing the ability to test and compare various iterations of a given model. The data that is used for testing the models is historic billed data and customer counts for each mass market class. Some of the model stats that are analyzed for each typically include:

   - R-Squared
   - Adjusted R-Squared
   - AIC
   - BIC

- Mean Squared Error
- Standard Error of Regression
- MAD
- MAPE
- Durbin Watson

d) Input and Output Data Parameters:

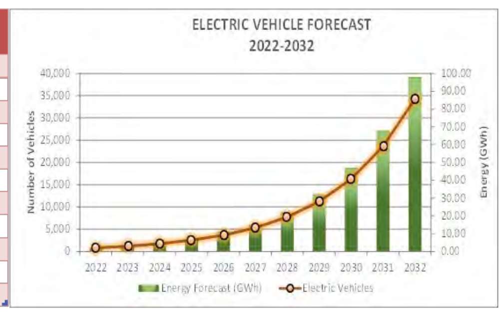
The number of years of historic data that are used to create mass market models are up to 25 years. The forecast estimates up to 30 years in the future for energy and customers.

e) EV and Heating Potential:

SaskPower explicitly includes an estimate for electric vehicles in the energy sales forecast. Including this sector was recommended by ICF as part of their review of the existing methodology in 2018. Electric heating has been included in the forecast for years, but the growth has typically been assumed to be very low. Future iterations of the forecast will include the potential for electric heat penetration to increase significantly.

The 2022F Q1 forecast included the following assumptions for electric vehicles:

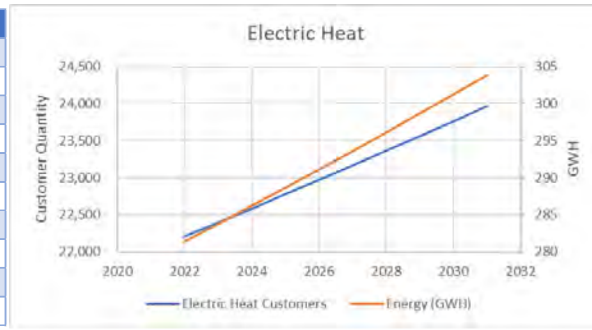
Fiscal Year	Electric Vehicles	Energy Forecast (GWh)
2022	834	2.00
2023	1,209	3.00
2024	1,753	5.00
2025	2,542	7.00
2026	3,687	11.00
2027	5,346	15.00
2028	7,751	22.00
2029	11,240	32.00
2030	16,297	47.00
2031	23,631	68.00
2032	34,264	98.00



As of Dec. 31, 2020, there were 517 plug-in vehicles, or 0.06% of all registered motor vehicles in Saskatchewan.

Electric Heat – 2022 FQ1 Forecast:

Fiscal Year	Electric Heat Customers	Energy (GWH)
2022	22,203	281.40
2023	22,393	283.80
2024	22,584	286.23
2025	22,778	288.68
2026	22,972	291.14
2027	23,169	293.63
2028	23,367	296.14
2029	23,566	298.67
2030	23,768	301.23
2031	23,971	303.80



SRRP Q78 Reference: Load Forecasts

a) For each of the ten most recent actual years, please provide a schedule showing the actual sales for each major customer group and the sales forecast from the load forecast immediately preceding the actual year. Please also include forecast and actual line losses and station service. Comment on any material variances between actuals and forecasts.
b) Please discuss how SaskPower evaluates the accuracy of its forecast methodology.
c) Please comment on how changes to forecast methodologies may have improved forecast accuracy since the last rate application.

a) Please see the table below that shows actual sales for each major customer group and the sales forecast from the load forecast immediately preceding the actual year.

Material variance explanations between actual and forecast are provided below:

1. 2012 – the potash and pipelines sectors were significantly lower than forecast.
2. Farm sales are impacted throughout the 10-year timeline by annual read cycles prior to AMI.
3. An implicit assumption for export sales was assumed in the losses forecast and was removed after 2021 fiscal.
4. The potash, pipeline, steel, and pulp & paper sectors in the Power Class make up nearly all the Power Class variance for 2020 & 2021 fiscal due to Covid-19 related impacts.

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Electricity Sales by Custmer Class (GWh)

Actuals	2011	2012	2013	2014	2015	2016/17	2017/18	2018/19	2019/20	2020/21
Residential	3,006	2,937	3,190	3,281	3,128	3,068	3,162	3,216	3,091	3,224
Commercial	3,447	3,532	3,663	3,788	3,795	3,777	3,862	3,862	3,748	3,540
Oilfields	2,901	3,177	3,448	3,503	3,494	3,621	3,877	3,962	4,163	3,728
Power Class	7,321	7,448	7,863	8,179	8,698	9,207	9,845	9,964	9,584	9,408
Farm	1,298	1,149	1,332	1,364	1,276	1,189	1,328	1,353	1,330	1,348
Reseller	1,253	1,254	1,257	1,274	1,234	1,218	1,208	1,202	1,156	1,129
Saskatchewan sales	19,226	19,497	20,753	21,389	21,625	22,080	23,282	23,559	23,072	22,377
Losses, Exports, & Station Service	1,965	2,211	1,944	1,992	2,078	2,149	1,778	1,873	1,535	1,721
Total Energy Requirements	***21,191***	***21,708***	***22,697***	***23,381***	***23,703***	***24,229***	***25,060***	***25,432***	***24,607***	***24,098***

Preceding Forecasts	2011	2012	2013	2014	2015	2016/17	2017/18	2018/19	2019/20	2020/21
Residential	2,926	2,929	3,011	3,014	3,139	3,274	3,324	3,323	3,246	3,192
Commercial	3,494	3,480	3,514	3,609	3,694	3,837	3,915	3,897	3,964	3,927
Oilfields	2,865	3,277	3,546	3,686	3,793	3,476	3,573	3,860	4,000	4,131
Power Class	8,120	8,648	8,469	8,234	8,522	9,190	9,376	9,555	10,183	10,269
Farm	1,297	1,281	1,331	1,305	1,318	1,331	1,308	1,214	1,279	1,304
Reseller	1,277	1,281	1,275	1,264	1,268	1,290	1,286	1,255	1,236	1,175
Saskatchewan sales	19,979	20,896	21,146	21,111	21,733	22,398	22,781	23,103	23,908	23,998
Losses, Exports, & Station Service	1,779	1,907	2,010	1,960	1,908	1,857	1,968	2,183	2,254	2,167
Total Energy Requirements	***21,759***	***22,802***	***23,157***	***23,072***	***23,641***	***24,256***	***24,749***	***25,286***	***26,162***	***26,165***

Variance	2011	2012	2013	2014	2015	2016/17	2017/18	2018/19	2019/20	2020/21
Residential	80	8	179	268	(11)	(206)	(162)	(107)	(155)	32
Commercial	(47)	52	149	179	101	(60)	(53)	(35)	(216)	(387)
Oilfields	36	(100)	(98)	(183)	(299)	145	304	102	163	(403)
Power Class	(799)	(1,200)	(606)	(55)	177	16	469	409	(599)	(861)
Farm	1	(132)	1	59	(42)	(143)	20	140	52	44
Reseller	(24)	(27)	(18)	10	(34)	(72)	(78)	(53)	(80)	(46)
Saskatchewan sales	(753)	(1,399)	(393)	278	(108)	(318)	501	456	(836)	(1,621)
Losses, Exports, & Station Service	185	305	(66)	32	171	292	(190)	(309)	(718)	(447)
Total Energy Requirements	***(568)***	***(1,094)***	***(460)***	***310***	***63***	***(27)***	***310***	***146***	***(1,554)***	***(2,068)***

											10-Year Avg
Total Sales Variance	*-3.8%*	*-7.2%*	*-1.9%*	*1.3%*	*-0.5%*	*-1.4%*	*2.2%*	*1.9%*	*-3.6%*	*-7.2%*	*-2.0%*
Total Energy Variance	*-2.6%*	*-4.8%*	*-2.0%*	*1.3%*	*0.3%*	*-0.1%*	*1.3%*	*0.6%*	*-5.9%*	*-7.9%*	*-2.0%*

b) SaskPower utilizes the Percent Error (PE) and Root Mean Square Error (RMSE) methods to evaluate the accuracy of its forecast methodology. There are other statistical methods available, including the Chow, Durbin-Watson D Statistic, Bartlett's, F ratio tests, t test, adjusted R2, standard deviation and sample variance analysis. However, since these methods do not offer comparative value or consider the growth in each sector, the Percent Error (PE) and Root Mean Square Error (RMSE) methods are used.

Percent Error or percentage error is an indication of the accuracy of the forecast for a given year, after actual numbers for the year become available. PE is calculated by subtracting the Forecasted value from the Actual value and then dividing it by forecasted value. Aside from indicating how much the actual numbers were over or under the forecast, the PE is also used to calculate the RMSE.

RMSE is calculated by squaring the PE of the forecast to arrive at an absolute value. This number is then converted back to its square root. Thus, the average of this square root for each of the forecast years is the RMSE. In other words, the calculation is an average of the percent error values over the forecast period, in absolute terms (no negative values). An example of the formula is as follows:

RMSE = SQRT((((PEt)2 + ((PEt-1)2 + ... + ((PEt-n)2)/n))

Where: RMSE = root mean square error

PE = percent error

n = sample size

t = year

These methods of forecast analysis have been chosen because they are relatively intuitive for the average user to interpret and can be calculated with comparative ease. The RMSE for each sector is calculated over all the years covered in the forecast in addition to the immediate five-year and Ten-year periods preceding the current forecast.

The Root Mean Square Error values are calculated using the most recent 5 or 10 Forecasts which have the corresponding number of forecasts to analyze. For example, the Year 1 RMSE is the only one which includes the most recently analyzed forecast. Year 2 subsequently excludes the most recent forecast in the calculation and so on.

c) Please see SaskPower's responses to 77 (a & b).

SRRP Q79 Reference: Load Forecasts

a) For each of the ten most recent actual years, please provide a schedule showing the actual customer counts for each major customer group and the customer count forecast from the load forecast immediately preceding the actual year. Comment on any material variances between actuals and forecasts.
b) Please discuss how SaskPower evaluates the accuracy of its forecast methodology.
c) Please comment on how changes to forecast methodologies may have improved forecast accuracy since the last rate application.

Response:

a) Please see the table below:

Number of Saskatchewan Customer Accounts

Actuals	2011	2012	2013	2014	2015	2016/17	2017/18	2018/19	2019/20	2020/21
Residential	345,854	353,435	362,738	373,109	380,392	388,006	392,314	396,536	399,394	403,782
Farm	62,475	61,737	61,076	59,792	59,262	58,775	58,492	58,322	57,978	58,035
Commercial	58,118	58,435	59,402	60,274	61,231	61,918	62,375	63,216	63,757	64,272
Oilfields	15,437	16,894	17,560	18,662	19,307	19,234	19,412	19,513	19,466	18,960
Power Class	99	108	101	102	121	124	124	125	130	128
Reseller	2	2	2	2	2	2	2	2	2	2
Total Customers	**481,985**	**490,611**	**500,879**	**511,941**	**520,315**	**528,059**	**532,719**	**537,714**	**540,727**	**545,179**

Preceding Forecasts	2011	2012	2013	2014	2015	2016/17	2017/18	2018/19	2019/20	2020/21
Residential	348,663	346,310	360,636	366,488	378,201	382,961	394,569	398,899	400,933	404,106
Farm	61,862	61,897	62,247	61,087	61,939	60,884	58,792	58,723	58,165	57,822
Commercial	55,808	55,162	56,386	57,712	60,204	60,600	62,471	63,021	63,771	64,153
Oilfields	14,755	15,281	17,524	18,562	18,433	18,805	19,487	19,748	19,749	19,546
Power Class	95	101	100	100	100	99	100	99	101	102
Reseller	2	2	2	2	2	2	2	2	2	2
Total Customers	**481,185**	**478,753**	**496,895**	**503,951**	**518,879**	**523,351**	**535,422**	**540,491**	**542,720**	**545,731**

Variance	2011	2012	2013	2014	2015	2016/17	2017/18	2018/19	2019/20	2020/21
Residential	(2,809)	7,125	2,102	6,621	2,191	5,045	(2,255)	(2,363)	(1,539)	(324)
Farm	613	(160)	(1,171)	(1,295)	(2,677)	(2,109)	(300)	(401)	(187)	213
Commercial	2,310	3,273	3,016	2,562	1,027	1,318	(96)	195	(14)	119
Oilfields	682	1,613	36	100	874	429	(75)	(235)	(283)	(586)
Power Class	4	7	1	2	21	25	24	26	29	26
Reseller	-	-	-	-	-	-	-	-	-	-
Total Customers	**2,811**	**13,870**	**5,997**	**10,004**	**3,451**	**4,708**	**(2,703)**	**(2,777)**	**(1,993)**	**(552)**
% from Actuals	*-0.2%*	*-2.4%*	*-0.8%*	*-1.6%*	*-0.3%*	*-0.9%*	*0.5%*	*0.5%*	*0.4%*	*0.1%*

											10-Year Avg
Total Customer Variance	*0.2%*	*2.5%*	*0.8%*	*1.6%*	*0.3%*	*0.9%*	*-0.5%*	*-0.5%*	*-0.4%*	*-0.1%*	*0.5%*

** Variance in Power Class exists because of how totalized customers are reported as a single customer in SAP*

b) Please see SaskPower's response to question 78(b).
c) Please see SaskPower's responses to question 77 (a & b).

SRRP Q80 Reference: Load Forecasts

Please comment on the steps SaskPower takes to verify large-scale industrial and commercial customer load forecasts and any changes SaskPower makes to these self-reported customer forecasts to reduce variability.

Response:

Several different methods are used to derive energy forecasts for key account customers. These methods include energy forecasts as provided by the customer, energy forecasts as estimated based on production estimates, energy intensity levels and regression analysis, and energy forecasts determined through extrapolation of current loads. The method employed is dependent upon a customer's industry and availability of information for that customer or industry.

SaskPower consults with the Ministry of Energy & Resources to review mine expansion plans in the province. SaskPower also develops a potash sector energy forecast based on the Ministry of Energy & Resources' potash production forecast. This forecast is used to compare to, and adjust, the individual potash customer forecasts, if required.

Forecast Assumptions:

- Monthly maintenance schedules for individual power customers are determined either by the customer's forecast or by assuming the same historical maintenance cycle.
- All customers who have Electrical Service Agreements (ESA) with SaskPower are included in the power class forecast.
- SaskPower will maintain its current customer base and market share, except where self-generation replaces SaskPower as the supplier.
- All potential expansion and contraction initiatives, including customer self-generation, are applied a probability of occurrence and start date and netted against the customer's existing base load requirements.
- Speculative load includes projects specifically identified by power class customers, except in the case of the potash industry where production forecasts provided by the Ministry of Energy & Resources produce a 'miscellaneous' speculative component.
- SaskPower monitors individual industrial customers and customer class loads monthly and includes any new information or updates in its Q3 (Mid-Year Update) load forecast.

SRRP Q81 Reference: Load Forecasts

a) Please provide the forecasted and top three actual system winter and summer peaks for each of the five most recent actual years.
b) Please comment on any material variances between actual and forecast peaks for the most recent five years as well as how any changes in methodology to the current system peak demand forecast will improve forecast accuracy.
c) Please provide the generation capacity by fuel type used to meet the top actual system winter and summer peaks.
d) Please elaborate on the statement on page 9 of the application that "In general, the residential, farm and reseller classes have shown relatively flat changes in demand, while the commercial, oilfields and power customers see more volatile changes in demand" and quantify the changes in peak demand by customer type for each of the last three years and forecasts for 2021/22 through 2023/24.

Response:

a) Please see the tables below showing the forecasted and top three actual system winter and summer potential and most likely peaks for each of the five most recent actual years:

	Instantaneous Peak (MW)				
Winter Peak	2016/17	2017/18	2018/19	2019/20	2020/21
Actual 1	3,747	3,792	3,723	3,722	3,722
Actual 2	3,710	3,725	3,689	3,702	3,665
Actual 3	3,673	3,712	3,684	3,680	3,665
Potential Peak Forecast	3,895	3,960	4,015	3,889	3,785
Variance 1	(148)	(168)	(292)	(167)	(63)
Variance 2	(185)	(235)	(326)	(187)	(120)
Variance 3	(222)	(248)	(331)	(209)	(120)

	Instantaneous Peak (MW)				
Summer Peak	2016/17	2017/18	2018/19	2019/20	2020/21
Actual 1	3,317	3,470	3,524	3,437	3,481
Actual 2	3,269	3,372	3,520	3,395	3,437
Actual 3	3,245	3,360	3,506	3,347	3,425
Potential Peak Forecast	3,524	3,591	3,633	3,524	3,489
Variance 1	(207)	(121)	(109)	(87)	(8)
Variance 2	(255)	(219)	(113)	(129)	(52)
Variance 3	(279)	(231)	(127)	(177)	(64)

b) The difference in forecast and actual peaks exists in part because SaskPower forecasts a Potential system peak demand, which is compared to the actual peaks in the table above. Potential system peak demands represent the highest level of demand placed on the system at any time during the year if typical lighting loads occur and all large consumers are operating at their normal levels during below average weather conditions. Because of this, it is expected that the actual peaks will be lower than forecast, as they are less likely to occur. The goal of the potential peak forecast is to ensure that SaskPower has enough generation if an abnormally cold winter occurs, while all major customers are running normally.

For cost-of-service purposes, SaskPower utilizes a Most-Likely peak forecast. The Most Likely system peak demand forecast represents the highest level of demand placed on the supply system at any time during the year if typical lighting loads occur and all large consumers are operating at their normal levels under 5-year average weather conditions. SaskPower uses the Most Likely peak forecast in cost of service as is it is more representative of what will occur and therefore will not overstate the demand related costs allocated to customers. A comparison of the Most Likely peak forecast to actuals results in much more favourable results:

	Instantaneous Peak (MW)				
Winter Peak	2016/17	2017/18	2018/19	2019/20	2020/21
Actual 1	3,747	3,792	3,723	3,722	3,722
Actual 2	3,710	3,725	3,689	3,702	3,665
Actual 3	3,673	3,712	3,684	3,680	3,665
Most Likely Forecast	3,727	3,800	3,863	3,800	3,725
Variance 1	20	(8)	(140)	(78)	(3)
Variance 2	(17)	(75)	(174)	(98)	(60)
Variance 3	(54)	(88)	(179)	(120)	(60)

	Instantaneous Peak (MW)				
Summer Peak	2016/17	2017/18	2018/19	2019/20	2020/21
Actual 1	3,317	3,470	3,524	3,437	3,481
Actual 2	3,269	3,372	3,520	3,395	3,437
Actual 3	3,245	3,360	3,506	3,347	3,425
Most Likely Forecast	3,372	3,446	3,495	3,412	3,375
Variance 1	(55)	24	29	25	106
Variance 2	(103)	(74)	25	(17)	62
Variance 3	(127)	(86)	11	(65)	50

Part of the variance in 2020's peak can be explained by the impact of Covid-19. Improving the peak forecast is one of the key areas of focus this year. However, in the absence of AMI data, it is difficult to ascertain exactly what transpired, particularly in the mass market sectors. SaskPower has engaged the services of iTron to help us model load shapes using a bottom-up approach, rather than the top-down method using historical class load factors. The hope is that aggregating discrete load shapes will provide a peak that is more reflective of the true use at time of system peak. Ultimately, more robust AMI data is critical to improving our future peak demand forecasts.

c)

2021/22 Peak Load information		Generation by Fuel Type (MW)					
Season	Peak (MW)	Hydro	Coal	Gas	Wind	Other	Import
Summer	3,547	508	1,237	1,494	108	0	200
Winter	3,910	355	1,008	1,950	149	1	447

d) For clarity, when SaskPower references 'demand' in the above statement, it is referring to customers' demand for energy, not to the customer classes' peak demands. Please see the table below that shows the actual and forecasted average annual 5- and 10-year growth rates for energy by customer class:

	Year	POWER	OILFIELDS	COMMERCIAL	RESIDENTIAL	FARM	RESELLER
ACTUALS	2013	7,863.0	3,448.0	3,663.0	3,190.0	1,332.0	1,257.0
	2014	8,179.0	3,503.0	3,788.0	3,281.0	1,364.0	1,274.0
	2015	8,698.0	3,494.0	3,795.0	3,128.0	1,276.0	1,234.0
	2016	9,206.7	3,620.8	3,776.9	3,068.6	1,188.8	1,218.7
	2017-2018	9,844.8	3,877.5	3,861.9	3,162.2	1,327.8	1,208.4
	2018-2019	9,964.1	3,962.4	3,861.8	3,215.8	1,353.6	1,201.7
	2019-2020	9,583.7	4,163.6	3,748.1	3,091.1	1,329.8	1,155.9
	2020-2021	9,408.4	3,727.6	3,539.7	3,223.7	1,348.4	1,128.8
	5 Year Growth Rate	4.9%	2.8%	1.1%	0.2%	0.3%	-0.9%
	5 Year Growth Rate	1.6%	1.3%	-1.4%	0.6%	1.1%	-1.8%
FCST.	2021-22	10,062.0	4,069.3	3,741.2	3,288.8	1,271.0	1,170.9
	2022-23	10,283.4	3,901.9	3,701.4	3,227.8	1,341.8	1,171.3
	2023-24	10,107.8	3,984.8	3,733.5	3,245.8	1,341.5	1,174.3
	3 Year Growth Rate	2.4%	2.2%	1.8%	0.2%	-0.2%	1.3%

The 2020 and 2021 fiscal year actuals are highlighted as they include the impacts of the Covid-19 pandemic on SaskPower's loads and are considered atypical. When removed, the 5-year average annual growth rates for the Power, Oilfield and Commercial classes are 4.9%, 2.8% and 1.1%, respectively while the Residential, Farm and Reseller classes are marginally above 0% or in negative territory. The 2022 Q1 forecast reflects this trend, showing a 3-year average annual growth rates of 2.4%, 2.2% and 1.8% for the Power, Oilfield and Commercial classes while holding the growth in the remaining classes relatively flat.

SRRP Q82 Reference: Load Forecasts

Please discuss what SaskPower believes to be the short-term versus long-term effects of Covid-19 on energy demand due to changes in the behavior of each major customer group and how SaskPower's models account for these short-term versus long-term changes.

Response:

SaskPower's 2022 FQ1 forecast accounted for COVID-19 impacts by inserting a time trend binary variable into both the Residential and Commercial forecast models. The function of the binary is to capture the effect of Covid-19 as compared to the previous years' data and project an impact into the future. It is expected that there will be some permanent remote work impacting the Residential sector, as well as some near to mid-term impact on the commercial class.

In the Oilfield and Power class sectors, there were some notable reductions in load in response to the pandemic. However, in both classes the sales rebounded quickly, and there is no assumed impact in the forecast. Similarly, Farm sales are not expected to be materially impacted.

SRRP Q83 Reference: Energy Efficiency

With reference to the response to first round information request SRRP Q111 from the 2018 rate application please provide a copy of the 2017 Conservation Potential Review and discuss the implementation of the study.

Response:

In 2017 SaskPower engaged Navigant Consulting Ltd to complete a Conservation Potential Review (CPR) and 5-year Demand Side Management (DSM) Plan. The CPR provided a comprehensive vision of the potential electricity savings and demand reductions achievable in Saskatchewan within a 20-year timeframe. The study provided an updated view of potential electricity savings and demand reductions for energy efficiency in Saskatchewan. The DSM Plan provided an implementation structure and optimal programming needed to realize the savings potentials. The Plan leveraged existing programming and benchmarked SaskPower with other Canadian utilities.

By 2019 SaskPower's business needs and customer interests were shifting and as a result DSM's programs evolved. Generation capacity was planned to be built to replace older generating facilities and meet environmental regulations. As a result, the need to purchase generation capacity from customers through DSM was no longer required in the short to medium term.

SaskPower continues to develop and deliver a diverse portfolio of programs that promote energy efficiency, conservation and self-generation. The current DSM portfolio is made up of programs that are designed to educate customers and encourage behaviour changes.

SaskPower's business environment continues to evolve. As result of anticipated growth in electric vehicles and electrification, increases to carbon taxes, and stricter regulations on electric utilities, SaskPower is reconsidering its DSM opportunities and those previously developed plans.

SaskPower Conservation Potential Review

Prepared for:

SaskPower

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TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

DISCLAIMER

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1. INTRODUCTION

1.1 Conservation Potential Review Background and Goals

SaskPower engaged Navigant Consulting Ltd. (Navigant or the team) to prepare a conservation potential review (CPR) for electricity across all of Saskatchewan from 2018 to 2036. The CPR's objective is to assess the energy efficiency potential in the residential, commercial, and industrial sectors by analyzing energy efficiency and peak load reduction measures and improving end-user behaviors—including operational and maintenance (O&M) activities to keep existing devices or equipment in good working order—to reduce energy consumption. The peak load reduction (demand response) and behavior opportunities are discussed in companion reports. The energy efficiency potential analysis efforts provide input data to Navigant's Demand-Side Management Simulator (DSMSim™) model, which calculates technical, economic, and achievable savings potential across the SaskPower service territory, which includes two resellers: City of Saskatoon and City of Swift. SaskPower may use these results as input to its own demand-side management (DSM) planning and long-term conservation goals, energy efficiency program design, integrated resource planning (IRP), and load forecasting models.

1.2 Report Organization

Section 2 describes the methodologies and approaches Navigant used to estimate energy efficiency and demand reduction potential, including discussions of base year calibration, reference case forecast, and measure characterization.

Section 3 offers the technical potential savings forecast for SaskPower, including the methods for estimating technical potential and the modeling results by customer segment and end use.

Section 4 offers the economic potential savings forecast for SaskPower, including the methods for estimating economic potential and the modeling results by customer segment and end use.

Section 5 offers the achievable potential savings forecast for SaskPower, including the methods for estimating economic potential and the modeling results by customer segment and end use.

Section 6 is a summary of the next steps that result from the development of this CPR.

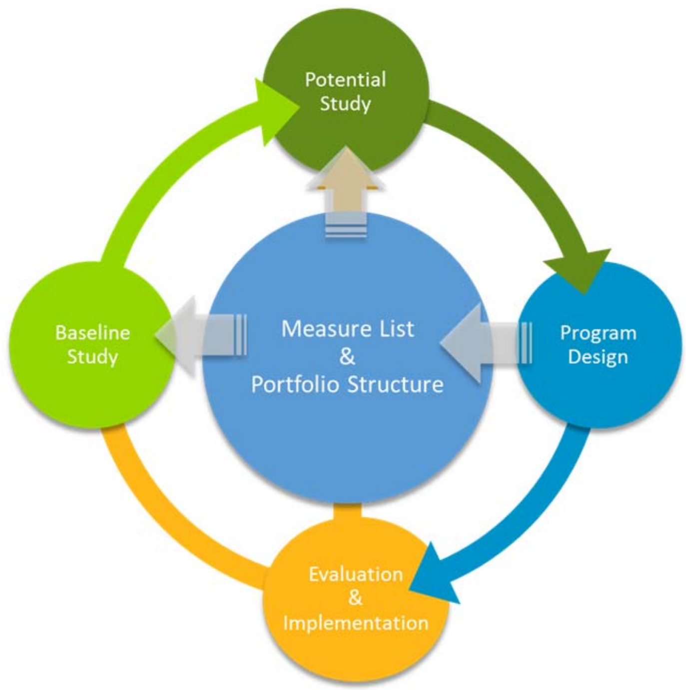
The accompanying appendices provide detailed model results and additional context around modeling assumptions.

Note: There are companion reports for the demand response (DR) and behavior program potential study methodology and results.

1.3 Why Complete a CPR?

CPRs, also known as potential studies, provide a long-range outlook on the cost-effective potential for delivering energy efficiency. As more utilities work to define a value proposition for energy efficiency as a grid resource in their IRPs, having a comprehensive review of achievable potential across their service territories validates the effects efficiency can have over the forecast period. The level of detail and accuracy provided by the current CPR will allow SaskPower to incorporate energy efficiency as a supply option in its IRP, inform the design of its current and future customer efficiency programs, and have a clear understanding of the budgets needed to pursue energy efficiency options. Figure 1 shows the interaction between the CPR and other energy efficiency activities. It illustrates the continuous process of defining the baseline energy use of the market through a baseline or saturation study, to forecasting the potential energy savings across that market, developing and evaluating efficiency programs designed to capture that savings, and then redefining the baseline based on programmatic impacts on efficiency improvements. This process flow ensures that the market is served based on the utility customer's need and potential to supplement SaskPower's customer delivery and experience.

Figure 1. CPR Process Flow



Source: Navigant

1.4 Study Objectives

The objectives of the current CPR cover a range of topics from providing input values for DSM planning and long-term energy conservation goals for use in IRPs to informing existing and future energy efficiency and conservation programs. Table 1 details these objectives and offers Navigant's approach to meeting each objective.

Table 1. Navigant's Approach to Addressing SaskPower's Objectives

Objective	Navigant's Approach
1. Provide input into DSM planning for program planning and long-term conservation goals and targets	Inform DSM planning and the establishment of long-term conservation targets and goals with potential study output results

Objective	Navigant's Approach
2. Develop new energy efficiency and conservation programs and initiatives	Present savings potential by measure to inform the development of new energy efficiency programs and initiatives that ***capture the most significant savings opportunities available within Saskatchewan***
3. Provide input to the IRP	Provide a ***supply curve of conservation potential*** for input to SaskPower's IRP
4. Provide input to load forecasting	***Appropriate treatment of natural conservation in the baseline*** and reference forecast and development of ***conservation potential for effective integration with SaskPower's load forecast***
5. Complete flexibility for sensitivities and scenarios, including maximum achievable potential	Develop an ***unconstrained budget scenario that could be used to estimate maximum achievable potential***
6. Obtain stakeholder approval of the scope, methodology, and presentation of the study	Robust stakeholder engagement approach for consensus throughout the process
7. Make the tools, methodology, and assumptions to construct the CPR transparent	Provide transparent methodology, assumptions, and inputs at each stage of this project
8. Consider all commercially available and emerging measures applicable in Saskatchewan	Thorough review and shared decision-making of selected measures
9. Inform participation estimates by historical SaskPower program performance	Addressed through effective baseline calibration
10. Focus on most sensitive assumptions and inputs	Focus on the most impactful assumptions and inputs
11. Compare results against current load, future load forecast, and past DSM program performance in Saskatchewan	Comprehensive and vetted baseline and reference forecast and calibration analysis
12. Disaggregate results and potential by utility as desired	Disaggregate overall provincial results for SaskPower, Saskatoon Light & Power, and Swift Current Light & Power

Source: Navigant

1.5 Caveats and Limitations

There are several caveats and limitations associated with the results of this study, which are detailed below.

1.5.1 Forecasting Limitations

Navigant obtained future energy sales forecasts from SaskPower. Each of the sector (residential, commercial, and industrial[1]) forecasts contain assumptions, methodologies, and exclusions. The team leveraged the assumptions underlying these forecasts as much as possible as inputs into the development of the reference case stock and energy demand projections. Where sufficient and detailed information could not be extracted—due to the granularity of the information available—Navigant developed independent projections of stock. These independent projections were based on secondary data resources and produced in collaboration with SaskPower. These secondary resources and any underlying assumptions are referenced throughout this report.

1.5.2 Segmentation

Navigant obtained any available data from SaskPower to segment the three sectors (residential, commercial, and industrial). Some of this data was supplemented by Navigant analysis with SaskPower input to ensure the allocation of sales and stock data are mapped to the appropriate segments. One notable segment not included for savings potential analysis in this study is street lighting.[2]

1.5.3 Measure Characterization

Efficiency potential studies may employ a variety of primary data collection techniques (e.g., customer surveys, onsite equipment saturation studies, and telephone interviews) that can enhance the accuracy of the results, though not without associated cost and time requirements. The scope of this study did not include primary data collection; rather, it relied on data from SaskPower, other regional efficiency programs and Canadian utilities, Natural Resources Canada (NRCan), and technical reference manuals (TRMs) from Pennsylvania, Illinois, Michigan, Wisconsin, Minnesota, Vermont, and Massachusetts to inform inputs to DSMSim.

The team uses the measure list used in this study to appropriately focus on those technologies likely to have the highest impact on savings potential over the potential study horizon. However, there is always the possibility that emerging technologies may arise that could increase savings opportunities over the forecast horizon, and broader societal changes may affect levels of energy use in ways not anticipated by this study.

1.5.4 Measure Interactive Effects

This study models energy efficiency measures independently. Thus, the total aggregated energy efficiency potential estimates may be higher or lower than the actual potential available if a customer installs multiple measures in their home or business. Multiple measure installations at a single site generate two types of interactive effects: within end-use interactive effects and cross end-use interactive effects. An example of a within end-use interactive effect is when a customer implements temperature

[1] Industrial customers are sometimes referred to as power accounts. SaskPower provides this designation to large customers. There are some customers that are power accounts and are not industrial. The discussion on the base year and reference case analysis describes the allocation of customers to appropriate sectors and segments.

[2] SaskPower owns most of the street lighting in Saskatchewan and provides the service of light to urban and rural municipalities that pay for it. The street lighting retrofits to LEDs are already in SaskPower's plans and will not be under the influence of any DSM programs.

control strategies but also installs a more efficient cooling unit. To the extent that the controls reduce cooling requirements at the cooling unit, the savings from the efficient cooling unit would be reduced. An example of a cross end-use interactive effect is when a homeowner replaces heat-producing incandescent light bulbs with efficient LEDs. This influences the cooling and heating load of the space—however slightly—by increasing the amount of heat and decreasing the amount of cooling generated by the heating, ventilation, and air conditioning (HVAC) system.

Navigant employed the following methods to account for measure interactive effects:

- Where measures clearly compete for the same application (e.g., electronically commutated motors [ECMs] and Q-Sync motors), the team created competition groups to eliminate the potential for double counting savings
- For measures with significant interactive effects (e.g., HVAC control upgrades and building automation systems), the team adjusted applicability percentages to reflect varying degrees of interaction
- Wherever cross end-use interactive effects were appreciable (e.g., lighting and HVAC), the team characterized those interactive effects for both same fuel (e.g., lighting and electric heating) and cross-fuel (e.g., lighting and gas heating) applications.

Appendix G provides further discussion of the challenges involved with accurately determining interactive effects.

1.5.5 Measure-Level Results

This report includes a high-level account of savings potential results across the SaskPower service territory and focuses largely on aggregated forms of savings potential. However, the accompanying Excel workbook provides the results for every characterized measure by scenario and customer segment. Navigant mapped the measure-level data to the customer segments and end-use categories to permit a reviewer to easily create custom aggregations.

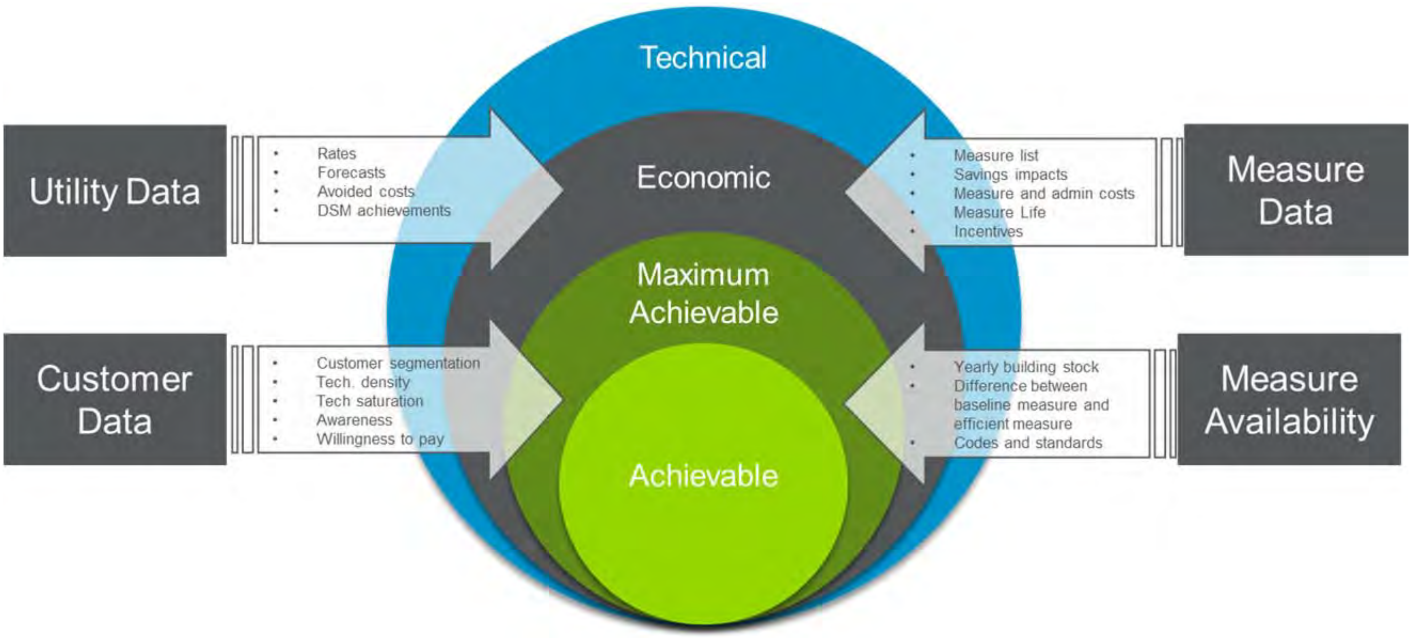
1.5.6 Gross Savings Study

Navigant and SaskPower agreed to show savings from this study at the gross level, whereby natural change (either natural conservation or natural growth in consumption) is not included in the savings estimates but rather is estimated separately. Providing gross potential is advantageous because it permits a reviewer to more easily calculate net potential when new information about changing end-use intensities (EUI) or net-to-gross (NTG) ratios become available.

2. APPROACH AND INPUTS FOR ESTIMATING ENERGY AND DEMAND SAVINGS POTENTIAL

Navigant developed forecasts of technical, economic, and program achievable electric savings potential in the SaskPower service territory from 2018 through 2036 using a bottom-up potential model. These efficiency forecasts relied on disaggregated estimates of building stock and electric energy sales before conservation, as well as a set of detailed measure characteristics for a comprehensive list of energy efficiency measures relevant to SaskPower's service region. This section details the team's approach and methodology for developing the key inputs to the potential model, as illustrated in Figure 2.

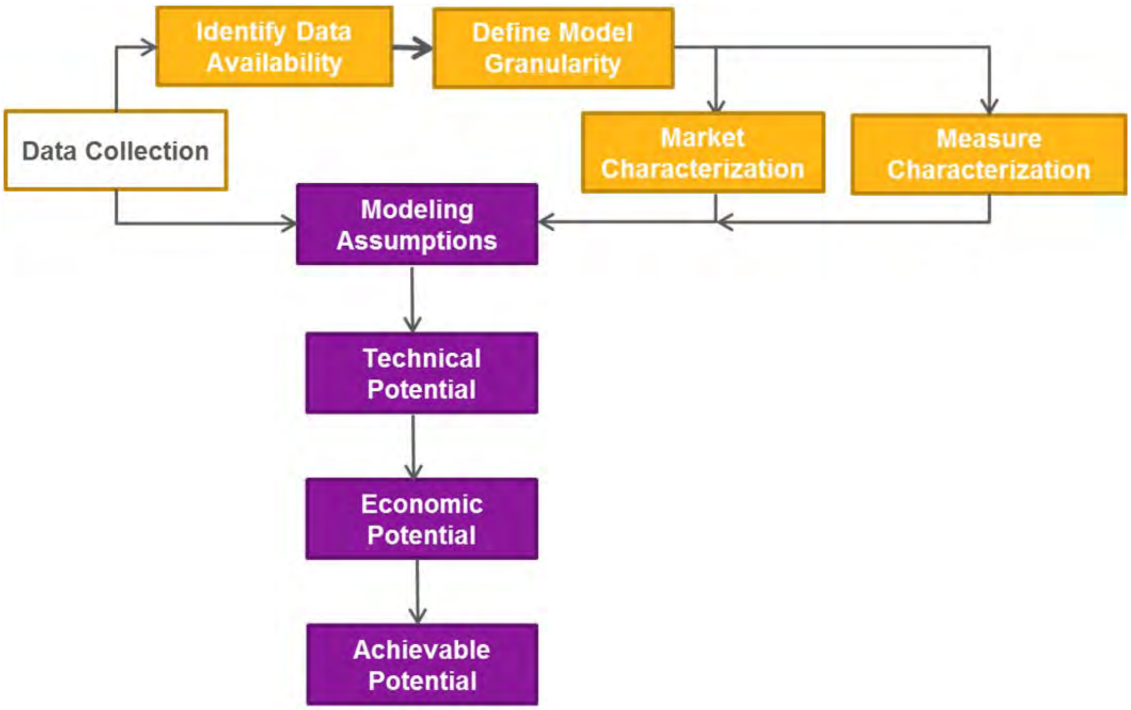
Figure 2. Potential Study Inputs



Source: Navigant

The methodology for calculating achievable potential includes several elements such as a base year calibration, a reference case forecast, the frozen EUI case, and full measure characterization. Figure 3 shows how these elements interact to result in the achievable savings potential.

Figure 3. High-Level Overview of Potential Study Methodology

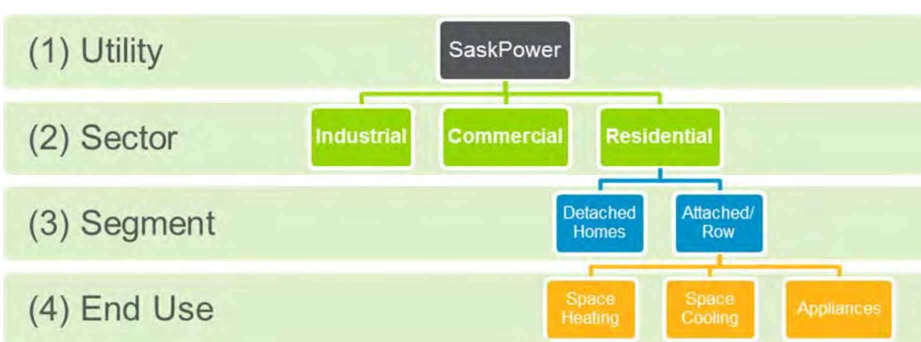


Source: Navigant

2.1 Base Year Profile

This section describes the approach used to develop the base year (2016) profile of electricity use in Saskatchewan, a key input to the potential model. The objective of the base year is to define a detailed profile of electricity consumption by customer sector, segment, and end use (Figure 4). The model later uses the base year as the foundation to develop the reference case forecast of electricity demand from 2018 through 2036.

Figure 4. Base Year Electricity Profile – Residential Example



Source: Navigant

Navigant developed the base year profile based on 2016 billing and customer account data provided by SaskPower because it was the most recent year with a fully complete and verified dataset. Where SaskPower-specific information was not available, Navigant utilized data from publicly available sources such as Statistics Canada (StatCan) and NRCan, in addition to internal Navigant data sources. The team's review of these resources was generally used to support the data sources provided by SaskPower and to ensure consistency with SaskPower data.

2.1.1 Customer Sectors and Segments

The first major task to develop the base year electricity calibration involved the disaggregation of the three main sectors—residential, commercial, and industrial—into specific customer segments. The team selected customer segments based on several factors including availability of data, level of detail, and level of importance to SaskPower. Table 2 shows the segmentation used for the residential, commercial, and industrial sectors. The following subsections provide additional detail for each sector.

Table 2. Customer Segments by Sector

Residential	Commercial	Industrial
Single Detached Homes	Office	Potash Mines
Attached/Row Housing	Food Retail	Northern Mines
Apartments/Condos	Non-Food Retail	Steel
Electrically Heated First Nations	Hospital	Oil & Gas
Non-Electrically Heated First Nations	Lodging	Pulp & Paper
Farm Houses	Restaurant	Manufacturing
Mobile/Other	School	Farms
	University/College	
	Warehouse/Wholesale	
	Ice Rinks	
	Other	
	Street Lighting	

Source: Navigant analysis

2.1.1.1 Residential Segments

Navigant divided the residential sector into seven customer segments. Table 3 provides descriptions for each residential segment.

This segmentation is largely consistent with the residential segments employed in SaskPower's 2010 CPR with two exceptions related to housing stock vintage and apartments. The 2010 CPR distinguished single family detached and attached homes based on vintage, using pre-1980 and post-1980. This CPR does not make this distinction. Rather, this study distinguishes housing stock between *existing* and *new* (or forecasted) stock (i.e., 2016 for the base year and post-2017 for the reference case). Additionally, the 2010 CPR differentiated between apartment living units and common areas, but this CPR does not make this distinction.

Table 3. Description of Residential Segments

Segment	Description
Single Detached Homes	Detached and duplex residential dwellings
Attached/Row Housing	Attached, row, and/or townhouses
Apartments/Condos	Apartment units located in low or high-rise apartment buildings
Electrically Heated First Nations	Residential dwellings located in First Nations communities and electrically heated
Non-Electrically Heated First Nations	Residential dwellings located in First Nations communities and non-electrically heated
Farm Houses	Resident farm houses or residential dwellings adjacent to farming operations
Mobile/Other	Manufactured, mobile, or other types of residential dwellings

Source: Navigant

2.1.1.2 Commercial Segments

Navigant divided the commercial sector into 12 customer segments. Table 4 provides descriptions for each commercial segment.

The team selected these commercial segments to be representative of the SaskPower population of commercial customers by comparing similar building characteristics such as patterns of electricity use, operating and mechanical systems, and annual operating hours. The selection of these commercial segments is similar to those from the 2010 CPR with two exceptions related to long-term care facilities and the size of commercial buildings. The 2010 CPR distinguished three customer segments—offices, non-food retail, and hotels—based on size: large and small/other commercial facilities. This study does not make any distinction based on size because the approach for characterizing commercial segments and commercial measures does not depend on building size. Additionally, the 2010 CPR had a separate customer segment for long-term care facilities. Navigant did analysis on the EUI comparisons of long-term care versus lodging and hospital and concluded that these facilities are more like the lodging customer segment for both market and measure characterization.

It is also important to note that the two universities and the resellers are considered power accounts; however, their loads and building type fall under commercial. Appendix 0 provides detail on the allocation of the sales and stock data into the commercial sector.

Table 4. Description of Commercial Segments

Segment	Description
Office	Administration, clerical services, consulting, professional, or bureaucratic work but not including retail sales
Food Retail	Engaged in retailing general or specialized food and beverage products
Non-Food Retail	Engaged in retailing services and distribution of merchandise but not including food and beverage products
Hospital	Diagnostic and medical treatment services such as hospitals and clinics
Lodging	Short-term lodging including related services such as restaurants and recreational facilities; includes residential care, nursing, or other types of long-term care
Restaurant	Establishments engaged in preparation of meals, snacks, and beverages for immediate consumption including restaurants, taverns, and bars
School	Primary schools, secondary schools (K-12), and miscellaneous educational centers
University/College	Post-secondary education facilities such as colleges, universities, and related training centers
Warehouse/Wholesale	Warehouse/storage facilities for general merchandise, refrigerated goods, and other wholesale distribution
Ice Rinks	Arenas used for hockey, ice skating, curling, etc.
Other	Establishments not categorized under any other sector, including but not limited to recreational, entertainment, and other miscellaneous activities
Street Lighting	Roadway lighting and traffic signal loads

Source: Navigant

2.1.1.3 Industrial Sector

Navigant divided the industrial sector into seven customer segments. Table 5 provides descriptions for each industrial segment.

Navigant selected these industrial segments based on a review of SaskPower's power account customers and with the objective of categorizing facilities with similar industrial processes, operations, production, and patterns of electricity use. Agriculture/farms are included in industrial because they are defined by a process activity.

Table 5. Description of Industrial Segments

Segment	Description
Potash Mines	Potash mining operations (e.g., PotashCorp, Mosaic)
Northern Mines	Non-potash mining operations including copper, gold, uranium, and other rare metal mines (e.g., Cameco, Prairie Mines, Areva operations)
Steel	Facilities engaged in the production of steel for a variety of purposes (e.g., EVRAZ)
Oil & Gas	Industries that explore, operate, or develop oil & gas resources including the production of petroleum, mining, and extraction of shale oil and oil sands (e.g., Enbridge, TransCanada, Husky)
Pulp & Paper	Pulp and paper industrial facilities dedicated to the chemical kraft process, the thermomechanical pulp (TMP), and associated production of wood products such as lumber, plywood, veneer, boards, panel boards, and pellets (e.g., Weyerhaeuser, Meadow Lake)
Manufacturing	Industrial facilities that engage in light and heavy manufacturing processes including fabricated metal, metal manufacturing, machinery, and textiles (e.g., ERCO, Praxair)
Farms	Farming operations engaged in growing crops, raising animals, irrigation, ranches, hatcheries, etc.

Source: Navigant

2.1.2 End Uses

The next step in the base year analysis was to establish end uses for each customer sector. The current CPR defines end uses as a specific activity or customer need that requires energy—such as space cooling, appliances, and water heating—without specifying the equipment used to satisfy that need.

Table 6 shows the list of end uses used for each sector in the CPR. Appendix B.1 provides definitions for these end uses. The end uses selected are important for several reasons. The team uses end uses as categories to report technical, economic, and achievable savings. Each energy efficiency measure is associated with an end use such that its savings can be rolled up and reported by these categories. For example, savings from ENERGY STAR refrigerators and freezers are reported under the appliances end use. End uses are also important because they incorporate natural changes in electricity EUI over time. For example, with the increased adoption of LED bulbs, the average electricity consumption per home for the lighting end use will decline. The team applied these natural changes in end-use consumption to all end uses and incorporated them into the reference case forecast.

Table 6. End Uses by Sector

Residential	Commercial	Industrial
Space Heating	Space Heating	Compressed Air
Space Cooling	Space Cooling	Fans & Blowers
Water Heating	Water Heating	Industrial Process
Appliances	Cooking	Lighting
Lighting	HVAC Fans/Pumps	Material Transport
Electronics	Lighting	Process Heating
Other	Office Equipment	Product Drying
	Refrigeration	Pumps
	Other	Process Cooling
		Space Heating

Source: Navigant

Navigant uses two additional end uses—not included above—to report measures savings: whole building and space heating and cooling. The team used these end uses to report savings from measures that impact electricity consumption across an entire home or facility, or from measures that impact both space heating and cooling consumption. For example, because smart thermostats result in electricity savings associated with both space heating and space cooling, savings from smart thermostats are assigned to the space heating and cooling end use rather than individually to either space heating or space cooling.

2.1.3 Electricity Resellers

SaskPower supplies electricity to residential, commercial, and industrial customers across most of the province, as well as to two electricity *resellers:* Saskatoon Light & Power (SL&P) and the City of Swift Current (SC). These resellers supply electricity locally to residential and commercial customers. Navigant added electricity use from these two resellers to SaskPower's base year sales, using the same customer sectors and segments. Appendix 0 explains the approach used to break down reseller electricity use by customer segment.

2.1.4 Base Year Consumption Inputs

This section summarizes the breakdown of electricity consumption at the sector level, segment level, and end-use level. The team used these base year consumptions as direct inputs to the potential model. Appendix B provides a detailed description of the methodology used to develop these estimates. 6.3Appendix J provides the reconciliation and derivation of the breakdown demand across the sectors, segments, and end uses.[3]

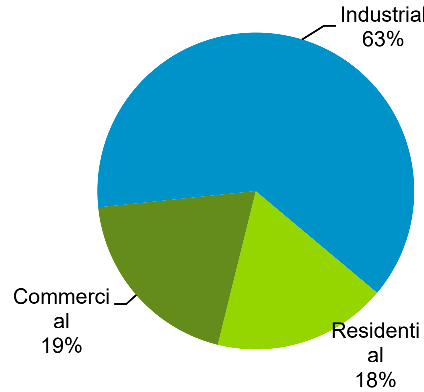
Table 7 and Figure 5 show the breakdown of electricity consumption by sector. Approximately two-thirds of total electricity consumption are from the industrial sector (63%), with the remainder coming from the commercial (19%) and residential (18%) sectors.

[3] Navigant developed the peak demand base case using the average peak demand factors from the 2016 consumption data for the top 50 hours in each season.

Table 7. Base Year Electricity Sector Consumption (GWh and MW)

Sector	GWh	MW
Residential	3,907	582
Commercial	4,289	1,674
Industrial	13,809	646
Total	**22,005**	**2,902**

Figure 5. Base Year Electricity Sector Breakdown (%, GWh)



Source: Navigant analysis

2.1.4.1 Residential Sector

Table 8 shows the base year residential stock, electricity consumption, and average electricity usage per home by residential segment. The base year residential stock is approximately 464,000 homes and accounts for just over 3,900 GWh of consumption.

Table 8. Base Year Residential Results

Segment	Stock (Accounts)	Electricity Use (GWh)	kWh per Acct
Single Detached Homes	312,154	2,858	9,156
Attached/Row Housing	32,425	146	4,494
Apartments/Condos	70,565	304	4,304
Electrically Heated First Nations	2,604	51	19,569
Non-Electrically Heated First Nations	12,988	158	12,152
Farm Houses	32,348	381	11,790
Mobile/Other	1,188	10	8,277
Total	**464,273**	**3,907**	**8,416**

Source: Navigant analysis of SaskPower data

Figure 6 and Figure 7 show the breakdown of base year residential electricity consumption by end use and segment, respectively. In terms of end uses, appliances, electronics, and lighting are the largest residential end uses and account for just under two-thirds of residential electricity consumption. The single family detached segment is the largest segment and accounts for close to 73% of consumption.

Figure 6. Base Year Residential Electricity End-Use Breakdown (%, GWh)

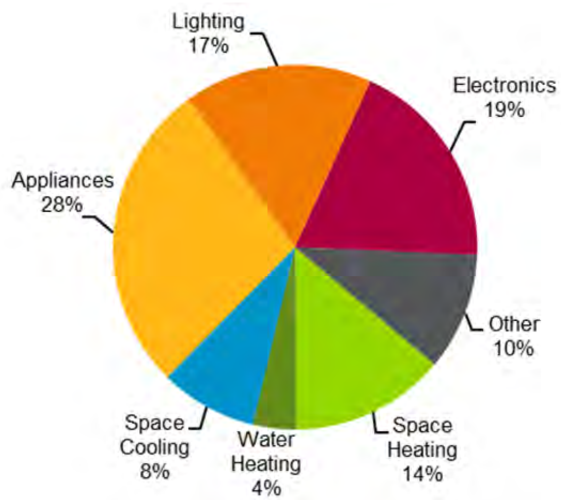
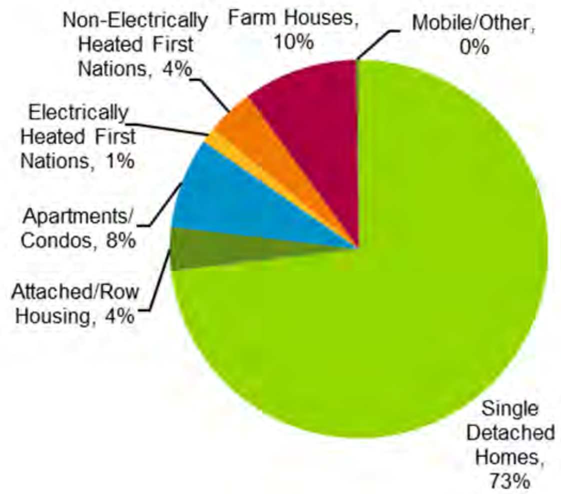


Figure 7. Base Year Residential Electricity Segment Breakdown (%, GWh)



Source: Navigant analysis

2.1.4.2 Commercial Sector

Table 9 shows the base year commercial stock (million square meters of floor space), electricity consumption, and average electricity usage per square meter by commercial segment. Commercial floor space stock is estimated at just under 29 million square meters and contributes approximately 4,300 GWh of consumption.

Table 9. Base Year Commercial Results

Segment	Stock (Million m^2)	Electricity Use (GWh)	kWh per m^2
Office	6.29	968	154
Food Retail	0.47	235	496
Non-Food Retail	3.53	523	148
Hospital	1.00	192	192
Lodging	1.34	178	132
Restaurant	0.62	211	339
School	1.59	131	82
University/College	1.71	310	181
Warehouse/Wholesale	5.84	568	97
Ice Rinks	0.28	58	207
Other	6.08	840	138
Street Lighting	-	74	-
Total	**28.76**	**4,289**	**149**

Source: Navigant analysis

Figure 8 and Figure 9 show the breakdown of base year commercial electricity consumption by end use and segment, respectively. Lighting, HVAC fans/pumps, and office equipment are the largest commercial end uses and account for 75% of commercial electricity consumption. Unlike the residential sector, consumption in the commercial sector is much more evenly distributed across segments. Offices and other are the two largest commercial segments and account for 23% and 20% of electricity consumption, respectively.

Figure 8. Base Year Commercial Electricity End-Use Breakdown (%, GWh)

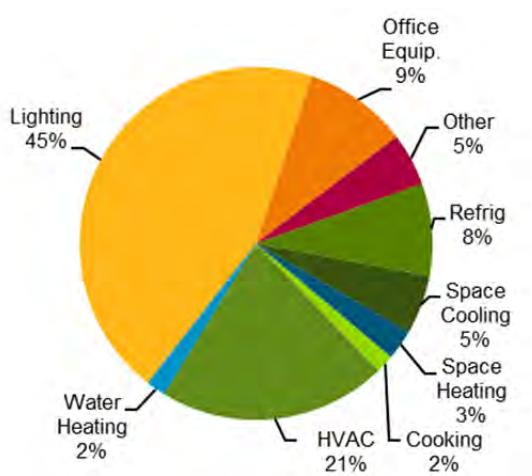
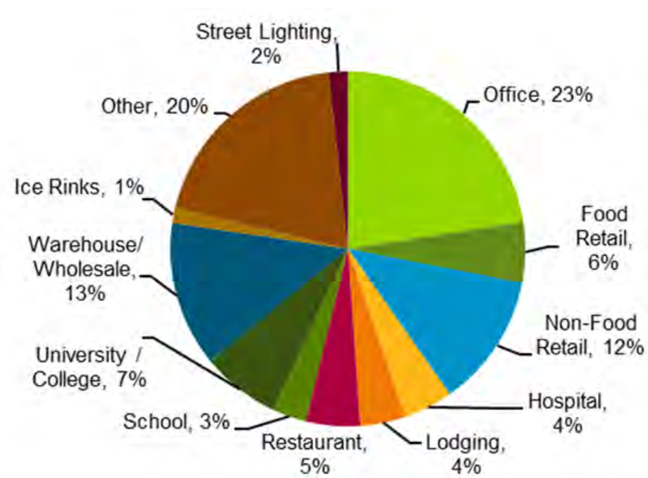


Figure 9. Base Year Commercial Electricity Segment Breakdown (%, GWh)



Source: Navigant analysis

2.1.4.3 Industrial Sector

Table 10 shows the base year industrial electricity consumption by segment. Total industrial electricity consumption is approximately 13,800 GWh.

Table 10. Base Year Industrial Results

Segment	Electricity Use (GWh)
Potash Mines	2,598
Northern Mines	558
Steel	610
Oil & Gas	6,664
Pulp & Paper	938
Manufacturing	1,630
Farms	810
Total	**13,809**

Source: Navigant analysis

Figure 10 and Figure 11 show the breakdown of base year industrial electricity consumption by end use and segment, respectively. Industrial process, pumps, and fans and blowers are the largest industrial end uses and account for over 60% of industrial electricity consumption. In terms of industrial segments, oil & gas is the largest industrial segment and accounts for just under 50% of industrial consumption.

Figure 10. Base Year Industrial Electricity End-Use Breakdown (%, GWh)

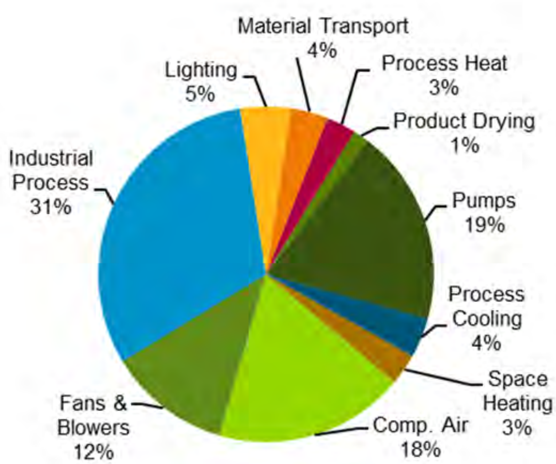
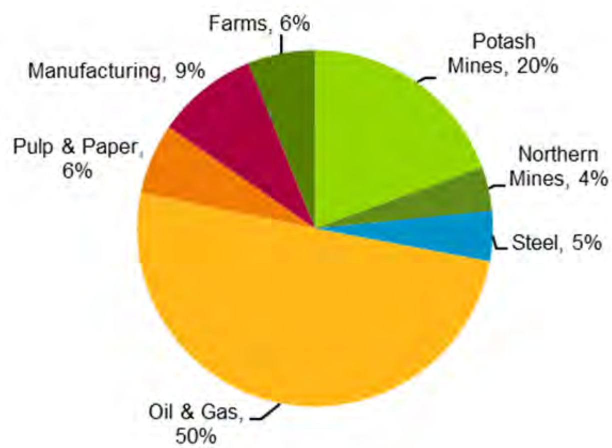


Figure 11. Base Year Industrial Electricity Segment Breakdown (%, GWh)



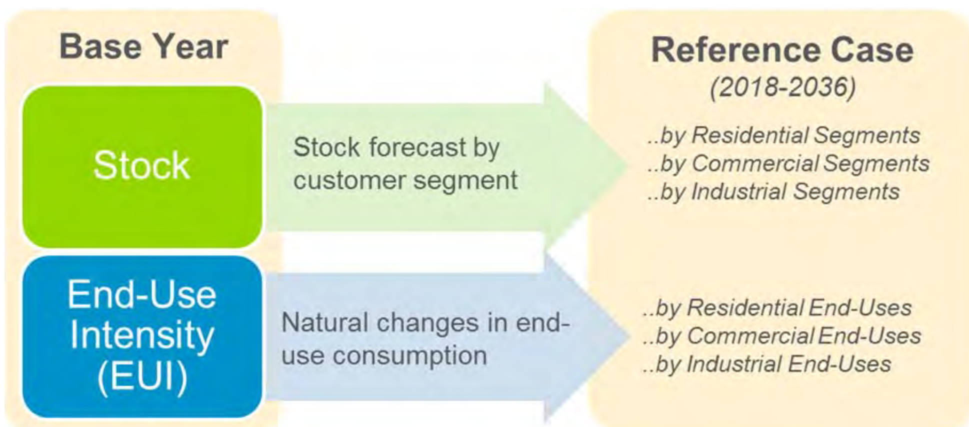
Source: Navigant analysis

2.2 Reference Case Forecast

This section presents the reference case forecast from 2018 to 2036. The reference case represents the expected level of electricity consumption over the CPR period, absent incremental DSM activities or load impacts from rates. Electricity consumption in the reference case is consistent with SaskPower's load forecast. The reference case is significant because it acts as the point of comparison (i.e., the reference) for the calculation of technical, economic, and achievable market potential scenarios.

Figure 12 illustrates the process used develop the reference case forecast. The reference case uses the base year profile as its foundation and applies changes in stock growth and EUI over time to develop the residential, commercial, and industrial forecasts.

Figure 12. Schematic of Reference Case



Source: Navigant

Navigant constructed the reference case forecast using two different approaches: one for the residential and commercial sector, and a second for the industrial sector.

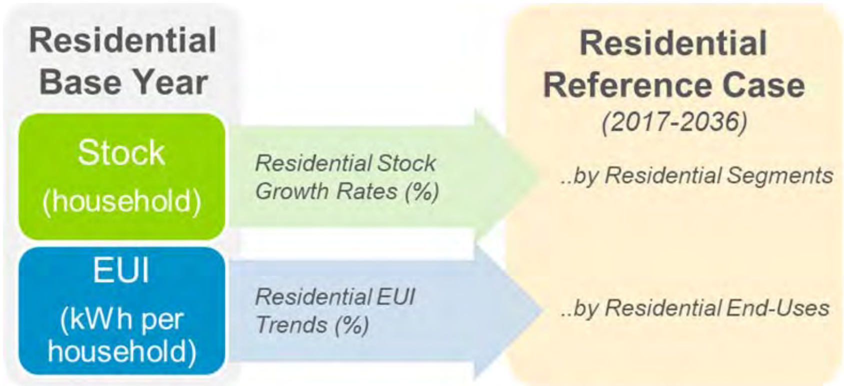
- **Residential and Commercial:** For the residential and commercial sectors, Navigant used two inputs: stock growth rates and EUI trends. Navigant developed stock growth projections of residential households and commercial floor area, and estimated the natural change in end-use consumption over time.
- **Industrial:** Because the industrial reference case forecast is built by applying the electricity sales growth rates—as projected by SaskPower's load forecast—to the base year industrial sales, Navigant did not develop stock forecasts or EUI changes for the industrial sector.

The following sections describe the approach and assumptions and present the results of the residential, commercial, and industrial reference case forecasts.

2.2.1 Residential Reference Case

Navigant built the residential reference case by first developing a forecast of residential stock and EUI trends and applying them to the base year profile. Figure 13 illustrates this process. Appendix B.2 provides a description of the process used to develop the residential stock forecast.

Figure 13. Residential Reference Case Schematic



Source: Navigant

The first step in developing the residential reference case involved developing stock growth rates for each residential segment over the 2018-2036 period. Navigant derived residential stock growth rates based on SaskPower's residential load forecast and applied them to the base year residential stock. Table 11 shows the growth in residential stock forecast from 2016 to 2036. Residential stock increases at an average annual growth rate of 1.5% from approximately 464,000 accounts in 2016 to 622,000 accounts in 2036.

Table 11. Residential Reference Case Stock Forecast (Accounts)

Segment	2016	2036
Single Detached Homes	312,154	423,229
Attached/Row Housing	32,425	43,963
Apartments/Condos	70,565	95,675
Electrically Heated First Nations	2,604	3,531
Non-Electrically Heated First Nations	12,988	17,610
Farm Houses	32,348	36,006
Mobile/Other	1,188	1,610
Total	**464,273**	**621,624**

Source: Navigant analysis of SaskPower's residential load forecast

The next step involved developing residential EUI trends. Navigant used SaskPower's 2016 Itron end-use model to develop the residential EUI trends. The Itron model incorporates two key inputs—equipment saturation and unit energy consumption—to develop a forecast of electricity consumption by equipment type (e.g., electric furnace, central air conditioner, freezers, refrigerators, etc.). Navigant rolled up these equipment types to the end-use level and used the resulting end-use forecasts as EUI trends. The team then calibrated the EUI trends so the residential reference case forecast was consistent with SaskPower's load forecast. Appendix B.2 provides a description of the process used to develop the EUI trends and the calibration process.

Table 12 shows the resulting EUI trends by residential end use. Space cooling, lighting, and electronics are the end uses with the most drastic changes in consumption over time. Electricity consumption from space cooling is expected to increase at an average annual growth rate of 1.4% per year, with increased penetration of central and room air conditioning systems. Electricity consumption from lighting is projected to decrease at 1.3% per year as the market share of more energy efficient lighting products continues to increase. Electronics consumption shows the largest increase in consumption at 2.2%, driven primarily by adoption of new consumer electronics and increased penetration of traditional large electronics.

Table 12. Residential Reference Case EUI Forecast (kWh/Account)

Segment	End Use	2016	2036
Single Detached Homes	Space Heating	1,221	1,340
	Space Cooling	768	1,038
	Water Heating	368	344
	Appliances	2,452	2,506
	Lighting	1,580	1,211
	Electronics	1,751	2,766
	Other	1,016	1,015
	Total	**9,156**	**10,220**
Attached/Row Housing	Space Heating	555	609
	Space Cooling	340	459
	Water Heating	94	88
	Appliances	1,700	1,737
	Lighting	698	535
	Electronics	854	1,350
	Other	252	252
	Total	**4,494**	**5,031**
Apartments/Condos	Space Heating	597	655
	Space Cooling	555	750
	Water Heating	106	99
	Appliances	1,489	1,521
	Lighting	612	469
	Electronics	727	1,149
	Other	219	219
	Total	**4,304**	**4,862**
Electrically Heated First Nations	Space Heating	9,338	10,253
	Space Cooling	847	1,145
	Water Heating	1,617	1,514
	Appliances	2,877	2,940
	Lighting	1,481	1,134
	Electronics	2,084	3,293

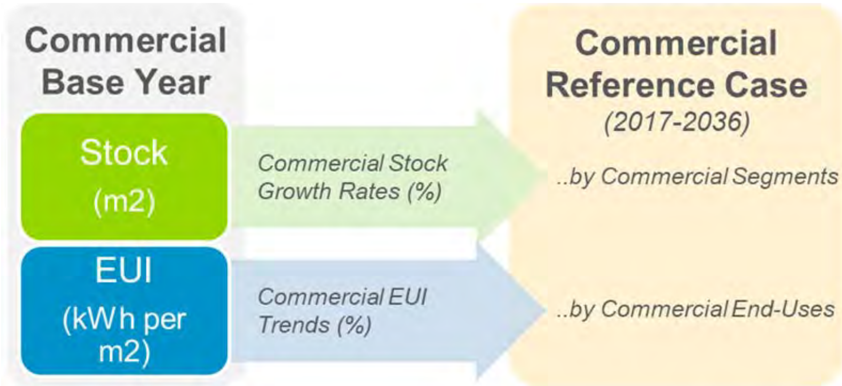
Segment	End Use	2016	2036
	Other	1,325	1,324
	Total	**19,569**	**21,602**
Non-Electrically Heated First Nations	Space Heating	1,558	1,710
	Space Cooling	1,003	1,355
	Water Heating	398	373
	Appliances	3,405	3,480
	Lighting	1,753	1,343
	Electronics	2,467	3,898
	Other	1,569	1,567
	Total	**12,152**	**13,725**
Farm Houses	Space Heating	1,572	1,726
	Space Cooling	989	1,337
	Water Heating	473	443
	Appliances	3,158	3,227
	Lighting	2,035	1,559
	Electronics	2,254	3,562
	Other	1,309	1,307
	Total	**11,790**	**13,161**
Mobile/Other	Space Heating	937	1,029
	Space Cooling	642	867
	Water Heating	815	763
	Appliances	2,179	2,227
	Lighting	1,122	859
	Electronics	1,579	2,494
	Other	1,004	1,003
	Total	**8,277**	**9,243**

Source: Navigant analysis of Itron End-Use Model and base year EUIs

2.2.2 Commercial Reference Case

Navigant built the commercial reference case by first developing commercial EUI trends. Navigant applied those EUIs to SaskPower's commercial load forecast and back calculated the implied commercial stock forecast. Figure 14 illustrates this process. Appendix 0 provides a description of the process used to develop the commercial stock forecast.

Figure 14. Commercial Reference Case Schematic



Source: Navigant

Navigant's approach for developing commercial EUI trends leveraged commercial equipment and end-use data from a different Canadian province. The team used this dataset to determine the frequency at which commercial customers upgrade existing equipment to more efficient equipment (e.g., on average, what percentage of office buildings upgrade space cooling equipment every year). The second piece of data required was the average improvement in equipment efficiency (e.g., the expected improvement in efficiency from upgrading space cooling equipment). The team estimated the average improvement in end-use efficiency by characterizing savings from energy efficiency measures. Navigant used this process to estimate expected changes in EUI for each commercial segment and end use.

Table 13 shows the base year EUIs and the 2036 EUIs calculated using the EUI trends. Appendix 0 provides a description of the process used to develop the commercial EUI trends. EUI trends in the commercial sector are different than those in the residential sector. Electricity consumption across all commercial end uses is projected to decrease on a kilowatt-hour (kWh) per square meter basis, whereas certain end uses are projected to increase in the residential sector. The end uses that show the biggest decrease in consumption over time are lighting and HVAC fans/pumps at an average of 1.0% and 0.8% per year, respectively.

Table 13. Commercial Reference Case EUI Forecast (kWh/m^2)

Segment	End Use	2016	2036
Office	Space Heating	5	5
	Space Cooling	13	12
	Water Heating	2	2
	Cooking	1	1
	HVAC Fans/Pumps	40	33
	Lighting	59	49
	Office Equipment	26	26
	Refrigeration	1	1
	Other	7	7
	Total	**154**	**136**

Segment	End Use	2016	2036
Food Retail	Space Heating	3	2
	Space Cooling	9	8
	Water Heating	4	4
	Cooking	6	5
	HVAC Fans/Pumps	41	35
	Lighting	114	91
	Office Equipment	3	3
	Refrigeration	306	276
	Other	10	10
	Total	**496**	**435**
Non-Food Retail	Space Heating	5	4
	Space Cooling	7	6
	Water Heating	1	1
	Cooking	2	2
	HVAC Fans/Pumps	21	18
	Lighting	88	70
	Office Equipment	15	15
	Refrigeration	5	4
	Other	6	6
	Total	**148**	**125**
Hospital	Space Heating	3	3
	Space Cooling	8	8
	Water Heating	1	1
	Cooking	8	7
	HVAC Fans/Pumps	72	60
	Lighting	74	62
	Office Equipment	15	15
	Refrigeration	4	3
	Other	8	8
	Total	**192**	**166**
Lodging	Space Heating	12	10
	Space Cooling	10	9
	Water Heating	5	5
	Cooking	5	5
	HVAC Fans/Pumps	30	28
	Lighting	53	44

Segment	End Use	2016	2036
	Office Equipment	14	14
	Refrigeration	2	2
	Other	2	2
	Total	**132**	**118**
Restaurant	Space Heating	17	15
	Space Cooling	17	17
	Water Heating	22	21
	Cooking	38	33
	HVAC Fans/Pumps	55	48
	Lighting	118	96
	Office Equipment	2	2
	Refrigeration	68	63
	Other	3	3
	Total	**339**	**297**
School	Space Heating	1	1
	Space Cooling	4	4
	Water Heating	1	1
	Cooking	3	2
	HVAC Fans/Pumps	13	11
	Lighting	38	30
	Office Equipment	15	15
	Refrigeration	2	1
	Other	7	7
	Total	**82**	**72**
University/College	Space Heating	1	1
	Space Cooling	8	7
	Water Heating	6	6
	Cooking	2	2
	HVAC Fans/Pumps	56	46
	Lighting	81	70
	Office Equipment	19	19
	Refrigeration	2	2
	Other	6	6
	Total	**181**	**159**
Warehouse/ Wholesale	Space Heating	2	2
	Space Cooling	4	4

Segment	End Use	2016	2036
	Water Heating	1	1
	Cooking	1	1
	HVAC Fans/Pumps	13	12
	Lighting	51	42
	Office Equipment	2	2
	Refrigeration	15	15
	Other	8	8
	Total	**97**	**87**
Ice Rinks	Space Heating	6	6
	Space Cooling	-	-
	Water Heating	2	2
	Cooking	2	2
	HVAC Fans/Pumps	13	11
	Lighting	69	55
	Office Equipment	4	4
	Refrigeration	109	106
	Other	2	2
	Total	**207**	**187**
Other	Space Heating	4	3
	Space Cooling	8	7
	Water Heating	3	3
	Cooking	3	2
	HVAC Fans/Pumps	35	29
	Lighting	62	51
	Office Equipment	14	14
	Refrigeration	4	4
	Other	7	7
	Total	**138**	**120**

Source: Navigant analysis

To develop the commercial stock forecast, Navigant applied the commercial EUIs to SaskPower's commercial load forecast. Table 14 shows the reference case commercial floor space stock. Commercial floor space stock is projected to increase at 1.5% per year from just under 29 million square meters in 2016 to almost 39 million square meters in 2036.

Table 14. Commercial Reference Case Stock Forecast (million m^2)

Segment	2016	2036
Office	6.29	8.45

Segment	2016	2036
Food Retail	0.47	0.64
Non-Food Retail	3.53	4.74
Hospital	1.00	1.34
Lodging	1.34	1.81
Restaurant	0.62	0.84
School	1.59	2.14
University/College	1.71	2.30
Warehouse/Wholesale	5.84	7.85
Ice Rinks	0.28	0.37
Other	6.08	8.18
Street Lighting	-	-
Total	**28.76**	**38.66**

Source: Navigant analysis

2.2.3 Industrial Sector

Navigant developed the industrial reference case forecast based on SaskPower's load forecast and did not incorporate stock or EUI trends. For the industrial sector, electricity load levels are analogous to building stocks such that the industrial reference case forecast grows or declines in accordance with SaskPower's forecast of industrial electricity consumption. Table 15 shows the industrial reference case forecast of electricity consumption.

Industrial electricity consumption is forecasted to grow more than 30% from just under 14,000 GWh in 2016 to over 18,000 GWh in 2036. The potash mines and oil & gas segments are projected to show the greatest increase in consumption over the forecast period.

Table 15. Industrial Reference Case Forecast (GWh)

Segment	2016	2036
Potash Mines	2,598	5,024
Northern Mines	558	689
Steel	610	783
Oil & Gas	6,664	8,148
Pulp & Paper	938	959
Manufacturing	1,630	1,868
Farms	810	650
Total	**13,809**	**18,121**

Source: Navigant analysis of SaskPower load forecast

2.2.4 Reference Case Forecast and Comparison with Utility Forecast

This section provides the final reference case forecast and compares the sector-level results of the reference case forecast with SaskPower's load forecast. Table 16 summarizes the results of the reference case for each sector and customer segment. Navigant computed these results by applying the stock and EUI forecasts presented in previous sections.

Table 16. Reference Case Forecast (GWh)

Sector	Segment	2016	2036
Residential	Single Detached Homes	2,858	4,325
	Attached/Row Housing	146	221
	Apartments/Condos	304	465
	Electrically Heated First Nations	51	76
	Non-Electrically Heated First Nations	158	242
	Farm Houses	381	474
	Mobile/Other	10	15
	Total Residential	**3,907**	**5,818**
Commercial	Office	968	1,146
	Food Retail	235	278
	Non-Food Retail	523	596
	Hospital	192	223
	Lodging	178	215
	Restaurant	211	248
	School	131	155
	University/College	310	365
	Warehouse/Wholesale	568	684
	Ice Rinks	58	70
	Other	840	981
	Street Lighting	74	96
	Total Commercial	**4,289**	**5,057**
Industrial	Potash Mines	2,598	5,024
	Northern Mines	558	689
	Steel	610	783
	Oil & Gas	6,664	8,148
	Pulp & Paper	938	959
	Manufacturing	1,630	1,868
	Farms	810	650
	Total Industrial	**13,809**	**18,121**
Total		**22,005**	**28,997**

Source: Navigant analysis

Table 17 compares the projected electricity consumption in 2036 between the reference case and SaskPower's load forecast. Because most of the demand growth assumptions underlying the load forecast were used as inputs to develop the reference case, the two forecasts are consistent.

Table 17. Comparison of Reference Case and SaskPower Load Forecast

Sector	2036 Sales (GWh)		Difference (%)
	Reference Forecast	SaskPower Forecast	
Residential	5,818	5,818	0.0%
Commercial	5,057	5,057	0.0%
Industrial	18,121	18,121	0.0%
Total	**28,997**	**28,997**	**0.0%**

Source: Navigant analysis

The demand forecast is addressed within the DR study.

2.3 Frozen EUI Case and Natural Change

Navigant's DSMSim model uses the building stock projections from the reference case forecast to calculate technical and economic potential but does not use the reference case's time-changing EUIs. Rather, it freezes the EUIs from the reference case forecast at 2016 levels and holds them fixed over time. This section describes the reasons for this approach and the method by which the team links the frozen EUI case back to the reference case using natural change. Appendix C provides the details of natural change.

2.3.1 Frozen EUI Case

The reference case includes many embedded assumptions derived from observed trends in the market and forward-looking expectations. The reference case allows for EUIs to change over time as a function of the following:

- Changing mix of efficient vs. inefficient equipment
- Changing use of building space (e.g., open plan office spaces)
- Changing mix of commercial activities (e.g., decrease in manufacturing and increase in service industries)
- New trends in consumption (e.g., increase in use of home electronics)
- Fuel-switching (e.g., switching from gas appliances to electric appliances, or vice versa)

Modeling these considerations at the measure level would require a detailed adoption forecast for every measure in each customer segment. Typically, potential studies forecast measure-level adoption when looking at achievable market potential in the context of utility-sponsored energy efficiency programs. The achievable market potential hinges on expected levels of incentives, program budgets, and marketing/advertising levels, and there is adequate industry experience to provide substance to these forecasts. Conversely, it is difficult to estimate retrospectively what would have happened with measure adoption in the absence of energy efficiency programs (typically estimated through NTG ratio studies), and it is even more difficult and uncertain to forecast such natural behavior at the measure level. Since program design is outside the scope of this study and considering the inherent uncertainty in forecasting natural adoption at the measure level, Navigant did not pursue and create detailed measure adoption forecasts for technical and economic potential. Rather, the study uses a frozen EUI approach to estimate technical and economic potential combined with an estimation of aggregate EUI trends to calculate the natural change expected at the end-use level.

Navigant calculated technical and economic potential assuming EUIs are frozen at 2016 levels, ensuring consistency between modeled energy sales and measure characterization. For example, measure characterization assumes a fixed mix of efficient and inefficient measures over time—absent any energy efficiency programs—implying that EUIs do not change over time when calculating technical and economic potential. However, building stock changes (e.g., growth in the residential customer count or commercial floor space) can increase overall energy sales and assumed total equipment counts, which would affect the estimates for technical and economic potential.

If EUIs are changing in the reference case, Navigant calculated what this study refers to as the natural change—defined in Section 2.3.2—of EUIs over time. The team then applied this natural change to the technical and economic potential results using the frozen EUI to estimate the shift in potential savings.

2.3.2 Natural Change

Navigant's definition of natural change stems from two related concepts: natural conservation and natural growth. Natural conservation is a well-established concept in DSM programs and typically refers to actions taken by utility customers—in the absence of utility-sponsored programs—to improve energy efficiency and reduce consumption. These actions are occurring naturally, with no influence from utilities or program administrators. Natural growth refers to actions taken by utility customers to increase consumption without the involvement of utility-guided programs. An example of natural growth is home electronics, where customers may be increasing their electric consumption (e.g., through addition of more televisions, computers, etc.) and causing an increase in the electronics EUI.

This study captures the effects of natural conservation as well as natural growth within the EUIs and defines these effects as natural change. Appendix C discusses how the team derived these natural changes of EUIs for the reference case. When natural change is positive for an end-use category, it reflects growth. When natural change is negative, it reflects conservation. The technical and economic results sections conclude with a comparison of potential before and after accounting for natural change.

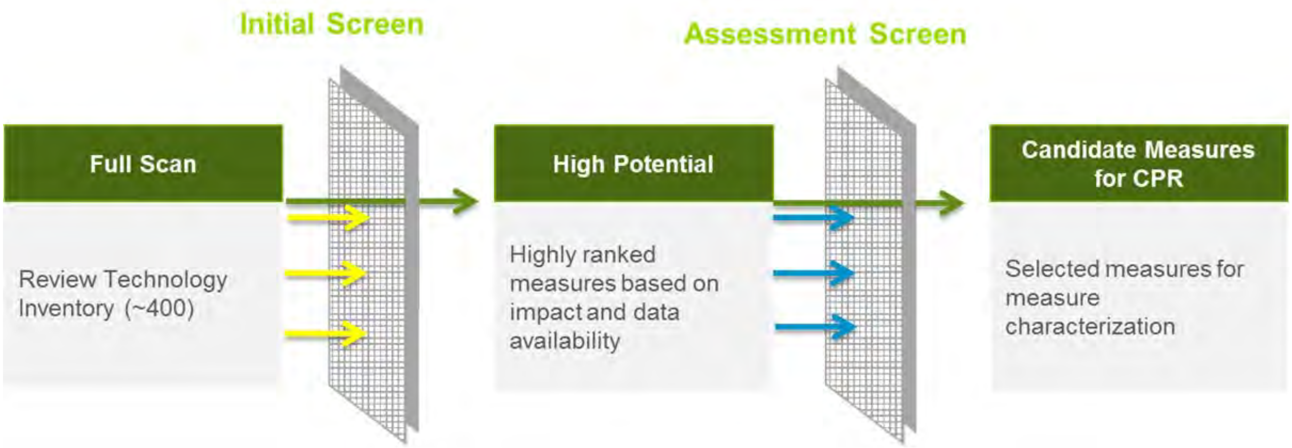
2.4 Measure Characterization

Navigant fully characterized over 140 measures across SaskPower's residential, commercial, and industrial sectors. The team prioritized high-impact measures with good data availability that are most likely to be cost-effective for inclusion into DSMSim.

2.4.1 Measure List

Navigant developed a comprehensive measure list of energy efficiency measures likely to contribute to achievable market potential. The team reviewed current SaskPower program offerings, the 2010 SaskPower CPR, other Canadian programs, and potential model measure lists from other jurisdictions in Canada to identify energy efficiency measures with the highest expected economic impact. The team supplemented the measure list using secondary data from publicly available sources including TRMs from various US regions including Pennsylvania, Illinois, Massachusetts, and the mid-Atlantic. Navigant prioritized measures in existing SaskPower programs based on data availability and measures most likely to be cost-effective. The team also ensured that high impact measures were captured in the list. The team worked with SaskPower to finalize the measure list and ensure it contained applicable industrial and ice rink measures as well as technologies viable for future SaskPower program planning activities. Figure 15 shows the process the team implemented to narrow down the measure list. Appendix D.1 provides the final measure list and assumptions.

Figure 15. Measure Screening Process



Source: Navigant

There were many measures included in the initial and assessment screens that did not make it into the CPR. The measures that did not become candidate measures for the CPR are documented in the accompanying *SaskPower_CPR_MeasureList* workbook. Working sessions with SaskPower staff revealed topics of note regarding the following measures:

- **Residential smart appliances:** Smart appliances monitor and control energy use in response to customer settings. Almost all smart appliance features contribute to customer convenience rather than energy savings. Some features shift load, which benefits the grid but does not necessarily save energy. Therefore, Navigant did not include smart appliances in this study.
- **Residential smart products:** These products include thermostats, plugs, power bars, switches, and light bulbs. Navigant included smart thermostats, plugs, and power bars in this study but did not include smart switches and light bulbs due to the lack of verified savings data for these measures.
- **Q-Sync motors (commercial):** Q-sync motors are proprietary synchronous motors manufactured by QM Power. These motors are more efficient than ECMs and are currently available for commercial refrigeration applications. Navigant included Q-Sync motors for commercial refrigeration in this study, which compete with ECMs. QM Power anticipates developing additional motors for residential applications and HVAC systems. Navigant recommends that SaskPower continue to track Q-Sync motors as a future measure for additional applications such as residential furnace fans and commercial/industrial HVAC systems.
- **Ice rink measures:** Navigant worked closely with SaskPower to include applicable ice rink measures in the commercial measure list. These measures include those currently offered by SaskPower as well as other technologies viable for future SaskPower program planning activities. Current SaskPower measures include ice rink equipment tune-ups, infrared temperature sensors, slab sensors, and night setback programmable controllers. Other technologies include mechanical vortex de-aerators and floating head pressure controls.

- **Industrial measures:** Navigant worked closely with SaskPower to develop and finalize the industrial measure list. The team used the SaskPower Industrial Energy Optimization Program (IEOP) history log and industrial measure expertise from previous potential studies and Navigant industrial subject matter experts to develop this list.

2.4.2 Measure Characterization Key Parameters

The measure characterization effort consisted of defining nearly 50 individual parameters for each of the 140 measures included in this study. This section defines the top nine key parameters and how they influence technical and economic potential savings estimates.

1. **Measure Definition:** The team used the following variables to qualitatively define each characterized measure:
    - ***Replacement Type:*** Replacing the baseline technology with the efficient technology can occur in three variations:
        i. Retrofit (RET): The model considers the baseline to be the existing equipment and uses the energy and demand savings between the existing equipment and the efficient technology during technical potential calculations. RET also applies the full installed cost of the efficient equipment during the economic screening.
        ii. Replace-on-Burnout (ROB): The model considers the baseline to be the code-compliant technology option and uses the energy and demand savings between the current code option and the efficient technology during technical potential calculations. ROB also applies the incremental cost between the efficient and code-compliant equipment during the economic screening.
        iii. New Construction (NEW): The model considers the baseline to be the least cost, code-compliant option and uses the energy and demand savings between this specific current code option and the efficient technology during technical potential calculations. NEW also applies the incremental cost between the efficient and code-compliant equipment during the economic screening.
    - ***Baseline Definition:*** Describes the baseline technology.
    - ***Energy Efficiency Definition:*** Describes the efficient technology set to replace the baseline technology.
    - ***Unit Basis:*** The normalizing unit for energy, demand, cost, and density estimates.
2. **Sector and End-Use Mapping:** The team mapped each measure to the appropriate end uses, customer segments, and sectors across SaskPower's service territory. Section 2.1 describes the breakdown of customer segments within each sector.
3. **Annual Energy Consumption:** The annual energy consumption in kWh for each base and energy efficient technology
4. **Fuel Type Applicability Multipliers:** Applies an adjustment to the total equipment stock to account for the proportion applicable to a given measure's fuel type. For example, a measure that replaces a baseline efficiency resistance water heater with a more efficient unit is only applicable to existing electric resistance water heaters. The team used this multiplier to restrict the existing water heater equipment stock to only those that use electricity. Table 18 provides the fuel share splits.

Table 18. Fuel Share Splits for Domestic Hot Water and Space Heating[4]

Customer Segment	DHW – Elec Only	DHW – Gas Only	Space Heating – EH + EC	Space Heating – EH + NC	Space Heating – GH + EC
Food Retail	0.15000	0.85000	0.021099	0.008901	0.706848
Hospital	0.01000	0.99000	0.007033	0.002967	0.721422
Ice Rinks	0.10000	0.90000	0.021099	0.008901	0.706848
Lodging	0.15000	0.85000	0.063297	0.026703	0.663126
Non-Food Retail	0.15000	0.85000	0.021099	0.008901	0.706848
Office	0.17500	0.82500	0.021099	0.008901	0.706848
Other	0.15000	0.85000	0.021099	0.008901	0.706848
Restaurant	0.15000	0.85000	0.070330	0.029670	0.655838
School	0.15000	0.85000	0.007033	0.002967	0.721422
University/College	0.15000	0.85000	0.007033	0.002967	0.721422
Warehouse/Wholesale	0.15000	0.85000	0.007033	0.002967	0.721422
Apartments/Condos	0.21622	0.78378	0.173077	0.038462	0.634615
Attached/Row Housing	0.11538	0.88462	0.074074	0.037037	0.629630
Electrically Heated First Nations	1.00000	0.00000	0.703297	0.296703	0.000000
Farm Houses	0.58000	0.34000	0.112527	0.047473	0.306058
Mobile/Other	0.32743	0.63717	0.073394	0.036697	0.559633
Non-Electrically Heated First Nations	0.00000	0.70411	0.000000	0.000000	0.728709
Single Detached Homes	0.11944	0.87500	0.042056	0.018692	0.671963

Source: Navigant analysis

5. **Measure Lifetime:** The lifetime in years for the base and energy efficient technologies. The base and energy efficient lifetimes only differ in instances where the two cases represent inherently different technologies, such as LEDs compared to a baseline incandescent bulb.
6. **Incremental Costs:** The incremental cost between the assumed baseline and efficient technology, using the following variables:
   - ***Base Costs*****:** The cost of the base equipment, including both material and labor costs.
   - ***Energy Efficient Costs:*** The cost of the energy efficient equipment.
7. **Technology Densities:** This study defines density as the penetration or saturation of the baseline and efficient technologies across the service territory. For residential, these saturations are on a per home basis; for commercial, they are per 1,000 square meters of building space; and for industrial, they are based on energy consumption.[5]

[4] EH = electric heating, EC = electric cooling, NC = no cooling, GH = gas heat

[5] Navigant sourced density estimates from the residential end-use survey (REUS), farm end-use survey (FEUS), commercial lighting end-use survey, program data, and other related secondary resources.

- ***Base Initial Saturation*:** The initial saturation of the baseline equipment for a given customer segment, as defined by the fraction of the end-use stock that has the baseline equipment installed.
- ***Energy Efficiency Initial Saturation:*** The initial saturation of the efficient equipment for a given customer segment, as defined by the fraction of the end-use stock that has the efficient measure installed.
- ***Total Maximum Density:*** The total number of both the baseline and efficient units for a given technology.

8. **Technology Applicability:** The percentage of the base technology that can be reasonably and practically replaced with the specified efficient technology. For instance, occupancy sensors are only practical for certain interior lighting fixtures (an applicability less than 1.0), while all existing incandescent exit signs can be replaced with efficient LED signs (an applicability of 1.0).
9. **Competition Group:** The team combined efficient measures competing for the same baseline technology density into a single competition group to avoid the double counting of savings. (Section 3.1.2 provides further explanation on competition groups.)

2.4.3 Measure Characterization Approaches and Sources

This section provides approaches and sources for the main measure characterization variables. SaskPower provided its measure and assumptions list for the residential and commercial sectors. Navigant worked with each of the SaskPower sector teams to ensure appropriate estimating of technical potential. Additional discussions occurred with the industrial team to further customize industrial measures.

Table 19. Measure Characterization Input Data Sources

Measure Input	Data Sources
Measure Costs, Measure Life, Energy and Gas Savings	• SaskPower program data • NRCan data • 2010 SaskPower CPR • British Columbia, Nova Scotia, and Ontario study data • US Department of Energy (DOE) Appliance Standards and Rulemakings supporting documents • Engineering analyses • Industrial Assessment Center (IAC) database • TRMs and Regional Technical Forum (RTF) measure workbooks • Navigant measure database and previous potential studies

Measure Input	Data Sources
Fuel Type Applicability Splits, Density, Baseline Initial Saturation, Technical Suitability, End-Use Consumption Breakdown	• SaskPower Residential End-Use Survey (REUS) • SaskPower Farm End-Use Survey (FEUS) • SaskPower program data • NRCan data • Industrial program data and technical audit reports • SaskPower Commercial Lighting Market Study • 2010 SaskPower CPR • ENERGY STAR shipment reports • Canadian Jurisdiction density and saturation data • Manufacturing Energy Consumption Survey (MECS) • Residential Building Stock Assessment (RBSA) and Commercial Building Stock Assessment (CBSA) • Navigant previous potential studies
Codes and Standards	• NRCan policies and standards • US DOE Code of Federal Regulations (CFR) engineering analyses

Source: Navigant

2.4.3.1 Energy Savings

Navigant took three general bottom-up approaches to analyzing residential and commercial measure energy savings:

1. **SaskPower measure and assumptions lists:** Navigant used the SaskPower residential and commercial TRM summary sheets as much as possible for unit energy savings calculations.
2. **Standard algorithms:** Navigant used standard algorithms for unit energy savings calculations for most measures. To supplement this, the team also leveraged NRCan data, DOE Appliance Standards and Rulemakings supporting documents, RTF measure workbooks, and TRMs.
3. **Engineering analysis:** Navigant used appropriate engineering algorithms to calculate energy savings for any measures not included in SaskPower programs or available TRMs. The team leveraged its internal expertise and experience with potential studies to calculate the energy savings.

2.4.3.2 Peak Demand Savings

Navigant used the 8,760 load shapes developed for this project for peak demand savings. The load shape development methodology and analysis is provided in Appendix F. The team developed load shapes for each segment and end use and assigned a load shape to each measure. A load shape provides the hourly percentage of annual load for a specific end use, meaning that the sum of hourly fractions over 1 year will result in 1 kWh. From these load shapes, Navigant calculated a peak load shape factor for winter and summer peak periods.

Equation 1. Peak Load Shape Factor (PLSF)

$$Peak\ Load\ Shape\ Factor = \sum_{i}^{n} Hourly\ Fractional\ Load_i$$

$$PLSF = HFL_{Hour\ 1} + HFL_{Hr\ 2} + HFL_{Hr\ 3} + HFL_{Hr\ 4} \ldots + HFL_{\ Hr\ (Peak\ Period\ Hours-1)} + HFL_{Hr\ Peak\ Period\ Hours}$$

Where, *i* = the hour during the peak period for *n* hours. For example, the winter peak period is the hours ending 18-21 on weekdays, non-holidays in December-February. The sum of the hourly fractional load during these hours multiplied by the annual kWh savings for the measure equals the measure peak demand savings.

Equation 2. Peak Demand Savings

$$Peak\ Demand\ Savings = \frac{Peak\ Load\ Shape\ Factor\ x\ Annual\ kWh\ Savings}{Peak\ Period\ Hours}$$

For this methodology, PLSF/Peak Period Hours is equal to the percentage of a measure's average energy savings that occur on a single peak hour. For this current study, the peak period hours are:

- Winter: Hours ending 18-21 on non-holiday weekdays in December-February
- Summer: Hours ending 15-18 on non-holiday weekdays in June-August

The Methodology for Peak Savings workbook includes the calculations of the PLSFs used for this study.

Reporting Peak Demand Savings

As described in Appendix E, the SaskPower system peak as it relates to available capacity switches from a winter peaking utility to a summer peaking utility in 2028. Therefore, the potential results for peak demand savings are provided for the winter peak period through 2027, and starting in 2028, the peak demand savings are provided for the summer peak period.

Prescriptive vs. Custom Peak Demand Savings Calculation

For the potential study analysis, all measures use the PLSF analysis approach for defining peak demand savings. This approach is for planning and forecasting use. However, it is recognized that some measures such as variable speed drives and occupancy sensors alter the end-use load shape. Because the load shapes are developed based on a standard building, they are a good approximation of the existing load shape and are deemed applicable to these subsets of measures. For some of these measures, especially the custom (industrial) measures, it is highly encouraged to use a customized calculation for the peak demand savings. The customized peak demand savings calculations should either be based on impact load shapes, which could be derived by modeling measures within the standard building prototypes, or via industry standard protocols for measurement and verification.[6]

[6] http://www.pjm.com/-/media/documents/manuals/m18b.ashx is the PJM Manual 18b: Energy Efficiency Measurement & Verification 2016. The document provides guidelines on the demand reduction value of the energy efficiency resource.

2.4.3.3 Peak Demand Forecast

Navigant derived a bottom-up base year and reference case peak demand forecast using reference case electricity consumption and weighted average peak load shape factors for each customer segment. 6.3Appendix J provides detail on developing the weighted average peak load shape factors and peak demand forecast. The Peak Demand Base and Reference Case workbook includes the calculation of the bottom-up peak demand forecast.

2.4.3.4 Incremental Costs

Navigant relied on the cost information in the SaskPower Measure and Assumptions list summary sheets as much as possible. The team conducted secondary research and used other publicly available cost data sources such as regional TRMs, RTF measure workbooks, the Database for Energy Efficient Resources (DEER), ENERGY STAR, and other state databases for all other cost data.

2.4.3.5 Building Stock and Densities

Navigant developed building stock estimates for the residential sector in terms of residential accounts and the commercial sector in terms of commercial floor space. The approach used to develop the base year and reference case building stock assumptions is described in Appendix B.

Measure densities—used to characterize the penetration or saturation of measures—were developed based on a variety of data sources including SaskPower's REUS and FEUS and commercial and industrial program data provided by SaskPower. For measures not included in these data sources, Navigant leveraged other secondary data sources such as NRCan, ENERGY STAR, RBSA, CBSA, and previous potential studies.

2.4.3.6 Industrial Measures

The industrial sector measure characterization deploys a high-level approach, which differs from the residential and commercial sectors. Navigant characterized industrial measures as a percentage reduction of the customer segment and end-use consumption. The team evaluated past project data from SaskPower to estimate the energy savings and incremental costs for industrial measures. Additionally, Navigant provided descriptions for each industrial segment in Appendix I. These descriptions help frame the analysis for this potential study as the SaskPower industrial load is significant relative to the residential and commercial sectors.

2.4.3.7 8,760 Load Profile

Appendix F provides detail on developing the end-use profiles. These profiles are 8,760 (i.e., hourly annual) end-use load shapes. These profiles are by end use (e.g., space heating, lighting, etc.), by sector (e.g., residential, commercial, etc.), and, where relevant and appropriate, by commercial and industrial segments (e.g., retail, office, etc.).

2.4.4 Codes and Standards Adjustments

NRCan publishes all federal energy efficiency regulations. Amendment 15[7] states that the intent of the amendment is to “align with energy efficiency standards in force or expected to be in force in the U.S.” The US DDOE Technical Support Documents (TSD)[8] contain information on energy and cost impacts of each appliance standard. Engineering analysis is available in Chapter 5 of the TSD, energy use analysis is available in Chapter 7, and cost impact is available in Chapter 8.

As these codes and standards take effect, the energy savings from existing measures impacted by these codes and standards decline and the reduction is transferred to the codes and standards savings potential. Navigant accounts for the effect of codes and standards through baseline energy and cost multipliers (sourced from the DOE’s analysis), which reduce the baseline equipment consumption starting from the year a code or standard takes effect. The baseline cost of an efficient measure impacted by codes and standards will often increase upon implementation of the code. For example, Navigant incorporated the 2020 incandescent/halogen lighting provision in this study, which results in the baseline for general service lighting changing from an incandescent/halogen to a CFL-level wattage in 2020. Accordingly, the model accounts for a reduction in energy consumption and an increase in cost in 2020 for the baseline technology through the codes and standards multipliers. As such, computed measure-level potential is net of these adjustments from codes and standards implemented after the first year of the study.

2.4.5 Measure Quality Control

Navigant fully vetted and characterized each measure in terms of its energy savings, costs, and applicability. The team then screened these measures to readily integrate with the DSMSim model. The characterization includes the following:

- Measure descriptions and baseline assumptions
- Energy savings and cost associated with the measure
- Cost of conserved energy (CCE), including O&M costs
- Lifetime of the measure (EUL and RUL[9])
- Applicability factors including initial energy efficient market penetration and technical suitability
- Load shape of measure
- Replacement type of measure

2.5 Overall Potential Methodology

Navigant employed its proprietary DSMSim potential model to estimate the technical, economic, and achievable savings potential for electric energy and electric demand across SaskPower’s service territory.

[7] Natural Resources Canada Amendment 15 to the Energy Efficiency Regulations. Access at: http://www.nrcan.gc.ca/energy/regulations-codes-standards/19384

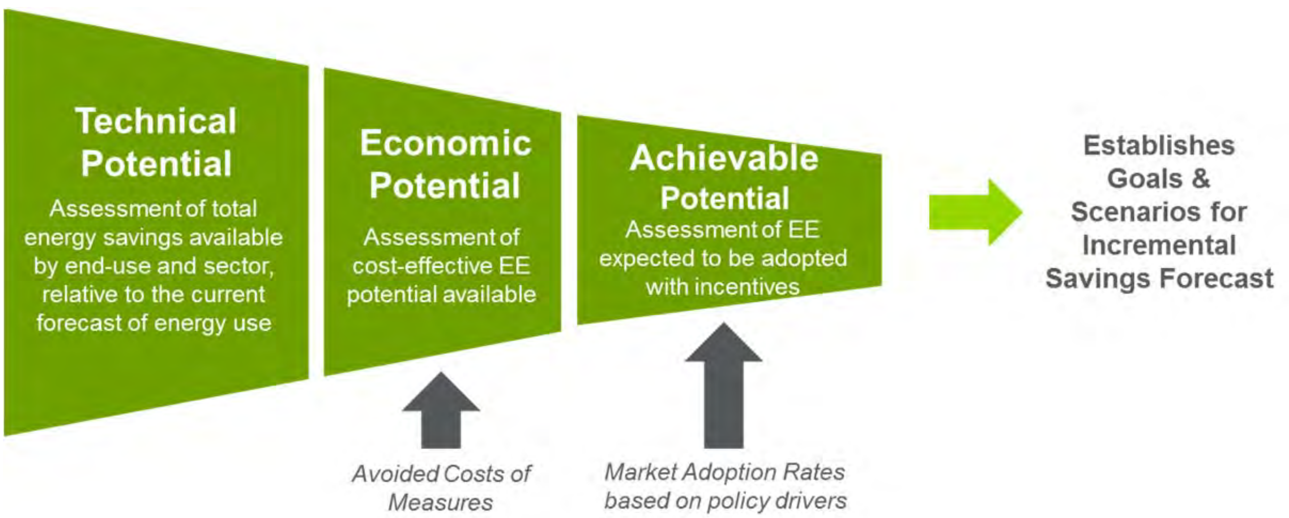
[8] Appliance standards rulemaking notices and TSD can be found at: http://energy.gov/eere/buildings/current-rulemakings-and-notices

[9] Remaining useful life

DSMSim is a bottom-up technology diffusion and stock tracking model implemented using a System Dynamics[10] framework. The DSMSim model explicitly accounts for different types of efficient measures such as RET, ROB, and NEW, and the effects these measures have on savings potential. The model then reports the technical, economic, and achievable potential savings in aggregate for the service territory, sector, customer segment, end-use category, and highest impact measures.

This study defines technical potential as the total energy savings available assuming all installed measures can immediately be replaced with the efficient measure/technology—wherever technically feasible—regardless of the cost, market acceptance, or whether a measure has failed and must be replaced. Economic potential is a subset of technical potential, using the same assumptions regarding immediate replacement as in technical potential but including only those measures that have passed the benefit-cost test chosen for measure screening—in this case, the Total Resources Cost (TRC) test.[11] Finally, the achievable potential is analyzed based on the measure adoption ramp rates and the diffusion of technology through the market. Figure 16 provides an overview of the methodology.

Figure 16. Potential Calculation Methodology



Source: Navigant

Savings reported in this study are gross rather than net, meaning they do not include the effects of natural change (as described in Section 2.3.2). Providing gross potential is advantageous because it permits a reviewer to more easily calculate net potential when new information about NTG ratios or changing EUIs become available.

Once the potential results and scenarios are analyzed, the output can be used to define the portfolio energy savings goals, budgets, and forecast for alignment into other utility planning landscapes like the IRP. These elements are described in Section 5.

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[10] See Sterman, John D. *Business Dynamics: Systems Thinking and Modeling for a Complex World*. Irwin McGraw-Hill. 2000 for detail on System Dynamics modeling. Also, see http://en.wikipedia.org/wiki/System_dynamics for a high-level overview.

[11] SaskPower quantifies the Utility Cost Test (UCT) for comparison to other energy resources. The UCT is reported for achievable potential.

3. TECHNICAL POTENTIAL FORECAST

This section describes Navigant's approach to calculating technical potential and presents the results for SaskPower's service territory.

3.1 Approach to Estimating Technical Potential

This study defines technical potential as the total energy savings available assuming all installed measures can immediately be replaced with the efficient measure/technology—wherever technically feasible—regardless of the cost, market acceptance, or whether a measure has failed and must be replaced.

Navigant used its DSMSim model to estimate the technical potential for demand-side resources in the regions considered for this study. DSMSim is a bottom-up technology diffusion and stock tracking model implemented using a system dynamics framework.[12]

Navigant's modeling approach considers an energy efficient measure to be any change made to a building, piece of equipment, process, or behavior that can save energy.[13] The savings can be defined in numerous ways depending on which method is most appropriate for a given measure. Measures like efficient water heaters are best characterized as some fixed amount of savings per water heater. Savings for measures like commercial automated building controls are typically characterized as a percentage of customer segment consumption or per square meter, while measures like industrial ventilation heat recovery are characterized as a percentage of end-use consumption. The model can appropriately handle savings characterizations for all three methods.

The calculation of technical potential in this study differs depending on the assumed measure replacement type. Technical potential is calculated on a per-measure basis and includes estimates of savings per unit, measure density (e.g., quantity of measures per home), and total building stock in each service territory. The study accounts for three replacement types, where potential from RET and ROB measures are calculated differently from potential for NEW measures. The formulae used to calculate technical potential by replacement type are shown in the following sections.

3.1.1 Retrofit and ROB Measures

Retrofit measures, commonly referred to as advancement or early retirement measures, are replacements of existing equipment before the equipment fails. Retrofit measures can also be efficient processes that are not currently in place and that are not required for operational purposes. Retrofit measures incur the full cost of implementation rather than incremental costs to some other baseline technology or process because the customer could choose not to replace the measure and would, therefore, incur no costs. In contrast, ROB measures, sometimes referred to as lost opportunity measures, are replacements of existing equipment that have failed and must be replaced or are existing processes that must be renewed. Because the failure of the existing measure requires a capital

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[12] See Sterman, John D. *Business Dynamics: Systems Thinking and Modeling for a Complex World*. Irwin McGraw-Hill. 2000 for detail on System Dynamics modeling. Also, see http://en.wikipedia.org/wiki/System_dynamics for a high-level overview.

[13] This study does not examine the impact of end-user electricity rates on consumption nor energy efficiency's impact on electricity rates.

investment by the customer, the cost of implementing ROB measures is always incremental to the cost of a baseline (and less efficient) measure.

Retrofit and ROB measures have a different meaning for technical potential compared with new construction measures. In any given year, the model uses the existing building stock for the calculation of technical potential.[14] This method does not limit the calculated technical potential to any pre-assumed rate of adoption of retrofit measures. Existing building stock is reduced each year by the quantity of demolished building stock in that year and does not include new building stock that is added throughout the simulation. For retrofit and ROB measures, annual potential is equal to total potential, thus offering an instantaneous view of technical potential. Equation 3 was used to calculate technical potential for retrofit and ROB measures.

Equation 3. Annual/Total RET/ROB Technical Savings Potential

Total Potential = Existing Building Stock$_{YEAR}$ (e.g., buildings[15]) X Measure Density (e.g., widgets/building) X Savings$_{YEAR}$ (e.g., kWh/widget) X Technical Suitability (dimensionless)

3.1.2 New Construction Measures

The cost of implementing new construction measures is incremental to the cost of a baseline (and less efficient) measure. However, new construction technical potential is driven by equipment installations in new building stock rather than by equipment in existing building stock.[16] New building stock is added to keep up with forecast growth in total building stock and to replace existing stock that is demolished each year. Demolished (sometimes called replacement) stock is calculated as a percentage of existing stock in each year, and this study uses a demolition rate of 0.5% per year for residential and commercial stock and 0% for industrial stock. New building stock (the sum of growth in building stock and replacement of demolished stock) determines the incremental annual addition to technical potential, which is then added to totals from previous years to calculate the total potential in any given year. The equations used to calculate technical potential for new construction measures are provided in Equation 4 and Equation 5.

Equation 4. Annual Incremental NEW Technical Potential (AITP)

AITP$_{YEAR}$ = New Buildings$_{YEAR}$ (e.g., buildings/year[17]) X Measure Density (e.g., widgets/building) X Savings$_{YEAR}$ (e.g., kWh/widget) X Technical Suitability (dimensionless)

Equation 5. Total NEW Technical Potential (TTP)

$$\text{TTP} = \sum_{YEAR=2018}^{YEAR=2035} AITP_{YEAR}$$

[14] In some cases, customer-segment-level and end-use-level consumption are used as proxies for building stock. These consumption figures are treated like building stock in that they are subject to demolition rates and stock-tracking dynamics.

[15] Units for building stock and measure densities may vary by measure and customer segment (e.g., 1,000 square meters of building space, number of residential homes, customer-segment consumption/sales, etc.).

[16] In some cases, customer-segment-level and end-use-level consumption are used as proxies for building stock. These consumption figures are treated like building stock in that they are subject to demolition rates and stock-tracking dynamics.

[17] Units for new building stock and measure densities may vary by measure and customer segment (e.g., 1,000 square meters of building space, number of residential homes, customer-segment consumption, etc.)

3.1.3 Competition Groups

Navigant's modeling approach recognizes that some efficient technologies will compete against each other in the calculation of potential. The study defines competition as an efficient measure competing for the same installation as another efficient measure. For instance, a consumer has the choice to install a compact fluorescent or LED lamp, but not both. These efficient technologies compete for the same installation.

General characteristics of competing technologies used to define competition groups in this study include the following:

- Competing efficient technologies share the same baseline technology characteristics, including baseline technology densities, costs, and consumption.
- The total (baseline plus efficient) measure densities of competing efficient technologies are the same.
- Installation of competing technologies is mutually exclusive (i.e., installing one precludes installation of the others for that application).
- Competing technologies share the same replacement type (RET, ROB, or NEW).

To address the overlapping nature of measures within a competition group, Navigant's analysis only selects one measure per competition group to include in the summation of technical potential across measures (e.g., at the end use, customer segment, sector, service territory, or total level). The measure with the largest energy savings potential in each competition group is used for calculating total technical potential of that competition group. This approach ensures that the aggregated technical potential does not double count savings. The model does still, however, calculate the technical potential for each individual measure outside of the summations.

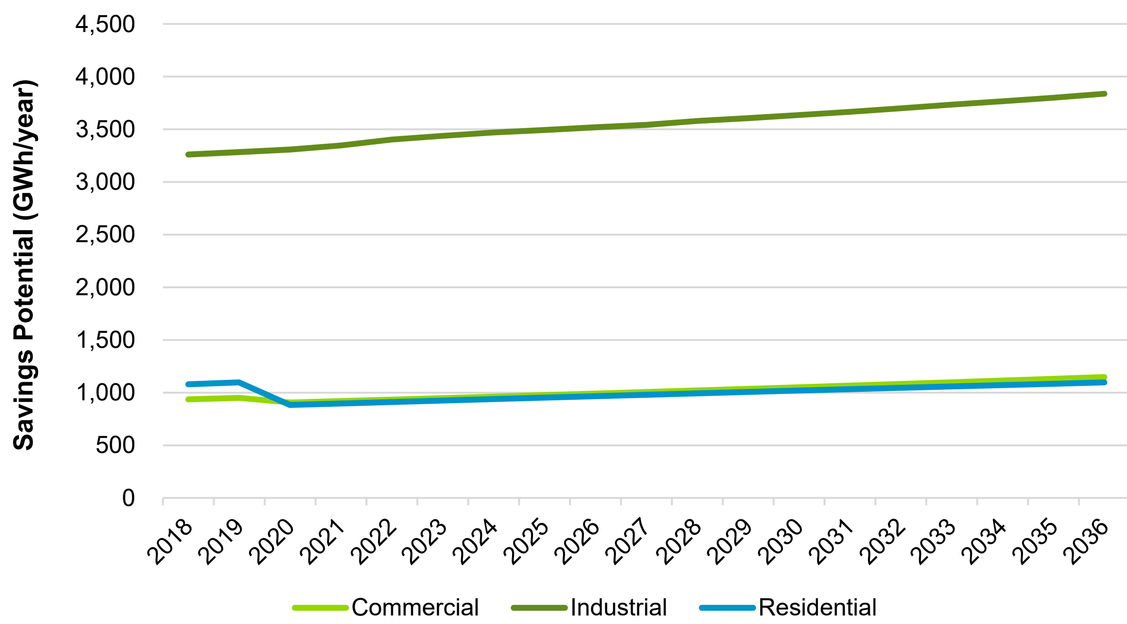
3.2 Technical Potential Results

This subsection provides DSMSim results pertaining to total technical savings potential at different forms of aggregation. Results are shown by sector, customer segment, and highest impact measures. The subsection concludes with a review of natural change and its impacts on technical potential.

3.2.1 Results by Sector

Figure 17 shows the total electric energy technical savings potential for each sector. The decrease in 2020 for the residential sector is the effect of the change in the general service lamp code, which results in the baseline changing from an incandescent/halogen to a CFL-level wattage.

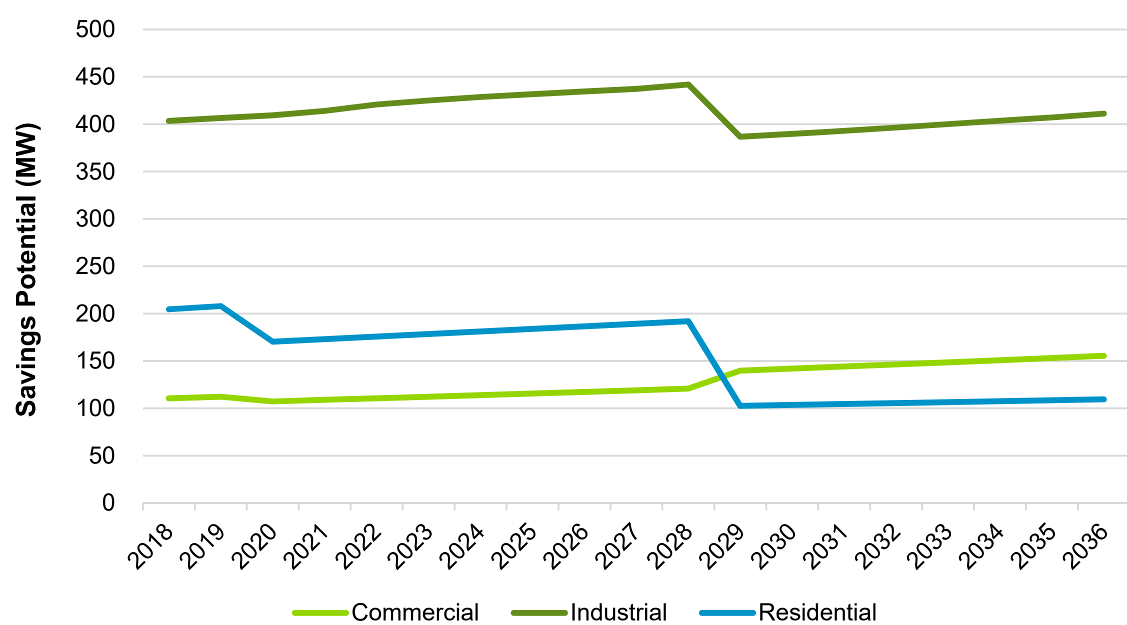
Figure 17. Electric Energy Technical Savings Potential by Sector (GWh/year): 2018-2036



Source: Navigant analysis

Figure 18 shows the electric demand savings potential for all sectors. There is a similar demand decrease in 2020 for the residential sector due to the lighting code change. However, the decrease in 2028 for the industrial and residential sectors is related to the switch from SaskPower being a winter peaking utility to a summer peaking utility.

Figure 18. Electric Demand Technical Savings Potential by Sector (MW): 2018-2036



Source: Navigant analysis

Table 20 shows the electric energy technical savings potential for each sector as a percentage of that sector's total forecasted consumption.

Table 20. Electric Energy Technical Savings Potential by Sector as a Percentage of Sector Consumption (%,GWh)

Year	All	Commercial	Industrial	Residential
2018	21.5%	20.2%	21.9%	21.4%
2019	21.3%	20.2%	21.7%	21.4%
2020	20.2%	19.0%	21.6%	17.0%
2021	20.1%	19.0%	21.5%	17.0%
2022	20.0%	19.0%	21.4%	17.0%
2023	20.0%	19.0%	21.4%	17.0%
2024	20.0%	19.0%	21.3%	17.0%
2025	19.9%	19.0%	21.2%	17.0%
2026	19.9%	19.0%	21.2%	17.0%
2027	19.9%	19.0%	21.1%	17.0%
2028	19.8%	18.9%	21.1%	17.0%
2029	19.8%	18.9%	21.0%	17.0%
2030	19.7%	18.9%	21.0%	17.0%
2031	19.7%	18.9%	20.9%	17.0%
2032	19.7%	18.9%	20.9%	17.0%
2033	19.6%	18.9%	20.8%	17.0%
2034	19.6%	18.9%	20.7%	17.0%
2035	19.6%	18.9%	20.7%	17.0%
2036	19.5%	18.9%	20.6%	17.0%

Source: Navigant analysis

3.2.2 Results by Customer Segment

Figure 19, Figure 20, and Figure 21 break out the electric energy technical savings potential for each sector by customer segment. For each sector, the largest technical potential is associated with the largest customer segment. These segments are residential single family detached homes, commercial office, and industrial oil & gas.

Figure 19. Residential Electric Energy Technical Potential Customer Segment Breakdown: 2036 (%,GWh)

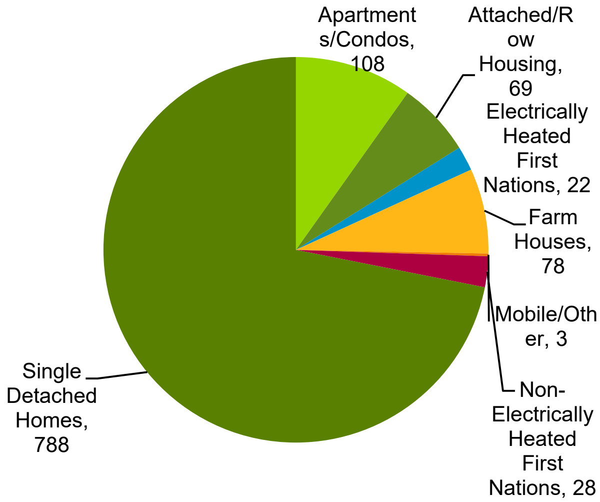


Figure 20. Commercial Electric Energy Technical Potential Customer Segment Breakdown: 2036 (%,GWh)

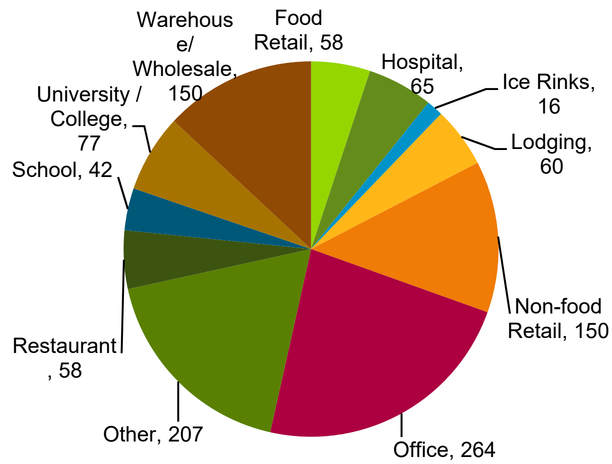
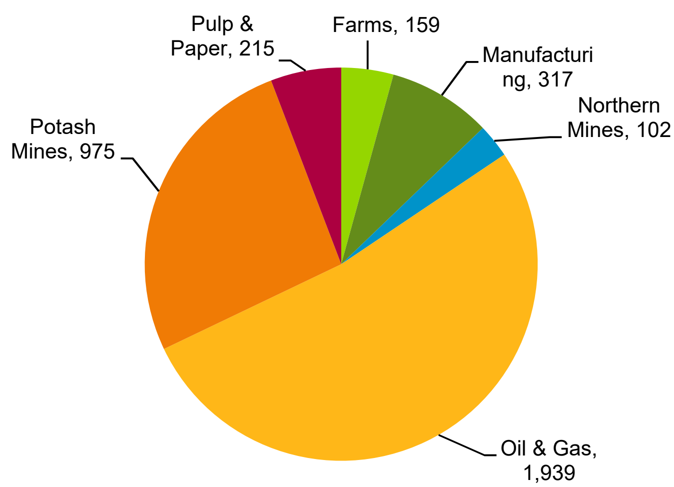


Figure 21. Industrial Electric Energy Technical Potential Customer Segment Breakdown: 2036 (%,GWh)



Source: Navigant analysis

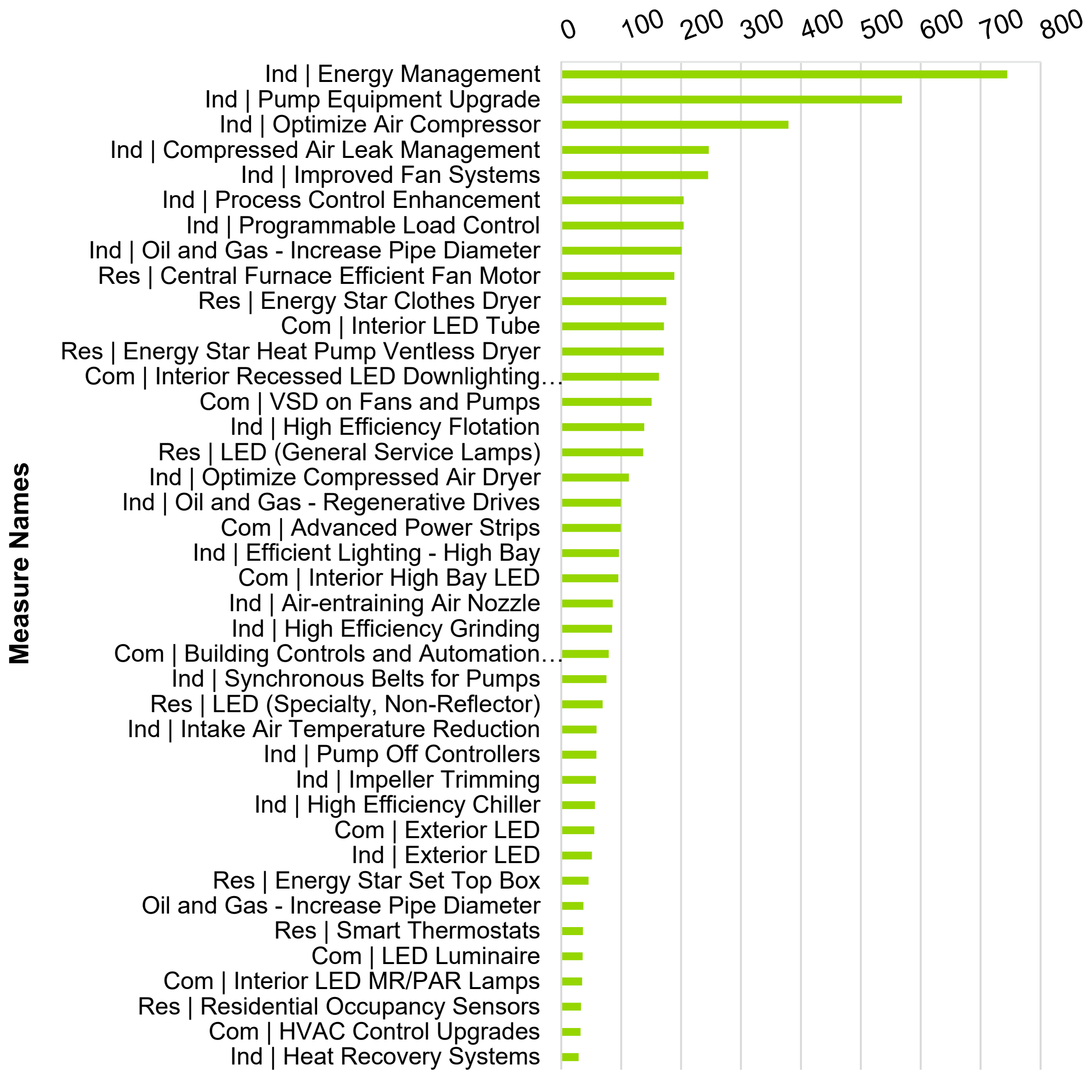
3.2.3 Results by Measure

Figure 22 presents the top 40 measures ranked by their electric energy technical savings potential in 2036. The measure-level savings potential shown in the figure is prior to adjustments made to competition groups. Some of the measures shown here are not included in the customer segment, end use, sector, and portfolio totals because they were not the measures with the greatest savings potential for their respective competition group.

Whenever a group of measures were similar in nature, their potential was consolidated into a representative measure name to produce a more succinct view at the measure level. For example, the LED potential in the figure represents the technical savings potential for several different types of LEDs: general service LEDs, reflector LEDs, troffer LEDs, exterior LEDs, interior recessed LED downlighting, etc.

The biggest energy savings potential is in the industrial segment. This is consistent with the breakdown of SaskPower's load, 63% of which is from the industrial segment. Of the top eight measures (all of which are industrial), two are specific to the oil & gas segment. The remaining two measures in the top 10 are the residential central furnace efficient fan motor and residential clothes dryer.

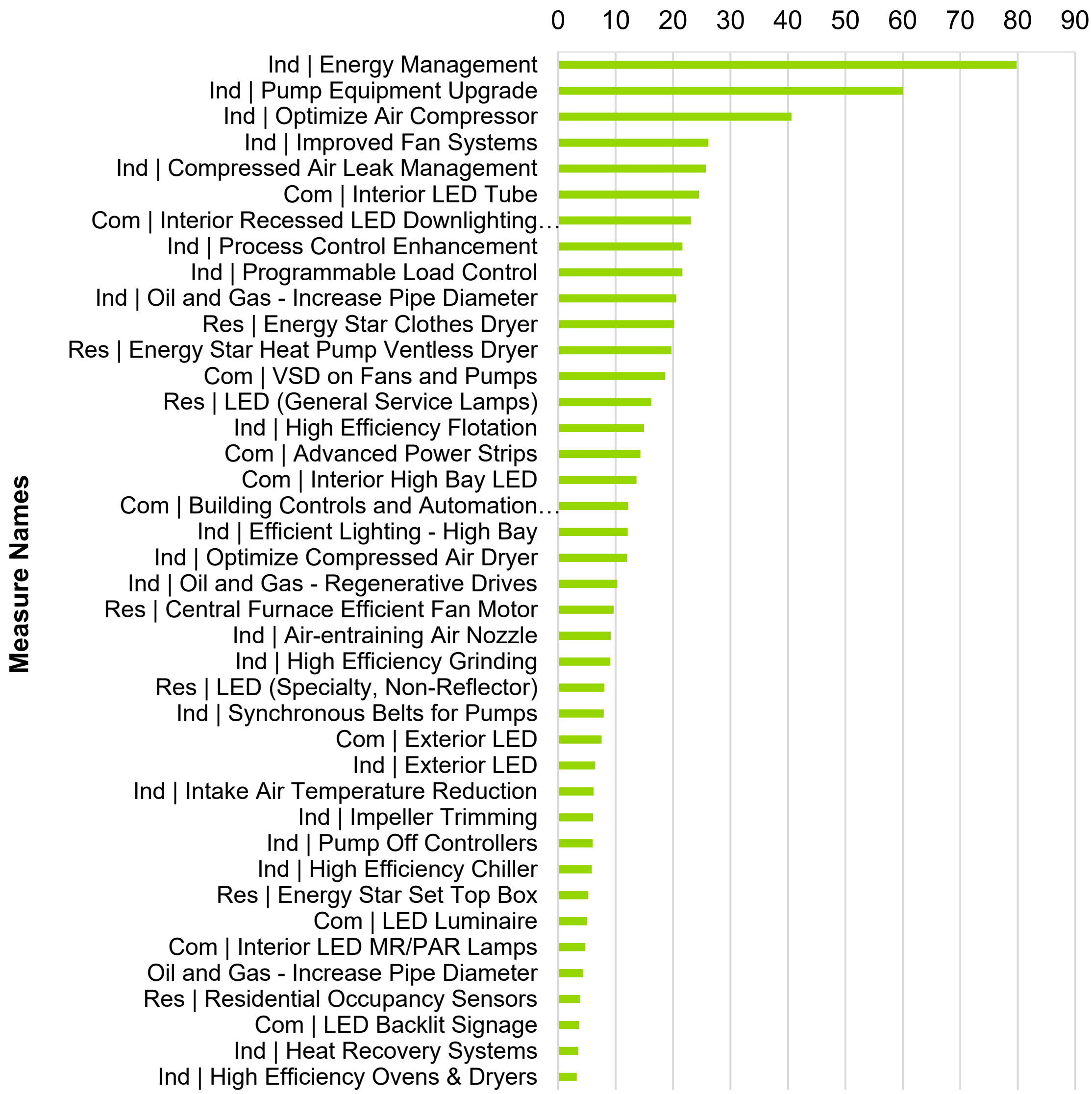
Figure 22. Top 40 Measures for Electric Energy Technical Savings Potential: 2036 (GWh/year)



Source: Navigant analysis

Figure 23 presents the top 40 measures ranked by their electric demand technical savings potential in 2036. Industrial measures do not make the top eight for demand technical potential. Two commercial lighting measures have high technical potential based on their load shapes. The residential central furnace fan motor is number 22 on the list because the summer peak period is the dominant peak period in 2036.

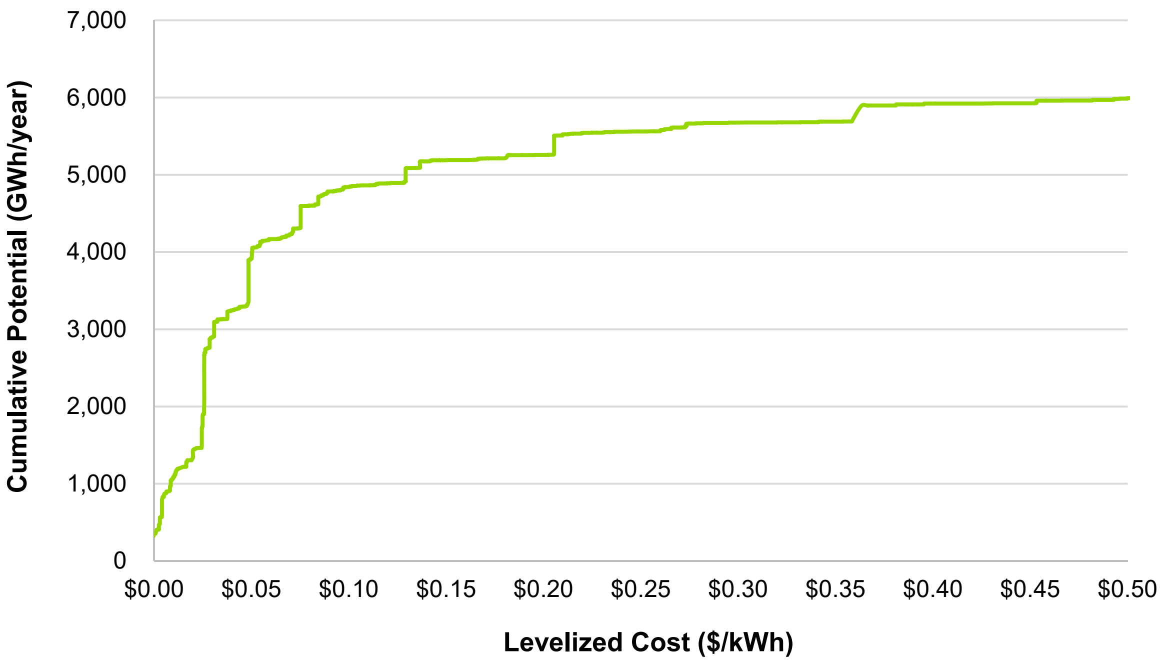
Figure 23. Top 40 Measures for Electric Demand Technical Savings Potential: 2036 (MW)



Source: Navigant analysis

Figure 24 provides a supply curve of savings potential versus levelized cost of savings in $/kWh for all measures considered in the study. From this chart, one can see that roughly half of the total identified technical potential is available at a levelized cost of $0.03/kWh or less and that roughly 75% of the total technical potential is available at less than $0.075/kWh levelized. In this chart, each data point represents a specific combination of efficiency measure and customer segment, hence the high degree of granularity in the curve.

Figure 24. Supply Curve of Electric Energy Technical Potential (GWh/year) vs. Levelized Cost ($/kWh): 2036



Source: Navigant analysis

4. ECONOMIC POTENTIAL FORECAST

This section describes the economic savings potential, which is potential that meets a prescribed level of cost-effectiveness, available in the utility's service territories. The section begins by explaining Navigant's approach to calculating economic potential and then presents the results for economic potential.

4.1 Approach to Estimating Economic Potential

Economic potential is a subset of technical potential, using the same assumptions regarding immediate replacement as in technical potential but including only those measures that have passed the benefit-cost test chosen for measure screening (in this case the TRC test, per the utility's guidance). The TRC ratio for each measure is calculated each year and compared against the measure-level TRC ratio screening threshold of 1.0. A measure with a TRC ratio greater than or equal to 1.0 is a measure that provides monetary benefits greater than or equal to its costs. If a measure's TRC meets or exceeds the threshold, it is included in the economic potential. It is recognized that SaskPower's economic screening should be the Utility Cost Test (UCT) when comparing SaskPower's cost to administer and implement energy efficiency programs versus traditional supply-side resources. However, the TRC is appropriate to evaluate measures, on the margin, for cost-effectiveness in absence of the administrator cots.

The TRC test is a benefit-cost metric that measures the net benefits of energy efficiency measures from the combined stakeholder viewpoint of the utility (or program administrator) and the customers. The TRC benefit-cost ratio is calculated in the model using Equation 6.

Equation 6. Benefit-Cost Ratio for the TRC Test

$$TRC = \frac{PV(Avoided\ Costs)}{PV(Technology\ Cost + Admin\ Costs)}$$

Where:

- *PV( )* is the present value calculation that discounts cost streams over time.
- *Avoided Costs* are the monetary benefits resulting from electric energy and capacity savings—e.g., avoided costs of infrastructure investments and avoided long-run marginal cost (commodity costs) due to electric energy conserved by efficient measures.
- *Technology Cost* is the incremental equipment cost to the customer.
- *Admin Costs* are the administrative costs incurred by the utility or program administrator.

Navigant calculated TRC ratios for each measure based on the present value of benefits and costs (as defined above) over each measure's life. Avoided costs, discount rates, and other key data inputs used in the TRC calculation are presented in Appendix D.2, while measure-specific inputs are provided in Appendix D.1. As agreed upon with the utility, effects of free ridership are not present in the results from this study, so the team did not apply a NTG factor. Providing gross savings results will allow the utility to easily apply updated NTG assumptions in the future and also allows for variations in NTG assumptions by reviewers.

Although the TRC equation includes administrative costs, the study does not consider these costs during the economic screening process because the study is concerned with an individual measure's cost-effectiveness on the margin. The model also excluded administrative costs from this analysis because those costs are largely driven by program design, which is outside of the scope of this evaluation.

Like technical potential, only one economic measure from each competition group is included in the summation of economic potential across measures (e.g., at the end-use category, customer segment, sector, service territory, or total level). If a competition group is composed of more than one measure that passes the TRC test, then the economic measure that provides the greatest electric savings potential is included in the summation of economic potential. This approach ensures that double counting is not present in the reported economic potential, though economic potential for each individual measure is still calculated and reported outside of the summation.

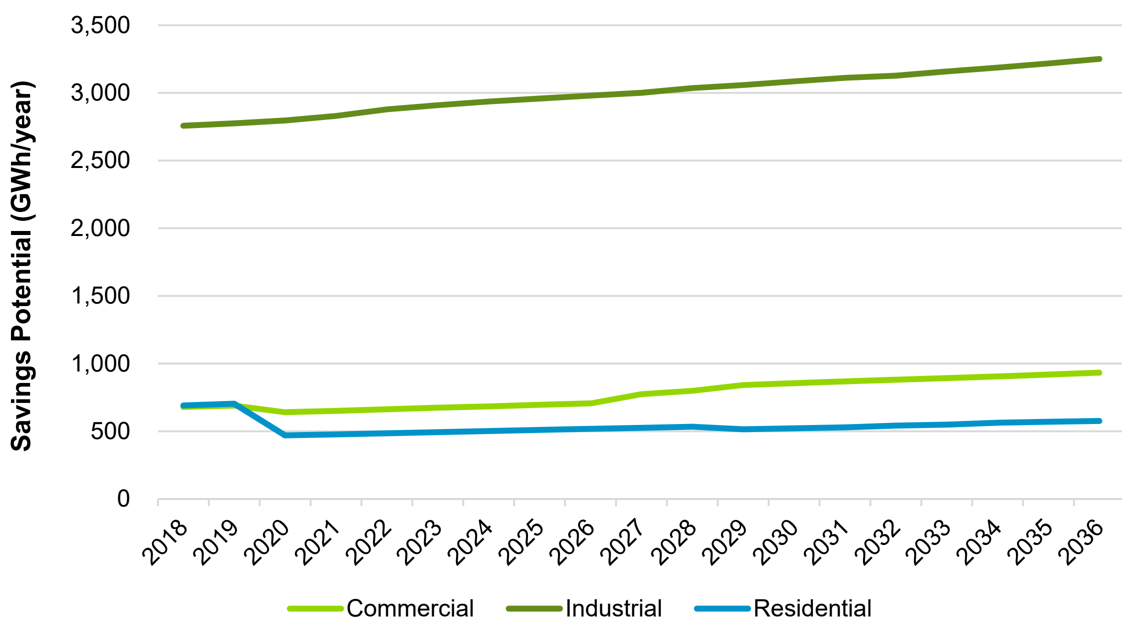
4.2 Economic Potential Results

This subsection provides DSMSim results pertaining to economic savings potential at different forms of aggregation. Results are shown by sector, customer segment, end-use category, and highest impact measures.

4.2.1 Results by Sector

Figure 25 shows economic energy savings potential across all sectors. The decrease in 2020 for the residential sector is the impact of the change in the general service lamp code, which results in the baseline changing from an incandescent/halogen to a CFL-level wattage.

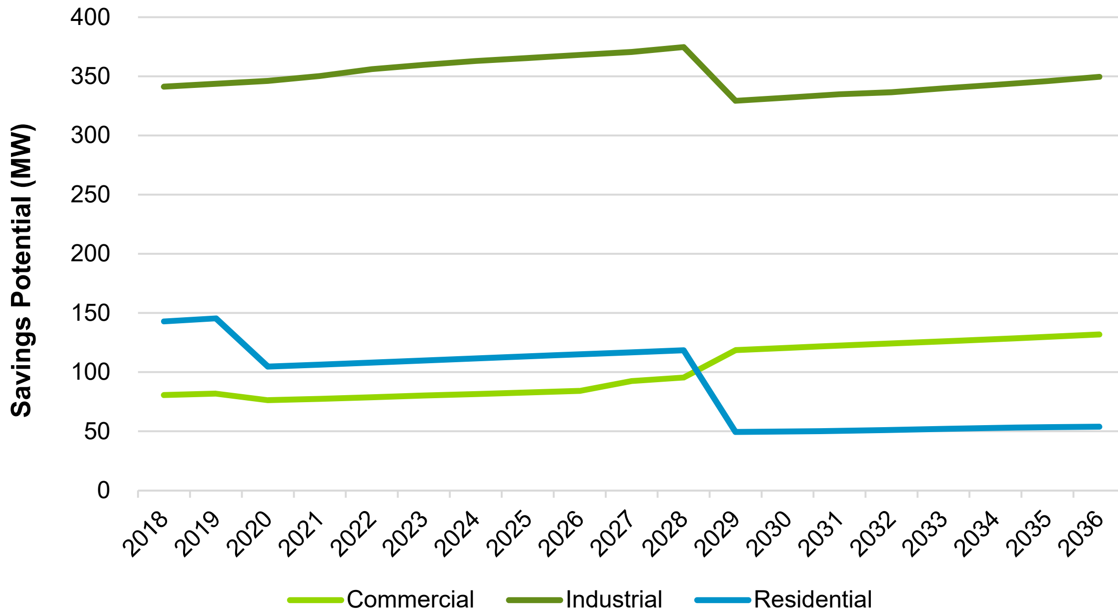
Figure 25. Electric Energy Economic Savings Potential by Sector (GWh/year): 2018-2036



Source: Navigant analysis

Figure 26 presents the economic demand potential in each of the sectors. There is a similar demand decrease in 2020 for the residential sector because of the lighting code change. However, the decrease in 2028 for the industrial and residential sectors is related to the switch from SaskPower being a winter peaking utility to a summer peaking utility.

Figure 26. Electric Demand Economic Savings Potential by Sector (MW): 2018-2036



Source: Navigant analysis

Table 21 shows the economic energy potential as a percentage of consumption for each sector. The economic potential for the residential segment is almost half of the technical potential. The industrial sector economic potential is about 85% of the technical potential.

Table 21. Electric Energy Economic Savings Potential by Sector as a Percentage of Sector Consumption (%, GWh)

Year	All	Commercial	Industrial	Residential
2018	16.8%	14.6%	18.5%	13.7%
2019	16.7%	14.6%	18.3%	13.7%
2020	15.4%	13.4%	18.3%	9.0%
2021	15.4%	13.4%	18.2%	9.0%
2022	15.4%	13.4%	18.1%	9.0%
2023	15.4%	13.5%	18.1%	9.0%
2024	15.3%	13.5%	18.0%	9.1%
2025	15.3%	13.5%	18.0%	9.1%
2026	15.3%	13.5%	18.0%	9.1%
2027	15.5%	14.6%	17.9%	9.1%
2028	15.5%	14.8%	17.9%	9.1%

Year	All	Commercial	Industrial	Residential
2029	15.5%	15.4%	17.8%	8.7%
2030	15.4%	15.4%	17.8%	8.7%
2031	15.4%	15.4%	17.8%	8.7%
2032	15.4%	15.4%	17.6%	8.8%
2033	15.3%	15.4%	17.6%	8.8%
2034	15.3%	15.4%	17.5%	8.9%
2035	15.3%	15.4%	17.5%	8.9%
2036	15.3%	15.4%	17.5%	8.9%

Source: Navigant analysis

4.2.2 Results by Customer Segment

Figure 27, Figure 28, and Figure 29 provide a breakdown of economic energy potential by customer segment and sector.

Figure 27. Residential Electric Energy Economic Potential Customer Segment Breakdown: 2036 (%,GWh)

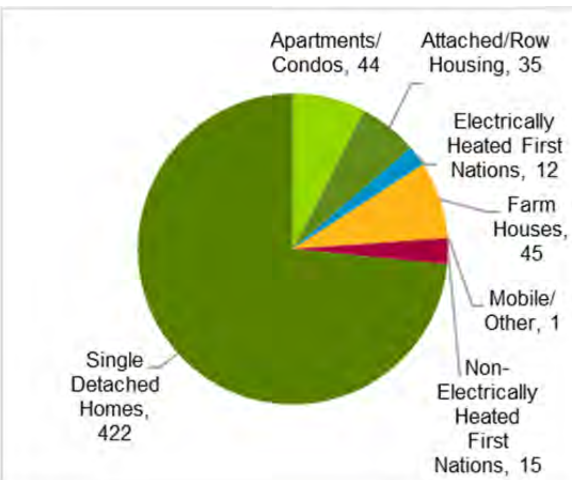


Figure 28. Commercial Electric Energy Economic Potential Customer Segment Breakdown: 2036 (%,GWh)

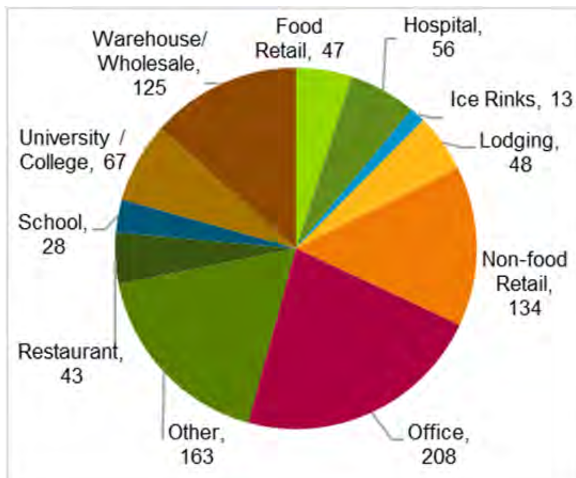
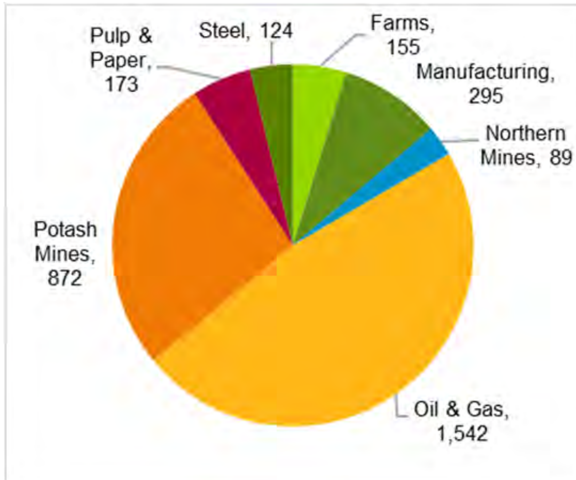


Figure 29. Industrial Electric Energy Economic Potential Customer Segment Breakdown: 2036 (%,GWh)

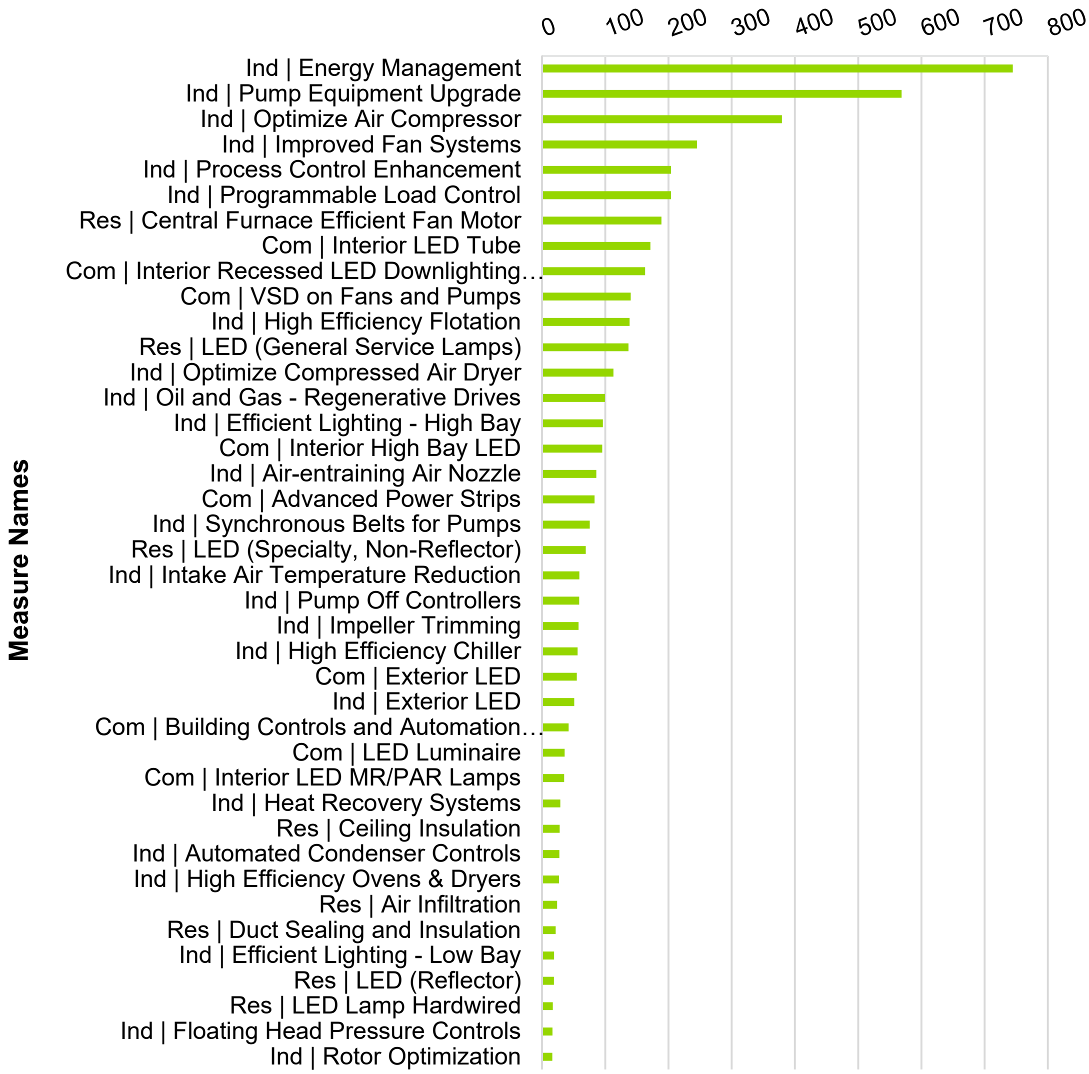


Source: Navigant analysis

4.2.3 Results by Measure

Figure 30 presents the top 40 measures ranked by their electric energy economic savings potential in 2036. The measure-level economic energy savings potential shown in the figure is prior to adjustments made to competition groups, as detailed in Section 3.1.3. When compared with technical potential there are some lighting measures that displaced some industrial measures from the top 10 due to their higher economic potential.

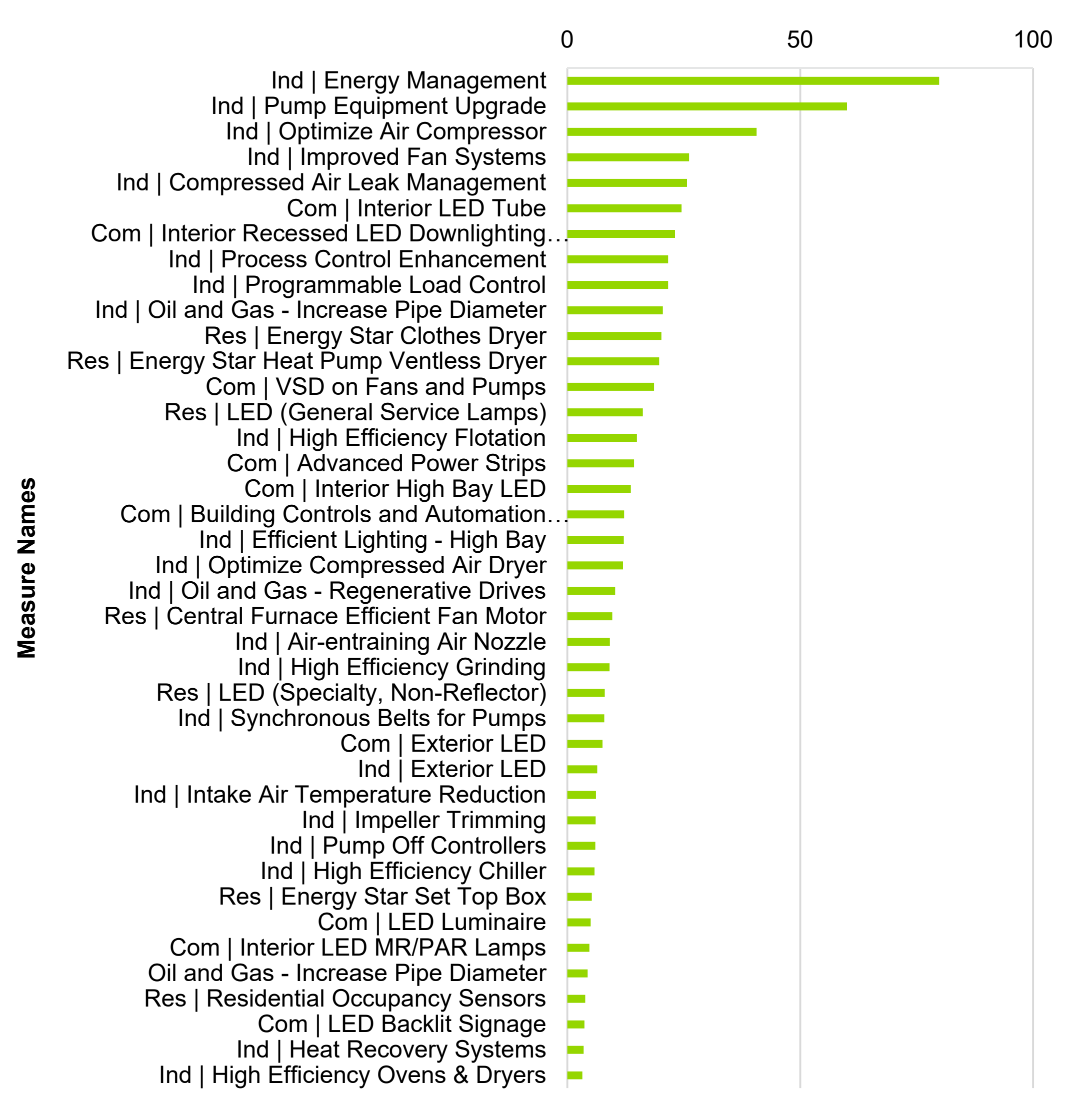
Figure 30. Top 40 Measures for Electric Energy Economic Savings Potential: 2036 (GWh/year)



Source: Navigant analysis

Figure 31 presents the top 40 measures ranked by their electric demand economic savings potential in 2036. The differences in technical and economic demand potential are similar to the differences between technical and economic energy savings potential. The top five technical and economic measures are the same. In aggregate, the industrial sector technical potential is mostly economic where the measures passed the modified TRC test.

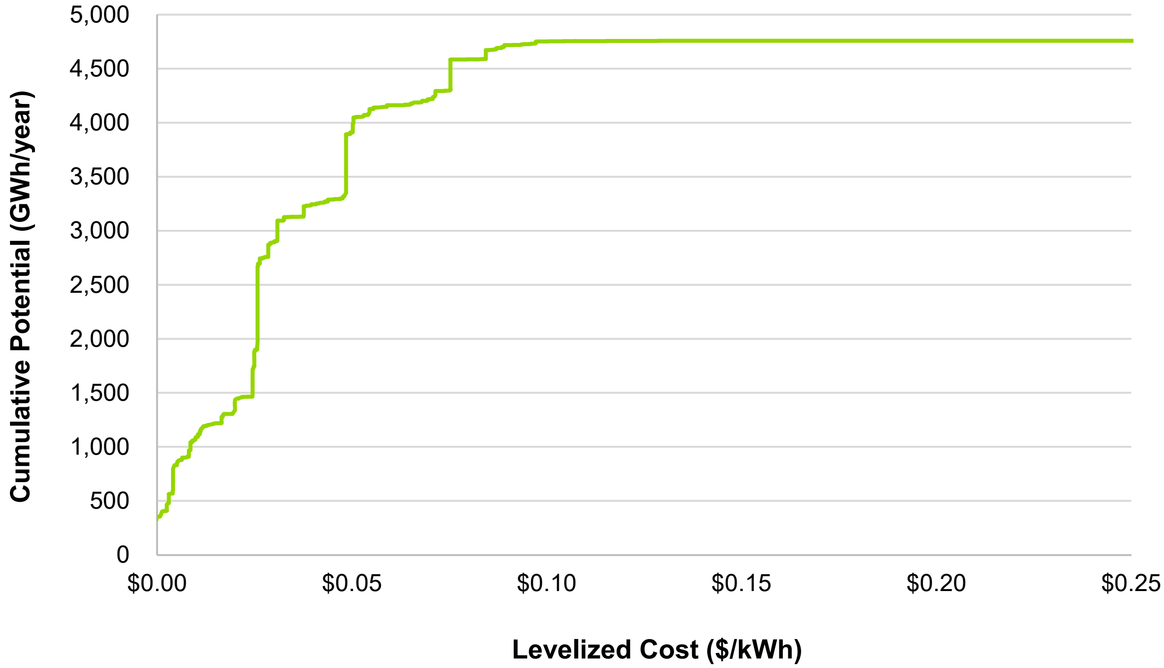
Figure 31. Top 40 Measures for Electric Demand Economic Savings Potential: 2036 (MW)



Source: Navigant analysis

Figure 32 provides a supply curve of savings potential versus levelized cost of savings in $/kWh for all measures considered in the study. The economic potential levels out at about $0.06/kWh; incremental savings above this level become costlier.

Figure 32. Supply Curve of Electric Energy Economic Potential (GWh/year) vs. Levelized Cost ($/kWh): 2036



Source: Navigant analysis

5. ACHIEVABLE POTENTIAL FORECAST

Achievable potential is defined as the subset of economic potential considered achievable given assumptions about the realistic market adoption of a given measure. It is the product of the technical potential with two measure-specific factors: the assumed maximum long-run achievability of each measure and a time-dependent factor that reflects barriers to market adoption. These adoption barriers include consideration of likely implementation strategies, available market delivery channels, potential for adoption by building code or appliance standards, and experience of SaskPower program staff with similar measures, among other factors.

The potential study model uses a maximum long-run achievability factor for each measure (a number between 0 and 1), which reflects the percentage of that measure's technical potential that can be achieved over a long-term time horizon without considering time-dependent barriers to market adoption. The product of this factor with the total technical potential over the study horizon yields the maximum achievable technical potential for each measure.

Navigant modeled the effects of time-dependent barriers to market adoption by applying ramp rates to the maximum achievable technical potential. These ramp rates spread each measure's maximum achievable technical potential over the study horizon, accounting for assumptions about the timing of when this potential will be realized.

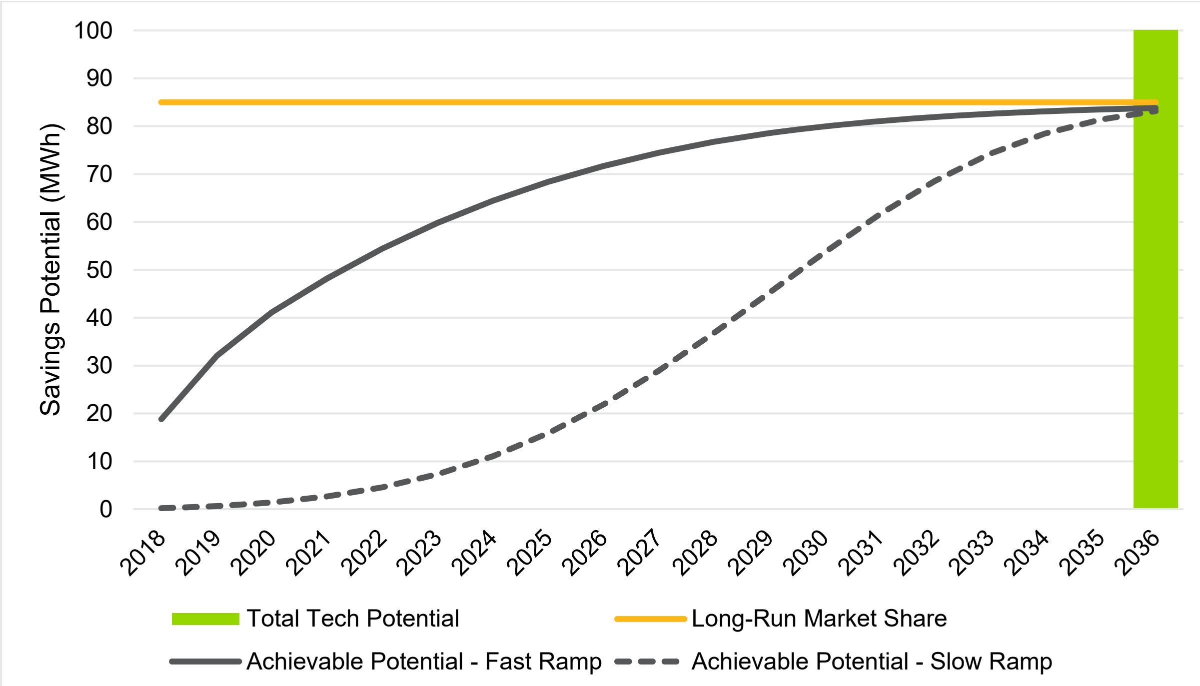
Using the definitions of cumulative total technical potential provided in Section 3.1, Equation 7 provides the formula for calculating achievable technical potential. As shown, Navigant calculated achievable technical potential by multiplying each measure's total technical potential by its maximum achievability factor (generally 100%) and then applying a ramp rate to the resulting maximum achievable technical potential.

Equation 7. Achievable Technical Potential

$$Achievable\ Tech\ Potential_{Year} = Total\ Technical\ Potential \times Max\ Achievability\ Factor \times Ramp\ Rate_{Year}$$

Figure 33 illustrates the relationship between total technical potential, maximum achievable technical potential, and final computed achievable technical potential in each year of the study as a function of ramp rate choice. The timing of achievable technical potential across the study horizon is driven by the choice of ramp rate. All values in the figure are for illustration purposes only.

Figure 33. Illustration of Achievable Technical Potential Calculation



Source: Navigant

For measures involved in competition groups, an additional computational step is required to compute achievable technical potential. While the technical potential for a competition group reflects only the measure in that group with the greatest savings potential, all measures in a competition group may be allocated achievable technical potential based on their attractiveness relative to one another. The product of the technical potential for the competition group with the maximum achievability factor for the group (all measures in a competition group had identical maximum achievability factors) provided the maximum achievable technical potential for that group. The team then allocated this potential across the various competing measures within the group based on their relative customer economics (payback).

For each competition group measure, Navigant computed the relative customer economics ratio to reflect all costs and savings a customer would experience as a result of implementing the measure. The team then input this ratio into a logit discrete choice model[18] to allocate market share across the competing measures based on their relative customer economics. The team then multiplied the resulting market share splits by the maximum achievable technical potential for the group to give the achievable technical potential for each individual measure. This methodology ensured that final estimates of achievable technical potential reflected the relative economic attractiveness of measures in a competition group and that the sum of achievable technical potential from all measures in a competition group reflected the maximum achievable technical potential of the group as a whole.

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[18] A logit formulation is based on documented consumer decision theory that accounts for consumer preferences in competing choices based on the relative and absolute differences between the choices.

See McFadden, D. and Train, K. "Mixed MNL Models for Discrete Response," *Journal of Applied Econometrics,* Vol. 15, No. 5, 447-470. 2000. and Train, K. *Discrete Choice Methods with Simulation*, (Massachusetts: Cambridge University Press, 2003).

5.1 Calculating Achievable Potential

This section demonstrates Navigant's approach to calculating achievable potential, including maximum achievable potential, which is fundamentally more complex than the calculation of technical or economic potential.

The critical first step in the process of accurately estimating achievable potential is to simulate market adoption of energy efficient measures. The team's approach to simulating the adoption of energy efficient technologies for purposes of calculating achievable potential can be broken down into the following two strata:

1. Calculation of the equilibrium market share
2. Calculation of the dynamic approach to equilibrium market share

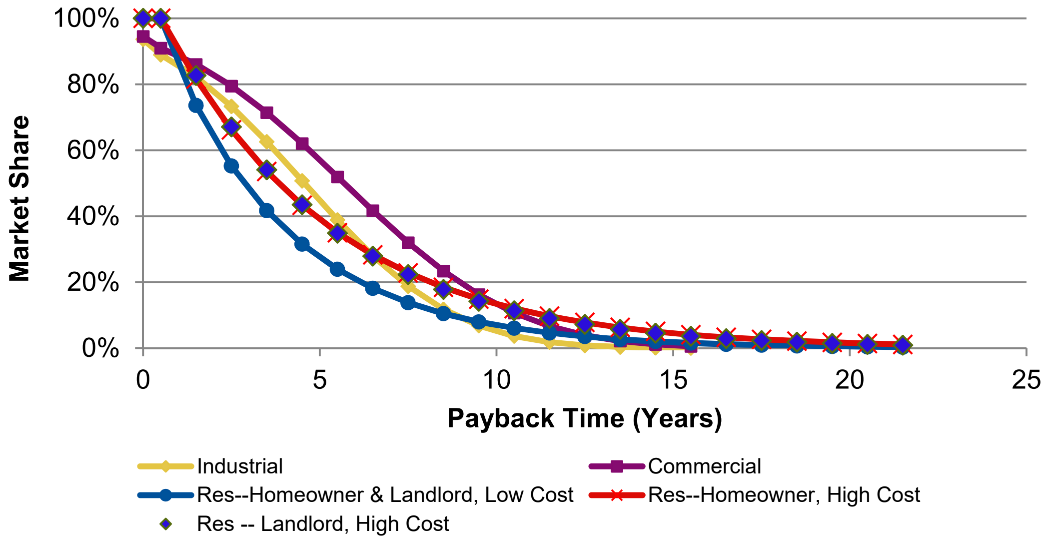
5.1.1 Calculation of Dynamic Equilibrium Market Share

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 energy efficient technologies, a key differentiating factor between the base technology and the efficient technology is the energy and cost savings associated with the efficient technology. That additional efficiency often comes at a premium in initial cost. Thus, in efficiency potential studies, equilibrium market share is often calculated as a function of the payback time of the efficient technology relative to the inefficient technology. While such approaches have limitations, they are nonetheless directionally reasonable and simple enough to permit estimation of market share for the dozens or even hundreds of technologies that are often considered in potential studies.

Navigant uses equilibrium payback acceptance curves that were developed using primary research conducted by Navigant in the Midwest US in 2012.[19] To develop these curves, Navigant conducted surveys of 400 residential, 400 commercial, and 150 industrial customers. These surveys presented decision makers with numerous choices between technologies with low upfront costs but high annual energy costs and measures with higher upfront costs but lower annual energy costs. Navigant conducted statistical analysis to develop the set of curves shown in Figure 34, which were leveraged in this study. Though SaskPower-specific data is not currently available to estimate these curves, Navigant considers that the nature of the decision-making process is such that the data developed using these surveyed customers represents the best data available for this study at this time.

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

Figure 34. Payback Acceptance Curves



Source: Navigant, 2015

Because 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, thus, recalculated for every time step within the market simulation to ensure the dynamics of technology adoption considers this effect. As such, the term 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; it is used nonetheless to facilitate understanding of the approach.

5.1.2 Calculation of the Approach to Equilibrium Market Share

The team used two approaches to calculate the approach to equilibrium market share (i.e., how quickly a technology reaches final market saturation): one for new technologies or those being modeled as a retrofit (a.k.a. discretionary) measures, and one for technologies simulated as ROB (a.k.a. lost opportunity) measures.[20] A high-level overview of each approach is provided in the following sections.

5.1.2.1 Retrofit/New Technology Adoption Approach

Retrofit and new technologies employ an enhanced version of the classic Bass diffusion model[21,22] to simulate the S-shaped approach to equilibrium that is commonly observed for technology adoption. Figure 35 provides a stock/flow diagram illustrating the causal influences underlying the Bass model. In this model, market potential flow to adopters through two primary mechanisms: adoption from external influences such as program marketing/advertising, and adoption from internal influences including word of

[20] 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.

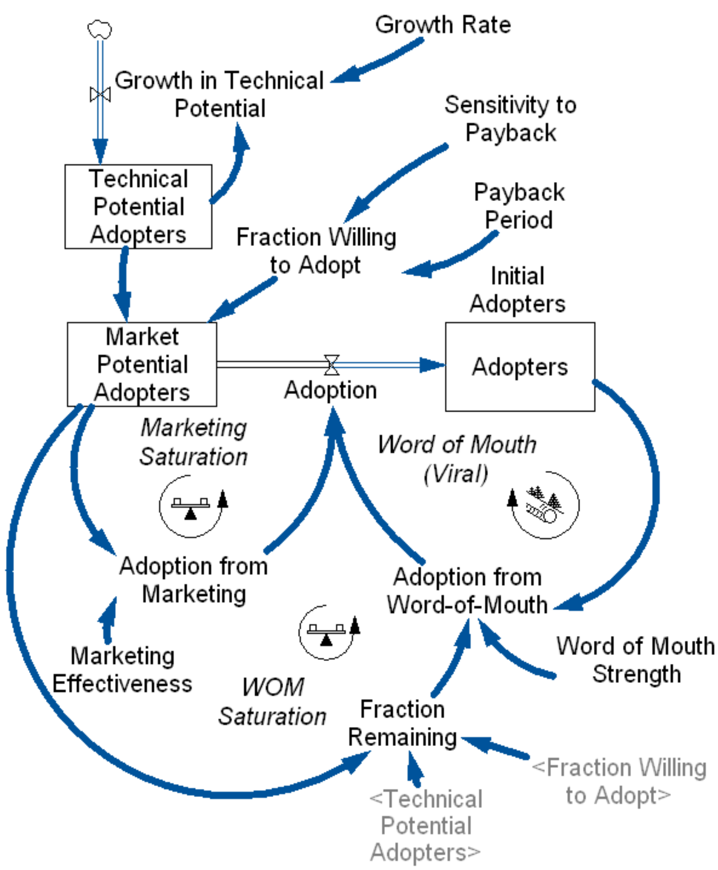
[21] Bass, Frank (1969). "A new product growth model for consumer durables." *Management Science* 15 (5): p215–227.

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

mouth. The fraction of the population willing to adopt is estimated using the payback acceptance curves illustrated in Figure 34.

The marketing effectiveness and external influence parameters for this diffusion model are typically estimated upon the results of case studies where these parameters were estimated for dozens of technologies.[23] Additionally, the calibration process outline previously permits adjusting these parameters as warranted (e.g., to better align with historic adoption patterns within the Saskatchewan market). Recognition of the positive or self-reinforcing feedback generated by the word of mouth mechanism is evidenced by increasing discussion of concepts like social marketing and the term viral, which has been popularized and strengthened most recently by social networking sites such as Facebook and YouTube. However, the underlying positive feedback associated with this mechanism has always been part of the Bass diffusion model of product adoption since its inception in 1969.

Figure 35. Stock/Flow Diagram of Diffusion Model for New Products and Retrofits



Source: Navigant, 2015

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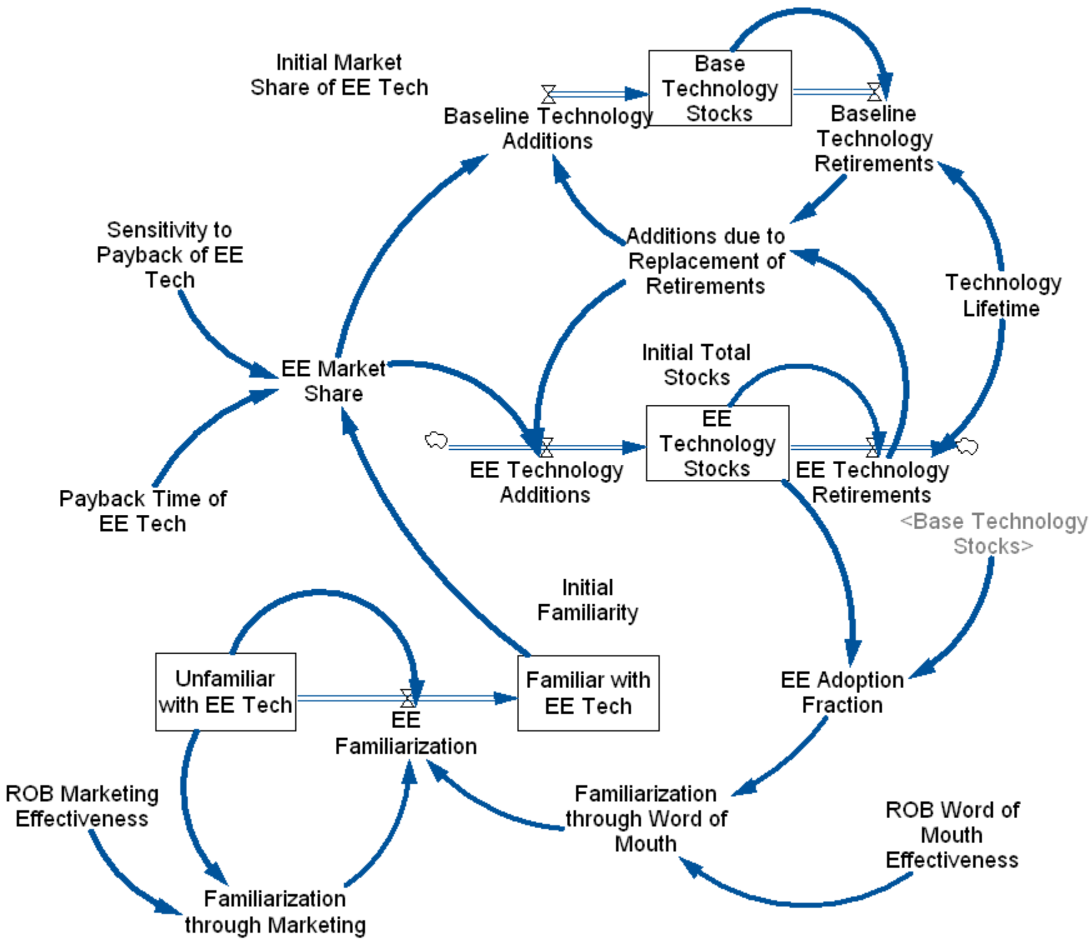
[23] See Mahajan, V., Muller, E., and Wind, Y. (2000). *New Product Diffusion Models.* Springer. Chapter 12 for estimation of the Bass diffusion parameters for dozens of technologies. This model uses the median value of 0.365 for the word of mouth strength in the base case scenario. The Marketing Effectiveness parameter was assumed to be 0.04, representing a somewhat aggressive value that exceeds the most likely value of 0.021 (75th percentile value is 0.055) per Mahajan 2000.

5.1.2.2 ROB Technology Adoption Approach

The dynamics of adoption for ROB technologies are somewhat more complicated than for new/retrofit technologies because it requires simulating the turnover of long-lived technology stocks. To account for this, 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, as 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. A simplified version of the model employed in DSMSim is illustrated graphically in Figure 36.

Figure 36. Stock/Flow Diagram of Diffusion Model for ROB Measures



Source: Navigant, 2015

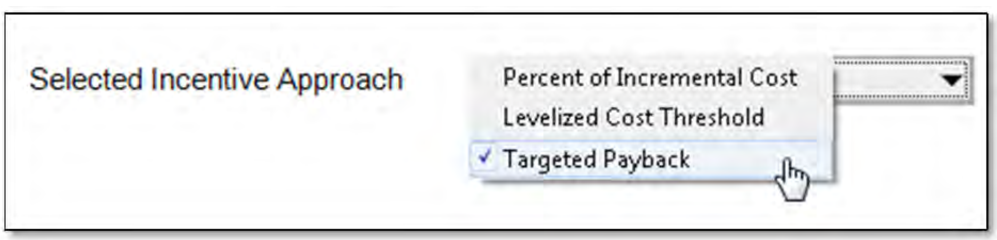
5.1.3 Model Calibration

Calibration of a predictive model imposes unique challenges, as future data is not available to compare against model predictions. While engineering models, for example, can often be calibrated to a high degree of accuracy because simulated performance can be compared directly with performance of actual hardware, predictive models do not have this luxury. **DSM models, 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 project, Navigant took several steps to ensure that forecast model results are reasonable and consider historic adoption, including:

- Comparing forecast values, by sector and end use, against historic achieved savings (e.g., program savings from 2016). Although some studies indicate that DSM potential models are calibrated to ensure first-year simulated savings precisely equal prior-year reported savings, Navigant notes that forcing such precise agreement has the potential to introduce errors into the modeling process by effectively masking the explanation for differences—particularly when the measures included may vary significantly. Additionally, there may be sound reasons for first-year simulated savings to differ from prior-year reported savings (e.g., a program is rapidly ramping up or savings estimates have changed). Thus, while Navigant endeavors to achieve agreement to a degree believed to be reasonable between past results and forecast first-year results, the team's approach does not force the model to do so—providing, the team believes, a degree of confidence that the model is internally consistent.
- Identifying and ensuring an explanation existed for significant discrepancies between forecast savings and prior-year savings, recognizing that some ramp-up is expected, especially for new measures or archetype programs.
- Calculating $/first-year kWh costs by sector and comparing them with past results.
- Calculating the split (percentage) in spending between incentives and variable administrative costs predicted by the model to historic values.
- Calculating total spending by sector and comparing the resulting values to historical spending.
- Calculating portfolio-level $/first-year kWh costs and comparing them with values Navigant researched through benchmarking of other utilities.

5.1.4 Achievable Potential Scenarios and Incentive Levels

A key component of any potential study is determining the appropriate level at which to set measure incentives for each scenario. Navigant's DSMSim model is highly flexible in this regard, offering several different strategies for setting incentive levels, each of which are accessible via DSMSim's graphical user interface, as illustrated below.



Selection of one of these incentive strategies is most relevant to the budget constrained achievable potential scenario, as incentives are set prescriptively at 100% of incremental measure cost for the unconstrained budget scenario. For SaskPower, the incentive level strategy characterized is the ***Levelized Cost Threshold Approach.*** In this approach, incentive levels are set to achieve a specified threshold spending level (on a $/levelized kWh saving basis). This threshold incentive level would be adjusted iteratively to a point where overall program spending meets the budget constraints identified by SaskPower. This approach is innovative in that it results in higher savings at lower cost than alternative approaches to specifying incentive levels, as detailed by Welch and Richerson-Smith (2012).[24] This approach also has the benefit of maximizing the net benefits achieved.

5.1.5 Scenario Analysis

Navigant ran multiple scenarios for achievable potential, including multiple budget constrained scenarios and an unconstrained budget scenario that represents maximum achievable potential. These approaches are described briefly below.

5.1.5.1 Budget Constrained Scenarios

As the starting point for this scenario, Navigant adjusted incentive levels using the incentive strategy of levelized cost approach described above until the resulting spending on a $/kWh for incentives was reasonably consistent with past program performance. Higher incentive levels result in higher budgets due to two mechanisms. First, per-unit costs to the utility increase as a result of higher payments for a given measure. Second, forecast participation increases as a result of improved economics to the participant (i.e., shorter payback times and higher equilibrium market share, as described earlier).

Navigant ran two budget constrained scenarios. The base case set incentives to values reasonably close to existing portfolio levels on a $/first-year kWh basis, which was achieved by varying the threshold $/levelized kWh input values to those illustrated in Table 22. The aggressive case doubles the incentive threshold levelized $/kWh used as the input for the incentive calculated for each measure.

Table 22. Budget Constrained Maximum Incentive Threshold (Levelized $/kWh) by Sector

Scenario	Commercial	Industrial	Residential
Base Case	$0.021	$0.01	$0.0117
Aggressive	$0.041	$0.02	$0.0234

Source: Navigant

5.1.5.2 Unconstrained Budget Scenario

In this scenario, Navigant set incentives to 100% of the incremental cost of a measure. If using the TRC test as the measure screen, incentive levels do not affect cost-effectiveness because incentives are treated as a pass through in the TRC test. Thus, setting incentives at 100% of incremental cost will result in the highest forecast savings levels (effectively a zero-payback time) but will also come with high budget forecasts.

5.2 Results

Values shown for achievable potential are termed annual incremental potential in that they represent the incremental new potential available in each year. The total cumulative potential over the time period is the

[24] Welch, Richerson-Smith. "Incentive Scenarios in Potential Studies: A Smarter Approach" Presented at the ACEEE Summer Study on Energy Efficiency in Buildings. Monterey, CA. August 2012. Available at http://www.aceee.org/files/proceedings/2012/data/papers/0193-000050.pdf.

sum of each year's annual incremental achievable potential. Economic potential, as defined in this study, can be thought of as a bucket of potential from which programs can draw over time. Achievable potential represents the draining of that bucket, the rate of which is governed by several factors including the lifetime of measures (for ROB technologies), market effectiveness, incentive levels, and customer willingness to adopt, among others. If the cumulative achievable potential ultimately reaches the economic potential, it would signify that all economic potential in the bucket had been drawn down, or harvested. However, achievable potential levels rarely reach the full economic potential level due to a variety of market and customer constraints that inhibit full economic adoption.[25]

All tables and figures (except for the following Section 5.2.1) have the potential savings for the base case scenario only.

5.2.1 Scenario-Level Results

As explained in Section 5.1.5, the achievable potential analysis was modeled with three different scenarios. The scenarios are based on the cost per levelized kWh:

- Base Case: Reflects existing program spend levels by sector
- Aggressive Case: 2 times the program spend levels by sector
- High Case: Incentives equal the measure cost (unconstrained cost)

One output of these scenarios is the resulting incentive levels. Table 23 summarizes the average incentives as a percentage of measure cost (incentive percentages differ by measure depending on each measure's levelized cost).

Table 23. Scenario Average Incentives as a Percentage of Measure Cost by Sector

Sector	Base	Aggressive	High
Residential	40%	69%	100%
Commercial	66%	87%	100%
Industrial	41%	69%	100%

Source: Navigant

Table 24. shows the incremental energy and demand savings per year for each scenario. Figure 37 and Figure 38 show the scenarios for annual energy and demand savings. The differences by scenario are less than a 10% change in savings.

[25] Constraints on achievable potential that inhibit realization of the full economic potential include the rate at which homes and businesses will adopt efficient technologies, as well as the word of mouth and marketing effectiveness for the technology. If a technology already has high saturation at the beginning of the study, it may theoretically be possible to fully saturate the market and achieve 100% of the economic potential.

Table 24. Incremental Savings by Scenario

Year	Electric Energy (GWh/Year)			Peak Demand (MW)		
	Base	Aggressive	High	Base	Aggressive	High
2018	100	107	114	14.4	15.4	16.5
2019	107	114	122	15.3	16.4	17.5
2020	88	95	102	12.4	13.3	14.3
2021	109	117	126	15.1	16.2	17.4
2022	129	138	150	17.6	18.9	20.4
2023	129	139	151	17.7	19.0	20.7
2024	138	149	164	18.9	20.4	22.3
2025	146	158	175	20.0	21.6	23.8
2026	159	173	193	21.6	23.4	26.0
2027	173	188	211	23.4	25.3	28.2
2028	199	216	241	26.5	28.7	32.0
2029	201	219	245	22.3	24.2	27.0
2030	213	232	259	23.6	25.6	28.5
2031	220	239	265	24.4	26.4	29.2
2032	227	245	270	25.0	27.0	29.7
2033	228	246	267	25.2	27.1	29.4
2034	222	238	255	24.4	26.1	27.9
2035	216	229	241	23.7	25.1	26.4
2036	210	220	226	23.0	24.1	24.7
Totals	**3,215**	**3,463**	**3,777**	**395**	**424**	**462**

Source: Navigant analysis

Figure 37. Electric Energy Achievable Savings Potential by Scenario (GWh/year)

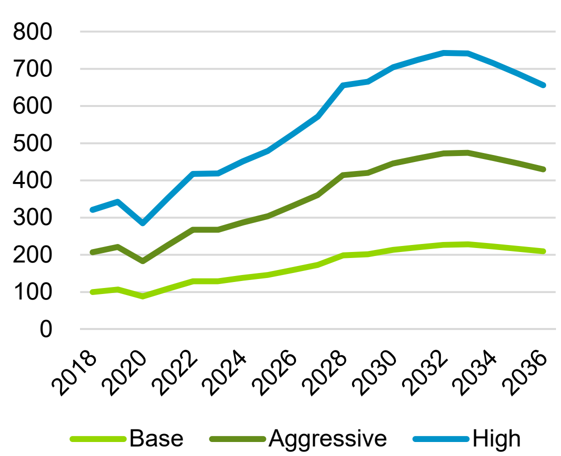
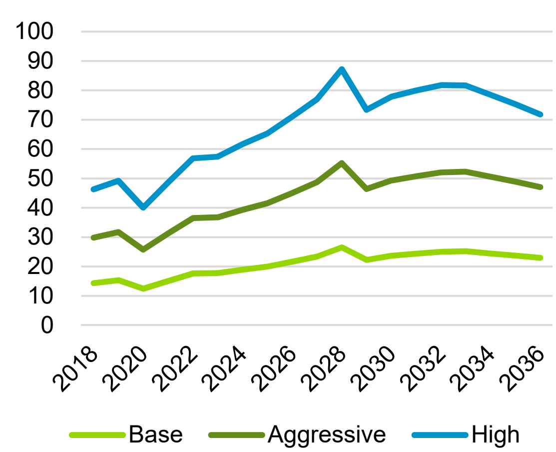


Figure 38. Peak Demand Achievable Savings Potential by Scenario (MW)



Source: Navigant analysis

The administrative and incentive costs for each scenario is provided in Table 25 for program year 2018. It is important to note the differences in these scenarios as compared to the savings achieved. The incentive costs increase substantially—174% and 152% for base to aggressive case and aggressive to high case, respectively—but the savings only increase by about 10%. The administrative costs increase on a $/kWh basis.

Table 25. Spending Breakdown for Achievable Potential ($/year): 2018

	Base	Aggressive	High
Incentives	$10,565,988	$18,369,656	$28,005,716
Administrative	$6,482,198	$7,012,056	$7,514,009
Total	**$17,048,186**	**$25,381,712**	**$35,519,725**

Source: Navigant analysis

SaskPower measures the benefit of energy efficiency as a resource with the UCT to compare other costs for each kWh generated. The UCT is a benefit-cost metric that measures the net benefits and costs of energy efficiency measures from the utility viewpoint. The UCT benefit-cost ratio is calculated in the model using Equation 8.

Equation 8. Benefit-Cost Ratio for Utility Cost Test

$$UCT = \frac{PV(Avoided\ Costs)}{PV(Incentive\ Cost + Admin\ Costs)}$$

Where:

- *PV( )* is the present value calculation that discounts cost streams over time.
- *Avoided Costs* are the monetary benefits resulting from electric energy and capacity savings—e.g., avoided costs of infrastructure investments, as well as avoided LRMC (commodity costs) due to electric energy conserved by efficient measures.
- *Incentive Cost* is the utility paid rebate to bring down the incremental equipment cost to the customer.
- *Admin Costs* are the administrative costs incurred by the utility or program administrator.

Navigant calculated UCT ratios for each measure based on the present value of benefits and costs (as defined above) over each measure's life. Avoided costs, discount rates, and other key data inputs used in the UCT calculation are presented in Appendix D.2, while measure-specific inputs are provided in Appendix D.1. As agreed upon with the utility, effects of free ridership are not present in the results from this study, so the team did not apply a NTG factor. Providing gross savings results will allow the utility to easily apply updated NTG assumptions in the future and allow for variations in NTG assumptions by reviewers.

The UCT for these scenarios by year are provided in the Table 26. Even with the big increases in incentives, all scenarios are cost-effective.

Table 26. Portfolio UCT Benefit-Cost Ratios for Achievable Potential (Ratio)

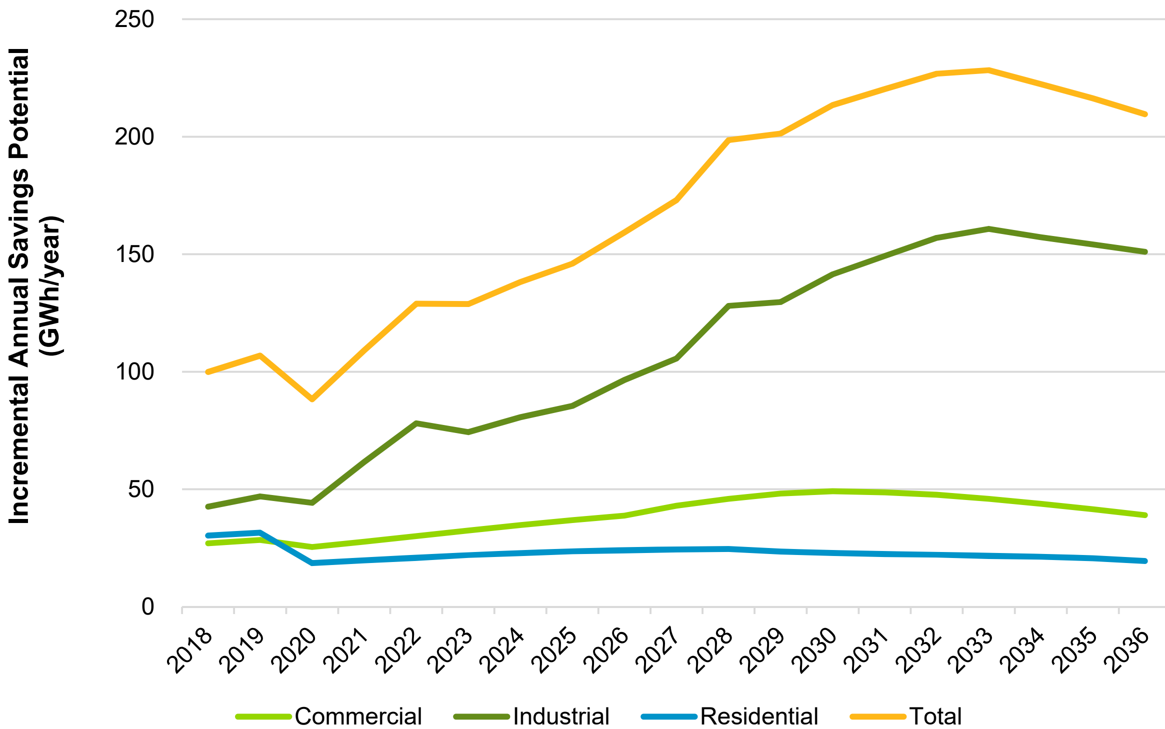
Year	Base	Aggressive	High
2018	3.78	2.73	2.09
2019	3.79	2.82	2.17
2020	3.72	2.84	2.15
2021	3.80	2.87	2.20
2022	3.85	2.90	2.21
2023	3.90	2.96	2.23
2024	3.92	2.99	2.24
2025	3.93	3.02	2.23
2026	3.94	3.03	2.23
2027	3.93	3.01	2.20
2028	3.96	3.01	2.19
2029	3.52	2.68	1.96
2030	3.54	2.68	1.96
2031	3.50	2.64	1.93
2032	3.49	2.62	1.91
2033	3.49	2.61	1.91
2034	3.49	2.60	1.90
2035	3.50	2.59	1.90
2036	3.49	2.58	1.90
2018-2036	3.71	2.80	2.07

Source: Navigant analysis

5.2.2 Achievable Potential Results by Sector

Figure 39 shows achievable energy savings potential across all sectors. The decrease in 2020 for the residential sector is the effect of the change in the general service lamp code, which results in the baseline changing from an incandescent/halogen to a CFL-level wattage. The increase in 2028 for the industrial sector is the change from considering winter peak period savings to summer peak period savings in the avoided costs calculation.

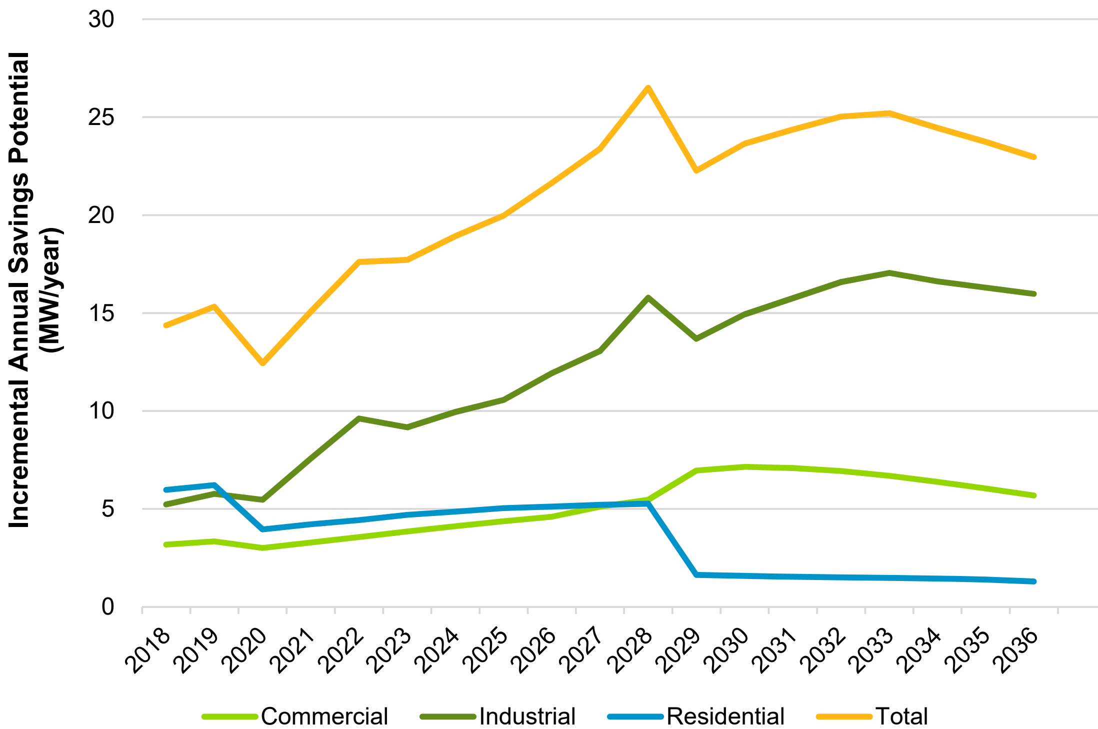
Figure 39. Electric Energy Incremental Base Case Achievable Savings Potential by Sector (GWh/year): 2018-2036



Source: Navigant analysis

Figure 40 presents the achievable demand potential in each of the sectors. There is a similar demand decrease in 2020 for the residential sector due to the lighting code change. However, the decrease in 2028 for the industrial and residential sectors is related to the switch from SaskPower being a winter peaking utility to a summer peaking utility.

Figure 40. Electric Demand Incremental Base Case Achievable Savings by Sector (MW): 2018-2036



Source: Navigant analysis

Table 27 provides the cumulative savings as a percentage of consumption for each sector. The average percentage over the study period is 0.54% of savings per year across all sectors. The commercial sector has the highest percentage of system load potential, mostly due to the potential in LED lighting retrofits.

Table 27. Cumulative Electric Energy Base Case Achievable Savings Potential by Sector as a Percentage of Sector Consumption (%, GWh)

Year	All	Commercial	Industrial	Residential
2018	0.4%	0.6%	0.3%	0.6%
2019	0.8%	1.2%	0.6%	1.2%
2020	1.2%	1.7%	0.9%	1.5%
2021	1.6%	2.2%	1.3%	1.9%
2022	2.0%	2.8%	1.7%	2.3%
2023	2.5%	3.4%	2.2%	2.6%
2024	3.0%	4.1%	2.6%	3.0%
2025	3.5%	4.7%	3.1%	3.4%
2026	4.0%	5.4%	3.7%	3.7%
2027	4.6%	6.1%	4.3%	4.1%
2028	5.2%	6.9%	5.0%	4.5%
2029	5.9%	7.7%	5.7%	4.8%

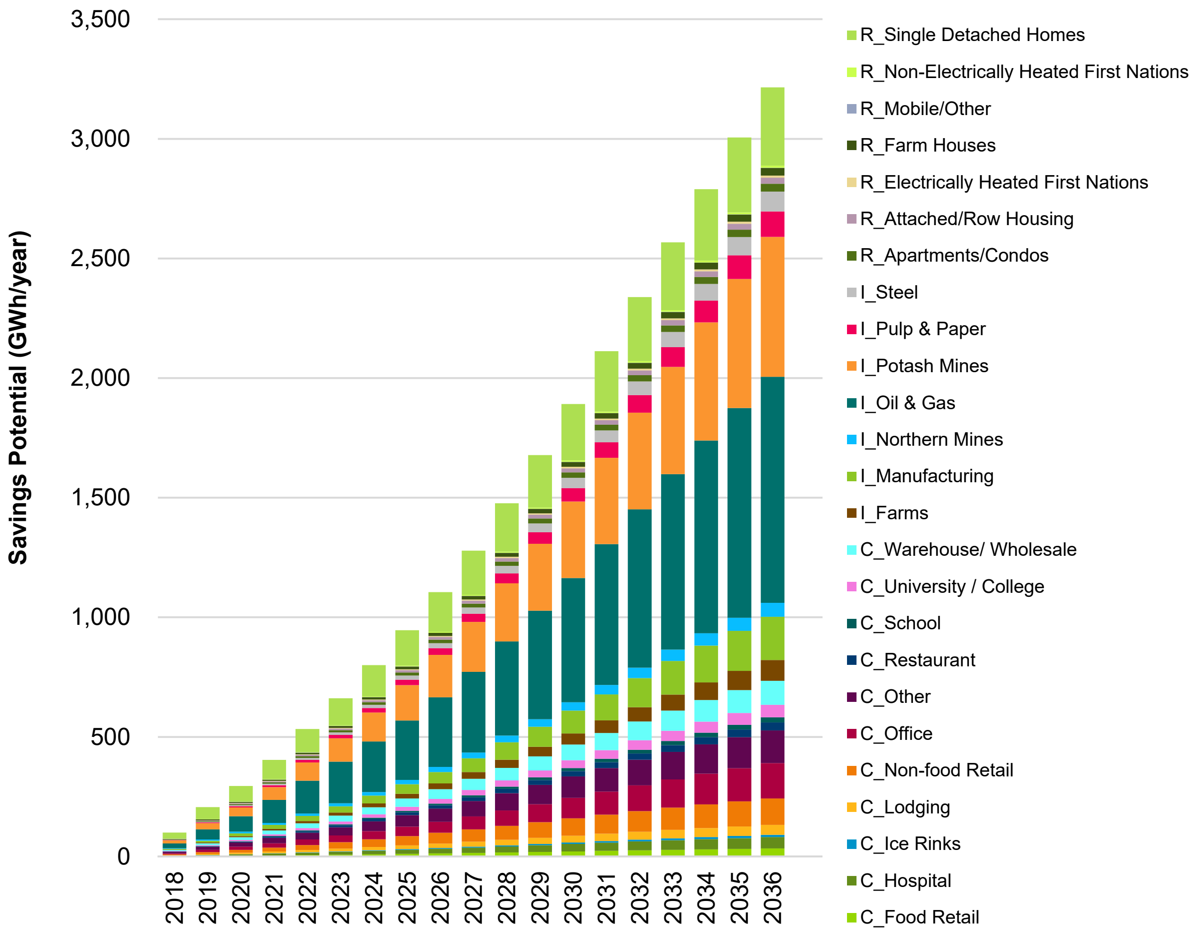
Year	All	Commercial	Industrial	Residential
2030	6.5%	8.4%	6.4%	5.1%
2031	7.2%	9.2%	7.2%	5.4%
2032	7.9%	9.9%	8.0%	5.7%
2033	8.6%	10.5%	8.8%	6.0%
2034	9.2%	11.1%	9.6%	6.3%
2035	9.8%	11.7%	10.3%	6.5%
2036	10.33%	12.1%	11.0%	6.7%

Source: Navigant analysis

5.2.3 Results by Customer Segment

Figure 41 provides savings allocation across all segments. The industrial sector has the biggest potential, followed by the commercial sector. The oil & gas and potash mines segments have the largest savings potential, mostly because they have the largest consumption. The single family detached homes segment starts out having the most potential in 2018 and then the third largest savings potential by 2036. In 2036, the industrial sector has a slow ramp-up in the savings initially because the current program levels show low savings achieved.

Figure 41. Segment Electric Energy Base Case Achievable Potential Customer Segment Breakdown

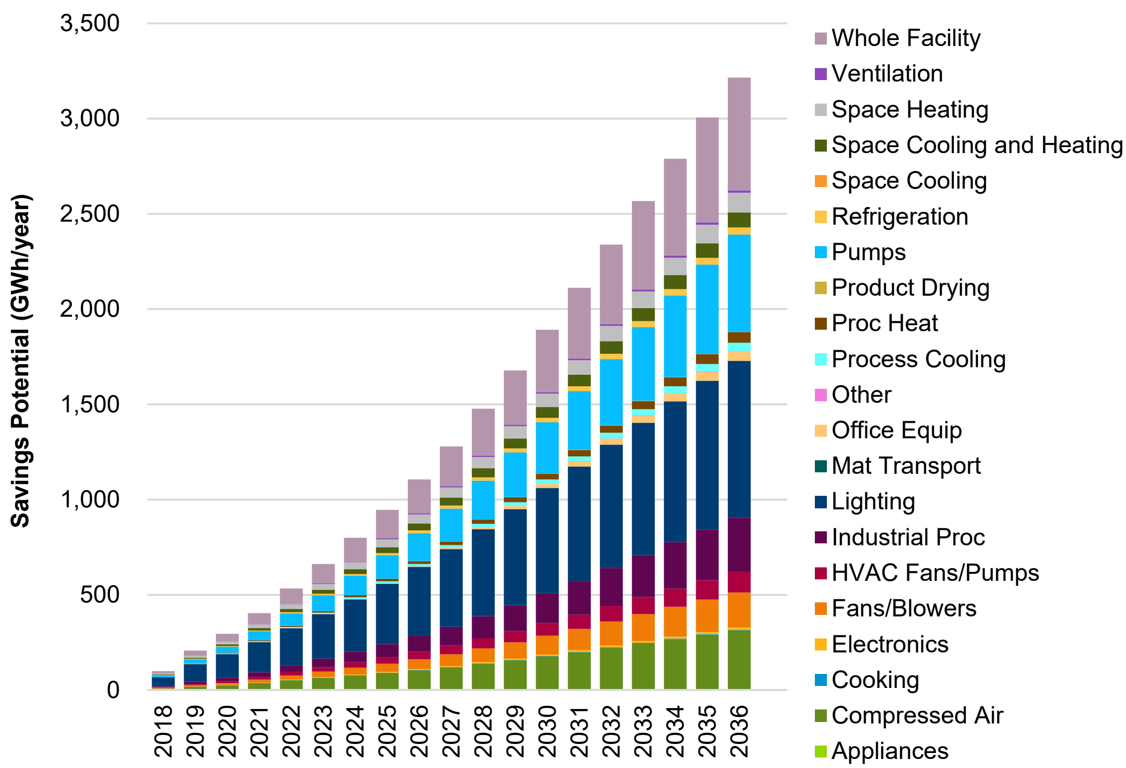


Source: Navigant analysis

5.2.4 Results by End Use

Figure 42 shows the breakdown by end use over the study period. The lighting end use leads the potential for the portfolio for every year of the study period. The whole facility end use in industrial is the second largest source of savings. In 2036, this end use includes 4% of its savings from the commercial sector.

Figure 42. Electric Energy Base Case Achievable Potential Breakdown



Source: Navigant analysis

Figure 43, Figure 44, and Figure 45 break out the electric energy achievable savings potential for each sector by end use. The largest achievable potential is associated with the residential and commercial lighting, industrial whole facility, and industrial pump end uses.

Figure 43. Residential Electric Energy Achievable Potential End-Use Breakdown (%,GWh)

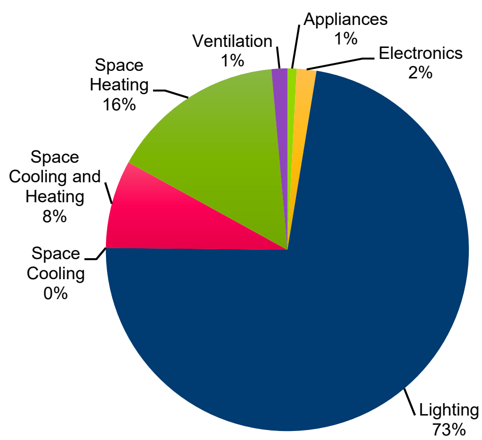


Figure 44. Commercial Electric Energy Achievable Potential End-Use Breakdown (%,GWh)

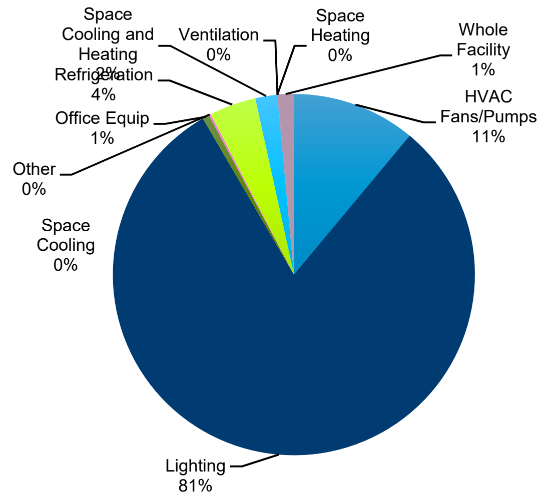
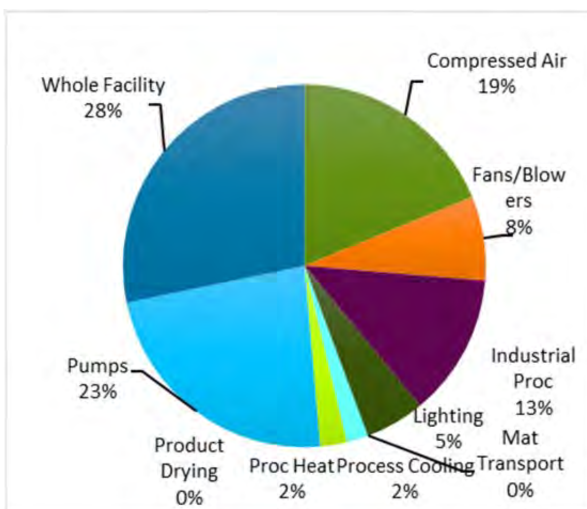


Figure 45. Industrial Electric Energy Achievable Potential End-Use Breakdown (%,GWh)



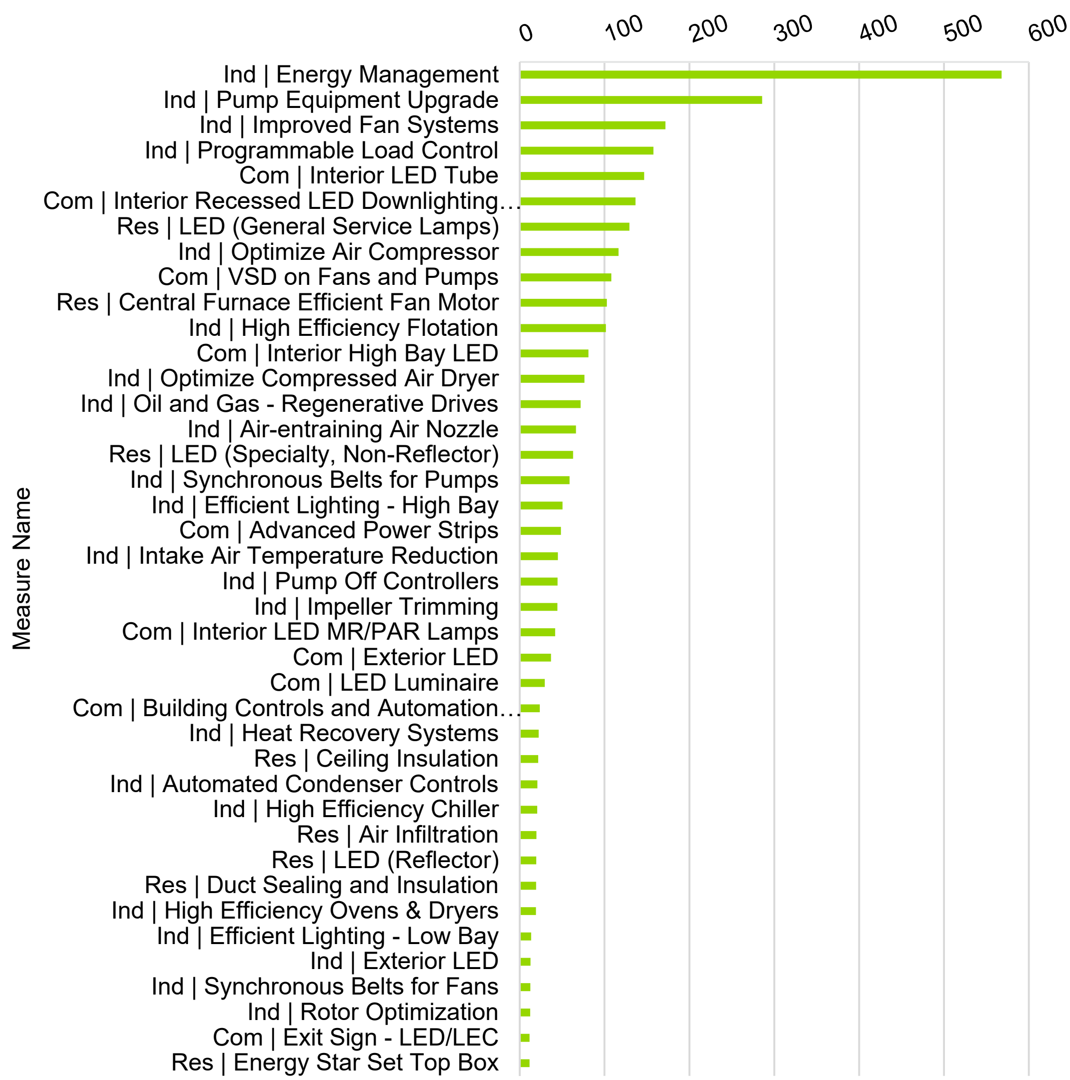
Source: Navigant analysis

5.2.5 Achievable Potential Results by Measure

Figure 46 presents the top 40 measures ranked by their electric energy base case achievable savings potential in 2036. The measure-level savings potential shown in the figure is after adjustments made to competition groups, as detailed in Section 3.1.3 Whenever a group of measures were similar in nature, their potential was consolidated into a representative measure name to produce a more succinct view at the measure level. For example, the LED potential in the figure represents the achievable savings potential for several different types of LEDs: general service LEDs, reflector LEDs, troffer LEDs, exterior LEDs, interior recessed LED downlighting, etc.

The biggest energy savings potential is in the industrial segment. This is consistent with the breakdown of SaskPower's load, 63% of which is from the industrial segment. Of the top 10 measures, half are industrial, two are residential, and three are commercial. The non-lighting residential and commercial measures include residential central furnace efficient fan motors and variable speed drives on fans and pumps, respectively.

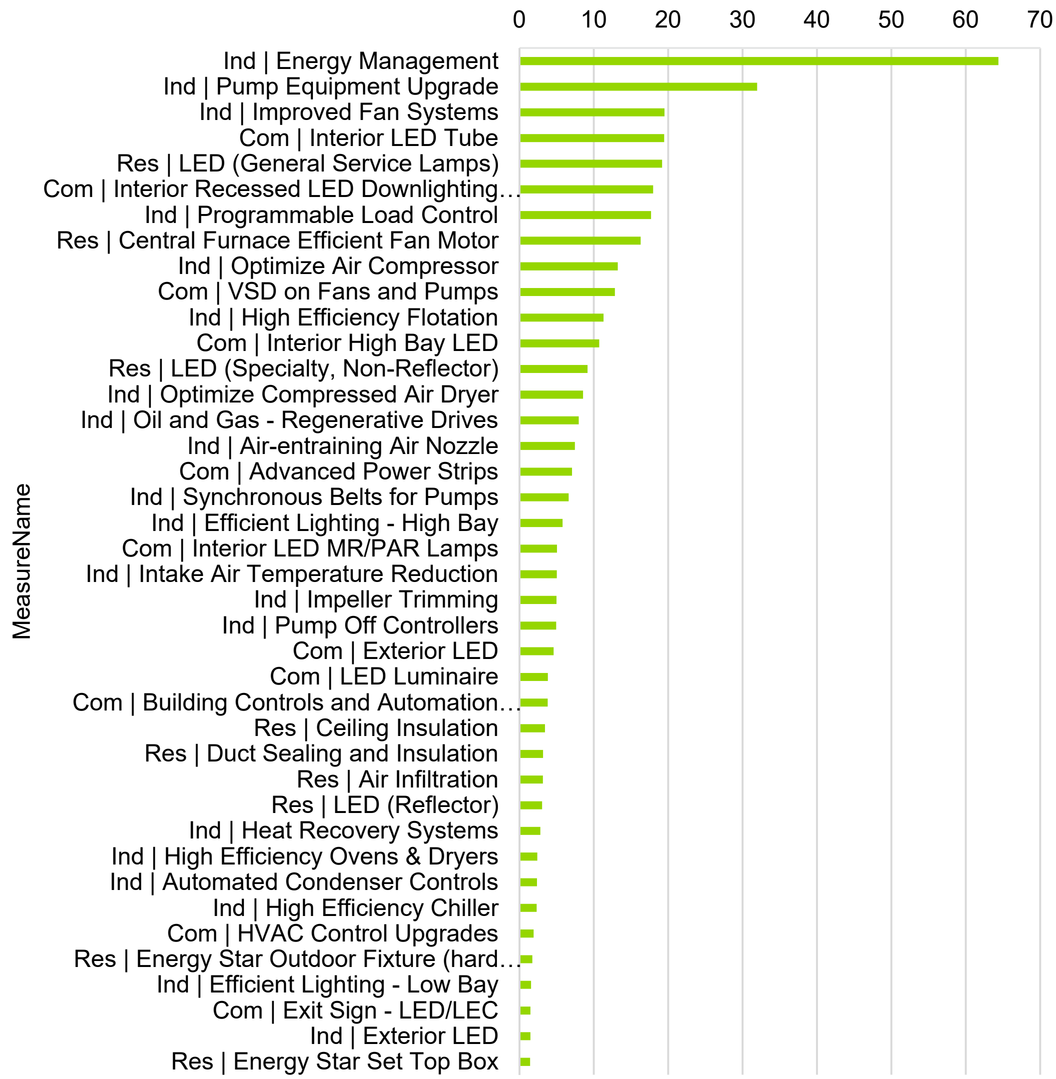
Figure 46. Top 40 Measures for Electric Energy Base Case Achievable Savings Potential: 2036 (GWh/year)



Source: Navigant analysis

Figure 47 presents the top 40 measures ranked by their electric demand base case achievable savings potential in 2036. In the top 10, half the measures are in the industrial sector. The top commercial and residential measures are lighting measures. In addition, residential central furnace efficient fan motors and commercial variable speed drives (VSDs) on fans and pumps also offer high savings. The top 10 measures are 60% of the demand savings.

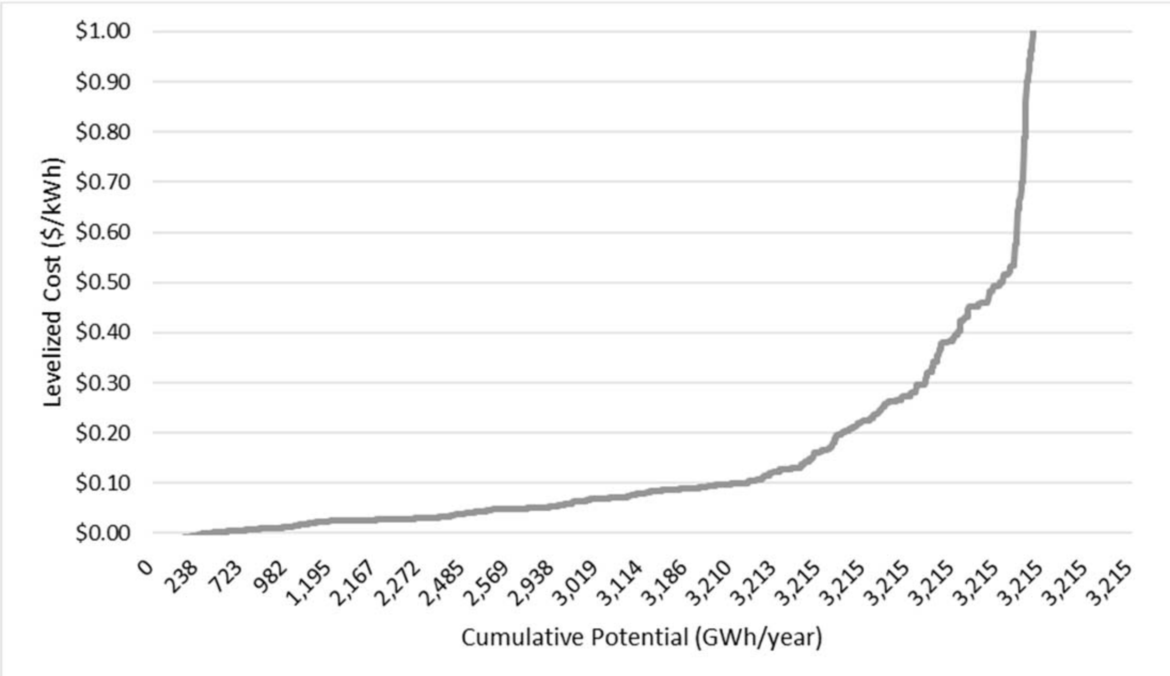
Figure 47. Top 40 Measures for Electric Demand Base Case Savings Potential: 2036 (MW)



Source: Navigant analysis

Figure 48 provides a supply curve of savings potential versus levelized cost of savings in $/kWh for all measures considered in the study. The achievable potential levels out at about $0.10/kWh; incremental savings above this level become costlier.

Figure 48. Supply Curve of Electric Energy Achievable Potential (GWh/year) vs. Levelized Cost ($/kWh): 2036



Source: Navigant analysis

5.2.6 Lifetime Savings

To calculate the overall savings achieved over the measure lifetimes, the incremental annual energy savings on a measure level is multiplied by the measure life. Over the study period as shown in Table 28, SaskPower can expect to achieve over 320,000 GWh of savings as result of program achievable savings from 2018-2036.

Table 28. Lifetime Energy Savings, Achievable Potential (GWh)

Year	Commercial	Industrial	Residential	Total
2018	352	450	496	1,299
2019	723	943	1,012	2,678
2020	1,055	1,404	1,327	3,786
2021	1,417	2,048	1,660	5,125
2022	1,810	2,863	2,010	6,683
2023	2,234	3,634	2,380	8,249
2024	2,688	4,466	2,763	9,917
2025	3,170	5,342	3,160	11,672
2026	3,677	6,330	3,562	13,569
2027	4,215	7,408	3,972	15,595
2028	4,775	8,714	4,385	17,874
2029	5,360	10,038	4,780	20,178
2030	5,957	11,486	5,164	22,606

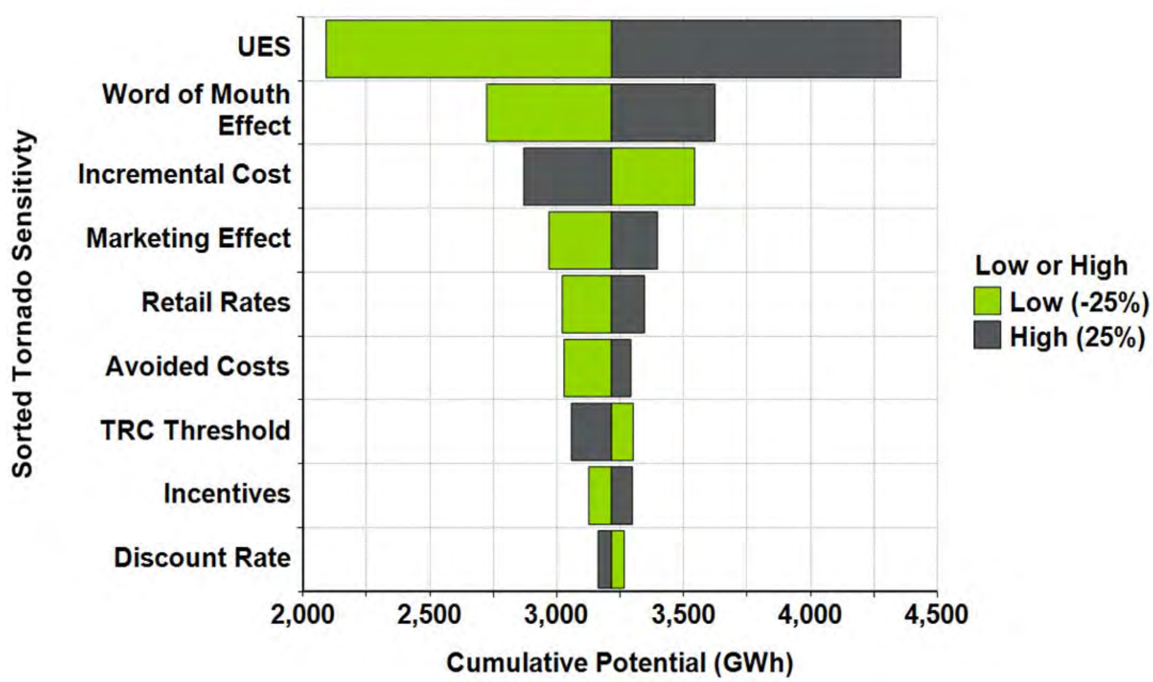
Year	Commercial	Industrial	Residential	Total
2031	6,548	13,019	5,540	25,106
2032	7,126	14,640	5,910	27,677
2033	7,684	16,310	6,270	30,264
2034	8,217	17,960	6,623	32,800
2035	8,722	19,595	6,962	35,280
2036	9,198	21,217	7,284	37,698
Total	84,930	167,868	75,260	328,058

Source: Navigant analysis

5.2.7 Uncertainty Analysis

The results of this sensitivity analysis will allow SaskPower and stakeholders to gauge the level of influence a variety of factors can have energy savings potential. Such understandings are critical to informing related policy decisions as well as informing effective program design. The following figure provides the sensitivity of the most influential factors impacting potential. Each of these parameters have a different affect to the measure level analysis in calculating potential.

Figure 49. Tornado Chart Cumulative Achievable Savings in 2036 Sensitivities to Changes in Key Variables



Source: Navigant analysis

Table 29 provides the percent change to the cumulative potential when the parameter changes +/- 25%. The unit energy savings (i.e. measure level savings) changes +/- 25%, the cumulative potential in 2036 changes +/- 35%. In contrast, the discount rate changes only +/-2% the portfolio savings estimate.

Table 29. Percent Change to Cumulative Potential with 25% Parameter Change

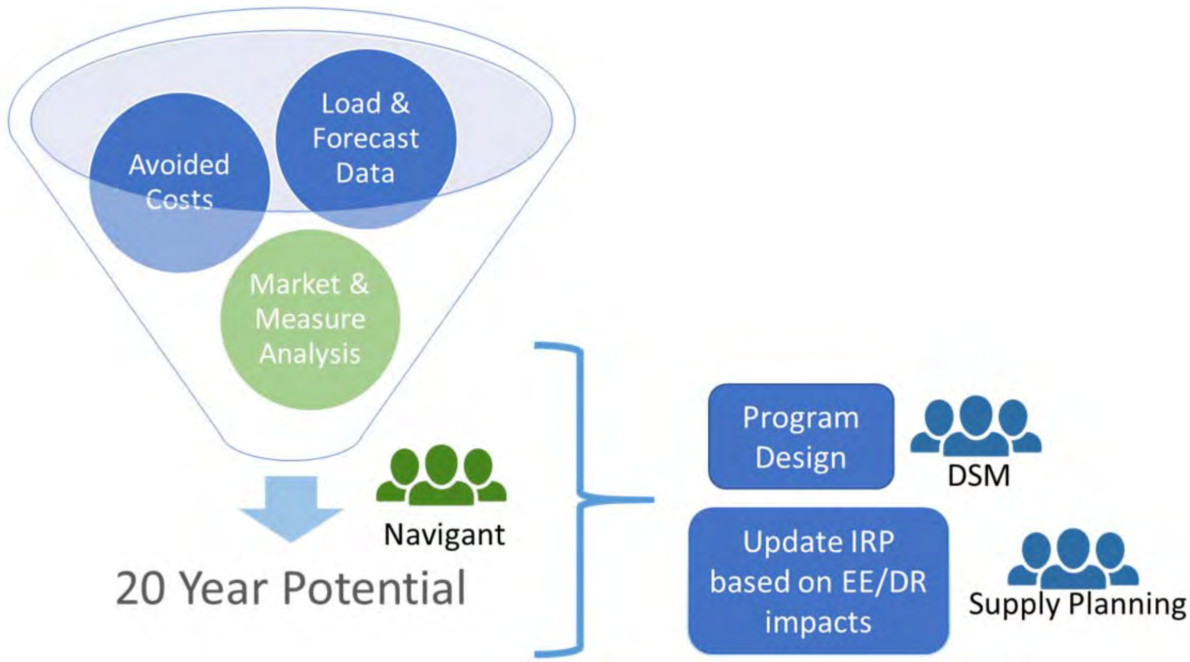
Parameter Name	Low (-25%)	High (25%)
Unit Energy Savings	-35%	35%
Word of Mouth Effect	-15%	13%
Incremental Cost	10%	-11%
Marketing Effect	-8%	6%
Retail Rates	-6%	4%
Avoided Costs	-6%	2%
TRC Threshold	3%	-5%
Incentives	-3%	3%
Discount Rate	2%	-2%

Source: Navigant analysis

6. NEXT STEPS

By completing a CPR, SaskPower now has data to provide to multiple groups in the company who can benefit from the modeling data results. Figure 50 provides an illustrative view of the data inputs and outputs of the potential study, most notably for IRP and program planning.

Figure 50. Integration of Potential Study Outputs to IRP and DSM Planning



Source: Navigant

6.1 IRP

The IRP is typically an iterative process to optimize the mix of supply resources and other resources to meet the utility's demand. The mix of supply-side resources dictate the costs, which transfer to be used as avoided costs. However, if the energy efficiency potential can vary the supply-side mix (i.e., reduce the need of costlier resources), the avoided costs will vary. The IRP outputs feed into the budget and goals to formulate the program design foundation.

The potential study provides the inputs to forecasting savings with DSM planning. These inputs are provided by sector, segment, and end use because each combination of these items is mapped to a load shape (see Appendix F). These load shapes are what define the hourly usage profiles for the portfolio.

6.2 Program Planning

The potential study has provided SaskPower with a wealth of data to support its DSM program planning efforts. This data ranges from measure characterization to load shape profiles for peak demand savings calculations, each providing building blocks to defining data inputs to the overall DSM program plan. The goal and budget is derived in tandem with the potential study results and the IRP process. A typical portfolio is made up of programs, which is made up of measures. The buildup of the measures into programs and into a portfolio result in a plan to achieve a defined goal at a certain budget. The potential study does not provide program-level potential; thus, the programmatic design such as delivery method and marketing strategies will have implications to the overall savings goals and budget. Additionally, near-term savings potential or actual achievable goals on a measure level will vary. The overall mix of measures is directionally considered with reviewing historical program participation, understanding current market conditions (with the team members who have their boots on the ground), and the potential study.

Some observations on the potential study results that can provide input to program planning indicate the following:

- Saskatchewan has a high penetration of gas space and water heating, so overall electric savings potential is minimal as a percentage of sales as compared to other provinces that have higher electric shares. Air conditioning load is growing in Saskatchewan; however, the equivalent full load hours (i.e., hours of operation) are relatively low. Thus, associated measures are not as cost-effective as observed in other provinces. Therefore, there may be opportunities to collaborate with SaskEnergy (the province's gas utility) in promoting measures that apply to both electric and gas savings.
- Industrial:
    - There is large, untapped cost-effective potential in the industrial sector with increasing sector budgets to be on the same level as the residential and commercial sectors.
    - In the industrial sector, potash mines and oil & gas have high savings potential. This potential is mainly from controls (energy management and programmable load control) affecting the whole facility and industrial processes and pumping loads.
- Commercial:
    - There remains large potential for LED fixture retrofits (not subject to the 2020 general service lamp update) and VSDs on fans and pumps.
    - Office and other building types have the most potential with lighting as the leading end use for savings potential.
- Residential:
    - There is high potential for lighting despite the 2020 general service lamp standard. There is about 16% savings potential in space heating due to efficient fan retrofits.
    - The top residential measures are general service lamps, central furnace efficient fan motors, and specialty LEDs (not subject to standard).

6.3 Further Research

Finally, the potential study identified gaps in SaskPower's datasets. This is common for most utilities; however; for SaskPower to have more accurate potential and information to support DSM planning, there is SaskPower-specific data that could support this end goal:

- Baseline and saturation studies for each sector
- Industrial end-use survey
- Commercial end-use survey

- Customer payback acceptance analysis specific to the Saskatchewan province

In addition, Navigant recommends the following two elements for consideration in future studies:

1. Combine with the gas utility for overall greenhouse gas reductions in the province, as well as optimizing the cost-effectiveness with consideration of fuel-switching measures
2. Include all distributed energy resources into the study with a time-dependent analysis. In the future, if SaskPower becomes capacity constrained seasonally and during certain hours of the day, understanding the benefit of behind-the-meter planning and potential can overall enhance the grid integrity and provide SaskPower more information for DSM and IRP planning.

APPENDIX A. ADDITIONAL MODEL RESULTS AND INPUT ASSUMPTIONS

These results and assumptions are provided separately in a set of workbooks.

Name	Description
Base Year Data	Base year 2016 sales and stock data disaggregated to sector, segment, and end use
ElectricRetailRateForecast	Customer electric retail rate for payback analysis
FlatFile_Output_AggressiveCase	Full model output for the aggressive case scenario
FlatFile_Output_BaseCase	Full model output for the base case scenario
FlatFile_Output_HighCase	Full model output for the high case scenario
FiguresAndTables_AggressiveCase	Figures and tables for the aggressive case scenario
FiguresAndTables_BaseCase	Figures and tables for the base case scenario
FiguresAndTables_HighCase	Figures and tables for the high case scenario
GasRetailRateForecast	Gas retail rate forecast for customer payback analysis
PeakHourDefinitions	Summer and winter peak period analysis
Methodology for Peak Savings	Peak load shape factor calculations
Peak Demand Base and Reference Case	Base and reference case peak demand calculations
Sask Weather 2015-2016	Weather files used for load profile development
SaskPower AvoidedCosts	Analysis for avoided energy and capacity costs
SaskPower Capacity Forecast	Define winter and summer peak capacity and which season dominates capacity constraints; derate factors for peak period definition; calibration to reference case peak demand
SaskPower Measure Details	Measure characterization details
SaskPower_CPR_MeasureList	Full and selected measure list by sector; includes descriptions of why a measure was not included in this study
SKP CPR Reference Case model	Raw data and analysis for the system, sector, segment, and end-use forecast

Source: Navigant

APPENDIX B. DETAILED METHODOLOGY

B.1 End-Use Definitions

Table B-1. Description of End Uses

Segment	End Use	Definition
Residential	Appliances	Large/small appliances including ovens, refrigerators, freezers, clothes washers, etc.
	Electronics	Televisions, computers and related peripherals, and other electronic systems
	Water Heating	Heating of water for domestic hot water use
	Lighting	Interior, exterior, and holiday/seasonal lighting
	Other	Miscellaneous loads
	Space Cooling	All space cooling, including both central air conditioning and room or portable air conditioning
	Space Heating	All space heating, including both primary heating and supplementary heating
Commercial	Cooking	Food preparation equipment including ranges, broilers, ovens, and griddles
	HVAC Fans/Pumps	HVAC auxiliaries including fans, pumps, and cooling towers
	Water Heating	Hot water boilers, tank heaters, and others
	Lighting	Interior, exterior, and holiday/seasonal lighting for main building areas and secondary areas
	Office Equipment	Computers, monitors, servers, printers, copiers, and related peripherals
	Other	Miscellaneous loads including elevators, gym equipment, and other plug loads
	Refrigeration	Refrigeration equipment including fridges, coolers, and display cases
	Space Cooling	All space cooling equipment, including chillers and DX cooling
	Space Heating	All space heating equipment, including boilers, furnaces, unit heaters, and baseboard units
Industrial	Compressed Air	Air compressors and related equipment
	Fans & Blowers	Fans and blowers for ventilation, combustion, and pneumatic conveyance
	Industrial Process	Industrial processes for various applications not addressed by processing cooling or heating such as mechanical processes like grinding, drilling, or injection molding
	Lighting	Interior, exterior, and seasonal lighting loads
	Material Transport	Feedstock and product movement by conveyance or stackers
	Process Heating	Process heating including heat treatment and industrial ovens
	Product Drying	Industrial drying equipment and systems
	Space Heating	All non-process space heating equipment (e.g., comfort heating)
	Pumps	Process pump systems
	Process Cooling	Process cooling and refrigeration systems including cooling towers, freezers, chillers, and refrigeration compressors

Source: Navigant

B.2 Residential Sector

The following sections describe the approach used to determine electricity consumption by segment, the approach used to estimate energy use intensities (EUIs), and the resulting residential household stock.

Base Year Stock and Electricity Sales

To determine the total number of residential housing stock (or accounts) in Saskatchewan, Navigant worked with SaskPower to first estimate residential stock in SaskPower's service territory and then to estimate residential stock served by the reseller utilities.

SaskPower Residential Stock

To estimate SaskPower's residential stock, Navigant and SaskPower proposed an approach that leveraged SaskPower's billing data. The challenge with this approach was that SaskPower's billing data identifies residential accounts using a customer name rather than the billing address. This can overstate the residential stock, as multiple tenants may occupy a single billing address over time. For example, a home with two different tenants (e.g., tenant A from January to June, and tenant B from July to December) are reported as two separate accounts and thus imply two separate residential households. This approach can also underestimate the average electricity usage by account. Navigant overcame these challenges by:

- Determining residential electricity consumption (GWh) and stock (#) from accounts with a full year of data (e.g., an account with 12 consecutive months of consumption)
- Determining the average electricity use per account (kWh/account) based on electricity consumption and accounts (with 12 months of data)
- Dividing the total residential electricity consumption by the kWh/account estimated above to estimate the true residential stock

The team applied this approach to each of the CPR residential segments as illustrated in Table B-2.

Table B-2. Example for Detached Homes

Step	Value	Calculation
(1) Total Consumption	1,000 GWh	
(2) Total Accounts	100,000 accts.	
(3) Implied Avg. Consumption	10,000 kWh/acct.	(1) / (2)
(4) Consumption from Accounts with 12 Months of Data	720 GWh	
(5) Accts with 12 Months of Data	60,000 accts.	
(6) Avg. Consumption from Accounts with 12 Months of Data	12,000 kWh/acct.	(4) / (5)
(7) Adjusted Number of Accounts	83,333 accts.	(1) / (6)

Source: Navigant analysis

Additional analyses for certain residential segments used the following methodology:

- **Detached and Attached/Row Housing.** SaskPower's billing data does not distinguish between detached and attached/row homes; rather, it captures both buildings types as Standard accounts. To break down Standard accounts into detached and attached/row accounts, Navigant applied a

91%/9% split[26] and applied the kWh per account values to each of the detached and attached/row accounts.

- **Farms.** SaskPower reports electricity consumption from farms as a total across the residential and industrial portions of farm accounts. Navigant applied a 32% factor[27] to estimate the residential consumption. The remaining 68% of farm consumption is categorized as industrial and is reported under the industrial farm segment.

The results of this approach are summarized in Table B-3.

Table B-3. SaskPower Direct Residential Base Year Results

Segment	Sales (GWh)	Stock (Accts.)	kWh/Acct.
Single Detached Homes	2,464	269,101	9,156
Attached/Row Housing	126	27,953	4,494
Apartments/Condos	240	55,773	4,304
Electrically Heated First Nations	51	2,604	19,569
Non-Electrically Heated First Nations	158	12,988	12,152
Farm Houses	381	32,348	11,790
Mobile/Other	9.83	1,188	8,277
Total (Weighted Average)	**3,429**	**401,956**	**8,532**

Source: Navigant analysis

- **Resellers Residential Stock.** To estimate the reseller residential stock, Navigant analyzed a collection of SaskPower billing data and other publicly available data associated with the resellers. Given the geographic location of Saskatoon and Swift Current (SC), Navigant and SaskPower assumed that the First Nations and farms segments are not in these cities. Furthermore, given the relatively negligible number of mobile/other homes in SaskPower's territory, Navigant assumed the presence of any mobile/other homes in Saskatoon and SC to be zero.

For Saskatoon Light & Power (SL&P), Navigant determined the total residential stock based on the SL&P 2015 annual report, which reports residential accounts from 2011 to 2015. Navigant used the 5-year trend (2011-2015) to extrapolate the 2015 stock and develop 2016 estimates. To determine the distribution of stock across standard (detached + attached) and apartments, SaskPower provided the team with a breakdown of SaskPower's residential accounts in Regina and Saskatoon, determined as 75% standard and 25% apartments. The breakdown of accounts in Regina and Saskatoon is assumed to be indicative of SL&P's stock distribution. Navigant then applied the same 91%/9% split to determine the mix of detached and attached homes within the standard category.

The team then applied the kWh/account numbers estimated for SaskPower to SL&P's stock numbers to determine the base year electricity consumption. The results of this analysis are shown in Table B-4.

[26] NRCan Comprehensive End-Use Database (CEUD). 2014 Households by Building Type.

[27] SaskPower 2011 Farm End-Use Survey (FEUS)

Table B-4. SP&L Residential Base Year Results

Segment	Sales (GWh)	Stock (Accts.)	kWh/Acct.
Single Detached Homes	340	37,165	9,156
Attached/Row Housing	17	3,861	4,494
Apartments/Condos	59	13,659	4,304
Electrically Heated First Nations			
Non-Electrically Heated First Nations			
Farm Houses			
Mobile/Other			
Total (Weighted Average)	**416**	**54,685**	**7,615**

Source: Navigant analysis

For SC, Navigant used the 2010 CPR estimate of SC residential accounts and extrapolated it to 2016 (using the SL&P average annual growth rate over the 2011-2015 period of 0.8%). To break down the total number of residential accounts into standard (detached + attached) and apartments, SaskPower provided Navigant with a breakdown of its residential accounts in Yorkton, determined as 85% standard and 15% apartments. The breakdown of accounts in Yorkton is assumed to be indicative of SC's stock distribution because Yorkton and SC have a similar population (approximately 15,000 vs. 16,000). The team then applied the same 91%/9% split to determine the mix of detached and attached homes within the standard category. Navigant then applied the kWh/account numbers estimated for SaskPower to SC's stock numbers to determine the base year electricity consumption. The results of this analysis are shown in Table B-5.

Table B-5. SC Residential Base Year Results

Segment	Sales (GWh)	Stock (Accts.)	kWh/Acct.
Single Detached Homes	54	5,888	9,156
Attached/Row Housing	3	612	4,494
Apartments/Condos	5	1,133	4,304
Electrically Heated First Nations			
Non-Electrically Heated First Nations			
Farm Houses			
Mobile/Other			
Total (Weighted Average)	**62**	**7,632**	**8,062**

Source: Navigant analysis

The combined results for SaskPower, SL&P and SC are shown in Table B-6.

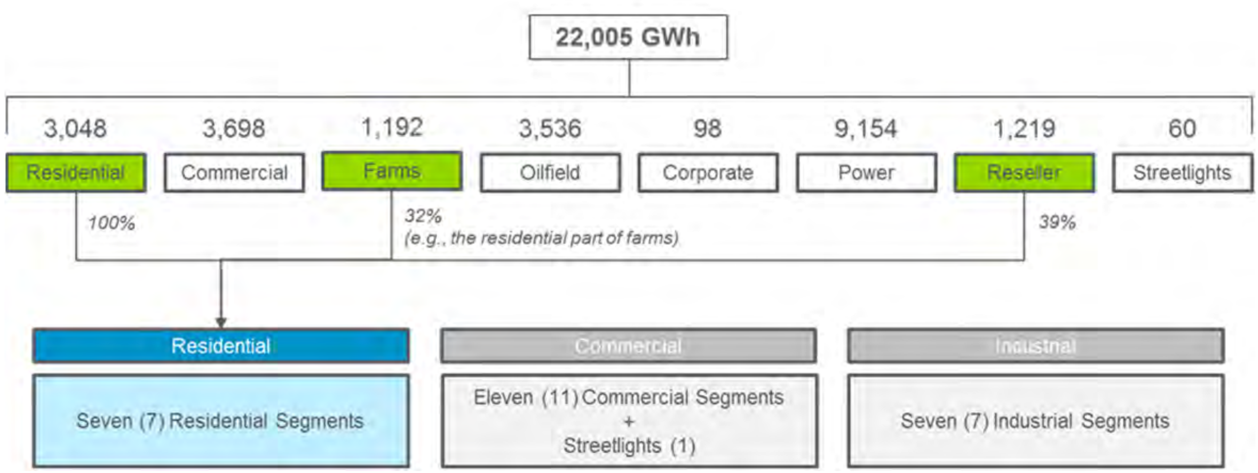
Table B-6. Combined Residential Base Year Results (SaskPower Direct + Resellers)

Segment	Sales (GWh)	Stock (Accts.)	kWh/Acct.
Single Detached Homes	2,858	312,154	9,156
Attached/Row Housing	146	32,425	4,494
Apartments/Condos	304	70,565	4,304
Electrically Heated First Nations	51	2,604	19,569
Non-Electrically Heated First Nations	158	12,988	12,152
Farm Houses	381	32,348	11,790
Mobile/Other	10	1,188	8,277
Total (Weighted Average)	**3,907**	**464,273**	**8,416**

Source: Navigant analysis

The approach described above for combining SaskPower's residential consumption with resellers' residential consumption and residential-farm consumption is summarized by the diagram in Figure B-1. This diagram illustrates the decomposition of SaskPower's total electricity consumption from its eight customer categories into the CPR's three customer sectors. The diagram also shows the residential sector as a combination of the residential category, the farms category (of which 32% is estimated to be residential), and the reseller category (of which 39% is estimated to be residential).

Figure B-1. Residential Breakdown of SaskPower Electricity Sales



Source: Navigant analysis

Base Year EUIs

To determine residential EUIs, Navigant leveraged SaskPower's Residential End-Use Survey (REUS) study results and the associated REUS end-use consumption model. The REUS end-use consumption model is a bottom-up estimation of kWh end-use consumption performed for each residential customer that participated in the REUS. This model uses REUS responses such as the space heating and cooling equipment used in each home—and their associated efficiencies—or the number of televisions and refrigerators used at each home for equipment densities and defining the allocation of energy across end uses. The team then used the penetration of end-use equipment in each home to estimate the kWh consumption in each home. Navigant used these EUIs and scaled them to match the target whole building electricity usage for single family detached homes determined from SaskPower's billing data, which was presented in the previous section.

However, before the process of scaling the end-use model EUIs to the target whole building consumption (for each segment), Navigant first aggregated the REUS results. Because the REUS end-use model estimated EUIs for each REUS participant, Navigant aggregated individual participant results to the building type categories used in the REUS. For example, all participants that self-identified their homes as detached bungalow were rolled up to estimate an average EUI across all detached bungalow participants. The team performed this aggregation of results for all building type categories in the REUS.

Once Navigant developed EUIs for each REUS building type, the team mapped these results to the residential segments used in this CPR. Table B-7 lists the REUS building types used to develop EUIs for each residential segment. For example, the first row shows that the single family detached homes segment is made up of three building types: detached bungalows, detached two-story, and duplex homes.

Table B-7. Mapping of REUS Building Types to CPR Residential Segments

Segment	Building Types
Single Detached Homes	Detached bungalow, detached two-story, and duplex homes
Attached/Row Housing	Townhouse/rowhouse homes
Apartments/Condos	Apartments and condominiums
Electrically Heated First Nations	All electrically heated detached homes (for space heating and water heating) and for all mobile homes (for all other end uses)
Non-Electrically Heated First Nations	All non-electrically heated detached homes (for space heating and water heating) and for all mobile homes (for all other end uses)
Farm Houses	Detached bungalow, detached two-story, and duplex homes
Mobile/Other	Mobile homes, other homes, and homes reported as *Don't know*

Source: Navigant

Table B-8 illustrates the process of scaling the REUS EUI to the CPR EUI estimates. The second column shows the EUI estimates from the REUS end-use model. For example, the REUS end-use model estimates that a detached home uses, on average, 1,248 kWh for space heating purposes, 785 kWh for space cooling, etc. The end-use model estimates the total electricity use for a detached home at 9,358 kWh per year. In comparison, based on SaskPower's 2016 billing data, the average electricity usage for a detached home is 9,156 kWh, or 2% lower than the estimate obtained by the end-use model.

Because the target EUI is 9,156 kWh, Navigant decreased the EUI estimates from the REUS end-use model by 2% such that the total whole building consumption decreased from 9,358 kWh to 9,156 kWh. Applying this 2% reduction decreased the space heating and space cooling EUIs to 1,221 kWh and 768 kWh, respectively, as shown by the last column of the table.

Table B-8. Example of EUI Adjustments (kWh per Acct.) for Detached Homes

End Use	REUS Model EUI Estimate (kWh/Acct.)	Adjusted EUIs (kWh/Acct.)
Space Heating	1,248	1,221
Space Cooling	785	768

End Use	REUS Model EUI Estimate (kWh/Acct.)	Adjusted EUIs (kWh/Acct.)
Water Heating	376	368
Appliances	2,506	2,452
Lighting	1,615	1,580
Electronics	1,789	1,751
Other	1,039	1,016
Total	**9,358**	**9,156**
Target EUI	*9,156*	
Target EUI is lower by:	*2%*	

Source: Navigant analysis

The team repeated this process for each residential segment (e.g., attached/row homes, apartments, etc.).

For certain segments, Navigant made adjustments due to limitations in the number of participants. For example, the number of First Nations participants (i.e., those participants whose geographic location was identified as a First Nations community) was only 14. In this case, the limited sample size of participants was not sufficient to adequately estimate EUIs. Because of this limitation, Navigant developed EUIs for the two First Nations residential segments using the following methodology:

- For electrically heated First Nations homes, Navigant assumed the space heating and water heating consumption to be equivalent to that of electrically heated detached homes. For all other end uses, Navigant assumed the consumption to be equivalent to that of mobile homes.
- For non-electrically heated First Nations homes, Navigant assumed the space heating and water heating consumption to be equivalent to that of non-electrically heated detached homes. For all other end uses, Navigant assumed the consumption to be equivalent to that of mobile homes.

Once Navigant aggregated the building type EUI results into residential segments, the team calibrated (or scaled) those EUIs to be equivalent to the whole building electricity consumption determined from SaskPower's 2016 billing data. For each residential segment, Navigant followed the process described above for single family detached homes. Table B-9 shows the resulting EUIs in the base year.

Table B-9. Base Year Residential EUIs (kWh per Acct.)

Building Segment	Space Heating	Space Cooling	Water Heating	Appliances	Lighting	Electronics	Other	Total
Single Detached Homes	1,221	768	368	2,452	1,580	1,751	1,016	**9,156**
Attached/Row Housing	555	340	94	1,700	698	854	252	**4,494**
Apartments/Condos	597	555	106	1,489	612	727	219	**4,304**
Electrically Heated First Nations	9,338	847	1,617	2,877	1,481	2,084	1,325	**19,569**
Non-Electrically Heated First Nations	1,558	1,003	398	3,405	1,753	2,467	1,569	**12,152**
Farm Houses	1,572	989	473	3,158	2,035	2,254	1,309	**11,790**

Building Segment	Space Heating	Space Cooling	Water Heating	Appliances	Lighting	Electronics	Other	Total
Mobile/Other	937	642	815	2,179	1,122	1,579	1,004	**8,277**

Source: Navigant analysis

Reference Case Stock

To develop the residential stock forecast through 2036, SaskPower provided Navigant with the household forecast underlying its residential load forecast. Because SaskPower's internal household forecast does not extend beyond 2028, SaskPower directed Navigant to extend the 2016-2028 forecast through 2036 using the same approach developed by SaskPower and a third-party consultant. Based on this approach, the team calculated the 2029 stock (i.e., the first year of the extended forecast) by adding the 2028 stock and the average growth in stock over the 10-year period from 2015 through 2024. For example, if the 2028 stock is 100,000 and the average growth in stock between 2015 and 2024 is 1,000, then the 2029 stock would be 101,000. The stock in 2030 would be 102,000, and so on through 2036. Navigant used this approach to extend the household forecast through 2036.

As SaskPower's household forecast did not distinguish stock using the same residential segments as this study, Navigant mapped the household forecast categories to the residential segments using Table B-10.

Table B-10. Mapping of CPR Residential Segments to Household Forecast

CPR Residential Segment	Residential Household Forecast Categories
Single Detached Homes	Households
Attached/Row Housing	Households
Apartments/Condos	Apartment
Electrically Heated First Nations	Households
Non-Electrically Heated First Nations	Households
Farm Houses	Farm Households
Mobile/Other	Households

Source: Navigant

With each residential segment assigned a household forecast category, Navigant applied the growth rates used in the household forecast to the residential segments. Table B-11 shows the growth in stock from 2016 to 2036 used in the reference case.

Table B-11. Reference Case Residential Stock Forecast (Accts.)

Segment	2016	2036
Single Detached Homes	312,154	423,229
Attached/Row Housing	32,425	43,963
Apartments/Condos	70,565	95,675
Electrically Heated First Nations	2,604	3,531
Non-Electrically Heated First Nations	12,988	17,610

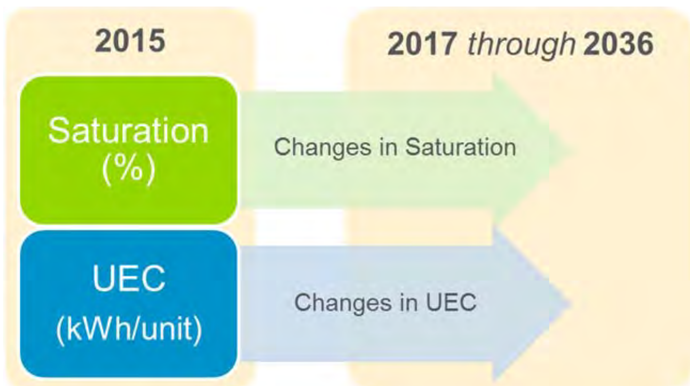
Segment	2016	2036
Farm Houses	32,348	36,006
Mobile/Other	1,188	1,610
Total	**464,273**	**621,624**

Source: Navigant analysis

Reference Case EUI Trending Approach

The Residential EUI trending approach is based on SaskPower's 2016 Itron end-use model. As illustrated by Figure B-2, the Itron model is based on two key inputs: (1) equipment saturation: measured in terms of equipment penetration (%), and (2) unit energy consumption (UEC): measured in terms of electricity consumption (kWh per unit). Using these two factors, the Itron model develops a forecast of electricity consumption by equipment type (e.g., electric furnace, central air conditioner, freezers, refrigerators, etc.).

Figure B-2. Itron Model Schematic



Source: Navigant

Navigant aggregated these equipment types into five of the seven residential end uses used in this CPR (i.e., space heating, space cooling, water heating, appliances, and electronics) and calculated the natural changes in EUI over the 2016-2036 period. For the remaining two end uses, lighting and other, Navigant used the following methodology:

- **Lighting.** The Itron model does not capture natural changes in lighting consumption, such as efficiency from increased penetration of CFLs and LEDs. To account for these changes, Navigant analyzed historical data on the penetration of screw-in lamps (incandescent, CFL, and LED lamps) and linear fluorescent lamps (T5, T8, and T12) in the residential sector for a neighboring Canadian province. Based on this data, Navigant estimates an average change of -1.8% per year in annual energy consumption from residential lighting. This negative natural change reflects a conservation effect because of more efficient lighting.
- **Other.** The other end use is not accounted for in the Itron model and—given the variety of loads it is intended to capture—is assumed to remain constant with no change in intensity over time.

Table B-12 shows the resulting EUI trends by residential end use.

Table B-12. Reference Case Residential EUI Trends (%/yr.)

End Use	EUI Trend (% per Year)
Space Heating	0.6%
Space Cooling	2.1%
Water Heating	-0.5%
Appliances	0.2%
Lighting	-1.8%
Electronics	3.2%
Other	0.0%

Source: Navigant analysis

B.3 Commercial Sector

To determine the total commercial floor space stock in Saskatchewan, Navigant first developed EUI estimates (kWh/m^2) for each commercial segment. The team then divided the electricity consumption for each segment by the EUIs to determine floor space stock.

The following sections describe the approach used to determine electricity consumption by segment, the approach used to estimate EUIs, and the resulting commercial floor space stock.

Base Year Electricity Sales

To determine the base year electricity consumption of each commercial segment, SaskPower engaged a third-party consultant to analyze its non-residential and non-power account electricity sales and assign an appropriate North American Industry Classification System (NAICS) code to each customer account, resulting in a breakdown of electricity sales by NAICS code. Navigant and SaskPower then worked together to develop a mapping of NAICS codes to commercial segments. These NAICS codes were both commercial and industrial so for the purposes of the commercial analysis, only the commercial NAICS codes were considered in the mapping. The team developed this mapping through various reviews of the data to minimize electricity consumption allocated to the other commercial segment.

In addition to the commercial NAICS electricity sales, Navigant added sales from power account consumption (associated with the University of Saskatoon and the University of Regina) and street lighting.

Table B-13 shows the breakdown of commercial sales resulting from this analysis.

Table B-13. SaskPower Direct Commercial Sales Breakdown (GWh)

Segment	Commercial NAICS (GWh)	Power Accts and Street Lighting (GWh)	Total (GWh)
Office	838		**838**
Food Retail	192		**192**
Non-Food Retail	427		**427**
Hospital	157		**157**
Lodging	145		**145**
Restaurant	172		**172**
School	107		**107**
University/College	12	242	**253**
Warehouse/Wholesale	463		**463**
Ice Rinks	47		**47**
Other	685		**685**
Street Lighting		60	**60**
Total	**3,246**	**302**	**3,548**

Source: Navigant analysis

The last step in determining total commercial sales required the team to estimate the breakdown of reseller commercial sales.

Table B-14 summarizes the breakdown of residential and commercial sales estimated from SL&P and SC. Navigant determined the residential sales based on the approach outlined in the previous section and calculated commercial sales as the remainder.

Table B-14. Breakdown of Reseller Sector Sales (GWh)

Sector	SL&P	SC	Total
Residential	416	62	**478**
Commercial	673	68	**741**
Total	**1,089**	**130**	**1,219**

Source: Navigant analysis

To break down the reseller commercial sales into segment sales, Navigant used the same split as that determined for SaskPower with one adjustment. The adjustment to the SL&P and SC commercial split is related to the lower incidence of office buildings in Saskatoon and SC as compared to SaskPower's service territory. This lower incidence of office buildings is a result of the increased presence of public sector buildings (such as federal and provincial government buildings) in Regina. To quantify the lower incidence of office buildings in Saskatoon and SC, Navigant used public sector employment data from Statistics Canada (StatCan).[28]

Table B-15 shows the breakdown of residential stock and public-sector employment across SaskPower's service territory, in Saskatoon, and in SC. Relative to the breakdown of residential stock, public sector employment is 26% lower in Saskatoon and SC. For example, Saskatoon accounts for approximately

[28] Source: http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/govt62e-eng.htm

11.8% residential stock but only 8.7% of public sector employment. Therefore, Saskatoon's share of public sector employment is 26% lower than its share of residential stock.

Table B-15. Reseller Adjustment to Offices

Utility/Region	Residential Split (Thousands)	Public Sector Employment Split (Thousands)	Change (%) Relative to Residential Split
SaskPower	402	135.2	N/A
Saskatoon	55	13.1	-26%
SC	8	1.9	-26%
Total	**464**	**150**	**N/A**

Source: Navigant analysis

Based on this approach, Navigant estimated the breakdown of electricity consumption from office buildings to be 26% lower in Saskatoon and SC compared to SaskPower's service territory. The team applied this 26% reduction to the mix of commercial electricity consumption from offices. For example, if offices account for 20% of SaskPower commercial consumption, they account for approximately 14.8% of commercial consumption in Saskatoon and SC (e.g., 26% lower than SaskPower's 20%). All other commercial electricity consumption is assumed to be split across all commercial segments proportionally to SaskPower's breakdown across all non-office commercial segments.

SL&P and SC's commercial sales by segment are shown in Table B-16.

Table B-16. Reseller Commercial Base Year Sales (GWh)

Segment	SL&P (GWh)	SC (GWh)	Total (GWh)
Office	118	12	**130**
Food Retail	39	4	**43**
Non-Food Retail	88	9	**96**
Hospital	32	3	**35**
Lodging	30	3	**33**
Restaurant	35	4	**39**
School	22	2	**24**
University/College	52	5	**57**
Warehouse/Wholesale	95	10	**105**
Ice Rinks	10	1	**11**
Other	140	14	**155**
Street Lighting	12	1	**14**
Total	**673**	**68**	**741**

Source: Navigant analysis

The combined commercial sales by segment across SaskPower, SL&P, and SC are shown in Table B-17.

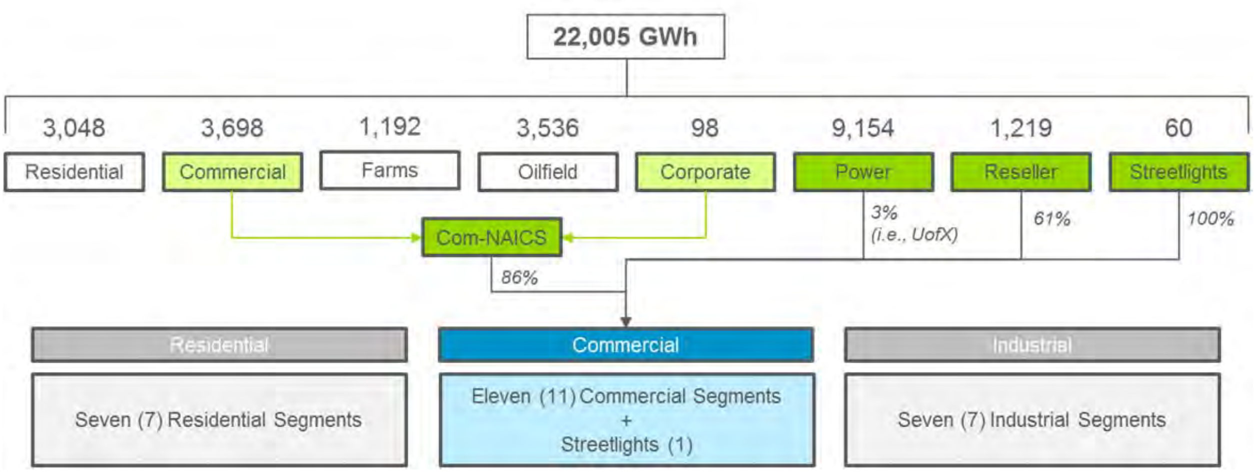
Table B-17. Combined Commercial Base Year Sales (GWh) – SaskPower + Resellers

Segment	Total (GWh)
Office	968
Food Retail	235
Non-Food Retail	523
Hospital	192
Lodging	178
Restaurant	211
School	131
University/College	310
Warehouse/Wholesale	568
Ice Rinks	58
Other	840
Street Lighting	74
Total	**4,289**

Source: Navigant analysis

The approach described above for combining commercial consumption from the NAICS analysis, resellers, power accounts, and street lights is summarized in Figure B-3. This diagram shows the commercial sector as a combination of the commercial and corporate categories (which make up the NAICS data), the power accounts category (of which 3% is estimated to be commercial), the reseller category (of which 61% is estimated to be commercial), and street lights.

Figure B-3. Commercial Breakdown of SaskPower Electricity Sales



Source: Navigant analysis

Base Year EUIs

To estimate commercial EUIs, Navigant used its proprietary commercial end-use model. This end-use model is a bottom-up representation of electricity consumption in commercial building types based on the mix of end-use equipment, equipment efficiencies, and fuel shares (e.g., gas vs. electricity). Navigant incorporated fuel share assumptions from SaskPower's 2006 Commercial End-Use Study (CEUS) and the 2010 CPR. For equipment efficiencies and mix—in the absence of granular commercial data specific to Saskatchewan—Navigant relied on the model's default assumptions regarding equipment penetration, which are based on another Canadian province.

Table B-18 shows the commercial EUIs determined using Navigant's end-use model.

Table B-18. SaskPower Commercial Base Year EUIs (kWh per m²)

kWh/m²	Space Heating	Space Cooling	Hot Water	Cooking	HVAC Fans/Pumps	Lighting	Office Equipment	Refrigeration	Other	Total
Office	5	13	-	1	40	59	26	1	7	**152**
Food Retail	3	41	-	114	3	13	306	9	3	**492**
Non-Food Retail	1	21	-	88	15	8	5	7	5	**147**
Hospital	8	72	-	74	15	8	4	8	3	**191**
Lodging	3	30	-	53	14	4	2	10	12	**127**
Restaurant	38	55	-	118	2	3	68	17	17	**317**
School	1	13	-	38	15	8	2	4	1	**81**
University/College	2	56	-	81	19	6	2	8	1	**175**
Warehouse/Wholesale	1	13	-	51	2	9	15	4	2	**96**
Ice Rinks	2	13	-	69	4	2	109	-	6	**205**
Other	3	35	-	62	14	7	4	8	4	**135**

Source: Navigant analysis

Commercial Stock

To determine the base year commercial floor space stock, Navigant divided electricity sales (GWh) by EUIs (kWh/m²). Table B-19 shows commercial sales, stock, and EUIs.

Table B-19. Combined Commercial Base Year Results – SaskPower + Resellers

Segment	Sales (GWh)	Stock (million m²)	kWh/m²
Office	968	6.29	152
Food Retail	235	0.47	492
Non-Food Retail	523	3.53	147
Hospital	192	1.00	191
Lodging	178	1.34	127
Restaurant	211	0.62	317
School	131	1.59	81
University/College	310	1.71	175
Warehouse/Wholesale	568	5.84	96
Ice Rinks	58	0.28	205
Other	840	6.08	135
Street Lighting	74	-	-
Total	**4,289**	**28.76**	**149**

Source: Navigant analysis

Reference Case EUI Approach

The commercial EUI trending approach uses two key pieces of data:

1. **Incidence of Commercial Equipment Upgrades** (by end use, by segment) [% per year]: Obtained from a recent CEUS, 2014) and provided to Navigant confidentially by a large Canadian electric utility
2. **Improvement in Equipment Efficiency** (by end use, by segment) [% improvement in efficiency relative to the baseline technology]: Data on the expected natural improvement in equipment efficiency determined by the ongoing work of characterizing energy efficiency measures

Incidence of Commercial Equipment Upgrades

The 2014 CEUS surveyed commercial customers across each commercial segment regarding upgrades made to end-use equipment over the past 5 years. The results of this survey determined the annual incidence in equipment upgrades (i.e., percentage of customers making equipment upgrades every year). The survey data did not report results for the ice rink segment; instead, Navigant used data from the other segment. Table B-20 shows the annual incidence of equipment upgrades by commercial segment and by end use. Two end uses—other and office equipment—are not reported in the survey data and are assumed to remain constant over time.

Table B-20. Annual Incidence of Equipment Upgrades by Segment and End Use

End Use	Lighting	Space Heating	Space Cooling	Hot Water	HVAC Fans/Pumps	Cooking	Refrigeration
Lodging	3.8%	3.0%	2.3%	3.8%	1.4%	2.6%	1.8%
Colleges & Universities	3.0%	3.4%	1.8%	5.0%	3.8%	2.6%	2.8%
Food Service	4.1%	3.6%	3.3%	4.9%	2.6%	3.5%	2.9%
Hospital	3.5%	3.2%	4.4%	3.0%	3.5%	3.8%	3.9%
Logistics & Warehouses	3.5%	2.4%	3.8%	3.3%	2.0%	3.1%	2.9%
Offices	3.8%	3.2%	4.8%	1.8%	3.3%	4.0%	4.1%
Other	3.8%	3.2%	4.8%	1.8%	3.3%	4.0%	4.1%
Retail - Food	4.5%	3.9%	4.7%	4.1%	3.2%	4.3%	3.9%
Retail - Non-Food	4.5%	3.9%	4.7%	4.1%	3.2%	4.3%	3.9%
Schools	4.9%	3.2%	1.7%	2.9%	2.1%	2.4%	1.9%
Ice Rinks	4.7%	2.4%	1.7%	3.7%	2.8%	2.4%	1.9%
Simple Average	**4.0%**	**3.2%**	**3.4%**	**3.5%**	**2.8%**	**3.3%**	**3.1%**

Source: Navigant analysis of confidential 2014 CEUS

On average, lighting upgrades are the most common type of equipment upgrade undertaken by commercial customers—average of 3.9% of customers per year—followed by space cooling and cooking equipment upgrades—3.7% and 3.5% per year, respectively. Differences across end uses reflect the likelihood of a commercial customer to target a certain end use for upgrades. Similarly, differences across commercial segments reflect a variety of factors such as availability of funds for equipment upgrades and level of importance attributed to end uses, among others.

Improvement in Equipment Efficiency

To determine the hypothetical improvement in upgrading equipment efficiency, Navigant compared the baseline (kWh_{BASE}) and efficient electricity consumption (kWh_{EE}) of measures corresponding to each end use. For example, to estimate the improvement in efficiency from space cooling equipment upgrades, the team averaged the following measure savings: PTAC/PTHP equipment, unitary and split system AC/HP equipment, CAC[29] tune-ups, electric chillers, and economizer controls. For each of these measures, Navigant recorded the baseline and efficient consumption, and averaged them to obtain an end-use average for the baseline and efficient consumption. Navigant used this process for all end uses.

Table B-21 shows the improvement in equipment efficiency by end use. The lowest improvements in efficiency are for water heating and space cooling measures at 6% and 8%, respectively. The highest improvements are for the HVAC fans/pumps and lighting measures at 27% and 25%, respectively.

[29] PTAC/PTHP = Package terminal air conditioner/package terminal heat pump; AC/HP = air conditioner/heat pump; CAC = central air conditioner.

Table B-21. Baseline vs. Efficient Consumption by End Use

End Use	Improvement in Efficiency (%)	Efficient Consumption as Percentage of Base Consumption (%)
Lighting	25%	75%
Water Heating	6%	94%
Space Cooling	8%	92%
HVAC Fans/Pump	27%	73%
Space Heating	19%	81%
Cooking	19%	81%
Refrigeration	13%	87%

Source: Navigant analysis of measure characterization

Commercial EUI Trends

Navigant calculated the natural change in EUI based on two parameters: the incidence of equipment upgrades, and the improvement in equipment efficiency. The following paragraph and Table B-22 walk through a sample calculation based on a hypothetical space cooling EUI of 10 kWh/m^2 for the lodging segment.

> In Year 1, the baseline EUI for the lodging facility is 10 kWh/m^2. In Year 2, the facility upgrades 2.3% of the space cooling equipment. The electricity consumption of the upgraded equipment is equivalent to 92% of the baseline consumption. Because a portion of the space cooling equipment has been upgraded, the team can expect the average EUI to decrease in Year 2. The team can estimate the Year 2 EUI based on the percentage of upgraded space cooling equipment and the efficiency improvement of the upgraded equipment. Equation B-1 details this calculation. The Year 2 EUI is determined based on the proportion of base and energy efficient equipment: 97.7% and 2.3%, respectively. The team then multiplies the proportion of base/energy efficient equipment with the estimated consumption (expressed as a percentage of base consumption). The resulting Year 2 EUI is 9.98 kWh/m^2, equivalent to a 0.2% reduction from Year 1.

Equation B-1. EUI Trending Adjustment

$$EUI_{Yr\,2} = EUI_{Yr\,1} * \left(EE\ equip_{\%} * EE\ consumption_{\%\ of\ Base} + Base\ equip_{\%} * Base\ consumption_{\%\ of\ Base}\right)$$

Table B-22. Example of EUI Trending Approach – Lodging, Space Cooling

Parameter	Equipment Consumption (as % of Base)	Year 1	Year 2
Baseline Equipment	100%	100%	97.7%
Efficient Equipment	92%	0%	2.3%
EUI Multiplier		100% $(100\% * 100\% + 0\% * 92\%)$	99.8% $(97.7\% * 100\% + 2.3\% * 92\%)$
EUI (kWh/m^2)	**10.00**	**10.00**	**9.98**

Source: Navigant

Table B-23 shows the EUI trends calculated for all end uses and segments.

Table B-23. EUI Trends by Commercial Segment and End Use

End Use	Lighting	Space Heating	Space Cooling	Hot Water	HVAC Fans/Pumps	Cooking	Refrigeration
Lodging	-1.0%	-0.6%	-0.2%	-0.2%	-0.4%	-0.5%	-0.2%
Colleges & Universities	-0.7%	-0.6%	-0.1%	-0.3%	-1.0%	-0.5%	-0.4%
Food Service	-1.0%	-0.7%	-0.3%	-0.3%	-0.7%	-0.6%	-0.4%
Hospital	-0.9%	-0.6%	-0.3%	-0.2%	-0.9%	-0.7%	-0.5%
Logistics & Warehouses	-0.9%	-0.5%	-0.3%	-0.2%	-0.5%	-0.6%	0.0%
Offices	-0.9%	-0.6%	-0.4%	-0.1%	-0.9%	-0.7%	-0.5%
Other	-0.9%	-0.6%	-0.4%	-0.1%	-0.9%	-0.7%	-0.5%
Retail - Food	-1.1%	-0.7%	-0.4%	-0.2%	-0.8%	-0.8%	-0.5%
Retail - Non-Food	-1.1%	-0.7%	-0.4%	-0.2%	-0.8%	-0.8%	-0.5%
Schools	-1.2%	-0.6%	-0.1%	-0.2%	-0.6%	-0.5%	-0.2%
Ice Rinks	-1.2%	-0.5%	-0.1%	-0.2%	-0.8%	-0.4%	-0.1%
Simple Average	**-1.0%**	**-0.6%**	**-0.3%**	**-0.2%**	**-0.8%**	**-0.6%**	**-0.4%**

Source: Navigant analysis

Reference Case Stock

To calculate the commercial reference case stock, Navigant first determined the commercial reference case electricity consumption. Because SaskPower's load forecast uses the same eight load categories as the base year sales data, Navigant performed the same breakdown process used to determine the commercial consumption in the base year.

Navigant divided the reference case electricity consumption by the commercial EUIs to calculate stock. Table B-24 illustrates this approach. To calculate the 2036 stock of 38.66 million m^2, Navigant divided the 5,057 GWh of consumption by the EUI of 131 kWh/m^2. The increase from approximately 29 million m^2 in 2016 to 39 million m^2 in 2036 is equivalent to an annual stock growth increase of 1.5% per year.

Table B-24. Reference Case Commercial Sector Results

	2016	2036
Sales (GWh)	4,289	5,057
EUI (kWh/m^2)	149	131
Stock (million m^2)	28.76	38.66

Source: Navigant analysis

B.4 Industrial Sector

Unlike the residential and commercial sectors, the industrial sector did not require the estimation of industrial stock. To determine the breakdown of industrial sales by end use, Navigant applied end-use allocation factors (%) to the sales of each industrial segment.

The following sections describe the approach used to determine electricity consumption by segment, and the approach used to determine end-use allocation factors (%).

Base Year Industrial Sales

To determine base year electricity sales by industrial segment, SaskPower provided Navigant with power account sales. SaskPower's power account categories are closely aligned with the industrial segments used in this study. Table B-25 shows the base year power account sales, the mapping to CPR segments, and the rollup of sales into industrial segments. Note: universities are not an industrial segment and are considered as part of the commercial sector.

Table B-25. Mapping of Power Account Sales to Industrial Segments

Power Acct Categories	*Mapping to CPR Segments*	GWh
Potash	*Potash Mines*	2,575
Pipelines	*Oil & Gas*	2,221
Pulp & Paper	*Pulp & Paper*	849
Steel	*Steel*	605
Chemical	*Manufacturing*	618
Oil	*Oil & Gas*	69
Refineries	*Oil & Gas*	839
Coal Mines	*Northern Mines*	80
Northern Mines	*Northern Mines*	449
Universities	*N/A*	242
Other	*Manufacturing*	609
Total		**9,154**

Source: Navigant analysis

In addition to the power account sales, the industrial sector also includes a portion of the NAICS sales that are categorized as industrial, the oilfields category, and the industrial portion of farms. This is illustrated by Table B-26.

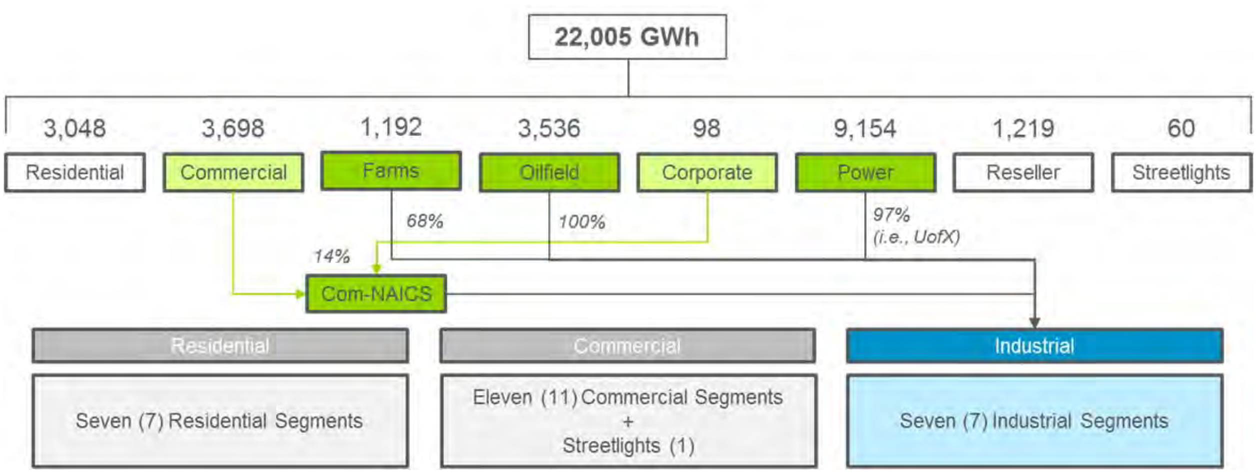
Table B-26. SaskPower Industrial Base Year Sales (GWh)

Segment	Power Accounts (GWh)	NAICS (GWh)	Oilfields/Farms (GWh)	Total (GWh)
Potash Mines	2,575	23		**2,598**
Northern Mines	529	29		**558**
Steel	605	5		**610**
Oil & Gas	3,128	-	3,536	**6,664**
Pulp & Paper	849	89		**938**
Manufacturing	1,227	403		**1,630**
Farms	-	-	810	**810**
Total	**8,912**	**549**	**4,347**	**13,809**

Source: Navigant analysis

The approach described above for combining commercial consumption from the power accounts, NAICS sales, and farms is summarized in Figure B-4. This diagram shows the makeup of the industrial sector as a combination of the commercial and corporate categories (which account for 14% of the NAICS data), the power accounts category (of which 97% is industrial, after removing universities), and the farms category (of which 68% is industrial).

Figure B-4. Industrial Breakdown of SaskPower Electricity Sales



Source: Navigant analysis

End-Use Allocation Factors (%)

Navigant developed industrial end-use allocation factors to estimate electricity consumption by industrial end use. To develop end-use allocation factors, Navigant used data from SaskPower-specific industrial facilities, in addition to a variety of other resources including the following:

- SaskPower 2008 industrial reports
- SaskPower 2011 tech reports
- SaskPower 2010 CPR
- SaskPower 2011 Farm End-Use Survey

- US Department of Energy (DOE) Steel report
- Navigant confidential studies on industrial energy efficiency

Table B-27 shows the end-use allocation factors developed for each industrial segment.

Table B-27. Industrial End-Use Allocation Factors (%)

Segment	Compressed Air	Fans & Blowers	Industrial Process	Lighting	Material Transport	Process Heating	Product Drying	Pumps	Process Cooling	Space Heating	Total
Potash Mines	11%	7%	28%	4%	15%	1%	0%	31%	0%	3%	**100%**
Northern Mines	7%	5%	57%	3%	5%	9%	0%	14%	0%	1%	**100%**
Steel	9%	17%	21%	3%	0%	42%	0%	7%	0%	0%	**100%**
Oil & Gas	25%	15%	34%	1%	0%	0%	0%	19%	6%	0%	**100%**
Pulp & Paper	27%	4%	26%	1%	2%	3%	22%	11%	0%	2%	**100%**
Manufacturing	13%	13%	36%	12%	2%	2%	0%	8%	4%	11%	**100%**
Farms	6%	11%	6%	33%	2%	0%[30]	0%	21%	7%	15%	**100%**

Source: Navigant analysis

The final step of the industrial analysis was applying the end-use allocation factors to the industrial sales calculated in the previous section. Table B-28 shows the breakdown of electricity sales by end use and industrial segment.

Table B-28. SaskPower Industrial Base Year Sales by Segment and End Use (GWh)

Segment	Compressed Air	Fans & Blowers	Industrial Process	Lighting	Material Transport	Process Heating	Product Drying	Pumps	Process Cooling	Space Heating	Total
Potash Mines	286	182	727	104	390	26	-	805	-	78	**2,598**
Northern Mines	37	27	316	16	27	52	-	77	-	6	**558**
Steel	56	104	129	18	-	257	-	41	1	3	**610**
Oil & Gas	1,638	989	2,260	63	-	-	-	1,292	411	11	**6,664**
Pulp & Paper	257	33	246	12	23	32	206	103	4	21	**938**
Manufacturing	214	209	584	191	38	31	-	125	63	175	**1,630**
Farms	49	90	45	271	14	-	-	170	53	118	**810**

Source: Navigant analysis

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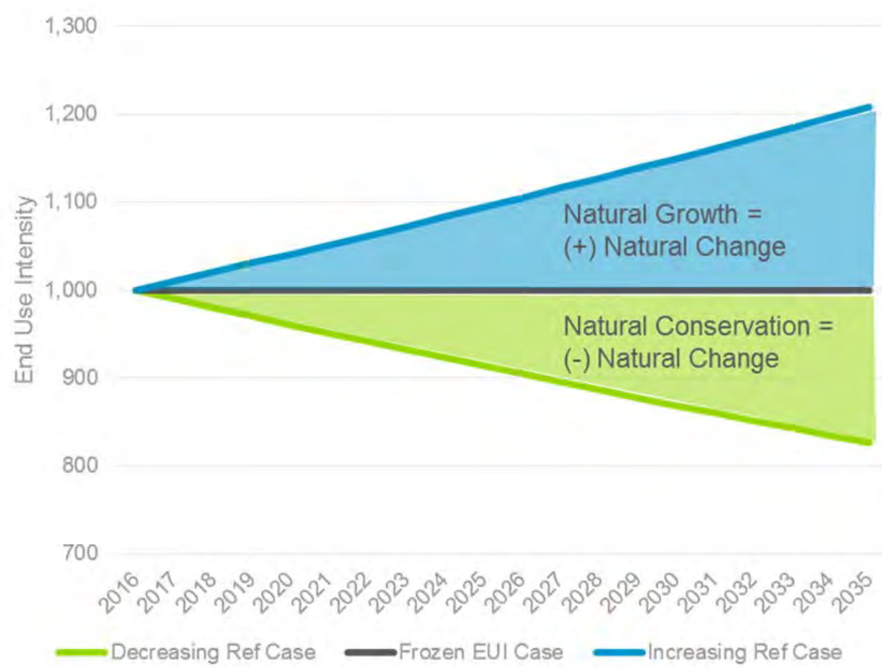
[30] The three datasets used to develop the farm end-use breakdown (i.e., other Canadian province, SKP's 2010 CPR, and SKP's 2011 FEUS), reported consumption under Space Heating, the other under Process Heating, and the last under Heating Systems. Navigant, therefore, assigned Process Heating 0% of consumption. Because there was a bit of ambiguity between the three datasets, Navigant calculated the average and opted to report that consumption under Space Heating.

APPENDIX C. NATURAL CHANGE

Navigant's definition of natural change stems from two related concepts: natural conservation and natural growth. Natural conservation is a well-established concept in DSM programs and typically refers to actions taken by utility customers—in the absence of utility-sponsored programs—to improve energy efficiency and reduce consumption. These actions occur naturally, with no influence from utilities or program administrators. Natural growth refers to actions taken by utility customers to increase consumption without the involvement of utility-guided programs. An example of natural growth is home electronics, where customers may be increasing their electric consumption (e.g., through addition of more televisions, computers, etc.) and causing an increase in the electronics EUI.

This study captures the effects of natural conservation as well as natural growth within the EUIs and defines these effects as natural change. When natural change is positive for an end-use category, it reflects growth. When natural change is negative, it reflects conservation. Figure C-1 illustrates this concept of natural change as it relates to the reference case EUIs as compared with a frozen EUI case. A frozen EUI assumes a fixed level of electricity consumption on a per-unit basis (i.e., kWh per home, or kWh per m^2) absent natural change.

Figure C-1. Natural Change in Context of EUI (kWh)



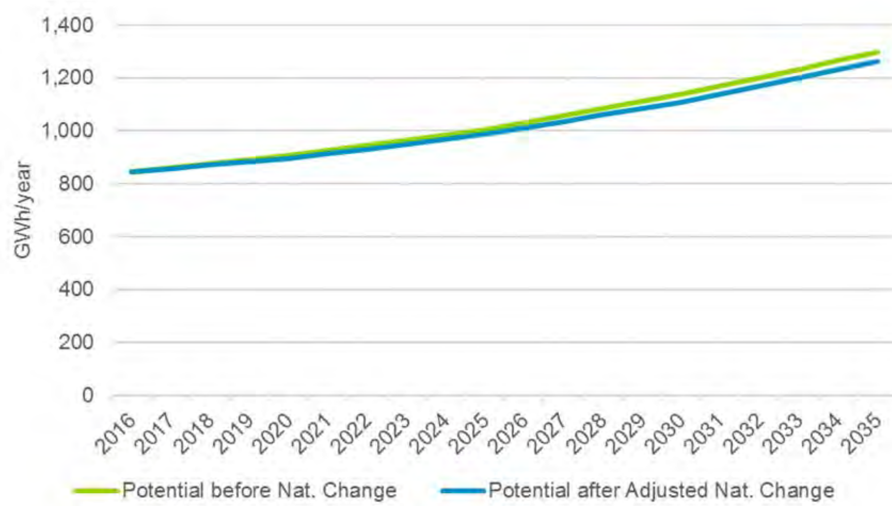
Source: Navigant

In this study, the reference case represents the expected level of electricity consumption projected across the province through 2036 absent incremental DSM activities. The reference case allows for EUIs to change over time as a function of natural change. However, the calculation of technical, economic, and achievable savings uses a frozen EUI approach based on base year EUI levels (2016). This is because measure characterization assumes a fixed mix of efficient and baseline measures over time for existing stock. For example, if the base year penetration of ENERGY STAR freezers is 10% and the penetration of standard efficiency freezers is 90%, this study calculates savings potential based on this mix of efficiencies for existing stock. Additionally, savings potential may increase over time because of new stock. Ultimately, Navigant aggregated and reported savings from all measures at the various levels of aggregation (i.e., end use, segment, sector, and utility level).

The study also reports saving by accounting for natural changes in EUI. Once the team quantifies natural changes, they apply it to the technical, economic, and achievable potential to estimate the shift in savings attributed to natural change. For example, Figure C-2 shows an illustrative level of savings potential before adjustments for natural change as well as potential after adjustments for natural change. In this example, natural change is negative in all years—decreasing the savings potential—and indicates an overall natural tendency toward increased electricity conservation rather than consumption. In general, the impact of natural change over time is not significant.

Figure C-2. Achievable Potential Adjustments for Natural Change

(Values for Illustration Purposes Only)



Source: Navigant

APPENDIX D. INPUT ASSUMPTIONS

D.1 Measure List and Characterization Assumptions

See *SaskPower_CPR_MeasureList* and *SaskPower Measure Details* for granular measure input to the model.

D.2 Avoided Costs and Cost-Effectiveness

Avoided Costs

To calculate utility benefits, the cost-effectiveness calculation uses the avoided costs of energy and capacity. These avoided costs reflect the cost that would have been incurred without the energy reduction. See *SaskPower_AvoidedCosts* for the accompanying workbook.

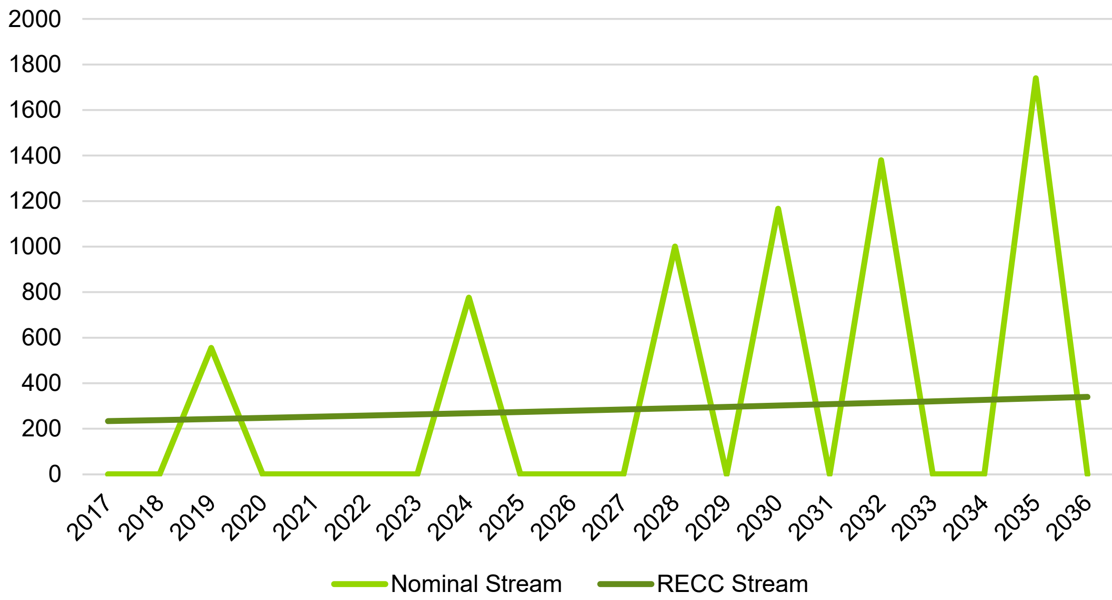
Source. SaskPower provided Navigant the marginal energy cost ($/MWh)[31] updated November 2016 and avoided capacity cost ($/kW)[32] updated December 2016.

Analysis Methodology. The avoided capacity costs provided were assumed to only occur at the time of new generation build. To fully amortize the costs over the years of calculating avoided costs, Navigant annualized this value. Navigant used a real economic carrying charge (RECC) approach to specify avoided costs over the analysis horizon. The RECC stream inflates over time at a constant inflation rate and has identical net present value (NPV) to the nominal avoided cost stream, which has zeros in non-decision years. The RECC approach ensures that there is a non-zero value to peak demand reduction in each year of the study in a way that respects the overall NPV of SaskPower's supply team's capital allocation schedule.

[31] Marginal energy cost averages from PROMOD run for most likely load for the years 2017-2036.

[32] Capacity cost calculation (Capacity Deferral Method) for use in avoided cost distribution – AVDCC2016 Gas.XLS

Figure D-1. Comparing Analysis Avoided Cost Methodologies



Source: Navigant

Summary. Table D-1 provides the avoided costs, which include line losses, used for the cost-effectiveness calculations. Avoided costs extend past the study period because savings occur for the life of the measures. SaskPower only provided its forecasted costs through 2036. Navigant used the 2% inflation rate to extend out the costs past 2036.

Table D-1. Avoided Marginal Cost

Data Years	kWh Avoided Cost ($/kWh)	kW Avoided Cost ($/kW)
2016	0.02946	228.61
2017	0.03005	233.18
2018	0.03175	237.84
2019	0.03285	242.60
2020	0.02735	247.45
2021	0.02600	252.40
2022	0.02738	257.45
2023	0.02809	262.60
2024	0.02836	267.85
2025	0.02917	273.21
2026	0.03107	278.67
2027	0.03273	284.25
2028	0.03620	289.93
2029	0.03458	295.73
2030	0.04643	301.64
2031	0.03895	307.68
2032	0.03951	313.83
2033	0.03737	320.11
2034	0.03810	326.51
2035	0.04044	333.04
2036	0.03815	339.70

Source: Navigant analysis

Additional Notes. SaskPower and Navigant decided to exclude avoided gas costs. SaskPower is an electric-only utility. Therefore, any avoided gas use from the electric energy efficiency measures would not be a resulting benefit stream for SaskPower.

Cost-Effectiveness Calculations

The potential analysis uses three forms of cost-effectiveness calculations. They are the Total Resource Cost (TRC) test and the Utility Cost Test (UCT) for utility cost-effectiveness. There is also the Participant Cost Test (PCT), which is mostly addressed by calculating the participant payback period instead of the benefit-cost ratio for the PCT. This section describes these tests, the inputs, and how they are used for the potential study.

Avoided Costs

The avoided costs are in both the TRC test and the UCT and are based on the annual energy savings and peak demand savings. The calculation is based on Equation D-1.

Equation D-1. Avoided Costs of Energy and Peak Demand Savings

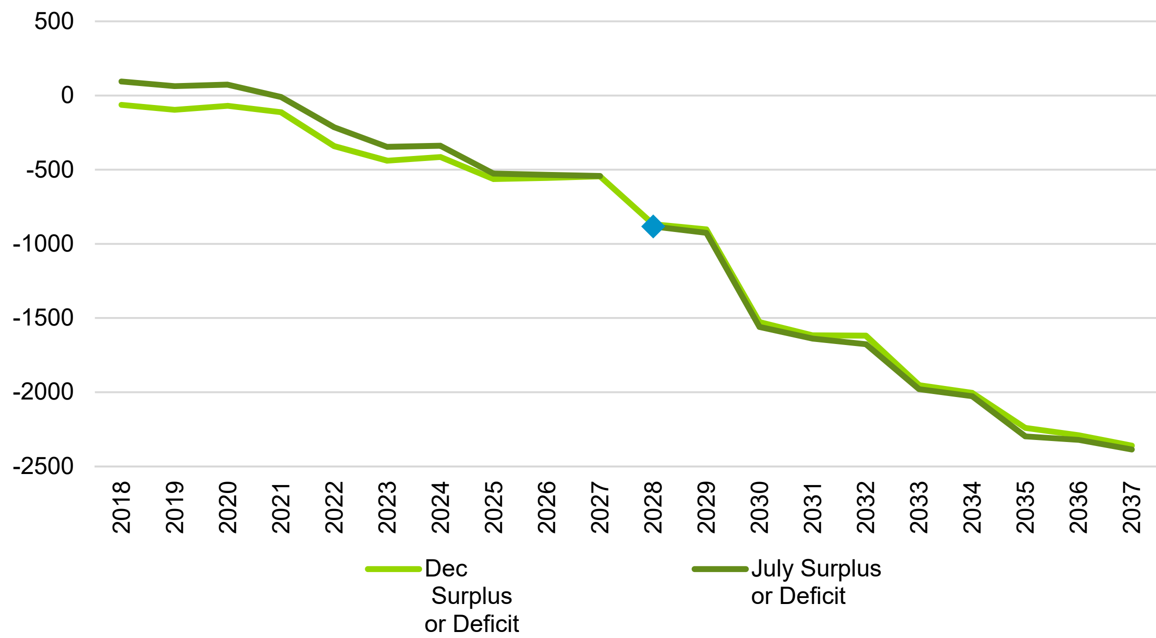
$$Avoided\ Costs(\frac{\$}{year})_i$$
$$= \$Avoided\ Energy\ Costs_i\ \left(\$/_{kWh}\right) \times kWhSaved(\frac{kWh}{year})$$
$$+ \$AvoidedCapacityCosts_i\left(\$/_{kW}\right) \times PeakDemandSavings(\frac{kW}{year})$$

The avoided costs only calculate the electric benefits. Because SaskPower is an electric utility, its stakeholder benefits do not include avoided gas consumption for any applicable measures. Electric benefits are both from energy and capacity. Some measures have both summer and winter peak demand reductions. However, the avoided capacity costs should not be calculated for both summer and winter peak savings because doing so would double count the benefit for the measure.

To properly value peak demand reductions from energy efficiency, Navigant adjusted the peak hour definition for marginal reductions in peak demand beginning in 2028. Prior to 2028, avoided capacity costs from reductions in demand during winter peak hours were included in each measure's net benefits for economic screening and UCT reporting. In 2028 and beyond, avoided capacity costs from summer peak demand reductions were used instead. This allowed Navigant's assessment of the capacity deferral value of energy efficiency to track SaskPower's supply planning assumptions at a sub-annual level and to capture the true marginal value of demand reduction in months where SaskPower's system is most constrained.

Figure D-2 illustrates SaskPower's seasonal forecasted capacity surplus or deficit through 2037 in the most constrained summer and winter months of the year: July and December. The blue diamond symbol indicates the point where the July deficit becomes greater in absolute value than the December deficit. Accordingly, the summer peak demand reduction value for each measure is assumed to provide the marginal annual benefit to the system in 2028 and beyond.

Figure D-2. Seasonal Surplus or Deficit



Source: Navigant analysis of SaskPower forecasted capacity

TRC Test

The TRC test is a benefit-cost metric that measures the net benefits of energy efficiency measures from the combined stakeholder viewpoint of the utility (or program administrator) and the customers. The TRC benefit-cost ratio is calculated in the model using Figure D-2.

Equation D-2. Benefit-Cost Ratio for TRC Test

$$TRC = \frac{PV(Avoided\ Costs)}{PV(Technology\ Cost + Admin\ Costs)}$$

Where:

- *PV( )* is the present value calculation that discounts cost streams over time.
- *Avoided Costs* are the monetary benefits resulting from electric energy and capacity savings—e.g., avoided costs of infrastructure investments, as well as avoided fuel (commodity costs) due to electric energy conserved by efficient measures.
- *Technology Cost* is the incremental equipment cost to the customer.
- *Admin Costs* are the administrative costs incurred by the utility or program administrator.

Navigant calculated TRC ratios for each measure based on the present value of benefits and costs (as defined above) over each measure's life. As agreed upon with the utility, effects of free ridership are not present in the results from this study, so the team did not apply a net-to-gross (NTG) factor. Providing gross savings results will allow the utility to easily apply updated NTG assumptions in the future and allow for variations in NTG assumptions by reviewers.[33]

The administrative costs are included when reporting sector-specific or portfolio-wide cost-effectiveness. However, they are not included at the measure level for economic potential screening. For this screening, it is important to identify measures that are cost-effective on the margin prior to assessing impacts for the achievable potential where administrative costs are considered depending on the amount and level of programmatic spend.

UCT

The UCT is a benefit-cost metric that measures the net benefits of energy efficiency measures from the stakeholder viewpoint of the utility (or program administrator) only. The UCT benefit-cost ratio is calculated in the model using Equation D-3.

Equation D-3. Benefit-Cost Ratio for Utility Cost Test

$$UCT = \frac{PV(Avoided\ Costs)}{PV(Incentives + Admin\ Costs)}$$

Where:

- *PV( )* is the present value calculation that discounts cost streams over time.
- *Avoided Costs* are the monetary benefits resulting from electric energy and capacity savings—e.g., avoided costs of infrastructure investments, as well as avoided fuel (commodity costs) due to electric energy conserved by efficient measures.
- *Admin Costs* are the administrative costs incurred by the utility or program administrator.
- *Incentives* are the incentive costs incurred by the utility or program administrator and are used to reduce the customer's payment.

Navigant calculated UCT ratios for each measure based on the present value of benefits and costs (as defined above) over each measure's life. As with the TRC, administrative costs are only included at the sector and portfolio level for reasons previously described. Measure-specific inputs are provided in Appendix D.1.As agreed upon with the utility, effects of free ridership are not present in the results from this study, so the team did not apply a NTG factor. Providing gross savings results will allow the utility to easily apply updated NTG assumptions in the future and allow for variations in NTG assumptions by reviewers.[34]

Participant Payback Period

Navigant calculates the customer payback period to assess customer potential to implement the energy-saving action. The payback period is used to assess the customer acceptance and adoption of the

[33] Currently, SaskPower does not use any metrics to address program attribution (i.e., free ridership), which is measured with the NTG estimate.

[34] Currently, SaskPower does not use any metrics to address program attribution (i.e., free ridership), which is measured with the NTG estimate.

measure. Additional details are described in the achievable potential methodology section. The payback period is calculated after the incentive is applied to the measure cost. Equation D-4 demonstrates the calculation.

Equation D-4. Participant Payback Period

$$Payback = \frac{Annual\ kWh\ Saved\ \times Annualized\ Retail\ Rate\ \left(\$/_{kWh}\right) + Annual\ Gas\ Saved\ \times Annualized\ Retail\ Rate\ (\$/_{m^3})}{Incremental\ Measure\ Cost - Incentive}$$

Where:

- *Annual kWh Saved* and *Annual Gas Saved* is calculated for each measure and segment (as appropriate).
- *Annualized Retail Rate* is the overall cost a customer pays per kWh or per m^3 consumed (see Appendix D.3).
- *Incremental Measure Costs* are the costs the participant would pay (without an incentive) to implement the measure. In ROB and new construction (depending on the measure) the difference in the cost of the efficiency and standard equipment is used instead of the full cost of installation (material and labor costs).
- *Incentives* are the incentive costs paid for the customer's out of pocket costs to be reduced.

D.3 Retail Rates

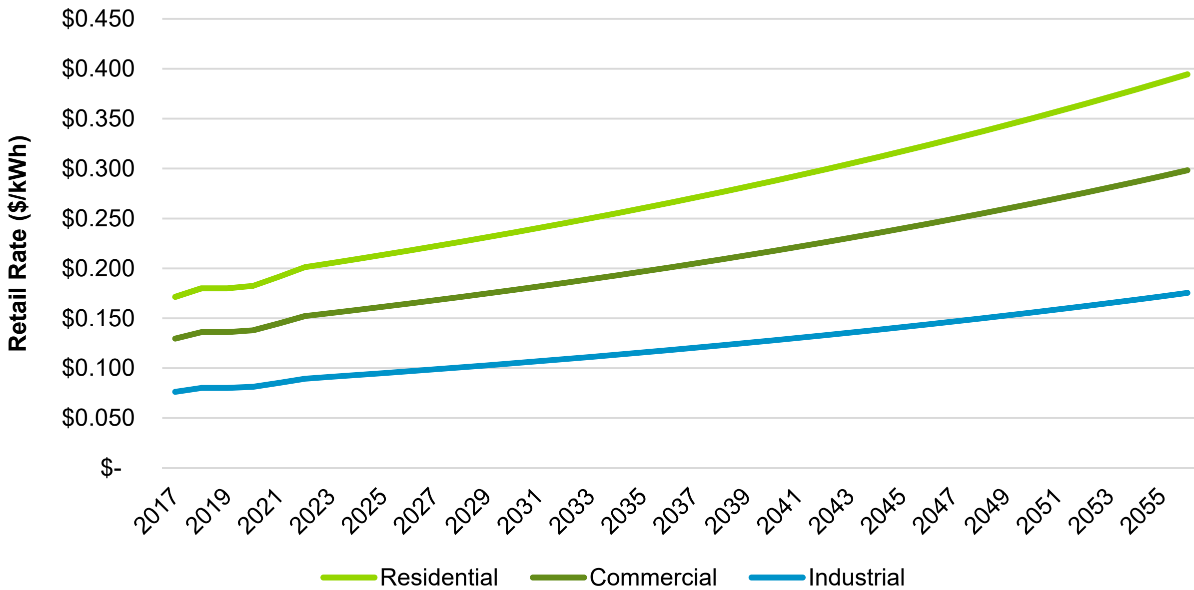
Both electric and gas utility cost savings are used to calculate the customer's payback period. The payback period is one of the metrics used to calculate the customer's potential adoption of the technology.

Electric Retail Rates

For the 2017 CPR, Navigant defined the electric retail rate as the electricity price paid by SaskPower customers for service, which is used to value electricity savings from efficiency conservation. Because customer economics is a primary driver of energy efficiency measure adoption, Navigant used a forecast of electric retail rates for each sector to estimate achievable energy and demand potential. SaskPower provided the retail rates by sector, as well as projected annual rate increases for years 2018-2023; the team used these to develop the retail rate forecasts through 2023. Navigant used the power account retail price for the industrial sector since SaskPower tracks most industrial customers under individual power accounts.

Navigant assumed annual rate increases after 2023 to be consistent with inflation at 2%. The average rate increase from 2018 to 2023 was 3.067%; however, using the inflation value provides a conservative estimate of forecasted energy efficiency potential since a lower retail electricity rate results in reduced benefit to the customer. Navigant recommends using the conservative approach to estimating increases in retail rates over the study period.

Figure D-3. Electricity Retail Rate Forecast: 2017-2055



Source: Navigant analysis

Gas Retail Rates

SaskEnergy (the province's gas utility) was unable to provide a retail natural gas price forecast, so Navigant leveraged historical data from the SaskEnergy website[35] to formulate a forecast to use for modeling. The team's method uses the latest published volumetric rates for natural gas in November 2016 and escalates these volumetric rates at inflation, assumed to be 2% per year.[36]

Navigant compared this approach to the NYMEX NG Futures (i.e., the traded Henry Hub forward curve), even though there is inherent uncertainty around the forward curve. Futures prices can change dramatically day to day as new information becomes available to the market. Therefore, taking the current gas price and inflating it is the most reasonable assumption for valuing efficiency savings for the customer over the next 20 years.

All sector-level retail price forecasts are direct inputs to the model so SaskPower can update them as new market conditions arise or other assumptions change over time.

The gas retail rate used corresponds to a total 2016 volumetric rate (volumetric commodity charge plus volumetric delivery charge) of $0.227/m^3 for residential customers and an average total 2016 volumetric rate of $0.208/m^3 for commercial customers. Navigant then escalated these values at the 2% inflation per year to estimate the retail rate forecast over the analysis period.

[35] http://www.saskenergy.com/residential/resrates_hist.asp and http://www.saskenergy.com/business/comrates_hist.asp

[36] Navigant averaged the small and large commercial rates to use as the starting rate in the analysis for this sector. There are relatively minor differences between the two rates so this method is sufficient (over a weighted average) to minimize any false precision in the estimates.

D.4 Other Key Input Assumptions

Per email communication from SaskPower in April 2017, the values in Table D-2 are consistent with supply planning.

Table D-2. Potential Study Assumptions

Variable Name	Percentage
Discount Rate	5.5%
Inflation Rate	2.0%

Source: SaskPower supply planning

APPENDIX E. PEAK PERIOD DEFINITION

Navigant analyzed two years of hourly load data from SaskPower to determine the peak period. The supply planning team recently confirmed a two-coincident peak approach as an appropriate method to allocate customer costs. Therefore, Navigant's analysis defined a summer and winter peak. In doing so, the team also considered summer derates in the analysis. The derating factors from supply planning (provided in June 2017) in Table E-1 are typical for SaskPower's existing natural gas generation. As the team adds more gas on the system, the numbers will get higher unless SaskPower mitigates this issue.

Table E-1. Typical SaskPower Gas Derate

Month	Gas Derate
Jan. 2018	13
Feb. 2018	42
Mar. 2018	76
Apr. 2018	147
May 2018	216
Jun. 2018	252
Jul. 2018	275
Aug. 2018	262
Sep. 2018	203
Oct. 2018	155
Nov. 2018	58
Dec. 2018	28

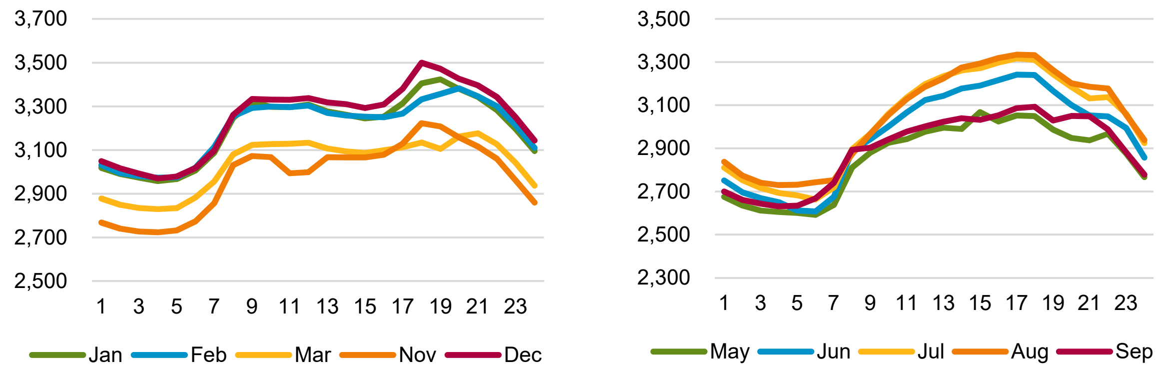
Source: SaskPower supply planning

To complete this analysis, Navigant first calculated the hourly average loads by month (weekday vs. weekend) over multiple years. This averaging normalizes any short-term weather differences. Using more than one year of data supports additional normalization due to weather (for example, 2016 was a significantly cooler December than 2015) or changes in consumption due to losses or gains of load. This analysis then can be used to observe any good separation between peak and non-peak hours.

The analysis did not need a review of the temperature. For example, there were big differences in December load between 2015 and 2016, and there were corresponding differences in temperature that were consistent with the differences in load (lower average temperature → higher load). Additional checks were conducted for other months to prove that there is a strong correlation between the temperature and load.

Navigant observed the highest peak hours in the winter period and considered each hour's load as a percentage of the peak load for the season. The observation per the graphs in Figure E-1 show that there is a peak occurring in certain hours and clear differences between the winter and summer season months and shoulder months.

Figure E-1.Winter and Summer Average Hourly Load by Month – Average of 2015 and 2016 Data



Source: Navigant analysis

As a result of these observations, Navigant determined that the peak period definition should be:

- **Winter:** Hour-ending 18-21 on weekdays in December-February
- **Summer:** Hour-ending 15-18 on weekdays in June-August

E.1 Winter to Summer Peak

SaskPower's monthly forecasted generation capacity surplus or deficit indicates that, in the absence of any future capacity additions, capacity shortfalls will become greater in the summer than the winter beginning in 2028 and persisting through the CPR study horizon. The change in season of the maximum annual capacity shortfall is consistent with SaskPower's expectation of transitioning over the next decade from being a winter peaking utility, as is presently the case, to a summer peaking utility in 2028 and beyond. This is consistent with SaskPower's supply planning analysis. SaskPower is still a winter peaking utility; however, the summer peak approaches over 91% of the winter peak on a consistent basis. Given that the capacity of network equipment can be reduced by as much as 20%-30% of the winter capacity due to higher temperatures and maintenance shutdowns, etc., it was determined that it is the summer capacity that determines the required installed capacity of certain facilities, not just the winter. It should be noted that mostly the urban areas tend to have maximum demands in the summer, while some rural areas tend to have maximum demands in the winter. Even if there is a switch in later years, the concept of using two peak planning approach remains important.

According to supply planning, considering the balance between demand and capacity to serve demand (i.e., generate, import, DR), the reserve margin difference between January and July by 2027 will go from a +2% difference in 2019 to a -1% difference in 10 years, meaning SaskPower will have less ability to serve the summer peak than the winter. The reserve margin is provided in Table E-2.

Table E-2. Reserve Margin

Year	January Reserve Margin	July Reserve Margin	Delta
2019	13.2%	15.2%	2%
2027	18.5%	17.5%	-1%

Source: SaskPower supply planning

To properly value peak demand reductions from energy efficiency, Navigant adjusted the peak hour definition for marginal reductions in peak demand beginning in 2028. Prior to 2028, avoided capacity costs from reductions in demand during winter peak hours were included in each measure's net benefits for economic screening and UCT reporting. In 2028 and beyond, avoided capacity costs from summer peak demand reductions were used instead. This allowed the team's assessment of the capacity deferral value of energy efficiency to track SaskPower's supply planning assumptions at a sub-annual level and to capture the true marginal value of demand reduction in months where SaskPower's system is most constrained.

APPENDIX F. HOURLY 8,760 ANALYSIS

Navigant developed an 8,760 hourly normalized end-use load shape library to support scenario-specific assessments of specific energy efficiency, demand response (DR), and other technologies assessed as part of this study. For this task, the team created representative end-use load shapes for each customer segment identified by SaskPower. Navigant also used these load shapes to calculate the peak savings for energy efficiency measures.

In the absence of end-use metered consumption, the US DOE prototype reference building models, simulated with local weather files, provide reasonable end-use load shapes for use in the potential model. The end-use load profiles are sensitive to several of the building model inputs (temperature setpoints, operation schedules, etc.); however, Navigant put considerable thought into adjusting these inputs to model typical consumption profiles for each building segment. The SaskPower distribution data provides a benchmark for purposes of calibration and assessing model fit to actual consumption profiles.

End-use metering provides load shapes with considerably less uncertainty, but the costs far exceed those of using prototypical building models. Energy analysts are currently exploring techniques using non-intrusive load monitoring (NILM) to algorithmically calculate end use load shapes from high-resolution whole building AMI data, however, these methods only work well for certain end uses that provide high signal-to-noise ratio, such as central air conditioners. The resulting end use load shape estimates may have high uncertainty. Additional rigor of the end use load shape estimate becomes critical when the valuation of energy efficiency and understanding of each electric using equipment load profile must match each kW as tracked by supply side resource planning. In these instances, end use metering may be warranted.

F.1 End-Use Load Shape Development

The load profile development followed these steps:

1. **Assess measures and identify load profiles.** Following SaskPower approval of the final list of measures to be characterized and included in the analysis, Navigant staff identified a set of end-use/sector/segment combinations of load profiles such that each conservation measure and base technology has an assigned load profile.
2. **Present load profile mapping for SaskPower feedback and approval.** Once Navigant staff mapped a load profile type to each measure, SaskPower reviewed the list of load profiles and the measures to which they map.
3. **Identify appropriate base load shapes.** To maximize value for SaskPower, Navigant leveraged its existing database of end-use sectoral load profiles for this analysis.
4. **Adapt load shapes to Saskatchewan.** The next section describes the approach used for this step.
5. **Apply load profiles to DSMSim outputs.** Navigant applied the final load shapes to the aggregated DSMSim outputs to deliver the 8,760 profile of conservation impacts required by SaskPower.

Representative end uses and customer segments are in Section 2.1.1 of the report.

Load Shape Development Approach

Navigant used the EnergyPlus building simulation software to run prototypical building energy models for residential and commercial customer segments. The team used updated versions of the US DOE commercial and residential reference building models to complete the simulations, which are representative of typical building constructions and represent typical energy and demand for buildings within the building stock. Navigant maintains this model set for extracting end-use load shapes for potential studies. The team made several updates to more accurately reflect typical hourly energy consumption of buildings, such as smoothing HVAC operation schedules and ramping HVAC setpoint changes over many hours, instead of a step-change in setpoint between two adjacent hours. Navigant also leveraged various end-use load shape metering studies to make informed model updates to more accurately reflect real-world operation of these equipment:

- Navigant updated the lighting profiles contained in the DOE commercial reference building models with Northeast Energy Efficiency Partnerships (NEEP) lighting profiles.[37] The NEEP lighting profiles are weather-normalized lighting profiles that were developed for the Northeast and Mid-Atlantic regions of the US using data from integral lighting meters. The metered data was collected for energy efficiency project evaluations ranging from 2000 to 2011. It is important to note that non-weather dependent end-uses can be transferable from one region to another, such as lighting and appliances.[38]
- Navigant updated the lighting profiles for the residential reference building with the residential lighting load shapes from a metering study in the Northeast. The metered data was collected in 2015.

Navigant utilized actual meteorological year (AMY) weather data for Regina and Saskatoon, Saskatchewan in the EnergyPlus modeling environment. The team ran the building energy models with both weather files for the 2015 weather year. The resulting load shapes are a weighted average of the two regions. This weighted average is based on the population above and below the centerline between Regina (48%) and Saskatoon (52%). Regarding the urban versus rural population, the team assumed these customers to be proportionally split from those above and below the centerline.

The potential study base year is 2016; however, the load profiles for residential and commercial are based on the 2015 calendar year since the 8,760 profile by sector was not available for 2015. This is an accurate methodology as load profiles do not materially change when normalized for weather.

Residential Load Shapes

SaskPower provided Navigant with 2015 distribution-level data containing hourly energy consumption for residential buildings across the SaskPower service territory. The team used the consumption data for the residential sector to visually calibrate the load shape outputs from the residential building models for the 2015 model year. To do this, Navigant processed the consumption data and the hourly building energy model output data to visually compare average daily profiles (weekday and weekend) for each month of

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[37] Lighting hourly load profiles were taken from the July 19, 2011 C&I Lighting Load Shape Project for NEEP (associated spreadsheet - Profiles v2.6_4_18-KIC.xls).

[38] Tables 3 and 4 identify the load shapes that are highly transferrable across regions. End-Use Load Data Update Project Final Report, www.neep.org/file/2693/download?token=aOWk8oud

the year. The team adjusted building model inputs to calibrate the total building load to the SaskPower distribution data.

For the residential building model, Navigant used the average daily load shapes from the SaskPower residential distribution data to adjust various inputs in the building model. The team adjusted building model input parameters to match the on-peak and off-peak energy consumption shapes and to ensure that the total facility energy peaks developed with the building model lined up temporally with the system peaks represented within the distribution data. Navigant made slight adjustments to lighting, equipment, and heating and cooling schedules to calibrate the residential model to the SaskPower distribution data.

Commercial Load Shapes

Navigant did not perform a similar visual calibration for building segments in the commercial sector, as the distribution data was only available at the entire commercial sector level—not the segment level. The variability in commercial segment energy consumption profiles limited the usefulness of the commercial distribution data for purposes of calibration.

The team used the commercial building models from its model library and simulated typical load shapes using the 2015 Regina and Saskatoon weather files. Navigant inputted these load shapes into the SaskPower potential model. Additionally, there is a streetlighting load shape which is applicable to all exterior lighting load profiles.

Industrial Load Shapes

SaskPower provided Navigant with 2016 hourly consumption data for the top one or two industrial customers within each industrial segment. The team used this data to develop typical daily consumption profiles for each industrial segment. If SaskPower provided more than one power account customer per segment, Navigant summed the contributions from each customer.

For each customer segment, the team calculated average daily profiles (weekday and weekend) for each month of the year. The purpose was to reduce the variability in the 8,760 hourly consumption data to more accurately reflect typical industrial consumption profiles in the potential model. Navigant then mapped the average daily load profiles to each day of the year to recreate an 8,760 hourly load shape. The current 8,760 profiles account for 68% of power account load.

Table F-1. Percentage of Reviewed Power Account Load by Segment

Segment	Load Included in 8,760 (%)
Potash Mining	83%
Other Mining	61%
Steel	100%
Oil & Gas	56%
Pulp & Paper/Wood Products	75%
Manufacturing	56%
Total	68%

Source: Navigant analysis

Navigant analyzed the power account 8,760 data from the SaskPower industrial customers to determine typical total facility 8,760 load profiles for each industrial segment (oil & gas, potash mining, etc.)

- **Process loads:** Navigant mapped the total facility load profile to each process end use for each individual industrial segment.
  - For industrial segments where SaskPower provided more than one power account, Navigant added the 8,760 hourly consumption of customers together.
  - The team calculated average hourly weekday/weekend profiles for each month of the year for each industrial segment.
  - Navigant then re-mapped the average weekday/weekend profiles back to each day of the year, rebuilding an 8,760 dataset that is more representative of typical consumption patterns for the industrial segments by reducing the daily variability of the consumption data.
- **Lighting and space heating profiles:** Navigant mapped a lighting and space heating load shape from the warehouse commercial building segment.

APPENDIX G. INTERACTIVE EFFECTS OF EFFICIENCY STACKING

The results shown throughout the body of this report assume that all measures are implemented in isolation from one another and do not include adjustments for interactive effects from efficiency stacking. Interactive effects from efficiency stacking are different from cross end-use interactive effects (e.g., efficient lighting affects heating/cooling loads), which are present regardless of stacking assumptions and are included in the reported savings estimates. This appendix describes the challenges related to accurately determining the effects of efficiency stacking, and why Navigant has modeled savings as though measures are implemented independently from one another.

G.1 Background on Efficiency Stacking

When a home or business installs two or more measures that impact the same end-use energy consumption in the same building, the total achievable savings is less than the sum of the savings from those measures independently. For example, in isolation, the installation of LED lighting might save 40% of electric consumption relative to baseline linear fluorescent fixtures, while occupancy sensors might save 25% of electric consumption relative to fixtures without occupancy sensors. However, if both the LED fixtures and occupancy sensors are installed in the same facility, the savings from the LED lighting decrease due to the reduced lighting operating hours caused by the occupancy sensors.

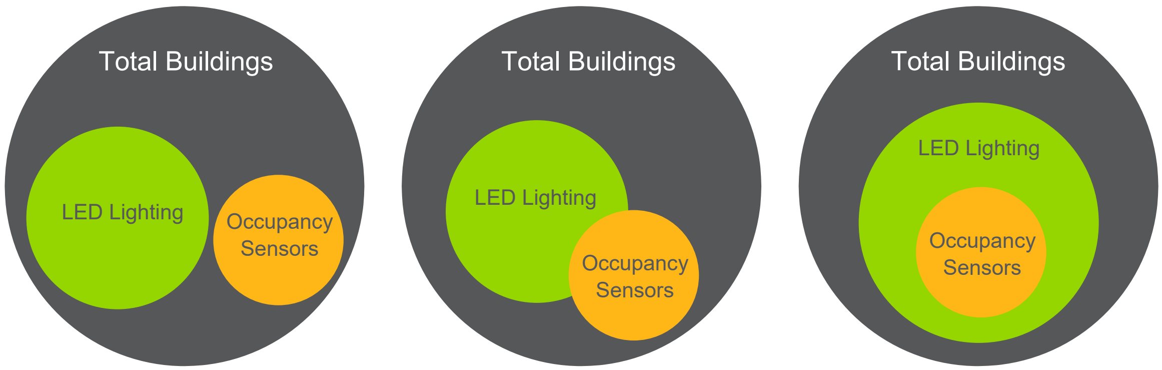
To generalize this concept Navigant refers to measures that convert energy as engines (boilers, light bulbs, motors, etc.), and refers to measures that affect the amount of energy that engines must convert as drivers (insulation, thermostats, lighting controls, etc.). Anytime an engine and driver are implemented in the same building, the expectation is that savings from the engine measure will decrease.[39]

Figure G-1 provides an illustration of three different efficiency stacking approaches. The modeled approach assumes no overlap in measure implementation and no efficiency stacking, which leads to an upper bound on savings potential. The opposite of the modeled approach is to assume all measures are stacked wherever possible, which provides a lower bound on savings. Lastly, there is the real-world approach where some measures are implemented in isolation and others are stacked. Unfortunately, the data is simply not available to accurately estimate the savings from the real-world approach.

[39] In practice, it does not matter whether one assumes the engine's savings decrease or the driver's savings decrease, as the final savings result is the same. In this discussion, the team has chosen to always reduce the savings from the engine measures, while holding the savings from the driver measures fixed.

Figure G-1. Venn Diagrams for Various Efficiency Stacking Situations

Upper Bound (Modeled): Savings are independent.	**Real World:** Uncertain mix of independent and stacked savings.	**Lower Bound:** Savings are stacked wherever possible.



Source: Navigant

The area of the colored circle represents the number of buildings with a given savings opportunity. Overlapping circles indicate a building has implemented both measures.

G.2 Illustrative Calculation of Savings after Efficiency Stacking

For a simplistic scenario looking at only two measures, it is possible to determine the stacked savings from the lower bound approach, which assumes efficiencies are stacked wherever possible. To find the LED lighting savings relative to the baseline after stacking, the team must perform several steps:

1. Find the complement of the occupancy sensor savings percentage:

   Occupancy Sensor Savings Complement = 100% - Occupancy Sensor Savings

   Occupancy Sensor Savings Complement = 100% - 25% = 75%

2. Reduce the LED lighting unstacked savings by the complement of the occupancy sensor savings:

   Stacked LED Lighting Savings = Unstacked LED Lighting Savings x Occupancy Sensor

   Savings Complement Stacked LED Lighting Savings = 40% x 75% = 30%

3. Find the greatest percentage of buildings where LED lighting and occupancy sensor stacking is possible:

   % of Buildings with Stacking = Buildings with Occupancy Sensors / Buildings with LED lighting x 100%

   % of Buildings with Stacking = 145,300 / 720,200 x 100% = 20.2%

4. Calculate the LED lighting weighted average savings across all buildings with occupancy sensors:

   Weighted LED Lighting Savings = Stacked LED Lighting Savings x % of Buildings with Stacking + Unstacked LED Lighting Savings x (100% - % of Buildings with Stacking)

   Weighted LED Lighting Savings = 30% x 20.2% + 40% x (100% - 20.2%) = 38%

Table G-1 summarizes the example for the LED lighting and occupancy sensors before and after stacking. As expected, the combined savings from the measures treated independently exceeds the combined savings after stacking.

Table G-1. Comparison of Savings Before and After Stacking

	LED Lighting	Occupancy Sensors
Applicable Buildings	720,200	145,300
Savings treated independently (no stacking)		
Savings Relative to Baseline (%)	40%	25%
Savings treated interactively (stacking)		
Savings Relative to Baseline (%)	38%	25%

G.3 Impetus for Treating Measure Savings Independently

Although it is possible to find the lower bound on savings with just one driver and one engine measure, the process quickly becomes intractable when multiple drivers and engines can be installed in the same facility. Table G-2 lists all the engine and driver measures included in this study that could have interactive effects within the commercial lighting end use, which is just one of many end uses across multiple sectors where stacking could occur.

Table G-2. Measures with Opportunity for Stacking in Commercial Lighting End Use

Engine Measures	Driver Measures
Exterior LED	Photocell
Interior LED Tube	Interior Daylighting Controls
Interior LED MR/PAR Lamps	Fixture or Wall-Mounted Occupancy Sensors
Interior Recessed LED Downlighting (Troffer LEDs)	
Interior High Bay LED	
LED Luminaire	

Source: Navigant

Determining the appropriate stacking and correctly weighting the savings percentages from each of the engine measures requires the following:

- Case by case expert judgment about the combinations of driver and engine measures that might realistically be found in the same building given historic and future construction practices
- The conditional probability that a building has an inefficient driver “A” and an inefficient engine “B” for all drivers and engines relevant to a given end use
- In-depth knowledge of program design and how managers are considering pursuing participants and bundling measure offerings

Answering the bullets above is beyond the scope of this study.

Lastly, at low levels of customer participation, assuming savings are independent is the best representation of what actual measure stacking would be. When customer participation is high, the real-world scenario is the best representation of actual measure stacking. Thus, under the plausible ranges of customer participation, the modeled (upper bound) scenario is likely to be a better representation of actual measure stacking than the lower bound scenario.

Although this report does not rigorously attempt to quantify the impact from efficiency stacking within the modeled service territories, Navigant's experience indicates that stacking can lead to a 5%-10% reduction in savings potential at high levels of technology adoption. This estimate is applicable to the residential and commercial sectors but is less applicable for the industrial sector because of reduced opportunity for stacking among the industrial measures considered in this study. Additionally, the 5%-10% reduction is highly uncertain and dependent upon the characteristics of any given building and bundling of measures.

APPENDIX H. COMPARISONS TO THE 2010 SASKPOWER CPR

This appendix describes key differences between this study and the 2010 SaskPower CPR, including segmentation, measure lists, and data sources.

H.1 Customer Segments

This section provides descriptions of the variance in customer segmentation in the 2010 CPR and this study. Navigant defined customer segments for the current study using available granularity in the data. For example, this study does not differentiate between building vintage or building size because the billing data and secondary sources were not available or reliable enough to discern at that level of detail.

Residential Segments

Navigant divided the residential sector into seven customer segments. This segmentation is largely consistent with the residential segments employed in SaskPower's 2010 CPR with two exceptions related to housing stock vintage and apartments. Table H-1 shows the residential customer segments in this study and the 2010 SaskPower CPR. The 2010 CPR distinguished single family detached and attached homes based on vintage using pre-1980 and post-1980. This CPR does not make this distinction. Rather, this study distinguishes housing stock between existing and new (or forecasted) stock (i.e., 2016 for the base year and post-2017 for the reference case). Additionally, the 2010 CPR differentiated between apartment living units and common areas, but this CPR does not make this distinction.

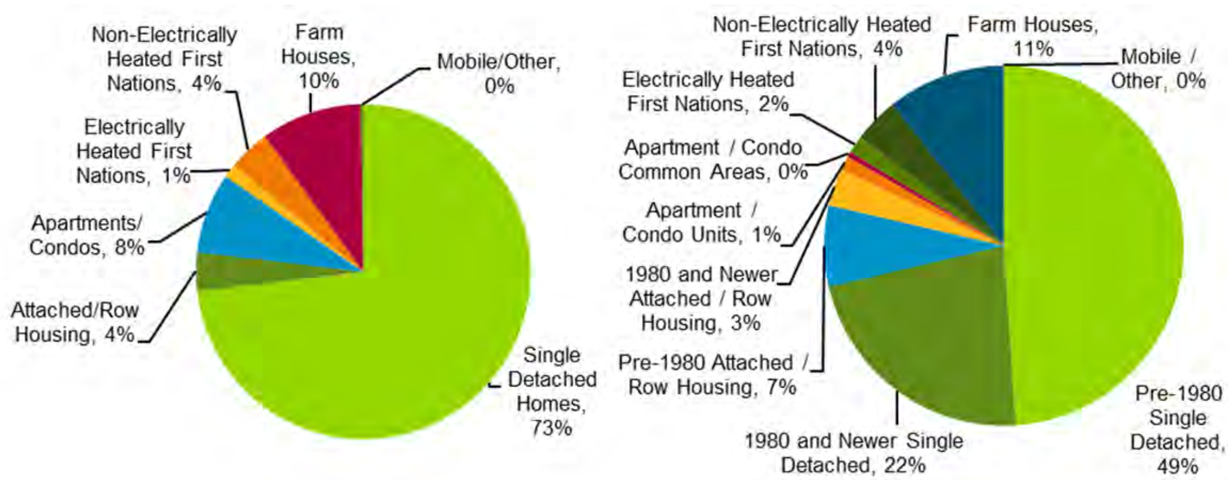
Table H-1. Residential Customer Segment Comparison

2017 CPR Segments	2010 CPR Segments
Single Detached Homes	Pre-1980 Single Detached
	1980 and Newer Single Detached
Attached/Row Housing	Pre-1980 Attached/Row Housing
	1980 and Newer Attached/Row Housing
Apartments/Condos	Apartment/Condo Units
	Apartment/Condo Common Areas
Electrically Heated First Nations	Electrically Heated First Nations
Non-Electrically Heated First Nations	Non-Electrically Heated First Nations
Farm Houses	Farm Houses
Mobile/Other	Mobile/Other

Source: Navigant

Figure H-1 shows the breakdown of base year residential electricity consumption by customer segment in this study and the 2010 SaskPower CPR. In both studies, the single family detached segment is the largest segment and accounts for about 73% of consumption in this study and 71% in the 2010 CPR. The share of consumption for attached/row housing decreased from 11% in the 2010 CPR to 4% in this study, while the share for apartments/condos increased from 2% in the 2010 CPR to 8% in this study.

Figure H-1. Base Year Residential Electricity Consumption by Customer Segment in 2017 CPR (Left) and 2010 CPR (Right)



Source: Navigant analysis

Commercial Segments

Navigant divided the commercial sector into 11 customer segments. The selection of these commercial segments is similar to those from the 2010 CPR with two exceptions related to long-term care facilities and the size of commercial buildings. Table H-2 shows the commercial customer segments in this study and the 2010 SaskPower CPR. The 2010 CPR distinguished three customer segments—offices, non-food retail, and hotels—based on size: large and small/other commercial facilities. This study does not make any distinction based on size because the approach for characterizing commercial segments and commercial measures does not depend on building size. Additionally, the 2010 CPR had a separate customer segment for long-term care facilities. Navigant included these facilities in the lodging customer segment.

Table H-2. Commercial Customer Segment Comparison

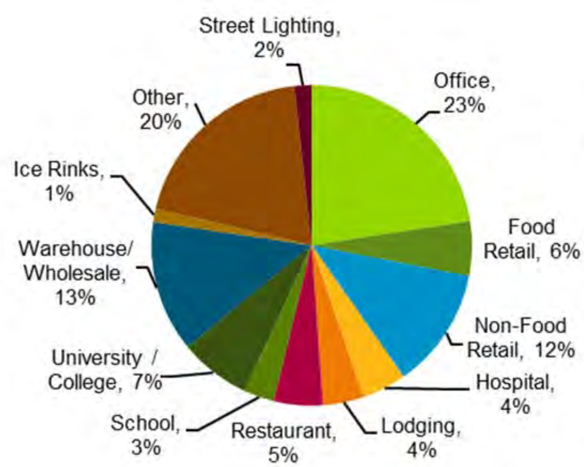
2017 CPR Segments	2010 CPR Segments
Office	Large Office
	Small Office
Food Retail	Food Retail
Non-Food Retail	Large Non-Food Retail
	Other Non-Food Retail
Hospital	Hospital
Lodging	Large Hotel
	Other Hotel/Motel
	Long-term Care
Restaurant	Restaurant
School	School
University/College	University/College
Warehouse/Wholesale	Warehouse/Wholesale

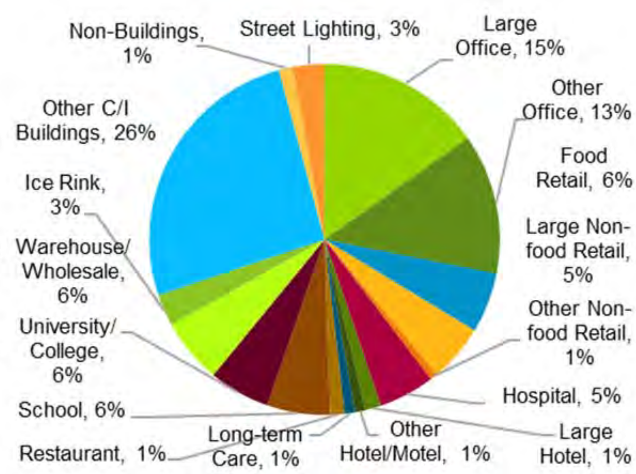
2017 CPR Segments	2010 CPR Segments
Ice Rinks	Ice Rink
Other	Other C/I Buildings

Source: Navigant analysis

Figure H-2 shows the breakdown of base year commercial electricity consumption by customer segment in this study and the 2010 SaskPower CPR. Unlike the residential sector, consumption in the commercial sector is much more evenly distributed across customer segments. In both studies, the office and other segments are the two largest commercial segments. The share of consumption for offices decreased from 28% in the 2010 CPR to 23% in this study, while the share for other decreased from about 27% in the 2010 CPR to 20% in this study. The share of consumption for non-food retail, restaurants, and warehouses increased when compared to the 2010 CPR.

Figure H-2. Base Year Commercial Electricity Consumption by Customer Segment in 2017 CPR (Left) and 2010 CPR (Right)





Source: Navigant analysis

Industrial Segments

Navigant divided the industrial sector into seven customer segments. The team selected these industrial segments based on a review of SaskPower's power account customers and with the objective of categorizing facilities with similar industrial processes, operations, production, and patterns of electricity use. This segmentation is consistent with the industrial segments employed in SaskPower's 2010 CPR, with exceptions related to the manufacturing and oil & gas customer segments. Table H-3 shows the industrial customer segments in this study and the 2010 SaskPower CPR. The 2010 CPR included paper manufacturing, petroleum refineries, iron and steel mills, and ferroalloy manufacturing in the other manufacturing – large customer segment, with the other manufacturing – SME segment including the remaining industrial facilities. Navigant included the following customer segments related to manufacturing: steel, pulp & paper, and manufacturing. Additionally, the team included petroleum refineries in the oil & gas customer segment rather than the manufacturing segment.

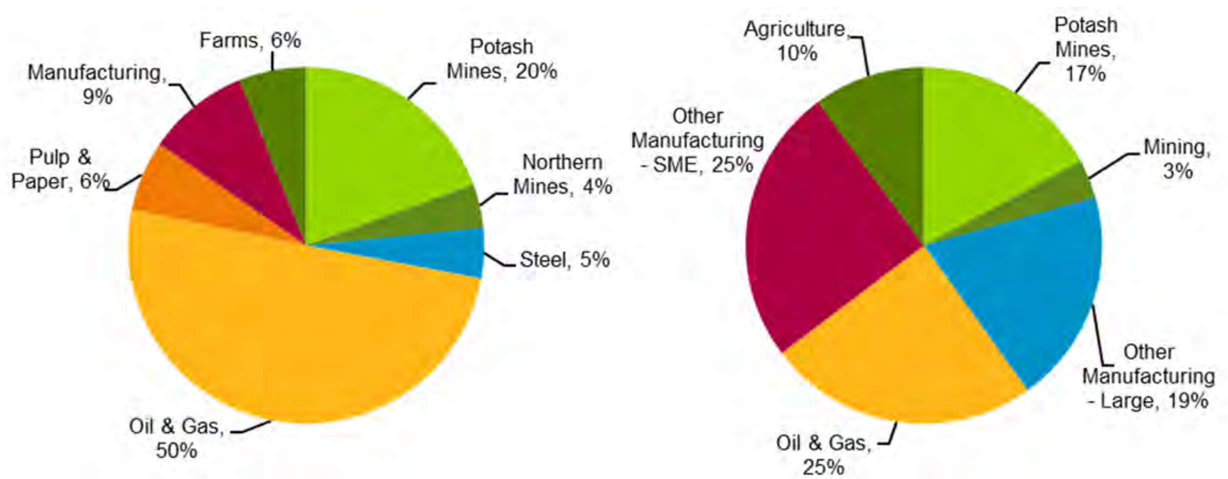
Table H-3. Industrial Customer Segment Comparison

2017 CPR Segments	2010 CPR Segments
Potash Mines	Potash Mines
Northern Mines	Mining
Steel	Other Manufacturing – Large
Pulp & Paper	
Manufacturing	Other Manufacturing – SME
Oil & Gas	Oil & Gas
Farms	Agriculture

Source: Navigant analysis

Figure H-3 shows the breakdown of base year industrial electricity consumption by customer segment in this study and the 2010 SaskPower CPR. The breakdown is similar for this study and the 2010 SaskPower CPR after considering the differences in customer segmentation between the studies.

Figure H-3. Base Year Industrial Electricity Consumption by Customer Segment in 2017 CPR (Left) and 2010 CPR (Right)



Source: Navigant analysis

H.2 Measure List

Navigant reviewed current SaskPower program offerings, the 2010 SaskPower CPR, other Canadian programs, technical resource manuals (TRMs), and potential model measure lists from other jurisdictions to identify energy efficiency measures with the highest expected economic impact. The team prioritized measures in existing SaskPower programs based on data availability and measures most likely to be cost-effective. The team also ensured that high impact measures were captured in the list. Navigant worked with SaskPower to finalize the measure list and ensure it contained technologies viable for future SaskPower program planning activities.

There are several differences between the measure lists in this study and the 2010 SaskPower CPR. The following sections summarize significant differences for each sector.

Residential Measure List

Table H-4 shows the residential measures included in both studies as well as those included only in this study or the 2010 CPR. This table includes general descriptions of measure types and does not include complete measure lists or descriptions from each study. Measures of note include the following:

- **Lighting:** The 2010 CPR primarily includes CFL and fluorescent lighting measures, as LED technologies were not mature and relatively expensive at the time of the study. The 2017 study does not include any CFL or fluorescent measures because SaskPower has moved away from these lighting types. The measure list for the 2017 study includes several types of LED technologies and assumes that costs will continue to decrease over the duration of the study.
- **High Efficiency New Construction:** The 2010 CPR included whole home new construction measures such as LEED, ENERGY STAR, and net-zero energy homes. The 2017 study does not include these measures, as Navigant characterized all measures as new replacement types to account for new construction building stock.
- **Pool Efficiency Measures:** The 2010 CPR included several pool-related efficiency measures such as timers, pumps, and heaters. The 2017 study does not include pool and spa measures because a small percentage of the market has swimming pools, leading to low potential impacts for these measures.
- **ENERGY STAR Electronics:** The 2010 CPR included ENERGY STAR electronics such as printers, fax machines, and televisions. The 2017 study does not include these measures because this market is moving without the influence of DSM programs.

Navigant excluded other measures due to low potential impact when compared to other measures in the same end use or shifts to newer technologies such as programmable to smart thermostats. The measure list workbook accompanying this report includes the rationale for excluding measures considered for the 2017 study.

Table H-4. Residential Measure List Comparison

Measures in 2010 and 2017 CPRs	Measures in 2010 CPR but Not 2017 CPR	Measures Included in 2017 CPR but Not 2010 CPR
Basement/crawlspace insulation	Ground source heat pumps	Smart thermostats
Air sealing/infiltration reduction	Programmable thermostats	Central furnace fan motors
High efficiency windows	Heat recovery ventilators (HRVs)	Duct sealing and insulation
Attic insulation	High performance new homes (LEED, ENERGY STAR, net-zero energy, etc.)	Ceiling insulation
Wall insulation	Whole house fans	Floor insulation
ENERGY STAR central AC	ENERGY STAR dehumidifiers	Radiant barrier
ENERGY STAR room AC	Convection ovens	Window film
ENERGY STAR ceiling fans	Induction cooktops	Heat pump ventless dryer
ENERGY STAR refrigerators	Indoor and outdoor CFLs	Interior recessed LED downlighting (troffer LEDs)
ENERGY STAR freezers	Dimmable CFLs	Indoor LED tube
ENERGY STAR clothes washers	Fluorescent T8 lamps	LED/LEC exit signs (multifamily)
ENERGY STAR clothes dryers	Point-of-use water heaters	LED specialty, non-reflector

Measures in 2010 and 2017 CPRs	Measures in 2010 CPR but Not 2017 CPR	Measures Included in 2017 CPR but Not 2010 CPR
LED lamps (general service)	Wastewater heat recovery systems	LED reflector
LED seasonal lights	Hot water recirculation systems	LED hardwired lamp
Occupancy sensors	Pool and hot tube pump timers	ENERGY STAR indoor and outdoor fixtures
Lighting timers	High efficiency pool pumps	Lighting dimmers
Water heater tank insulation	Insulating pool and hot tub covers	Faucet aerators
Water heater pipe insulation	Heat pump pool heaters	Smart plugs
Low-flow showerheads	Solar pool heaters	ENERGY STAR set top box
Smart power bars/advanced power strips	Timer/thermostats for vehicle block heaters	
	ENERGY STAR printers and faxes	
	ENERGY STAR televisions	

Source: Navigant analysis

Commercial Measure List

Table H-5 shows the commercial measures included in both studies as well as those included only in this study or the 2010 CPR. This table includes general descriptions of measure types and does not include complete measure lists or descriptions from each study. Measures of note include the following:

- **Lighting:** The 2010 CPR primarily includes fluorescent, halogen, metal halide, and CFL lighting measures, as LED technologies were not mature and relatively expensive at the time of the study. The 2017 study does not include any fluorescent, halogen, metal halide, or CFL measures because SaskPower has moved away from these lighting types. The measure list for the 2017 study includes several types of LED technologies and assumes that costs will continue to decrease over the duration of the study.
- **High Efficiency New Construction:** The 2010 CPR included whole building new construction measures that assume a percent reduction in energy consumption compared to current design practice. The 2017 study does not include these measures, as Navigant characterized all measures as new replacement types to account for new construction building stock.
- **Building Recommissioning:** This measure is included as a behavioral measure.
- **ENERGY STAR Office Equipment:** The 2010 CPR included ENERGY STAR office equipment such as computers and printers. The 2017 study does not include ENERGY STAR office equipment because measure penetration is high in the current commercial market.

The 2010 CPR included high efficiency cooking equipment, refrigeration measures, and ice rink refrigeration plant controls. However, Navigant was not able to determine which measures were included in these bundles. As a result, cooking, refrigeration, and ice rink measures listed under the 2017 CPR in Table H-5 may also be included in the 2010 CPR.

Navigant excluded other measures due to low potential impact when compared to other measures in the same end use or shifts to newer technologies such as programmable to smart thermostats. The measure list workbook (*SaskPower_CPR_MeasureList*) accompanying this report includes the rationale for excluding measures considered for the 2017 study.

Table H-5. Commercial Measure List Comparison

Measures in 2010 and 2017 CPRs	Measures in 2010 CPR but Not 2017 CPR	Measures Included in 2017 CPR but Not 2010 CPR
Occupancy sensors	T8 and T5 lighting systems	Interior recessed LED downlighting (troffer LEDs)
Daylighting controls	Induction lamps	Interior high bay LEDs
LED lamps (general service)	Indoor and outdoor CFL lamps	LED luminaires
Photocells	Halogen infrared lamps	LED backlit signage
Exhaust hood (demand controlled kitchen ventilation)	Indoor and outdoor metal halide lamps	Interior LED tube
Ovens	High performance glazing	LED/LEC exit signs
ENERGY STAR refrigerators	Wall insulation	Exterior LEDs
ENERGY STAR freezers	Roof insulation	Tankless hot water heater
Refrigeration waste heat recovery	Air sealing	Recirculation demand controls for CDHW
Ground source heat pumps	Low-flow faucet aerators	Ozone laundry
Infrared/radiant heaters	Low-flow showerheads	Ovens[40]
Chillers	Low-flow pre-rinse spray valves	Pressureless steamer
Packaged DX AC and heat pump equipment	Hot water tank insulation	LED refrigeration case lighting[41]
HVAC control upgrades (including demand controlled ventilation)	Drain water heat recovery	Commercial ice makers
Variable speed drives on fans and pumps	High volume, low-speed destratification fans	Anti-sweat heater controls
High efficiency motors	Air-to-air heat recovery	Automatic door closers for walk-in coolers and freezers
Parking lot controllers	Programmable thermostats	Vertical display case with doors
Building controls and automation systems	ENERGY STAR computers	Evaporator fan controls
	ENERGY STAR office equipment	Floating head pressure controls
	Energy efficient server technologies	Night covers
	Recommissioning	ECM motors
	New buildings – percentage better than current design practice	Q-Sync motors
	Low-emissivity ceilings (ice rinks)	Door gaskets for walk-in and reach-in coolers and freezers
		Zero energy door

[40] The 2010 CPR included high efficiency cooking equipment, but Navigant was not able to determine which measures were included in that bundle.

[41] The 2010 CPR included refrigeration measures, but Navigant was not able to determine which measures were included in that bundle.

Measures in 2010 and 2017 CPRs	Measures in 2010 CPR but Not 2017 CPR	Measures Included in 2017 CPR but Not 2010 CPR
		Smart thermostats
		High efficiency compressors
		Variable speed drives on compressors
		Economizer controllers
		Packaged terminal AC and heat pump equipment
		Advanced power strips
		Mechanical vortex de-aerators for ice rinks
		Ice rink equipment tune-up
		Infrared temperature sensor for compressor cycling42
		Slab sensor for compressor cycling
		Night setback programmable controller

Source: Navigant analysis

Industrial Measure List

Table H-6 shows the industrial measures included in both studies as well as those included only in this study or the 2010 CPR. This table includes general descriptions of measure types and does not include complete measure lists or descriptions from each study. Measures of note include the following:

- **Optimize Air Compressor:** Navigant often takes a systems approach to industrial measure characterization rather than characterizing individual measures. The 2017 CPR includes a comprehensive air compressor measure that includes efficient air compressors, VSDs for air compressors, compressor resizing, and compressor operation sequencing.
- **Improved Fan Systems:** Like air compressors, Navigant took a systems approach to fan efficiency rather than characterizing individual measures. The 2017 CPR includes a comprehensive fan efficiency measure that includes premium efficiency fans, fan energy management, fan optimization, and VSDs on fans.
- **Pump Equipment Upgrade:** Like air compressors and fan systems, Navigant took a systems approach to pump equipment efficiency rather than characterizing individual measures. The 2017 CPR includes a comprehensive pump equipment measure that includes pump right-sizing, pump optimization, premium efficiency pumps, and VSDs on pumps.
- **Transformers:** The 2010 CPR included transformers; however, the 2017 study only includes demand-side measures.

[42] The 2010 CPR included refrigeration plant controls for ice rinks, but Navigant was not able to determine which measures were included in that bundle.

Navigant excluded other measures due to low potential impact when compared to other measures in the same end use. The measure list workbook accompanying this report includes the rationale for excluding measures considered for the 2017 study.

Table H-6. Industrial Measure List Comparison

Measures in 2010 and 2017 CPRs	Measures in 2010 CPR but Not 2017 CPR	Measures Included in 2017 CPR but Not 2010 CPR
Energy management systems	Submetering	Regenerative drives (oil & gas)
Programmable load controls	Energy efficient transformers	Pump off controllers
Premium efficiency pumps	Gathering system pigging	Low-flow irrigation systems
Impeller trimming	Hydrate mitigation	Agricultural pump variable frequency drives
Pump system optimization	Gathering system measurement	High efficiency ovens and dryers
Variable speed drives on fans and pumps	Glycol dehydrator control system	Furnace covers
Optimized pump selection	Desiccant dehydrator	Optimized compressed air dryer
Premium efficiency fans	Fractionation unit optimization	Air-entraining air nozzle
Optimized fan distribution systems	Optimized fractionation condenser settings	Efficient pulp screen
Ventilation optimization	Pumpjack checks and maintenance	Enhanced mechanical pulping
Fan housing and airflow improvements	Advanced water heater controls	High efficiency flotation
Premium efficiency motors	Air curtains	High efficiency grinding
Correctly sized motors	Preventative maintenance	Rotor optimization
Optimized motor control	Refrigeration control system	Increase pipe diameter (oil & gas)
Synchronous belts	Smart defrost controls	Efficient process dehumidification
Heat recovery systems	Chiller sub-cooler	Exterior LEDs
Variable speed drives on air compressors	Packaged HVAC equipment	Efficient conveyor belts
Optimized air compressor distribution system	Ventilation heat recovery	Electric servo systems
Air receiver tanks	Automated temperature control (HVAC)	Conveyor off controllers
Intake air temperature reduction	Setback temperature settings (HVAC)	High efficiency kilns
High efficiency air compressors	Destratification fans	Advanced veneer dryer
Compressed air sequencing control	Warehouse loading dock seals	
Compressed air leak management	Compression ratio optimization (gas compressors)	
Process control enhancement	Optimize compressor performance (gas compressors)	
Chiller	Right-sizing (gas compressors)	

Measures in 2010 and 2017 CPRs	Measures in 2010 CPR but Not 2017 CPR	Measures Included in 2017 CPR but Not 2010 CPR
Floating head pressure controls	Volume pocket adjustments (gas compressors)	
Pipe insulation (process cooling)	Minimal cylinder clearance (gas compressors)	
Automated condenser controls	Inlet and interstage cooling (gas compressors)	
High efficiency lights and ballasts	Gathering systems pigging (gas compressors)	
Lighting controls	Improved gathering systems (gas compressors)	
	Hydrate formation mitigation (gas compressors)	
	Gathering systems measurement (gas compressors)	

Source: Navigant analysis

H.3 Data Sources

Navigant gave priority to program data provided by SaskPower when characterizing measures. Where necessary, the team supplemented data gaps using broader Canadian and US data sources such as NRCan data and US DOE appliance standards and rulemakings supporting documents. Navigant also used assumptions from previous potential studies and TRMs, when appropriate. The team used several sources that were not available at the time of the 2010 SaskPower CPR:

- SaskPower 2015 Residential End-Use Study
- SaskPower 2016 Commercial Lighting Market Study
- Recent SaskPower residential and commercial program data and measure assumptions

APPENDIX I. INDUSTRIAL MEASURE DESCRIPTION

This appendix provides descriptions of the industrial measures characterized for the CPR.

I.1 Compressed Air

Optimize Compressed Air Dryer

- **Energy Use Equipment Applicability:** Generally applicable to dual-tower desiccant dryer systems where compressed air is used to sequentially dry out one of the towers.
- **Energy Loss Reduction Mechanism:** Energy efficiency is increased by reducing the compressed air that is exhausted in the desiccant dryers.
- **Energy Measure Description:** There are several dryer systems that are more efficient than purge desiccant dryer systems such as refrigerated dryers, heated dryers, and changing the tower drying process from timed to moisture-controlled.
- **References:** Vendor data and prior measure characterization for Navigant potential study, specific to Canada.

Optimize Air Compressor

- **Energy Use Equipment Applicability:** Applies to all compressed air systems.
- **Energy Loss Reduction Mechanism:** Single stage and non-VFD air compressors are considerably less efficient than more modern compressors, allowing for significant energy savings if the old compressor is replaced.
- **Energy Measure Description:** Replacing old, outdated, air compressors with newer, more efficient models. This includes switching from single- to dual-stage compressors and adding VFDs and more efficient motors.
- **Reference:** Prior measure characterization for Navigant potential study, specific to Canada.

Compressed Air Leak Management

- **Energy Use Equipment Applicability:** Applies to all compressed air systems.
- **Energy Loss Reduction Mechanism:** Leaks are a considerable energy loss source in compressed air systems. This measure assumes approximately 25% loss due to leaks in the system, which is a commonly quoted value.
- **Energy Measure Description:** Includes initial repair of the leaks and implementing a leak detection and leak management system to identify and repair future leaks in the system.
- **Reference:** Prior measure characterization for Navigant PECO and Nova Scotia potential studies.

Air-Entraining Air Nozzle

- **Energy Use Equipment Applicability:** Compressed air systems implemented for a blow-off application.
- **Energy Loss Reduction Mechanism:** Blow-off applications can be made more efficient with an engineered nozzle.
- **Energy Measure Description:** Both handheld and fixed air nozzles use compressed air for cleaning or drying. An air-entraining air nozzle uses 46% less compressed air by grabbing or entraining surrounding atmospheric air, reducing air compressor energy use.
- **References:** Vermont TRM and prior measure characterization for Navigant PECO potential study, updated with data from Spraying System Co.: How to Reduce Compressed Air Consumption in Drying and Blow-Off Applications, http://www.spray.com/literature_pdfs/WP102_Reduce_Air_Use_Drying_Blowoff.pdf

Intake Air Temperature Reduction

- **Energy Use Equipment Applicability:** Applies to all compressed air systems.
- **Energy Loss Reduction Mechanism:** Efficiency (SCFM/kW) increases with inlet air temperature reduction because the mass flow rate increases while power consumption only slightly increases.
- **Energy Measure Description:** Assumes a 10°F reduction in inlet air temperature, primarily by moving the intake to a cooler location.
- **Reference:** Compressed Air Efficiency, Queensland Government: http://www.ecoefficiency.com.au/Portals/56/factsheets/genmanufacture/00976%20M3%20Compressed%20air.pdf

Compressed Air Storage Tank

- **Energy Use Equipment Applicability:** Compressed air systems that have load/no load compressors.
- **Energy Loss Reduction Mechanism:** Adding a storage tank (also called an air receiver) reduces the number of cycles the compressor undergoes.
- **Energy Measure Description:** Adding a storage tank to buffer the air demands of the system.
- **References:** Vermont TRM and prior measure characterization for Navigant PECO potential study

I.2 Fans and Blowers

Improved Fan Systems

- **Energy Use Equipment Applicability:** This measure is applicable to a variety of fan systems used in industrial facilities including systems used for ventilating large industrial areas, boiler fans, and product drying fans used for coal and ore concentrate.
- **Energy Loss Reduction Mechanism:** The energy loss reduction mechanisms cover several areas including replacing damper control with VSDs, reducing fan sizes to better meet needs,

improving duct system layouts, and replacing inefficient fans with more efficient fans such as air foil units.

- **Energy Measure Description:** This measure does not refer to a specific fan system measure but rather to upgrades of complete systems.
- **Reference:** Prior measure characterization for Navigant potential study, specific to Canada.

Synchronous Belts for Fans

- **Energy Use Equipment Applicability:** Fans that can be improved by replacing a V-belt with a synchronous belt.
- **Energy Loss Reduction Mechanism:** Synchronous (or cogged) belts deliver power from the motor to the fan more directly and efficiently than traditional V-belts.
- **Energy Measure Description:** Retrofit a motor/drive with synchronous belts instead of V-belts.
- **References:**
    - US Department of Energy, “Synchronous Belt Fact Sheet,” 2012.
    - National Renewable Energy Laboratory, 2014, *Synchronous and Cogged Fan Belt Performance Assessment*, pg. 17.

I.3 Industrial Process

Ventilation Optimization

- **Energy Use Equipment Applicability:** Ventilation systems in the manufacturing customer segment.
- **Energy Loss Reduction Mechanism:** Energy losses are reduced by improved control of ventilation to reduce heat loss from more inside/outside air exchanges than are needed. During audits of these facilities, building management systems (BMSs) are often not in place.
- **Energy Measure Description:** The energy-saving measure involves installing heat wheels and/or BMSs that control intake and exhaust fans so the building is maintained at the proper pressure. The systems also ensure that fans are not in operation or at reduced operation when the building is not in use.
- **References:** Prior measure characterization for Navigant potential study, Industrial Assessment Center (IAC) database.

Efficient Pulp Screen

- **Energy Use Equipment Applicability:** Pulp screens in mechanical pulp mills.
- **Energy Loss Reduction Mechanism:** The pulp screens are rotating devices that separate woody fiber material from the refined pulp. The more efficient units use less energy at the screen drive motors.
- **Energy Measure Description:** Replace the existing screen/motor assemblies with more efficient slotted screens.
- **Reference:** Prior measure characterization for Navigant potential study, specific to Canada.

Enhanced Mechanical Pulping

- **Energy Use Equipment Applicability:** Thermomechanical pulping (TMP) process
- **Energy Loss Reduction Mechanism:** The overall measure is a process control enhancement where inputs and outputs are more accurately measured, and data collection and data processing is enhanced to reduce electrical energy use in the TMP process.
- **Energy Measure Description:** A suite of mostly process control enhancement measures including accurate data monitoring and collection for optimizing the TMP process.
- **Reference:** Prior measure characterization for Navigant potential study, specific to Canada.

Process Control Enhancement

- **Energy Use Equipment Applicability:** Process systems in all customer segments.
- **Energy Loss Reduction Mechanism:** By better monitoring the outputs of industrial processes, the energy used is more accurately matched to the energy required.
- **Energy Measure Description:** Process control is enhanced by using better measurements and more sophisticated data collection and data processing.
- **References:** Information was obtained from the following two articles, as well as prior measure characterization for Navigant potential study, specific to Canada:
    - Process Integration, Natural Resources Canada, April 2012
    - Success Stories, Natural Resources Canada, 2008-2011

High Efficiency Flotation

- **Energy Use Equipment Applicability:** Froth flotation in the metal mining sector that separates fine waste material from the end-product concentrate.
- **Energy Loss Reduction Mechanism:** The electrical energy that is used in this equipment with respect to pumps, agitators, and compressed air is reduced.
- **Energy Measure Description:** There are different systems now available that are more efficient than the typical systems that are in place.
- **References:** Vendor data and prior measure characterization for Navigant potential study, specific to Canada.

High Efficiency Grinding

- **Energy Use Equipment Applicability:** Semi-autogenous grinding (SAG) mills used in mining applications.
- **Energy Loss Reduction Mechanism:** The energy used for size comminution is reduced.
- **Energy Measure Description:** SAG mills are replaced with high pressure grinding mills.
- **References:** Prior measure characterization for Navigant potential study, specific to Canada and a relatively detailed paper—*Energy and Cost Comparisons of HPGR Based Circuits with the SABC Circuit Installed at the Huckleberry Mine*— that compared SAG with high pressure grinding.

Rotor Optimization

- **Energy Use Equipment Applicability:** Rotors in the pulp and paper industry that are not optimized for their application.
- **Energy Loss Reduction Mechanism:** Rotors are often replaced and more efficient rotors have recently been developed, making this an easy opportunity in the pulp and paper industry.
- **Energy Measure Description:** Energy efficient re-pulping rotors can cut the associated energy by 20%-30%.
- **Reference:** Statistics Canada, Energy-efficient re-pulper rotor, *Focus on Energy*: https://focusonenergy.com/sites/default/files/repulperrotor_bestpracticessheet.pdf

Programmable Load Control for Non-Vehicle Applications

- **Energy Use Equipment Applicability:** Industrial processes.
- **Energy Loss Reduction Mechanism:** Enhanced load control can both shift load and decrease energy use.
- **Energy Measure Description:** A suite of options including process rescheduling, machinery interruption/restart cycles, thermal energy storage, use of backup generation, automation, etc.
- **References:**
    - Leonardo Energy, *Electric Load Management in Industry*, 2009.
    - Olsthoorn, Schleich, & Klobasa, *Barriers to electricity load shift in companies: a survey-based exploration of the end-user perspective*, 2014.
    - Gruber, Biedermann, & Von Roon, *The Merit Order of Demand Response in Industry*, 2014.
    - Shoreh, Siano, Shafie-Khah, Loia & Catalão, *A survey of industrial applications of Demand Response*, 2016.

Increase Pipe Diameter

- **Energy Use Equipment Applicability:** Distribution pipes in oil & gas facilities.
- **Energy Loss Reduction Mechanism:** Increasing the pipe diameter reduces the energy needed to pump liquid through the pipes.
- **Energy Measure Description:** Increase pipe diameter, in this case from 8” to 12”.
- **Reference:** Prior measure characterization for Navigant potential study, specific to Canada.

I.4 Lighting

Efficient Lighting – Low Bay

- **Energy Use Equipment Applicability:** Lighting systems where generally the floor to ceiling height is less than 7.7 meters.
- **Energy Loss Reduction Mechanism:** Retrofit existing T12s with T8s with electronic ballasts, T5HOs, and LEDs.

- **Energy Measure Description:** This measure captures a typical lighting upgrade project. There is a large variation in project types and retrofits that are potential projects.
- **Reference:** Prior measure characterization for Navigant potential study, specific to Canada.

Efficient Lighting – High Bay

- **Energy Use Equipment Applicability:** Lighting systems where generally the floor to ceiling height is greater than 7.7 meters; usually large industrial facilities such as pulp mills, mine processing facilities, and sawmills where the existing lighting is typically high-pressure sodium, metal halide, or mercury vapor
- **Energy Loss Reduction Mechanism:** Retrofit existing lighting systems to either LEDs, induction, or T5HOs.
- **Energy Measure Description:** This measure captures a typical lighting upgrade project. There is a large variation in project types and retrofits that are potential projects.
- **Reference:** Prior measure characterization for Navigant potential study, specific to Canada.

Lighting Controls

- **Energy Use Equipment Applicability:** This measure applies to all industrial segments.
- **Energy Loss Reduction Mechanism:** The loss mechanism for this measure is the use of lighting in locations and at times when no one is in the location and there is no need for lighting.
- **Energy Measure Description:** The prime measures are BMSs and occupancy sensors.
- **Reference:** Prior measure characterization for Navigant potential study, specific to Canada.

Exterior LED

- **Energy Use Equipment Applicability:** Exterior lighting.
- **Energy Loss Reduction Mechanism:** A mixture of high pressure sodium exterior lights and metal halides.
- **Energy Measure Description:** Replace existing lighting with efficient, long-lasting LED lights.
- **References:** IAC database and prior measure characterization for Navigant potential study.

I.5 Material Transport

Efficient Conveyor Belts

- **Energy Use Equipment Applicability:** Blow lines (pneumatic conveyance) in the pulp mill and wood product segments.
- **Energy Loss Reduction Mechanism:** There are generally several blow lines in pulp mills and saw mills because they are much less costly to construct compared to conveyors. However, from an energy consumption perspective, they use approximately 10 times as much energy as a mechanical conveyor.
- **Energy Measure Description:** Replace blow line with mechanical conveyor.
- **References:** IAC database and prior measure characterization for Navigant potential study.

Electric Servo Systems

- **Energy Use Equipment Applicability:** Conveyor systems and complex process machines such as veneer lathes.
- **Energy Loss Reduction Mechanism:** The electric power used for hydraulic systems is reduced significantly when hydraulic actuators are replaced with electric drives.
- **Energy Measure Description:** Hydraulic actuators are replaced with electric servo systems.
- **Reference:** Prior measure characterization for Navigant potential study, specific to Canada.

Oil & Gas – Regenerative Drives

- **Energy Use Equipment Applicability:** Beam pumps in the oil & gas industry.
- **Energy Loss Reduction Mechanism:** Beam pumps draw oil from wells that do not have sufficient well pressure. The nature of the application means that energy can be recovered when the motor is offset by the counterweight (the non-working portion of the stroke).
- **Energy Measure Description:** Regenerative drives store the power generated during the offset portion of the stroke and reapply the energy to the down stroke.
- **References:**
  - Green Energy Futures, "Pumpjack Power Plants," 2012, http://www.greenenergyfutures.ca/episode/16-pumpjack-powerplants
  - SPE, "New Technology to Cut Electric Costs, Not Production," 2016. https://spe.org/en/print-article/?art=1549
  - Cenovus Report, 2014

Conveyor Off Controllers

- **Energy Use Equipment Applicability:** Material transport in manufacturing/pulp and paper segments.
- **Energy Loss Reduction Mechanism:** Approximately 50% of conveyors have controls that could be enhanced.
- **Energy Measure Description:** Enhanced control measures to reduce conveyor use during non-production or low production periods.
- **References:** Vendor data and prior measure characterization from Navigant potential study.

I.6 Process Cooling

Efficient Process Dehumidification

- **Energy Use Equipment Applicability:** Process cooling.
- **Energy Loss Reduction Mechanism:** Desiccant dehumidifiers are efficient methods of dehumidifying for process cooling because they rely on heat rather than electricity to dehumidify the air. Efficient systems use exhaust air from other processes to activate the desiccant.

- **Energy Measure Description:** Install desiccant dehumidification system.
- **References:** Prior measure characterization from Navigant potential study and IAC database.

High Efficiency Chiller

- **Energy Use Equipment Applicability:** Any process cooling area with an older chiller.
- **Energy Loss Reduction Mechanism:** Older chillers are often left in place for long periods of time as they are expensive to replace. These chillers can have an kW/ton value as high as 1.23, whereas newer models can improve that value by 50%.
- **Energy Measure Description:** Replace existing chillers with more efficient models.
- **References:** Reports completed by Florida Power and Light and Progress Energy:
    - Florida Power and Light, *Water-Cooled Chillers*: https://www.fpl.com/business/pdf/water-cooled-chillers-primer.pdf
    - Progress Energy, *Chiller Optimization and Energy-Efficient Chillers*: https://www.progress-energy.com/assets/www/docs/business/chiller-fact-sheet-052005.pdf

Floating Head Pressure Controls (FHPCs)

- **Energy Use Equipment Applicability:** Process cooling systems that do not currently have automated condenser controls or FHPCs installed.
- **Energy Loss Reduction Mechanism:** Allows the head pressure to drop with decreasing outside temperature, reducing compressor use significantly, while causing a slight increase in evaporative condenser energy use.
- **Energy Measure Description:** Add FHPCs to system.
- **Reference:** Focus on Energy, “Industrial Refrigeration Systems,”: https://www.focusonenergy.com/sites/default/files/Doug_R_Refrigeration_2_Handout_Final.pdf

Improved Insulation (Pipe Insulation)

- **Energy Use Equipment Applicability:** The equipment involved in process cooling.
- **Energy Loss Reduction Mechanism:** A significant amount of the energy used to cool a process is lost due to insufficient insulation. While not as significant as the energy lost in heating, it is less often implemented.
- **Energy Measure Description:** Installing insulation on the equipment involved.
- **References:** Environmental Protection Agency and prior measure characterization for Navigant potential study, specific to Canada.

Automated Condenser Controls

- **Energy Use Equipment Applicability:** Process cooling.
- **Energy Loss Reduction Mechanism:** Similar to FHPCs.
- **Energy Measure Description:** Control the speed of the condenser fans, control the flow of the cooling water, flood the condensers with liquid refrigerant.

- **References:**
    - Solution Dynamics, "Ammonia Condenser Fans VFDs Case Study," 2015: http://www.sol-dyn.com/CASE_STUDY_AMMONIA_REFRIGERATION_CONDENSER_FANS_VFDs.pdf
    - Manske, Reindl, and Klein, *Evaporative Condenser Control in Industrial Refrigeration Systems*, 2001: http://lms.i-know.com/pluginfile.php/28693/mod_resource/content/62/Evaporative%20Condenser%20Control.pdf

I.7 Process Heating

High Efficiency Ovens & Dryers

- **Energy Use Equipment Applicability:** High-temperature ovens and dryers; does not include lumber kilns or veneer dryers, which are covered separately. Examples are metal heat-treating oven/furnaces and lime kilns at pulp mills.
- **Energy Loss Reduction Mechanism:** The efficiency measure involves improving the effective transfer between the hot combustion gases and the material to be treated, as well as heat recovery. In general, energy losses exhausted to the environment are reduced.
- **Energy Measure Description:** The energy measure involves retrofitting ovens and dryers, installing heat recovery, and improving process control so the combustion process more accurately matches the heat or drying requirements.
- **References:** Vendor data and prior measure characterization for Navigant potential study, specific to Canada.

High Efficiency Furnaces

This measure is included in the High Efficiency Ovens and Dryers – see description for that measure above.

Heat Recovery Systems

- **Energy Use Equipment Applicability:** Large process heat systems.
- **Energy Loss Reduction Mechanism:** Heat is recovered from exhaust and used to heat input air or the product itself.
- **Energy Measure Description:** Normally involves a heat exchanger in the steam or gas exhaust.
- **Reference:** Prior measure characterization for Navigant potential study, specific to Canada.

Furnace Covers

- **Energy Use Equipment Applicability:** Process heating, where furnaces and tanks are uncovered.
- **Energy Loss Reduction Mechanism:** Significant process heat is lost in situations where portions of furnaces and tanks are left uncovered during the heating process.
- **Energy Measure Description:** Adding covers to uncovered furnaces.

- **References:** IAC database and prior measure characterization from a Navigant potential study.

I.8 Product Drying

High Efficiency Kilns

- **Energy Use Equipment Applicability:** This measure focuses on lumber drying kilns.
- **Energy Loss Reduction Mechanism:** The main opportunities for energy loss reduction are to more accurately provide the lumber with the drying energy that is needed, and recover heat at the start up and completion of the drying cycle.
- **Energy Measure Description:** Older kilns are either replaced with new ones or older kilns are given a major retrofit. The specific improvements include enhanced controls, variable speed fans, heat recovery, and improved airflow distribution. The latest efficient variety is a continuous kiln where the exhaust heat from one batch is used to preheat the next batch.
- **Reference:** Prior measure characterization for Navigant potential study, specific to Canada

Advanced Veneer Dryer

- **Energy Use Equipment Applicability:** The dryers in plywood mills within the wood product segment.
- **Energy Loss Reduction Mechanism:** Energy losses in exhaust are reduced and the energy input is more accurately matched to the heat energy required to dry the veneer.
- **Energy Measure Description:** Either new dryers replace older dryers or older dryers are given a major retrofit. Measures include heat recovery, VSDs, and synchronous belts.
- **Reference:** Vendor data and prior measure characterization for Navigant potential study, specific to Canada.

I.9 Pumps

Pump Equipment Upgrade

- **Energy Use Equipment Applicability:** Pumping systems mainly in the pulp, food and beverage, and mining segments.
- **Energy Loss Reduction Mechanism:** The energy loss reduction mechanisms cover several areas including replacing valve control with VSDs, reducing pump sizes to better meet needs, improving piping system layouts, and replacing inefficient pumps with more efficient pumps.
- **Energy Measure Description:** This measure does not refer to a specific pump system measure but rather to upgrades of complete systems.
- **Reference:** Prior measure characterization for Navigant potential study, specific to Canada.

Pump Off Controllers

- **Energy Use Equipment Applicability:** All pumping systems should be reviewed to determine if there are times when they are running and could be turned off. Many industrial water systems will pump water from a holding pond and recirculate excess supply to the pond. There are often times when some or all the pumps involved could be turned off.

- **Energy Loss Reduction Mechanism:** Electric power for pumping energy is reduced. For many projects, there will also be water savings.
- **Energy Measure Description:** The measure to obtain the savings usually requires some type of process measurement device, data processing equipment, and control method for turning pumps off or on.
- **Reference:** Prior measure characterization for Navigant potential study, specific to Canada.

Synchronous Belts for Pumps

- **Energy Use Equipment Applicability:** Pumps that can be improved by replacing a V-belt with a synchronous belt.
- **Energy Loss Reduction Mechanism:** Synchronous (or cogged) belts deliver power from the motor to the pump more directly and efficiently than traditional V-belts.
- **Energy Measure Description:** Retrofit a motor/drive with synchronous belts instead of V-belts.
- **References:**
    - National Renewable Energy Laboratory, *Synchronous and Cogged Fan Belt Performance Assessment*, pg. 17, 2014.
    - Foszcz, “Basics of belt drives,” 2001: http://www.plantengineering.com/single-article/basics-of-belt-drives/981c1be10d400323db10aa592e4cc7b3.html

Impeller Trimming

- **Energy Use Equipment Applicability:** Centrifugal pumps that are oversized for their application.
- **Energy Loss Reduction Mechanism:** Impeller trimming effectively reduces the size of the pump to better match the actual requirements when a centrifugal pump is oversized for the application.
- **Energy Measure Description:** Trimming an impeller to as much as 75% of the original diameter, reducing both the pump’s flow rate and pressure. This reduces excess energy use by a pump that is producing excessive head.
- **References:**
    - Impeller Replacement or Trimming, *Industrial Efficiency Technology Database*, 2010: http://ietd.iipnetwork.org/content/impeller-replacement-or-trimming
    - US DOE, “Energy Tips – Pumping Systems,” 2006: https://energy.gov/sites/prod/files/2014/05/f16/trim_replace_impellers7.pdf

Low-Flow Irrigation Systems

- **Energy Use Equipment Applicability:** Agricultural irrigation systems.
- **Energy Loss Reduction Mechanism:** Traditional irrigation systems waste both water and energy. Low-flow/low pressure irrigation (drip or efficient spray heads) directs the water to where it is needed at a lower pressure and with less water and energy.
- **Energy Measure Description:** Low-flow/low pressure irrigation systems.

- **References:** Prior measure characterization for Navigant potential studies.

Agricultural Pump VFDs

- **Energy Use Equipment Applicability:** Agricultural irrigation pumps.
- **Energy Loss Reduction Mechanism:** Approximately 25% of energy used for irrigation is wasted due to poor pump and motor efficiency.
- **Energy Measure Description:** Adding VFDs to agricultural irrigation pumps to better match required irrigation load and decrease wear on the pump.
- **References:** Prior measure characterization for Navigant potential studies.

I.10 Whole Building

Energy Management

- **Energy Use Equipment Applicability:** Whole building throughout the entire industrial sector.
- **Energy Loss Reduction Mechanism:** Utilizing building control systems to reduce energy use in the building as a whole.
- **Energy Measure Description:** Instituting SCADA systems and similar control and information systems to reduce energy use facility-wide by optimizing and running equipment more efficiently.
- **References:**
    - NRCan, *EMIS Manual*, 2016.
    - NRCan, *Energy Management Systems Implementation Guidelines*, 2012.
    - Bureau of Energy Efficiency, *Energy Monitoring and Targeting*, February 2005.

APPENDIX J. PEAK DEMAND CALCULATIONS

Navigant derived a bottom-up base year and reference case peak demand forecast using reference case electricity consumption and peak load shape factors for each customer segment. The reference case forecast represents the expected level of electricity consumption from 2018 to 2036, absent incremental DSM activities or load impacts from rates. Section 2.2 explains the development of the reference case forecast in detail.

Navigant used the 8,760 load shapes developed for this study to calculate peak load shape factors for winter and summer peak periods. Appendix F provides the load shape development methodology and analysis. The team calculated peak load shape factors for each customer segment and end use using Equation J-9.

Equation J-9. Peak Load Shape Factor (PLSF)

$$PLSF = \sum_{i}^{n} Hourly\ Fractional\ Load_i$$

$$PLSF = HFL_{Hour\ 1} + HFL_{Hr\ 2} + HFL_{Hr\ 3} + HFL_{Hr\ 4} \ldots + HFL_{\ Hr\ (Peak\ Period\ Hours-1)} + HFL_{Hr\ Peak\ Period\ Hours}$$

Where, *i* = the hour during the peak period for *n* hours. Navigant developed a weighted average peak load shape factor for each customer segment using the peak load shape factors for each end use and the base year (2016) distribution of end uses within a segment. Appendix B describes the development of EUIs in detail. The team used Equation J-10 to calculate the weighted average peak load shape factor for each customer segment.

Equation J-10. Weighted Average PLSF

$$Weighted\ Average\ PLSF = \sum_{i}^{n} End\ Use\ Weight_i\ x\ End\ Use\ PLSF_i$$

Where *i* = end use 1 and *n* is the number of end uses for a customer segment. The sum of the weighted average peak load shape factor multiplied by the reference case electricity consumption by customer segment equals the peak demand, as shown in Equation J-11.

Equation J-11. Peak Demand

$$Peak\ Demand = \sum_{i}^{n} \frac{Weighted\ Average\ PLSF_i\ x\ Reference\ Case\ kWh_i}{Peak\ Period\ Hours}$$

Where *i* = customer segment 1 and *n* is the number of customer segments. For this methodology, Weighted Average PLSF/Peak Period Hours is equal to the percentage of a customer segment's energy consumption that occurs in a single peak hour. For this study, the peak period hours are:

- Winter: Hours ending 18-21 on non-holiday weekdays in December-February
- Summer: Hours ending 15-18 on non-holiday weekdays in June-August

The Methodology for Peak Savings workbook includes the calculations of the peak load shape factors used for this study. The Peak Demand Base and Reference Case workbook includes the calculation of the bottom-up peak demand forecast.

SRRP Q84 Reference: Energy Efficiency

a) With reference to the energy efficiency programs summarized in section 2.1 of the application, please provide the actual costs associated with these programs for the three most recent actual years and forecasts for 2021/22 through 2023/24.
b) Please provide summary details of any other energy efficiency, demand side management, or conservation programs currently administered by SaskPower beyond those summarized in section 2.1 of the application.

Response:

Program Costs (Actual & Forecast)

Program costs

	Actual 2018-19	Actual 2019-20	Actual 2020-21	Forecast 2021-22	Business Plan 2022-23	Business Plan 2023-24
Online Energy Assessment for Homes	$ 180,724	$ 91,052	$ 136,984	$ 90,000	$ 90,000	$ 90,000
Energy Assistance Program	-	191,064	175,884	313,194	1,033,190	750,000
Northern First Nation Home Retrofit Program	-	-	154,281	97,127	797,351	800,000
Walk-Through Energy Assessment Program & Energy Management Professional Training	234,726	25,030	141,671	34,835	-	-
Municipal Ice Rink Program	16,575	2,500	-	-	-	-
Power Support Service (Pilot)	-	-	-	45,293	-	-
Efficiency Partner Program	3,771	108	-	-	5,000	5,000
Industrial Energy Optimization Program	2,132,907	2,135,690	1,340,427	63,051	-	-
Total	$ 2,568,704	$ 2,445,443	$ 1,949,247	$ 643,500	$ 1,925,541	$ 1,645,000

Notes:
1. Energy Assistance Program, Northern First Nation Home Retrofit Program, and Walk-Through Energy Assessment Program & Energy Management Professional Training leveraged external sources of funding. The costs and forecasts listed include only SaskPower's contributions.
2. COVID-19 impacted the actual costs in 2020/21 and 2021/22 for Energy Assistance Program and Efficiency Partner Program. Both programs underspent in 2020/21 and 2021/22 due to pandemic restrictions which limited the ability to deliver these programs.

There are no additional programs currently administered by SaskPower beyond those summarized in section 2.1 of the application.

SRRP Q85 Reference: Demand Response Program

a) Please comment on any changes that have occurred to the Demand Response program since the last rate application.
b) Please provide a summary of subscriptions to the demand response program, including the total number of customers and the total amount of capacity subscribed to each rate option for each of the last three years.

Response:

a) DR1 has been renamed Spinning Capacity Reserve and the fixed payment has been increased to $70,000 per MW-year since the last rate application. DR2 has been renamed Planned Operating Capacity Reserve since the last rate application.

b)

Spinning Capacity Reserve

Year	Providers	Capacity (MW)
2019	2	86
2020	1	60
2021	2	63

Planned Operating Capacity Reserve

Year	Providers	Capacity (MW)
2019	1	50
2020	0	0
2021	0	0

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2022 AND 2023 RATE APPLICATION
SRRP INTERROGATORIES

SRRP Q86 Reference: Net Metering Program

a) Please provide a summary of subscriptions to the net metering program including the total number of customers subscribed, the total installed capacity, and the total generation delivered from customers to SaskPower under the program for each of the last three years.
b) Please discuss how SaskPower determined the Net metering credit of 7.5 cents per kWh was appropriate.
c) With reference to SaskPower's website at: https://www.saskpower.com/Our-Power-Future/Powering-2030/Generating-Power-as-an-Individual/Using-the-Power-You-Make/Net-Metering/What-We-Heard-From-You-Pricing-Review
Please provide any supporting studies or analysis used by SaskPower to support the statement "It is more cost-effective for us to meet our 2050 emission reduction goals through utility-scale low-or non-emitting projects."

Response:

a)

	Total Customers Subscribed to Net Metering	Total Installed Capacity	Total Generation Delivered
2018/19	1355	15.24 MW	6.00 GWh
2019/20	2184	31.37 MW	12.71 GWh
2020/21	2334	34.43 MW	21.56 GWh

b)

In 2019, Net Metering was revised after the program reached its approved 16MW capacity. The price offered for excess power was changed from the retail rate of (approximately) 14¢/kWh to 7.5¢/kWh which was closer to SaskPower's average cost for electricity at that time. Near the end of 2021, SaskPower extended the price of 7.5¢/kWh to March 31, 2026.

Before the extension, SaskPower engaged with customers and stakeholders for input, benchmarked against other utilities, and reviewed the financial implications. There was no consensus reached between supporters or participants of Net Metering and customers not interested in Net Metering on what an appropriate price should be. Benchmarking indicates that SaskPower's price paid for excess power (7.5¢/kWh) provides a comparable payback to other Canadian jurisdictions. Customers who joined Net Metering prior to the program changes in 2019 are still compensated at the retail rate and will continue that way until their contracts expire in 2029.

c)

SaskPower's levelized cost of electricity (*SaskPower 2022 & 2023 Rate Application*, page 23) indicates utility scale wind and solar options are the lowest cost supply options. Smaller-scale customer generation options such as Net Metering and Power Generation Partner Program are more expensive.

SRRP Q87 Reference: Cost of Service Study

a) Please confirm SaskPower's current cost of service study has accepted and implemented the Elenchus recommendations to implement the average and excess method to classify SaskPower's generating assets, to implement the minimum system method to classify distribution transformers and urban and rural distribution line costs, and to replace the existing NCP data used for allocation purposes with the class maximum diversified demand. If not confirmed, please provide an explanation.

b) Please discuss when SaskPower anticipates its next external review of its cost of service methodology will take place.

c) Please elaborate on the reasons for changing the classification of wind generation ratebase and expenses to use the Average & Excess Demand (AED) method instead of using a method based on planning studies regarding the capacity value of wind generation. Please also provide tables that compare:
   i. The proportion of costs classified to energy and demand using the AED method compared to the previous classification method.
   ii. The allocation of total revenue requirement to each customer class using the AED method and the previous classification method.

d) Please discuss if there have been any other changes made to the cost of service study methodology since the last external review and if so, please itemize them and provide a discussion of the rationale for the change.

e) Please discuss if in SaskPower's view the cost of service study results are influenced by sales and peak demand changes by customer class related to the Covid-19 pandemic.

Response:

a) SaskPower confirms that the current cost of service has accepted and implemented the Average and Excess Demand (AED) method to classify SaskPower's generating assets, the minimum system method to classify distribution transformers and urban and rural distribution line costs and replaced the existing NCP data used for allocation purposes with the class maximum diversified demand.

b) SaskPower anticipates the next external cost of service review will take place in 2023.

c) During the 2017 cost of service review, SaskPower engaged the services of Elenchus Research Associates who recommended that SaskPower transition from the Equivalent Peaker (EPM) to the Average and Excess Demand (AED) methodology to classify its generating assets between energy and demand. The rationale behind AED is that a utility's average annual demand is required to meet its energy requirements, and any demand exceeding that average is required to meet its peaking requirements, regardless of the type of generation technology utilized. It is for this reason that SaskPower changed the classification of all its generation rate base, regardless of type, to reflect the AED method. The one exception in the universal application of the AED methodology to classify SaskPower's generation units is diesel. It was decided to continue to classify diesel generation units 100% to demand, as they were under the EPM methodology, as these units are used to serve remote communities that are not connected to SaskPower's grid.

In their final report filed to SaskPower on June 30, 2017 ('Review of Cost Allocation and Rate Design Methodologies"), Elenchus states that, "*A classification methodology based on customer consumption provides more stable classification results over time than a generation classification method based on generation assets, whose initial purpose may change over time, reflecting change in operational circumstances and/or Government policy*" (pg. 43) and that the AED method "*is based on customer consumption as the cost causality driver; it is not intended to reflect historical decisions to invest additional capital that may have been made for many reasons that may or may not be relevant in the current circumstance*" (pg. 10).

i. Please see the tables below showing the comparison of classified revenue requirements using the previous method (Equivalent Peaker) to the Average & Excess Demand (AED) for 2023 & 2024 fiscal years:

	2022-23 Fiscal Revenue Requirement							
Methodology	**Demand**		**Energy**		**Customer**		**Total**	
	($millions)	**(%)**	**($millions)**	**(%)**	**($millions)**	**(%)**	**($millions)**	**(%)**
EPM	1,165.3	45.2%	1,111.4	43.1%	302.2	11.7%	2,579.0	100.0%
AED	1,049.2	40.7%	1,227.6	47.6%	302.2	11.7%	2,579.0	100.0%
Variance	***(116.2)***	***-4.5%***	***116.2***	***4.5%***	***-***	***0.0%***	***-***	***0.0%***

	2023-24 Fiscal Revenue Requirement							
Methodology	**Demand**		**Energy**		**Customer**		**Total**	
	($millions)	**(%)**	**($millions)**	**(%)**	**($millions)**	**(%)**	**($millions)**	**(%)**
EPM	1,219.4	45.4%	1,145.4	42.7%	320.4	11.9%	2,685.3	100.0%
AED	1,099.3	40.9%	1,265.6	47.1%	320.4	11.9%	2,685.3	100.0%
Variance	***(120.2)***	***-4.5%***	***120.2***	***4.5%***	***-***	***0.0%***	***-***	***0.0%***

ii. Please see the tables below showing the total revenue requirement to each customer class using the AED and Equivalent Peaker (EP) method for the 2023 & 2024 fiscal years:

	2022-23 Fiscal Revenue Requirement			
Customer Class	**EPM ($millions)**	**AED ($millions)**	**Change ($millions)**	**(%)**
Residential	605.5	598.3	(7.2)	-1.2%
Farms	190.8	189.7	(1.1)	-0.6%
Small Commercial	223.8	222.6	(1.2)	-0.5%
General Service	248.9	249.0	0.1	0.0%
Total Commercial	**472.6**	**471.6**	**(1.1)**	**-0.2%**
Power - Published Rates	552.3	557.0	4.7	0.9%
Power - Contract Rates	245.9	247.7	1.7	0.7%
Total Power	**798.2**	**804.7**	**6.5**	**0.8%**
Oilfields	393.5	397.2	3.7	0.9%
Streetlights	19.0	19.0	0.0	0.2%
Reseller	99.4	98.5	(0.9)	-0.9%
Total (System)	**2,579.0**	**2,579.0**	**0.0**	**0.0%**

	2023-24 Fiscal Revenue Requirement			
Customer Class	**EPM ($millions)**	**AED ($millions)**	**Change ($millions)**	**(%)**
Residential	637.5	630.1	(7.5)	-1.2%
Farms	197.2	196.1	(1.1)	-0.6%
Small Commercial	236.4	235.1	(1.2)	-0.5%
General Service	261.7	261.8	0.1	0.0%
Total Commercial	**498.0**	**496.9**	**(1.1)**	**-0.2%**
Power - Published Rates	561.2	566.0	4.9	0.9%
Power - Contract Rates	252.1	253.9	1.7	0.7%
Total Power	**813.3**	**819.9**	**6.6**	**0.8%**
Oilfields	417.2	421.2	3.9	0.9%
Streetlights	18.9	19.0	0.0	0.2%
Reseller	103.1	102.2	(0.9)	-0.9%
Total (System)	**2,685.3**	**2,685.3**	**0.0**	**0.0%**

d) No additional changes have been made to the cost-of-service methodology since the last external review.

e) SaskPower's view is that the cost-of-service study results are continuously influenced by changes in energy sales and peak demands, regardless of the source of the change. It's important to note that the cost-of-service study results will vary from year to year for several reasons, including:

1. Class Revenue Changes
2. Class Revenue Requirement Changes, due to:
    i. Non-uniform escalation of generation, transmission, distribution & customer service costs (e.g., capital expenditures, fuel & purchased power, OM&A, and depreciation expense)
    ii. Changes to cost-of-service methodology

iii. Changes to class demand (e.g., customer load factors) at system peak, due to:
  1. Economic conditions
  2. Mechanical failures
  3. Unforeseen shutdowns
  4. Operational changes
  5. Variations in weather patterns

SaskPower attempts to mitigate influences on cost of service by using assumptions based on a "most likely" scenario, to stabilize rate designs and protect all customers from outlying or anomalous conditions that may occur.

There is no doubt that energy consumption (and therefore the corresponding impact to peak demand) for some customer classes have been influenced by the Covid-19 pandemic, and those influences are reflected to some extent in the load forecast used in this application. Whether those changes are permanent is more difficult to ascertain, and it highlights the importance of utilities being allowed to conduct regular rebalancing maintenance, as SaskPower can then make continuous adjustments to its rates to reflect new trends in usage.

SRRP Q88 Reference: Proposed Rates Revenue to Revenue Requirement Ratios

a) Please provide the revenues and revenue requirement breakdowns by class in dollars supporting the calculation of the 2022/23 revenue to revenue requirement ratios illustrated in the first table on page 34 of the application and the 2023/24 revenue requirement ratios illustrated in the first table on page 35 of the application.
b) Please provide a detailed explanation for why the streetlights class is proposed to receive a lower than average rate increase when its revenue to revenue requirement ratio is below 1.00.
c) Please provide a detailed explanation for why the power – contract rate class is proposed to receive a lower than average rate increase when its revenue to revenue requirement ratio is below 1.00.
d) Please provide a table showing the 2022/23 and 2023/24 percentage rate increases by class that would be required to have all customer classes achieve revenue to revenue requirement ratios of between 0.98 and 1.02 by 2023/24.

Response:

a) Please see the table below that shows the revenues and revenue requirement breakdowns by customer class that supports the R/RR ratios in the 2022-23 & 2023-24 rate application:

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2022 AND 2023 RATE APPLICATION
SRRP INTERROGATORIES

Year 2023F Rate Change & R/RR Ratios

(A)	(B)	(C)	(D = B * N)	(E = C + D)	(F)	(G = F / E)	(H)	(I = F * H)	(J = B * O)	(K = C + J)	(L = F + I)	(M = L / K)
			2022-23 Revenue at Existing Rates						2022-23 Revenue at Adjusted Rates			
Class of Service	Allocated Rate Base ($millions)	Allocated Expenses ($millions)	Allocated Return ($millions)	Allocated Rev. Reqt. ($millions)	Revenue ($millions)	Revenue to Rev. Reqt. Ratio	Revenue Change (%)	Revenue Change ($millions)	Allocated Return ($millions)	Allocated Rev. Reqt. ($millions)	Revenue ($millions)	Revenue to Rev. Reqt. Ratio
Residential	$ 2,585.6	$ 511.9	$ 86.5	$ 598.3	$ 579.5	0.97	4.2%	$ 24.2	$ 112.0	$ 623.9	$ 603.8	0.97
Farms	$ 834.9	$ 161.8	$ 27.9	$ 189.7	$ 181.6	0.96	4.5%	$ 8.3	$ 36.2	$ 198.0	$ 189.9	0.96
Small Commercial	$ 1,048.2	$ 187.5	$ 35.1	$ 222.6	$ 228.3	1.03	4.4%	$ 9.9	$ 45.4	$ 232.9	$ 238.3	1.02
General Service	$ 1,077.0	$ 212.9	$ 36.0	$ 249.0	$ 257.0	1.03	3.9%	$ 10.0	$ 46.7	$ 259.6	$ 266.9	1.03
Total Commercial	**$ 2,125.2**	**$ 400.5**	**$ 71.1**	**$ 471.6**	**$ 485.3**	**1.03**	**4.1%**	**$ 19.9**	**$ 92.1**	**$ 492.5**	**$ 505.2**	**1.03**
Power - Published Rates	$ 1,925.4	$ 492.6	$ 64.4	$ 557.0	$ 559.1	1.00	4.1%	$ 22.8	$ 83.4	$ 576.0	$ 581.9	1.01
Power - Contract Rates	$ 855.7	$ 219.1	$ 28.6	$ 247.7	$ 242.9	0.98	3.8%	$ 9.3	$ 37.1	$ 256.1	$ 252.3	0.98
Total Power	**$ 2,781.1**	**$ 711.7**	**$ 93.0**	**$ 804.7**	**$ 802.0**	**1.00**	**4.0%**	**$ 32.1**	**$ 120.5**	**$ 832.2**	**$ 834.2**	**1.00**
Oilfields	$ 1,687.1	$ 340.7	$ 56.4	$ 397.2	$ 416.0	1.05	3.4%	$ 14.0	$ 73.1	$ 413.8	$ 430.0	1.04
Streetlights	$ 101.4	$ 15.6	$ 3.4	$ 19.0	$ 18.2	0.95	2.5%	$ 0.5	$ 4.4	$ 20.0	$ 18.6	0.93
Reseller	$ 331.0	$ 87.4	$ 11.1	$ 98.5	$ 96.3	0.98	4.3%	$ 4.2	$ 14.3	$ 101.7	$ 100.5	0.99
Total (System)	**$ 10,446.3**	**$ 2,229.6**	**$ 349.4**	**$ 2,579.0**	**$ 2,579.0**	**1.00**	**4.0%**	**$ 103.2**	**$ 452.5**	**$ 2,682.1**	**$ 2,682.1**	**1.00**

	2022-23 Revenue at Existing Rates				2022-23 Revenue at Adjusted Rates			
	(B)	(C)	(F)	(N = (F-C)/B)	(B)	(C)	(L)	(O = (L-C)/B)
	Rate Base ($millions)	Expenses ($millions)	Revenue ($millions)	RORB	Rate Base ($millions)	Expenses ($millions)	Revenue ($millions)	RORB
Return on Rate Base	$ 10,446.3	$ 2,229.6	$ 2,579.0	3.34%	$ 10,446.3	$ 2,229.6	$ 2,682.1	4.33%

Year 2024F Rate Change & R/RR Ratios

(A)	(B)	(C)	(D = B * N)	(E = C + D)	(F)	(G = F / E)	(H)	(I = F * H)	(J = B * O)	(K = C + J)	(L = F + I)	(M = L / K)
			2023-24 Revenue at Existing Rates						2023-24 Revenue at Adjusted Rates			
Class of Service	Allocated Rate Base ($millions)	Allocated Expenses ($millions)	Allocated Return ($millions)	Allocated Rev. Reqt. ($millions)	Revenue ($millions)	Revenue to Rev. Reqt. Ratio	Revenue Change (%)	Revenue Change ($millions)	Allocated Return ($millions)	Allocated Rev. Reqt. ($millions)	Revenue ($millions)	Revenue to Rev. Reqt. Ratio
Residential	$ 2,661.2	$ 531.1	$ 99.0	$ 630.1	$ 607.8	0.96	4.2%	$ 25.6	$ 126.1	$ 657.2	$ 633.4	0.96
Farms	$ 836.8	$ 165.0	$ 31.1	$ 196.1	$ 189.8	0.97	4.5%	$ 8.6	$ 39.7	$ 204.6	$ 198.4	0.97
Small Commercial	$ 1,084.9	$ 194.8	$ 40.4	$ 235.1	$ 240.6	1.02	4.4%	$ 10.5	$ 51.4	$ 246.2	$ 251.1	1.02
General Service	$ 1,097.3	$ 220.9	$ 40.8	$ 261.8	$ 269.3	1.03	3.9%	$ 10.5	$ 52.0	$ 272.9	$ 279.7	1.02
Total Commercial	**$ 2,182.2**	**$ 415.7**	**$ 81.2**	**$ 496.9**	**$ 509.8**	**1.03**	**4.1%**	**$ 21.0**	$ 103.4	**$ 519.2**	**$ 530.8**	**1.02**
Power - Published Rates	$ 1,870.9	$ 496.4	$ 69.6	$ 566.0	$ 571.9	1.01	4.1%	$ 23.3	$ 88.7	$ 585.1	$ 595.2	1.02
Power - Contract Rates	$ 839.1	$ 222.7	$ 31.2	$ 253.9	$ 247.6	0.98	3.8%	$ 9.4	$ 39.8	$ 262.4	$ 257.0	0.98
Total Power	**$ 2,710.0**	**$ 719.1**	**$ 100.8**	**$ 819.9**	**$ 819.5**	**1.00**	**4.0%**	**$ 32.8**	$ 128.4	**$ 847.5**	**$ 852.2**	**1.01**
Oilfields	$ 1,730.4	$ 356.8	$ 64.4	$ 421.2	$ 438.9	1.04	3.4%	$ 14.7	$ 82.0	$ 438.8	$ 453.7	1.03
Streetlights	$ 99.6	$ 15.3	$ 3.7	$ 19.0	$ 18.8	0.99	2.5%	$ 0.5	$ 4.7	$ 20.0	$ 19.3	0.97
Reseller	$ 327.0	$ 90.0	$ 12.2	$ 102.2	$ 100.6	0.98	4.3%	$ 4.4	$ 15.5	$ 105.5	$ 105.0	1.00
Total (System)	**$ 10,547.2**	**$ 2,293.0**	**$ 392.3**	**$ 2,685.3**	**$ 2,685.3**	**1.00**	**4.0%**	**$ 107.5**	$ 499.8	**$ 2,792.8**	**$ 2,792.8**	**1.00**

	2023-24 Revenue at Existing Rates				2023-24 Revenue at Adjusted Rates			
	(B)	(C)	(F)	(N = (F-C)/B)	(B)	(C)	(L)	(O = (L-C)/B)
	Rate Base ($millions)	Expenses ($millions)	Revenue ($millions)	RORB	Rate Base ($millions)	Expenses ($millions)	Revenue ($millions)	RORB
Return on Rate Base	$ 10,547.2	$ 2,293.0	$ 2,685.3	3.72%	$ 10,547.2	$ 2,293.0	$ 2,792.8	4.74%

b) SaskPower is currently converting all its streetlights from High Pressure Sodium Vapour (HPSV) to LED lighting under its Streetlight Conversion Project. The goal is to update nearly 100,000 streetlights in the province over the next 10 years. It is expected that the conversion to LED lighting will result in lower energy usage for the streetlight class that will subsequently be reflected in their future rates. There are several factors currently challenging this assumption:

1. At an existing R/RR ratio of 0.95, SaskPower is already not collecting enough revenue to cover the allocated costs to the streetlight class, and they are therefore being subsidized by other customer classes.
2. In theory, as the number of streetlights converted to LED increases, the class revenue requirement should decrease due to their lower energy usage, automatically increasing their R/RR ratio and getting them closer to the targeted level of 1.02.
3. However, because of their small size, the Streetlight class is extremely sensitive to relatively large changes to their allocated costs. Due to current uncertainties in the supply chain and higher than expected inflation, it is reasonable to assume that the costs of the Streetlight Conversion Program may increase beyond initial expectations and diminish the potential benefits associated with their lower energy usage. It is therefore SaskPower's position to wait until the project has been completed, with all costs recorded, before assessing the full impacts to the Streetlight class.
4. Unfortunately, without a rate increase, the streetlight R/RR ratio will continue to degrade further, increasing the subsidy they receive from others and potentially making it more difficult to transition them towards a R/RR ratio of 1.02 in future applications.

Therefore, SaskPower's strategy is to minimize increases to the streetlight class to maintain their current R/RR ratio at a consistent level until the conversion project is completed. Although the streetlight class is expected to have a R/RR ratio below 1.00 by 2023-24, its projected ratio of 0.97 falls within the utility standard range of 0.95-1.05.

c) Power – Contract customers are those customers who have signed Electrical Service Agreements (ESA) with SaskPower. Included in these agreements are defined rate escalations that have been negotiated between the customer and SaskPower. As such, these escalations may be associated with other metrics not tied to SaskPower's cost increases and may therefore be larger (or smaller) than what is required for SaskPower to achieve its targeted R/RR ratio of 1.02 for the Power-Contract class.

While the specific terms of each contract escalation cannot be discussed due to confidentiality, SaskPower can state that each customer within the Power – Contract class has received the maximum increase allowable as defined under their specific contract terms.

d) Please see the tables below:

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2022 AND 2023 RATE APPLICATION
SRRP INTERROGATORIES

Year 2023F Rate Change & R/RR Ratios
4.0% General Rate Increase With Rebalancing Maintenance

Class of Service	2023F R/RR Ratio (Existing Rates)	2023F Rate Change	2023F R/RR Ratio (Revised Rates)
Residential	0.97	4.8%	0.97
Farms	0.96	4.9%	0.96
Small Commercial	1.03	4.2%	1.02
General Service	1.03	3.5%	1.02
Total Commercial	**1.03**	**3.8%**	**1.02**
Power - Published Rates	1.00	4.1%	1.01
Power - Contract Rates	0.98	3.8%	0.98
Total Power	**1.00**	**4.0%**	**1.00**
Oilfields	1.05	2.5%	1.03
Streetlights	0.95	5.2%	0.95
Reseller	0.98	4.6%	0.99
Total (System)	**1.00**	**4.0%**	**1.00**

Year 2023F Revenue Impacts
4.0% General Rate Increase With Rebalancing Maintenance

Class of Service	2023F Revenue (Existing Rates) ($)	2023F Revenue Change (%)	2023F Revenue Change ($)	2023F Number of Accounts	2023F Average Monthly Revenue ($/Cust/month)	2023F Revenue Change ($/Cust/month)
Residential	579.5	4.8%	27.8	412,079	117	6
Farms	181.6	4.9%	8.8	58,077	261	13
Small Commercial	228.3	4.2%	9.6	56,384	337	14
General Service	257.0	3.5%	9.0	5,710	3,750	131
Total Commercial	**485.3**	**3.8%**	**18.6**	**62,094**	**651**	**25**
Power - Published Rates	559.1	4.1%	22.8	92	506,434	20,631
Power - Contract Rates	242.9	3.8%	9.3	14	1,446,060	55,540
Total Power	**802.0**	**4.0%**	**32.1**	**106**	**630,536**	**25,242**
Oilfields	416.0	2.5%	10.5	19,122	1,813	46
Streetlights	18.2	5.2%	0.9	3,144	481	25
Reseller	96.3	4.6%	4.4	3	2,674,931	122,828
Total (System)	**2,579.0**	**4.0%**	**103.2**	**554,624**	**387**	**15**

Notes:
- The rate increase for Power Contracts is for customers whose contracts are tied to published rates. There is also escalation included in the contract customer's existing rates revenue as per their specific contract terms.

Year 2024F Rate Change & R/RR Ratios
4.0% General Rate Increase With Rebalancing Maintenance

Class of Service	2024F R/RR Ratio (Existing Rates)	2024F Rate Change	2024F R/RR Ratio (Revised Rates)
Residential	0.97	4.8%	0.98
Farms	0.97	4.9%	0.98
Small Commercial	1.02	4.2%	1.02
General Service	1.02	3.5%	1.02
Total Commercial	**1.02**	**3.8%**	**1.02**
Power - Published Rates	1.01	4.1%	1.02
Power - Contract Rates	0.98	3.8%	0.98
Total Power	**1.00**	**4.0%**	**1.01**
Oilfields	1.03	2.5%	1.02
Streetlights	1.02	5.2%	1.02
Reseller	0.99	4.6%	1.00
Total (System)	**1.00**	**4.0%**	**1.00**

Year 2024F Revenue Impacts
4.0% General Rate Increase With Rebalancing Maintenance

Class of Service	2024F Revenue (Existing Rates) ($)	2024F Revenue Change (%)	2024F Revenue Change ($)	2024F Number of Accounts	2024F Average Monthly Revenue ($/Cust/month)	2024F Revenue Change ($/Cust/month)
Residential	611.4	4.8%	29.4	416,739	122	6
Farms	190.3	4.9%	9.2	57,951	274	13
Small Commercial	240.3	4.2%	10.2	56,904	352	15
General Service	268.3	3.5%	9.4	5,761	3,880	136
Total Commercial	**508.5**	**3.8%**	**19.6**	**62,665**	**676**	**26**
Power - Published Rates	571.9	4.1%	23.3	91	523,684	21,334
Power - Contract Rates	247.6	3.8%	9.4	14	1,473,673	56,110
Total Power	**819.4**	**4.0%**	**32.7**	**105**	**650,349**	**25,971**
Oilfields	435.4	2.5%	11.0	19,193	1,890	48
Streetlights	19.3	5.2%	1.0	3,153	511	27
Reseller	100.9	4.6%	4.6	3	2,801,598	128,644
Total (System)	**2,685.2**	**4.0%**	**107.6**	**559,809**	**400**	**16**

Notes:
- The rate increase for Power Contracts is for customers whose contracts are tied to published rates. There is also escalation included in the contract customer's existing rates revenue as per their specific contract terms.

SRRP Q89 Reference: Proposed Rates

a) Please confirm SaskPower is proposing to eliminate the existing differences in the basic monthly charge between city accounts and rural accounts for residential, general service and small commercial customers. Please also discuss if this effectively eliminates all differences between city and rural rate codes.

b) Please provide a schedule that compares, for each rate class:
   i. The 2023/24 class revenue requirement classified to each of energy, demand, and customer.
   ii. The forecast 2023/24 total class revenue generated by each of energy charges, demand charges, and customer charges.

c) Please indicate when SaskPower last adjusted rates that included a degree of rate rebalancing.

Response:

a) SaskPower confirms it is proposing to eliminate the existing differences in the basic monthly, energy and demand charges between urban accounts and rural accounts for residential, general service and small commercial customers as part of its ongoing rate simplification program. Under this program, SaskPower has been steadily removing any redundant or unused rate codes while gradually merging its urban and rural rates for residential and commercial customers over the last number of applications. The program was initiated due to the SRRP's recommendation that SaskPower reduce the number of rate codes it administers to better align with industry standards. If approved, the only difference remaining between the urban and rural rates will be their respective first tier energy blocks that will be addressed in future applications.

b) i:

Annual SaskPower Revenue Requirement Classified by Class Per Year
(in $ Millions)

	2023F Revenue Requirement			
Customer Class	**Total**	**Demand**	**Energy**	**Customer**
Residential	$ 623.9	$ 255.5	$ 191.2	$ 177.2
Farms	$ 198.0	$ 89.3	$ 71.8	$ 36.8
Commercial	$ 492.5	$ 225.3	$ 211.7	$ 55.5
Power Class	$ 832.2	$ 311.7	$ 516.5	$ 3.9
Oilfields	$ 413.8	$ 178.1	$ 207.0	$ 28.7
Streetlights	$ 20.0	$ 1.1	$ 1.6	$ 17.3
Reseller	$ 101.7	$ 43.0	$ 58.6	$ 0.1
Total	**$ 2,682.1**	**$ 1,104.0**	**$ 1,258.5**	**$ 319.6**

	2024F Revenue Requirement			
Customer Class	**Total**	**Demand**	**Energy**	**Customer**
Residential	$ 657.2	$ 268.7	$ 198.7	$ 189.8
Farms	$ 204.6	$ 93.3	$ 74.0	$ 37.3
Commercial	$ 519.2	$ 238.0	$ 220.8	$ 60.3
Power Class	$ 847.5	$ 320.6	$ 522.8	$ 4.1
Oilfields	$ 438.8	$ 190.3	$ 218.0	$ 30.5
Streetlights	$ 20.0	$ 1.0	$ 1.5	$ 17.5
Reseller	$ 105.5	$ 44.9	$ 60.5	$ 0.1
Total	**$ 2,792.8**	**$ 1,156.8**	**$ 1,296.2**	**$ 339.8**

ii:

	2023F Revenue by Billing Determinant - Proposed Rates			
Customer Class	**Total**	**Demand**	**Energy**	**Customer**
Residential	$ 603.8	$ -	$ 474.7	$ 129.1
Farm	$ 189.8	$ 7.4	$ 154.1	$ 28.3
Commercial	$ 505.2	$ 94.1	$ 382.1	$ 29.0
Power Class	$ 834.2	$ 178.5	$ 646.3	$ 9.3
Oilfield	$ 430.0	$ 129.6	$ 281.5	$ 18.9
Streetlights	$ 18.6	$ -	$ -	$ 18.6
Reseller	$ 100.5	$ 41.9	$ 58.3	$ 0.4
Total	$ 2,682.1	$ 451.5	$ 1,997.0	$ 233.6

	2024F Revenue by Billing Determinant - Proposed Rates			
Customer Class	**Total**	**Demand**	**Energy**	**Customer**
Residential	$ 633.4		$ 483.4	$ 150.0
Farm	$ 198.4	$ 7.6	$ 158.3	$ 32.5
Commercial	$ 530.8	$ 109.8	$ 387.8	$ 33.2
Power Class	$ 852.2	$ 204.2	$ 637.9	$ 10.2
Oilfield	$ 453.7	$ 154.5	$ 278.4	$ 20.8
Streetlights	$ 19.3	$ -	$ -	$ 19.3
Reseller	$ 105.0	$ 44.0	$ 60.6	$ 0.4
Total	$ 2,792.8	$ 520.2	$ 2,006.4	$ 266.3

c) The last time SaskPower had a rate adjustment that included a degree of rate rebalancing was the 2015 rate application.

SRRP Q90 Reference: Proposed Rates

Please provide a summary of municipal surcharges, including both the percentage of the surcharge and the total dollars collected for the most recent actual year available.

Response:

Cities can request a Municipal Surcharge of up to 10%, while towns and villages can request a Municipal Surcharge of up to 5%. Currently, each city in the municipal surcharge program has requested a 10% payment. Each participating town and village has requested a 5% payment.

The municipal surcharge is calculated as either 10% or 5% of the customer's total electrical charges before taxes which includes the basic monthly charge, demand, consumption, and federal carbon charge. The proceeds of the municipal surcharges collected by the corporation are paid to the municipal councils monthly.

In fiscal year 2020-21 SaskPower collected the Municipal Surcharge on behalf of 392 Saskatchewan cities, towns and villages from customers and remitted $74.4 million to local governments pursuant to Section 36 of the Power Corporation Act.

Please see the following for the amounts collected and remitted per city, town and village.

Saskatchewan Power Corporation - Municipal Surcharge
2020-2021 Fiscal Year

TOTAL	$ 74,384,680.04

CITY	AMOUNT
ESTEVAN	$ 1,415,760.94
HUMBOLDT	727,847.06
LLOYDMINSTER	598,640.66
MARTENSVILLE	802,523.32
MEADOW LAKE	626,434.53
MELFORT	671,697.45
MELVILLE	548,340.43
MOOSE JAW	3,927,552.55
NORTH BATTLEFORD	1,721,748.07
PRINCE ALBERT	3,786,502.95
REGINA	29,322,136.74
SASKATOON	13,296,957.07
SWIFT CURRENT	229,498.38
WARMAN	971,738.16
WEYBURN	1,328,512.38
YORKTON	2,516,447.62
CITY TOTAL	$ 62,492,338.31

TOWN / VILLAGE	AMOUNT
ABBEY	8,114.56
ABERDEEN	33,035.74
ABERNETHY	9,299.08
ALAMEDA	18,015.92
ALBERTVILLE	5,653.86
ALIDA	12,876.84
ALLAN	28,699.09
ALVENA	5,361.27
ARBORFIELD	17,685.79
ARCHERWILL	13,469.42
ARCOLA	39,101.33
ARRAN	2,295.78
ASQUITH	25,065.52
ASSINIBOIA	148,986.98
AVONLEA	39,910.20
AYLSHAM	5,678.59
B SAY TAH	16,082.08
BALCARRES	35,419.96
BALGONIE	71,950.35
BANGOR	2,263.58
BATTLEFORD	219,076.18
BEATTY	2,502.71
BEAUVAL	48,190.37
BEECHY	17,663.74
BENGOUGH	23,889.60
BETHUNE	21,937.17
BIENFAIT	34,626.10
BIG RIVER	47,660.63
BIGGAR	258,958.94
BIRCH HILLS	49,732.20
BLADWORTH	3,289.93
BLAINE LAKE	29,548.60
BORDEN	15,523.24
BRADWELL	8,472.61
BREDENBURY	20,200.94
BRIERCREST	9,138.02
BROADVIEW	37,670.67
BROCK	10,155.96
BRODERICK	4,932.98
BROWNLEE	3,715.53
BRUNO	27,383.21
BUCHANAN	12,350.98
BUFFALO NARROWS	96,363.63
BURSTALL	18,503.84
CABRI	28,485.51
CADILLAC	6,072.34
CALDER	7,049.20
CANORA	115,545.48
CANWOOD	20,639.40

TOWN / VILLAGE	AMOUNT
CARIEVALE	$ 14,163.80
CARLYLE	97,995.58
CARNDUFF	67,662.56
CARROT RIVER	60,997.01
CENTRAL BUTTE	35,885.38
CEYLON	11,122.34
CHAMBERLAIN	8,353.94
CHAPLIN	16,219.79
CHITEK LAKE	20,580.60
CHOICELAND	22,562.78
CHRISTOPHER LAKE	18,551.43
CHURCHBRIDGE	42,630.16
CLAVET	18,103.95
CLIMAX	9,894.45
COCHIN	28,838.56
CODERRE	2,465.19
CODETTE	8,977.48
COLEVILLE	19,499.11
COLONSAY	23,102.02
CONQUEST	7,617.80
CORONACH	42,950.30
CRAIK	29,187.59
CREELMAN	7,115.94
CUDWORTH	36,647.95
CUPAR	30,602.91
CUT KNIFE	46,560.13
DALMENY	65,166.22
DAVIDSON	72,574.19
DEBDEN	20,370.87
DELISLE	57,611.14
DENHOLM	4,916.74
DENZIL	7,937.54
DINSMORE	18,152.35
DISLEY	2,546.96
DODSLAND	13,564.02
DRAKE	24,978.57
DUBUC	4,361.22
DUCK LAKE	49,611.58
DUFF	1,702.94
DUNDURN	28,140.80
DUVAL	4,647.19
DYSART	10,460.95
EARL GREY	10,491.11
EASTEND	35,367.46
EATONIA	28,929.74
EBENEZER	7,848.23
EDAM	31,273.33
EDENWOLD	9,514.46
ELBOW	27,058.23
ELFROS	5,510.36
ELROSE	29,762.14
ENDEAVOUR	6,971.48
ENGLEFELD	28,419.69
ESTERHAZY	151,905.80
ESTON	62,634.05
EYEBROW	7,902.28
FAIRLIGHT	2,990.82
FENWOOD	2,484.74
FILLMORE	23,501.76
FLAXCOMBE	6,611.67
FLEMING	5,340.42
FOAM LAKE	80,089.56
FORGET	2,898.66
FORT QU'APPELLE	137,960.54
FOX VALLEY	14,184.94
FRANCIS	8,515.70
FROBISHER	7,692.19
FRONTIER	20,728.22

TOWN / VILLAGE	AMOUNT
GAINSBOROUGH	$ 14,911.94
GLASLYN	35,962.12
GLEN EWEN	7,017.71
GLENAVON	12,040.03
GLENSIDE	3,103.59
GOLDEN PRAIRIE	2,956.51
GOODEVE	2,853.31
GOODSOIL	17,633.25
GOVAN	11,323.18
GRAND COULEE	19,893.23
GRANDVIEW BEACH	6,823.07
GRAVELBOURG	72,210.11
GRAYSON	13,698.23
GREEN LAKE	29,706.90
GRENFELL	60,312.31
GULL LAKE	55,821.55
HAFFORD	22,145.43
HAGUE	42,384.84
HANLEY	31,707.69
HARRIS	9,811.80
HAWARDEN	3,504.23
HAZENMORE	3,817.99
HAZLET	7,381.86
HEPBURN	28,618.19
HERBERT	40,093.90
HEWARD	1,849.70
HODGEVILLE	11,394.60
HOLDFAST	9,952.64
HUBBARD	2,242.01
HUDSON BAY	325,778.02
HYAS	1,855.59
IMPERIAL	26,057.70
INDIAN HEAD	106,302.54
INVERMAY	13,452.70
ISLE A LA CROSSE	89,627.93
ITUNA	37,276.89
JANSEN	6,906.11
KAMSACK	114,348.39
KATEPWA BEACH	51,260.63
KELLIHER	15,862.87
KELVINGTON	50,364.97
KENASTON	19,483.05
KENDAL	3,610.09
KENNEDY	12,033.15
KENOSEE LAKE	18,250.33
KERROBERT	68,504.77
KINCAID	10,284.49
KINDERSLEY	357,275.60
KINISTINO	35,070.57
KINLEY	2,371.86
KIPLING	65,304.36
KISBEY	11,084.48
KRYDOR	1,414.77
KYLE	28,652.29
LA LOCHE	154,384.82
LA RONGE	202,658.67
LAFLECHE	25,848.99
LAIRD	11,492.35
LAKE LENORE	14,812.68
LAMPMAN	42,194.66
LANCER	3,490.60
LANDIS	11,227.24
LANG	9,610.47
LANGENBURG	70,170.25
LANGHAM	59,395.55
LANIGAN	72,290.71
LASHBURN	44,466.89
LEADER	56,357.32

TOWN / VILLAGE	AMOUNT
LEASK	$ 23,658.56
LEBRET	10,879.04
LEMBERG	18,751.18
LEOVILLE	20,296.96
LEROY	25,106.98
LIBERTY	4,522.37
LIMERICK	7,903.24
LINTLAW	8,535.55
LIPTON	15,995.00
LOON LAKE	18,204.08
LOREBURN	8,701.31
LOVE	3,704.15
LUCKY LAKE	20,869.83
LUMSDEN	85,980.03
LUSELAND	37,478.76
MACKLIN	88,574.04
MACNUTT	4,522.56
MACRORIE	4,841.72
MAIDSTONE	71,024.61
MANITOU BEACH	36,049.07
MANKOTA	16,949.63
MANOR	15,336.96
MAPLE CREEK	139,431.16
MARCELIN	8,344.63
MARENGO	10,545.89
MARGO	4,208.49
MARKINCH	3,758.09
MARSDEN	14,602.02
MARSHALL	21,608.05
MARYFIELD	22,588.47
MAYMONT	8,977.01
MCTAGGART	4,406.09
MEACHAM	5,397.35
MEATH PARK	9,591.23
MEDSTEAD	10,152.43
MENDHAM	1,478.81
MEOTA	20,126.66
MERVIN	9,493.34
MIDALE	30,274.99
MIDDLE LAKE	12,512.07
MILDEN	9,667.64
MILESTONE	31,657.53
MINTON	3,890.35
MISTATIM	4,273.03
MONTMARTRE	29,190.24
MOOSOMIN	196,311.90
MORSE	15,385.08
MOSSBANK	21,157.41
MUENSTER	18,769.84
NAICAM	38,247.09
NEILBURG	23,797.18
NETHERHILL	1,654.79
NEUDORF	12,153.69
NEVILLE	7,238.21
NIPAWIN	248,941.79
NOKOMIS	22,231.36
NORQUAY	26,449.34
NORTH PORTAL	13,767.31
ODESSA	11,359.20
OGEMA	22,642.14
OSAGE	2,479.76
OSLER	45,789.60
OUTLOOK	123,114.90
OXBOW	83,297.77
PADDOCKWOOD	8,259.94
PANGMAN	12,655.37
PARADISE HILL	28,963.65
PARKSIDE	5,342.52
PAYNTON	6,796.45
PELLY	14,019.89
PENNANT	6,186.84
PERDUE	18,752.82

TOWN / VILLAGE	AMOUNT
PIERCELAND	$ 26,884.04
PILGER	4,181.11
PILOT BUTTE	115,511.82
PINEHOUSE	55,430.87
PLENTY	9,702.72
PLUNKETT	3,877.25
PONTEIX	30,726.33
PORCUPINE PLAIN	45,166.76
PREECEVILLE	64,083.20
PRELATE	7,082.84
PRUDHOMME	8,115.27
PUNNICHY	13,153.33
QU'APPELLE	31,766.34
QUILL LAKE	22,254.12
QUINTON	4,384.15
RADISSON	25,079.15
RADVILLE	47,728.78
RAMA	4,987.61
RAYMORE	39,548.44
REDVERS	67,669.18
REGINA BEACH	72,752.79
RHEIN	7,446.66
RICHARD	1,044.54
RICHMOUND	8,325.18
RIDGEDALE	3,917.43
RIVERHURST	9,469.44
ROCANVILLE	57,208.41
ROCHE PERCEE	4,933.43
ROCKGLEN	27,389.39
ROSE VALLEY	18,547.76
ROSETOWN	167,541.06
ROSTHERN	96,473.00
ROULEAU	23,624.22
RUDDELL	1,757.67
RUSH LAKE	2,698.32
SALTCOATS	23,661.56
SANDY BAY	49,950.22
SCEPTRE	6,152.81
SCOTT	4,607.22
SEDLEY	14,808.37
SEMANS	11,150.27
SENLAC	3,213.36
SHAMROCK	1,644.82
SHAUNAVON	116,687.86
SHEHO	8,159.54
SHELL LAKE	15,194.71
SHELLBROOK	88,919.75
SIMPSON	8,491.12
SINTALUTA	6,425.33
SMEATON	11,458.63
SMILEY	3,296.54
SOUTH LAKE	10,466.40
SOUTH MAKWA	4,625.22
SOUTHEY	42,870.31
SPALDING	12,303.08
SPEERS	3,814.89
SPIRITWOOD	60,499.83
SPRINGSIDE	20,700.52
SPY HILL	12,092.33
ST BRIEUX	107,936.35
ST LOUIS	22,003.33
ST WALBURG	40,875.28
STAR CITY	18,430.60
STENEN	5,169.26
STEWART VALLEY	5,920.16
STOCKHOLM	16,914.19
STORTHOAKS	4,901.45
STOUGHTON	48,055.84
STRASBOURG	43,156.55
STRONGFIELD	2,906.20
STURGIS	31,151.59
TANTALLON	5,391.65

TOWN / VILLAGE	AMOUNT
TESSIER	$ 1,258.25
THEODORE	19,349.24
TISDALE	218,985.86
TOBIN LAKE	16,989.04
TOGO	7,019.84
TOMPKINS	11,538.46
TORQUAY	11,432.48
TRAMPING LAKE	3,082.92
TUGASKE	6,199.35
TURTLEFORD	34,918.08
UNITY	131,149.92
VAL MARIE	9,065.57
VALPARAISO	852.79
VANGUARD	14,619.01
VIBANK	19,304.12
VISCOUNT	15,887.95
VONDA	27,967.82
WADENA	76,645.38
WAKAW	50,872.97
WALDECK	10,546.06
WALDHEIM	46,139.64
WALDRON	1,198.01
WAPELLA	17,068.91
WASECA	6,965.45
WATROUS	114,900.25
WATSON	42,844.34
WAWOTA	32,312.04
WEBB	3,729.39
WEEKS	4,211.85
WEIRDALE	2,940.26
WELDON	6,243.02
WHITEFOX	18,066.34
WHITEWOOD	58,293.33
WILCOX	20,229.28
WILKIE	79,086.44
WILLOWBUNCH	18,266.55
WINDTHORST	12,590.98
WISETON	4,107.12
WOLSELY	47,840.47
WOOD MOUNTAIN	2,263.04
WYNYARD	144,373.07
YARBO	4,046.64
YELLOW GRASS	20,374.29
YOUNG	13,342.19
ZEALANDIA	6,464.24
ZELMA	1,676.24
ZENON PARK	8,913.92
TOWN TOTAL	**$ 11,892,341.73**

SRRP Q91 Reference: Capacity Reservation Service

a) How many customers are currently subscribed to SaskPower's Capacity Reservation Service?
b) Please provide an update on how SaskPower is addressing the recommendations made in section 4.1 of the Elenchus report dated April 2020.
c) Please confirm whether or not the Capacity Reservation Service rate is considered 'interim' and if so, when and by what process SaskPower anticipates making it a permanent rate offering.

Response:

a) There is currently one customer subscribed to SaskPower's Capacity Reservation Service (CRS) rates.
b) A summary of SaskPower's progress regarding Elenchus' CRS recommendations is provided in the table below:

Elenchus' Recommendations	SaskPower's Response
CRS rates should be developed for all rate classes based on SaskPower's cost allocation model.	SaskPower agrees. CRS rates have been developed for all demand customer classes (except Small Commercial less than 75kVA demand). SaskPower is currently awaiting final approval from Cabinet before releasing any further CRS rates.
CRS rates should be designed on the basis that the Reservation Capacity is equivalent to a 100% load factor.	SaskPower disagrees. Setting the CRS rates equivalent to a 100% load factor would result in an extremely high demand charge that would make self-generation uneconomic to customers, which is not SaskPower's intent. CRS demand charges will therefore continue to be set at the average load factor of the customer classes they reside in.
The Bary Correction should not be used in setting the CRS demand and energy charges and should be phased out of the published rates.	SaskPower agrees. The Bary Correction was not used in the setting of the CRS rates and SaskPower plans to begin removing the Bary Correction from our published rates with this rate application. Its complete removal will be staged over several applications.

c) Capacity Reservation Service (CRS) rates are still considered 'interim', pending formal approval from Cabinet. It is expected that CRS rates will be reviewed by Cabinet following the conclusion of the rate application process.

SRRP Q92 Reference: Competitiveness

Please identify which other utilities are included in the 'range of rates at Canadian utilities' and 'thermal average' figures provided in the chart on page 14 of the application.

Response:

The following Canadian utilities are included in the survey:

1. SaskPower
2. Hydro-Québec
3. ENMAX
4. Maritime Electric
5. EPCOR
6. Nova Scotia Power
7. NB Power
8. Hydro Ottawa
9. Newfoundland and Labrador Hydro (customers with a power demand of 30,000 kV or more); Newfoundland Power (all other customer categories)
10. Toronto Hydro
11. BC Hydro
12. Manitoba Hydro

SaskPower considers the following utilities as thermal utilities for comparison purposes:

1. SaskPower
2. ENMAX
3. Maritime Electric
4. EPCOR
5. Nova Scotia Power
6. NB Power
7. Hydro Ottawa
8. Newfoundland and Labrador Hydro (customers with a power demand of 30,000 kV or more); Newfoundland Power (all other customer categories)
9. Toronto Hydro

SRRP Q93 Reference: Competitiveness

a) Please provide a table showing the calculation of bills before applicable taxes and after applicable taxes, including the carbon charge rider and any bill relief programs that may have been in place, for each of the following types of customers located in Regina at rates effective April 1, 2021, and proposed for September 1, 2022 and April 1, 2023. Please also confirm which rate code would apply to each customer:
   i. A residential customer using 625 kWh in a month.
   ii. A small commercial customer with demand of 14 kW and using 2,000 kWh in a month.
   iii. A large power customer using 5,000 kW of demand and 3,060,000 kWh in a month.

b) Please confirm the rates shown in the calculation of the rate change impacts provided in Appendix C of the application do not include the carbon charge rider, municipal surcharges, and other taxes and that these are applied to bills in addition to the rates shown in Appendix C.

Response:

a) Please see the tables below:

RESIDENTIAL	EXISTING	SEPT 1,2022	APR 1, 2023
Consumption kWh	625	625	625
Basic Monthly Charge	$ 22.79	$ 26.11	$ 29.99
Energy Charge	$ 88.93	$ 91.91	$ 93.09
Monthly bill excluding taxes	$ 111.72	$ 118.02	$ 123.08
Municpal Surcharge (10%)	$ 11.17	$ 11.80	$ 12.31
GST (5%)	$ 5.59	$ 5.90	$ 6.15
Carbon Tax	$ 4.00	$ 4.00	$ 5.15
GST on Carbon Tax (5%)	$ 0.20	$ 0.20	$ 0.26
Monthly bill including taxes	$ 132.67	$ 139.91	$ 146.96
Rate schedule applied	E01	E01	E01

SMALL COMMERCIAL	EXISTING	SEPT 1,2022	APR 1, 2023
Demand kW	14	14	14
Consumption kWh	2,000	2,000	2,000
Basic Monthly Charge	$ 31.14	$ 35.81	$ 41.18
Energy Charge	$ 273.38	$ 288.86	$ 300.32
Demand Charge	$ -	$ -	$ -
Monthly bill excluding taxes	$ 304.52	$ 324.67	$ 341.50
Municpal Surcharge (10%)	$ 30.45	$ 32.47	$ 34.15
PST (6%) on Consumption and Municipal Surcharge	$ 20.10	$ 21.43	$ 22.54
GST (5%)	$ 15.23	$ 16.23	$ 17.08
Carbon Tax	$ 12.75	$ 12.75	$ 16.37
GST on Carbon Tax (5%)	$ 0.64	$ 0.64	$ 0.64
Monthly bill including taxes	$ 383.69	$ 408.19	$ 432.27
Rate schedule applied	E75	E75	E75

LARGE POWER	EXISTING	SEPT 1,2022	APR 1, 2023
Demand kVA (5000 KW) @ 95% Power Factor	5,263	5,263	5,263
Consumption kWh	3,060,000	3,060,000	3,060,000
Basic Monthly Charge	$ 7,615.80	$ 8,275.25	$ 8,403.75
Energy Charge	$ 186,935.40	$ 187,119.00	$ 184,365.00
Demand Charge	$ 43,598.69	$ 51,251.09	$ 60,977.12
Monthly bill excluding taxes	$ 238,149.89	$ 246,645.34	$ 253,745.87
Municpal Surcharge (10%)	$ 23,814.99	$ 24,664.53	$ 25,374.59
PST (6%) on Consumption and Municipal Surcharge	$ 15,717.89	$ 16,278.59	$ 16,747.23
GST (5%)	$ 11,907.49	$ 12,332.27	$ 12,687.29
Carbon Tax	$ 18,557.98	$ 18,557.98	$ 23,782.32
GST on Carbon Tax (5%)	$ 927.95	$ 927.95	$ 927.95
Monthly bill including taxes	$ 309,076.20	$ 319,406.67	$ 333,265.24
Rate schedule applied	E24	E24	E24

b) SaskPower confirms that the rates shown in the calculation of the rate change impacts provided in Appendix C of the application do not include any federal carbon charge riders, municipal surcharges, or other taxes and that those items are applied to bills in addition to the rates shown in Appendix C.

SRRP Q94 Reference: Competitiveness

Please provide details of the Saskatchewan Economic Recovery Rebate program, including the dates the program was in effect, program eligibility requirements, the methods by which the rebate was calculated and applied to customer bills, and the total amount of rebate provided to each class of customer.

Response:

The Saskatchewan Economic Recovery Rebate program ("the rebate") was in effect for one year from December 1, 2020, to November 30, 2021. The program provided all SaskPower customers with a 10% rebate on the cost of electricity — basic monthly fee, demand charges, and consumption charges. The program was fully funded by the Province of Saskatchewan and has no impact on SaskPower's financial results.

The customers of SaskPower's two resellers, City of Saskatoon Light and Power and City of Swift Current, were also eligible for the rebate program.

Saskatchewan Economic Recovery Rebate Program
Rebate per Customer Class
in millions

Residential	$	59.2
Farm		17.9
Commercial		47.9
Oilfields		41.0
Power		77.5
Streetlight		1.7
Reseller		17.0
	$	262.2

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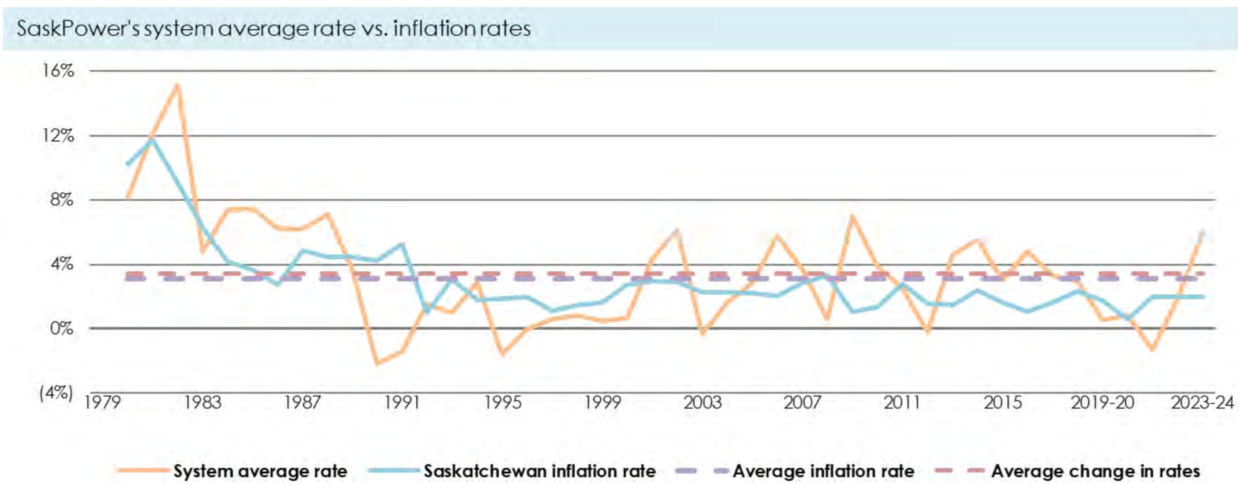
2022 AND 2023 RATE APPLICATION
SRRP INTERROGATORIES

SRRP Q95 Reference: Competitiveness

Please expand the rates versus inflation figure on page 16 of the application to include SaskPower's proposed rate increases for 2022/23 and 2023/24 and the inflation rates assumed in SaskPower's most recent business plan.

Response:



SRRP Q96 Reference: System Operations

Please describe SaskPower's dispatch policies or rules for use of the various fuel sources to meet capacity and energy requirements. Please highlight any changes to these dispatch policies or rules since the last rate application.

Response:

There are no changes to the dispatch policies or rules since the last rate application.

After meeting all transmission constraints, generation constraints and reserve requirements, available units are dispatched in ascending order of incremental costs.

SRRP Q97 Reference: System Operations

a) Please provide a table summarizing transmission SAIDI, transmission SAIFI, distribution SAIDI, distribution SAIFI, and distribution CAIDI for the most recent five years of actuals available for each of:
   i. SaskPower
   ii. Canadian utility averages
b) Please discuss any factors contributing to SaskPower's performance relative to the average of the other utilities such as reporting framework (e.g., including or excluding major events, different requirements for planned outages, etc.).
c) Please discuss how SaskPower considers its reliability indicator performance when developing its capital plan. Does SaskPower prioritize capital spending to address particular areas or types of outages observed to impact reliability performance?
d) For each of transmission and distribution, please provide a breakdown of the causes of outages by type for both outage frequency and duration for each of the last three actual years available, similar to the format of the response to SRRP Q131 from the first round interrogatories in the 2018 Rate Application review.
e) Please provide SaskPower's actual system average generation equivalent availability factor (EAF) for the most recent 5 actual years available and provide explanations for any changes over time.
f) Please discuss how SaskPower monitors or evaluates the reliability of purchased power generation and whether purchased power availability influences the calculation of EAF for SaskPower's own generation.
g) With reference to page 52 of SaskPower's 2020-21 Corporate Responsibility & Sustainability Report:
   i. Provide the transmission and distribution SAIDI and SAIFI metrics for each year with Major Event Days included and with Major Event Days removed.
   ii. Please provide the definition of a "Major Event Day" and provide a list of the Major Event Days that occurred in each year from 2018/19 through 2020/21.
   iii. Please explain how the 2021/22 targets were determined and provide any updated targets for 2022/23 or 2023/24 if available.
h) Please provide a chart summarizing SaskPower's transmission health index by structure grade for the three most recent actual years available and comment on the reasons for any changes over time.
i) Does SaskPower calculate a momentary average interruption frequency index (MAIFI)? If so, please provide the MAIFI for each of the last five actual years. If not, please explain why not.

Response:

a) The following table summarizes actual results for transmission SAIDI and SAIFI, and distribution SAIDI, SAIFI and CAIDI from 2016 through 2020 (calendar years), for both SaskPower and Canadian utility averages.

SAIDI, SAIFI and CAIDI

	Actual 2016	Actual 2017	Actual 2018	Actual 2019	Actual 2020
Transmission					
SAIDI (minutes)					
SaskPower (excluding MEDs)	121.0	211.2	183.0	167.8	141.7
SaskPower (including MEDs)	121.0	211.2	464.5	167.8	193.3
Canadian utilitiy average (CEA)*	184.3	237.4	345.7	276.2	172.2
SAIFI (interruptions)					
SaskPower (excluding MEDs)	2.7	3.1	3.4	3.2	3.0
SaskPower (including MEDs)	2.7	3.1	5.0	3.2	3.0
Canadian utilitiy average (CEA)*	1.8	1.4	1.9	1.9	1.4
Distribution					
SAIDI (hours)					
SaskPower (excluding MEDs)	4.6	5.3	6.1	5.5	6.1
SaskPower (including MEDs)	4.8	7.2	7.0	5.9	6.5
Canadian utilitiy average (excluding MEDs)*	4.5	5.1	4.8	4.8	4.8
SAIFI (interruptions)					
SaskPower (excluding MEDs)	2.1	2.3	2.3	2.1	2.8
SaskPower (including MEDs)	2.1	2.5	2.5	2.2	2.9
Canadian utilitiy average (excluding MEDs)*	2.4	2.2	2.2	2.1	2.2
CAIDI (interruptions)					
SaskPower (excluding MEDs)	2.2	2.3	2.6	2.6	2.1
SaskPower (including MEDs)	2.3	2.9	2.8	2.7	2.2
Canadian utilitiy average (excluding MEDs)*	2.0	2.2	2.1	2.2	2.1

b) Consistent with the utility industry, SaskPower uses System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI) to monitor reliability. These indices measure the duration and frequency, respectively, of outages on the system.

In 2019-20, SaskPower began to exclude Major Event Days (MEDs) when reporting distribution reliability statistics both internally and externally, consistent with its industry. An MED is an outage event that is beyond what a utility's infrastructure is built to withstand. Prior to this, severe storms and other unusual weather conditions could cause significant fluctuations in results and do not represent the performance of our distribution system during regular operations.

With an average of approximately three customer accounts per circuit kilometre of distribution and transmission lines, SaskPower has one of the lowest customer densities relative to grid infrastructure in the country. While this means that response time in rural areas are often longer due to repair location identification and travel time, it also means that the funding of capacity increases and ongoing maintenance can be challenging due to a smaller revenue base relative to the size of the grid.

SaskPower system delivery points are primarily fed from a single-circuit supply, meaning that the Corporation's transmission system is more prone to the effects of weather and equipment failures compared to other utility systems that are multi-circuit, or have more than one supply point. As such, transmission outages in our province can impact a greater number of customers and/or have longer durations in comparison to utilities with multi-circuit networked grids, which allow for immediate rerouting of transmission loads.

c) To provide its customers with a safe, continuous and adequate supply of electricity, SaskPower strives to enhance reliability while maximizing the in-service time of existing generation assets.

SaskPower prioritizes its capital expenditures based on a number of criteria and objectives, including: providing a reliable energy supply to meet forecasted load requirements; maintaining system reliability, security and power quality; meeting or exceeding environmental regulations and guidelines; and minimizing the cost of electricity for customers.

SaskPower strives to keep pace with the performance of other utilities by implementing improved frameworks for making data driven, risk-based decisions that encourage continuous performance improvement and effective risk and cost management. In monitoring its reliability performance, SaskPower tracks major causes of both transmission and distribution outages and prioritizes capital accordingly.

Due to the characteristics of SaskPower's system, as assets age and more extreme weather effects of climate change become a reality, the performance challenges will increase compared to other utilities.

d) The following tables provide breakdowns for transmission and distribution of the causes of outages by type for both outage frequency and duration for the past three years.

Distribution outage causes

	2018-19		2019-20		2020-21	
Reason	**Hours**	**Interruptions**	**Hours**	**Interruptions**	**Hours**	**Interruptions**
Unknown	293,307	147,147	196,428	116,309	165,775	109,775
Planned	887,928	304,496	695,227	244,890	618,387	268,045
Lightning	327,287	101,631	277,581	96,562	272,905	95,970
Icing	380,470	88,522	64,445	17,163	73,495	25,577
Other weather	156,158	45,952	193,159	44,351	279,012	74,967
Trees	411,715	116,057	196,234	65,668	204,769	69,701
Other vegetation	1,313	593	896	409	1,333	649
Birds / Animals	186,316	119,125	197,043	88,170	119,157	70,121
Accidents / internal (SPC)	4,126	3,074	3,160	4,863	552	1,446
Accidents / external	163,955	58,739	162,304	50,405	156,832	70,072
Vandalism	281	113	1,376	692	456	364
Loss of Transmission supply	195,478	66,771	360,949	131,256	658,664	425,452
Faulty equipment	577,224	207,869	512,612	186,503	331,416	160,025
Contamination	60,384	16,078	39,743	10,881	11,451	9,535
Overload	49,434	17,447	21,344	7,962	14,238	9,572
Cause code left blank	-	-	384,102	220,079	313,018	122,166
	3,695,378	**1,293,614**	**3,306,602**	**1,286,163**	**3,221,461**	**1,513,437**

	2018-19		2019-20		2020-21	
Reason	**Duration**	**Frequency**	**Duration**	**Frequency**	**Duration**	**Frequency**
Unknown	7.9%	11.4%	5.9%	9.0%	5.1%	7.3%
Planned	24.0%	23.5%	21.0%	19.0%	19.2%	17.7%
Lightning	8.9%	7.9%	8.4%	7.5%	8.5%	6.3%
Icing	10.3%	6.8%	2.0%	1.3%	2.3%	1.7%
Other weather	4.2%	3.6%	5.8%	3.5%	8.7%	5.0%
Trees	11.2%	9.0%	5.9%	5.1%	6.4%	4.6%
Other vegetation	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Birds / Animals	5.1%	9.2%	6.0%	6.9%	3.7%	4.6%
Accidents / internal (SPC)	0.1%	0.2%	0.1%	0.4%	0.0%	0.1%
Accidents / external	4.4%	4.5%	4.9%	3.9%	4.9%	4.6%
Vandalism	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%
Loss of Transmission supply	5.3%	5.2%	10.9%	10.2%	20.4%	28.1%
Faulty equipment	15.6%	16.1%	15.5%	14.5%	10.3%	10.6%
Contamination	1.6%	1.2%	1.2%	0.9%	0.4%	0.6%
Overload	1.4%	1.4%	0.7%	0.6%	0.4%	0.6%
Cause code left blank	0.0%	0.0%	11.6%	17.1%	9.7%	8.1%
	100.0%	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Transmission outage causes

	2018-19		2019-20		2020-21	
Reason	**Duration (Minutes)**	**Interruptions***	**Duration (Minutes)**	**Interruptions***	**Duration (Minutes)**	**Interruptions***
Defective Equipment	9,510	129	16,331	143	20,865	146
Adverse Weather	100,940	1,092	12,513	492	14,792	474
Adverse Environment	28,661	191	8,103	102	571	19
System Condition	3,317	33	168	5	623	23
Human Element	4,018	46	2,662	90	304	6
Foreign Interference	1,384	22	9,302	65	5,644	76
System Configuration	12,631	90	1,344	81	3,257	23
Unknown	5,661	200	1,570	176	1,766	194
	166,122	**1,803**	**51,993**	**1,154**	**47,822**	**961**

	2018-19		2019-20		2020-21	
Reason	**Duration (Minutes)**	**Interruptions***	**Duration (Minutes)**	**Interruptions***	**Duration (Minutes)**	**Interruptions***
Defective Equipment	5.7%	7.2%	31.4%	12.4%	43.6%	15.2%
Adverse Weather	60.8%	60.6%	24.1%	42.6%	30.9%	49.3%
Adverse Environment	17.3%	10.6%	15.6%	8.8%	1.2%	2.0%
System Condition	2.0%	1.8%	0.3%	0.4%	1.3%	2.4%
Human Element	2.4%	2.6%	5.1%	7.8%	0.6%	0.6%
Foreign Interference	0.8%	1.2%	17.9%	5.6%	11.8%	7.9%
System Configuration	7.6%	5.0%	2.6%	7.0%	6.8%	2.4%
Unknown	3.4%	11.1%	3.0%	15.3%	3.7%	20.2%
	100.0%	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

*Count of delivery point affected

e) The following table provides SaskPower's actual system average generation Equivalent Availability Factor (EAF) for the last five years.

Equivalent Availability Factor	2016	2017	2018-19	2019-20	2020-21
Coal	85.7%	86.2%	84.0%	83.8%	78.2%
Gas	81.9%	77.0%	82.4%	77.0%	82.9%
Hydro	87.1%	92.1%	94.1%	93.3%	88.0%
Wind	97.3%	98.0%	98.0%	97.9%	97.3%
Total system average	**85.5%**	**85.6%**	**86.0%**	**84.1%**	**82.7%**

SaskPower's EAF performance remained fairly consistent from 2016 through 2018-19, and experienced slight decreases in the past two years due to unexpected complications experienced at our natural gas-fired generation stations in 2019-20 as well as unexpected repairs required on a number of the Corporation's coal-fired generation units, combined with the extension of a major overhaul on Boundary Dam Unit #6 in 2020-21. The extension of the major overhaul on E.B. Campbell Hydroelectric Station Unit #3 also contributed to the reduction in EAF in the most recent fiscal period.

f) SaskPower monitors the performance of power purchase agreements (PPAs) with independent power producers (IPPs) through its monthly billing process and reports quarterly on the performance/reliability of these generation sources. IPPs are incentivized to ensure strong performance to maximize shareholder returns as they will lose revenue if they are unable to satisfy the performance obligations stipulated in their respective PPA, whereas SaskPower must balance its various strategic priorities when making operational decisions.

SaskPower's EAF calculations are based on SaskPower-owned generation only; the availability of PPA generation does not influence this calculation. SaskPower does not have access to the data required to include PPAs from IPPs in EAF calculations.

g)

i. Please refer to the table below for transmission and distribution SAIDI and SAIFI metrics for each year with Major Event Days included and removed.

SaskPower SAIDI and SAIFI

	Actual 2018-19	Actual 2019-20	Actual 2020-21	Forecast 2021-22	Target 2022-23	Target 2023-24
Distribution						
SAIDI (hours)						
Excluding MEDs	6.2	5.9	6.0	5.9	5.9	5.9
Including MEDS	7.0	6.2	8.6	•	•	•
SAIFI (outages)						
Excluding MEDs	2.1	2.3	2.8	2.4	2.7	2.7
Including MEDS	2.5	2.4	3.3	•	•	•
Transmission						
SAIDI (hours)						
Excluding MEDs	185	146	134	140	135	135
Including MEDS	464	146	313	•	•	•
SAIFI (outages)						
Excluding MEDs	3.5	3.2	2.7	3.1	3.0	3.0
Including MEDS	5.0	3.2	3.6	•	•	•

• As MEDs are events that are beyond the control of management, SaskPower does not develop targets for performance inclusive of these events.

ii. Major Event Days (MEDs) are defined as unusual weather events, or events that exceed the reasonable design and/or the operational limits of the power system. As per Canadian Electricity Association (CEA) defined methodology, MEDs are excluded from the SAIDI calculation using a modified Institute of Electrical and Electronics Engineering (IEEE) 2.5 Beta method.

Please see below for a list of Major Event Days occurring in each year from 2018-19 through 2020-21:

Date	Description
2018-19	
June 1, 2018	Severe weather events experienced in southeast Saskatchewan in June 2018 resulted in significant infrastructure damage.
June 10, 2018	Severe weather events experienced in southeast Saskatchewan in June 2018 resulted in significant infrastructure damage.
July 7, 2018	A storm near Christopher Lake resulted in many outages that spread from Meadow Lake to Yorkton.

December 4, 2018	On December 4, 2018, SaskPower experienced the most widespread outage in nearly 40 years. The weight of heavy rime frost, which formed over several days of foggy weather, caused power lines to fall and sag and damaged between 40-50 transmission structures. The downed lines caused all our coal-fired generation units to trip, which resulted in the loss of 1,530 megawatts (MW), or 34%, of our total 4,493 MW generation capacity. The outage left between 75-100 communities and over 200,000 customers across the province without power. Our Outage Centre handled more than 45,000 calls from customers while our employees focused on safely restoring power to almost all customers within 13 hours.
2019-20	
October 2019	A public vehicle accident destroyed the Queen Elizabeth Unit #3 transmission structure in Saskatoon and left 17,500 customers without power for more than six hours.
December 2019	Outages due to icing on two separate transmission lines as well as a power plant switch that tripped a third transmission line were the combined cause of the second MED of the year.
2020-21	
June 14, 2020	Several storm-related outages occurred across the province.
July 30, 2020	Large storms triggered outages on SaskPower's transmission system.
January 13 & 14, 2021	An Alberta Clipper with record winds triggered outages on our transmission system across southern Saskatchewan.
March 29, 2021	Large storms caused outages on our transmission system, resulting in the fourth MED of the 2020-21 year.

iii. Transmission - The targets were established based on the average five-year historical SAIDI & SAIFI results, excluding MEDs.

Distribution - The targets were established based on the average five-year historical SAIDI & SAIFI results, excluding MEDs. The 2021-22 target is based on the multi-year implementation of SaskPower's Grid Modernization initiative, starting with the Outage Management System (OMS) in late 2019. The OMS provides accurate outage data that was not available with SaskPower's previous outage tracking system. Industry experience with outage management implementation indicates SaskPower can expect to discover performance is worse than past reporting has shown as the new system will report outages that would have previously gone unreported.

The targets noted in g(i) above for 2022-23 and 2023-24 represent the most recent

Balanced Scorecard targets.

h) Please see below for a chart summarizing SaskPower's transmission health index by structure grade for the 2018 through 2020 calendar years.

Transmission Health Index	2018	2019	2020
Excellent	23%	30%	34%
Good	34%	28%	23%
Fair	16%	16%	16%
Poor	11%	12%	13%
Very Poor	8%	9%	10%
Unknown	8%	5%	4%
Total	100%	100%	100%

SaskPower's transmission health index has remained fairly stable among most categories; however, there has been a shift from good to excellent in the past two years. This shift is attributable to the significant investment SaskPower has made in its transmission grid in recent years, including increased spending on sustainment activities as well as construction of new interconnections required for renewable generation projects coming online.

i) SaskPower does not calculate Distribution MAIFI because it does not have the outage data required to support that metric. Our system devices do not have the ability to record trip and reclose events, of which there approximately > 50,000 each year across the system. In the future, as SaskPower's grid modernization rolls out, it will have the ability to track momentary outages in certain locations; however, it will be unable to track MAIFI system wide.

However, Transmission MAIFI is calculated by the Corporation, and generally represents temporary fault conditions that do not cause significant equipment damage or require a field check. The Transmission MAIFI for the past five years is included below:

SaskPower Transmission MAIFI	Actual **2016-17**	Actual **2017-18**	Forecast **2018-19**	Target **2019-20**	Target **2020-21**
Transmission					
MAIFI (outages)	1.53	1.51	1.60	1.52	1.18

SRRP Q98 Reference: Resource Planning

a) With reference to page 54 of SaskPower's 2020-21 annual report, please provide a summary that can be made public of:
   i. the goals and objectives of SaskPower's Integrated Resource Plan
   ii. an overview of the methods used to develop the plan, including models or decision analysis frameworks used in the plan

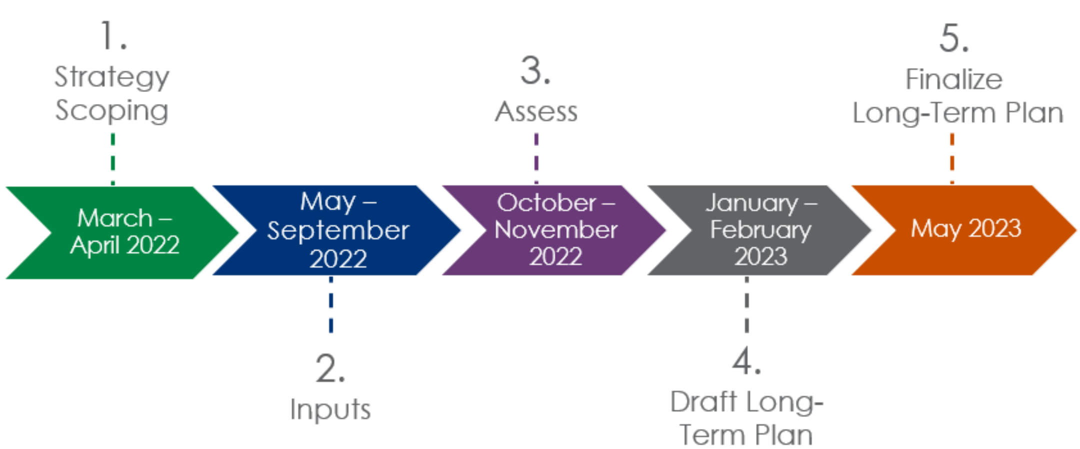
b) With reference to tab 17 of the MFRs, please provide a summary of the results of SaskPower's online dialogues from the spring of 2021 related to resource planning and discuss how SaskPower is using the information obtained during those discussions

Response:

a)

SaskPower goes through a long-term planning approach on a regular basis. The plan must provide cost-effective, reliable power service that meets greenhouse gas emissions targets. We're set to cycle through the long-term plan development process again in 2022.

There are five stages to the process. We'll be incorporating input from our customers at each stage. Help Plan Our Power Future (saskpower.com)



b)

The full report of what we heard "Deliberative Dialogue Detailed Report" and "Deliberative Dialogue Executive Summary" can be found here: What We've Heard From You (saskpower.com). Page 3 of the executive summary outlined our next steps.

The decisions made today will impact future generations. Along with the residents of Saskatchewan, SaskPower values our electricity legacy. We'll be asking customers what matters to them when planning the future power system of Saskatchewan to help us find criteria that provides the most fulsome view to 2050.

SRRP Q99 Reference: Resource Planning

a) Please itemize the planning criteria used by SaskPower in developing its Resource Plans such as firm energy and capacity requirements. Please include any policy objectives such as reducing greenhouse gas emissions or installing a particular capacity of renewable generation.
b) With reference to the chart on page 23 of the application, please describe how or if SaskPower considers intermittent resources in its resource planning? Does SaskPower consider intermittent resources to contribute to the ability to meet firm energy and/or capacity requirements?
c) Please discuss SaskPower's current plans for utility scale battery or other storage technologies.

Response:

a)

SaskPower performs reliability studies for assessing generation resource adequacy and prepares a ten-year supply plan annually which outlines its generation plan to meet the province's future resource needs. It considers retirement of existing units, planned and major overhauls to units, degradation of unit performance, escalating fuel prices, escalating capital costs for new units, unit operating costs and regulatory requirements. The amount of generation required is determined through reliability modeling. Once the generation requirement is assessed, various strategies and supply alternatives that could be available by the required date are taken into consideration to meet the capacity shortfall.

SaskPower's resource planning criteria include the following guidelines:

a. SaskPower uses two criteria for determining adequate generating capabilities. The first method is to calculate Expected Unserved Energy (EUE), which seeks to balance the cost to install generation with the interruption costs to customers to establish an overall least societal cost. This energy criterion is then correlated to a capacity related criterion called Planning Reserve Margin (PRM). The PRM states how much extra firm capacity is available above the expected peak demand. SaskPower's PRM level ensures to meet the potential peak demand and deliver a reliable supply of electricity during instances like when a power plant goes off, lower than expected renewable generation occurs, high energy demand periods during abnormal weather conditions (extreme heat or cold etc.), or the loss of a generating unit due to planned and unplanned maintenances.
b. SaskPower's goal is to reduce GHG emissions to 50% below 2005 levels by 2030.
c. The Federal/Provincial Equivalency Agreement that requires SaskPower to have at least 40% of the province's electrical generation capacity come from non-emitting sources by 2030.
d. Current net-zero target of 2050.

In addition to SaskPower's planning criteria the following are also considered when making supply decisions:

- Cost relative to other supply options
- Operating behaviour of existing and future generators, such as annual number of starts and the amount/frequency of ramping, is reviewed to ensure they are within acceptable parameters and the system is operable/flexible enough to accommodate variable renewable generation such as wind and solar

b)

Renewable generation is assigned a firm capacity value to represent its capacity to serve firm peak load. Intermittent renewable energy is among the least cost options available to SaskPower; however, it is not able to meet the capacity needs on its own. With the addition of almost 400 MW of wind coming online in early 2022, more than doubling existing wind capacity, the amount of firm capacity is anticipated to change and may decrease. SaskPower currently considers 10% of wind capacity to be firm capacity in the summer and 20% in the winter. This value is assessed annually in July and adjusted as needed.

c)

SaskPower is constructing a 20 MW – 20 MWh battery energy storage system at its Fleet Street transmission station to offset imbalances between load and generation within our system. SaskPower is currently planning the expansion of that facility up to 80 MW – 80 MWh within the next few years. The facility has provisions for expansion to provide additional flexibility on the transmission system to mitigate SaskPower's changing resource mix. SaskPower is also exploring the development of up to a 200 MW – 800 MWh battery energy storage system in the near term. The battery energy storage system will be able to provide a faster balancing service than SaskPower's generation fleet and support a more efficient and cost-effective operation of the grid. As SaskPower gains more experience with the application of batteries, other benefits (value stacking) may materialize.

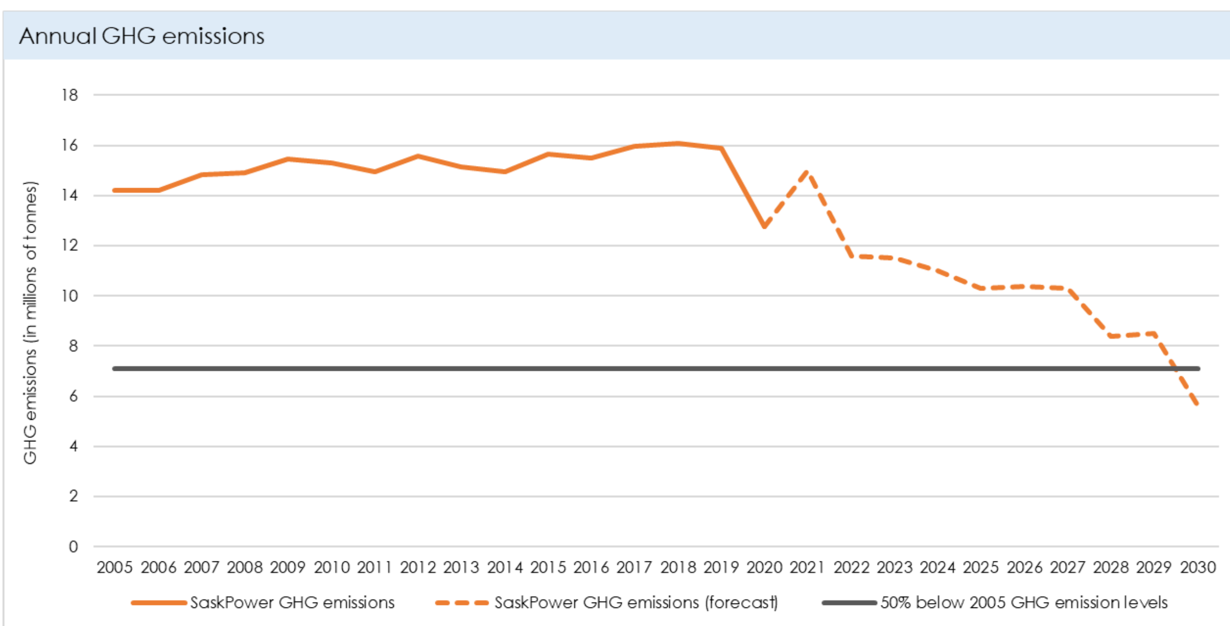
SRRP Q100 Reference: Resource Planning

a) At page 4 of the application, SaskPower states it has updated its GHG emissions reduction target to 50% below 2005 by 2030. Please provide a chart that shows SaskPower's actual and forecast GHG emissions by year from 2005 through 2030.
b) Please provide a table that shows the contribution to SaskPower's GHG emissions by generation type for each year from 2005 through 2030.
c) Please provide an estimate of the levelized cost of GHG savings incurred by SaskPower to achieve its target.
d) Please confirm what percentage of total energy supply (GW.h) would be provided by renewable generation resources if the 50% renewable capacity target were achieved.
e) Does SaskPower consider imports from Manitoba Hydro under long-term contract to contribute to the 50% renewable capacity target.

Response:

a) The following chart provides SaskPower's actual and forecasted GHG emissions by year from 2005 through 2030.

Note that SaskPower GHG emissions are from SaskPower-owned generation and large facilities owned by independent power producers with whom SaskPower has purchased power agreements, as per the scope outlined in provincial regulations.



b) The following table provides the contribution to SaskPower's GHG emissions by generation type for each year from 2005 through 2030.

GHG emissions by generation type

Year	Coal	Gas
2005 Actuals	89.4%	10.6%
2006 Actuals	87.1%	12.9%
2007 Actuals	87.7%	12.3%
2008 Actuals	86.7%	13.3%
2009 Actuals	88.8%	11.2%
2010 Actuals	87.8%	12.2%
2011 Actuals	85.6%	14.4%
2012 Actuals	83.3%	16.7%
2013 Actuals	78.5%	21.5%
2014 Actuals	77.6%	22.4%
2015 Actuals	75.4%	24.6%
2016 Actuals	72.6%	27.4%
2017 Actuals	73.9%	26.1%
2018 Actuals	68.5%	31.5%
2019 Actuals	69.1%	30.9%
2020 Actuals	63.9%	36.1%
2021 Forecast	68.1%	31.9%
2022 Business Plan	62.2%	37.8%
2023 Business Plan	61.3%	37.8%
2024 Business Plan	59.7%	35.0%
2025 Business Plan	53.9%	35.2%
2026 Business Plan	54.0%	35.2%
2027 Business Plan	54.7%	33.6%
2028 Business Plan	41.1%	30.8%
2029 Business Plan	42.2%	30.9%
2030 Business Plan	2.9%	45.0%

c) The incremental cost of renewables is expected to decline as carbon taxes increase. As an example, in 2030 a natural gas facility may be exposed to approximately \$60/MWh of carbon tax (\$170/Tonne of CO_2 on 350 kg of CO_2 released per MWh of electricity generated) plus fuel costs and variable O&M. The all-in cost of renewables will likely be less than the variable cost of natural gas fired generation in 2030.

d) In 2030, 50.2% of generation would be supplied by non-emitting generation sources 49.8% would be supplied by emitting generation sources if the 50% renewable capacity target was achieved.

e) SaskPower considers long-term purchased power agreements with Manitoba Hydro as part of its plan to achieve its 50% renewable capacity target by 2030.

SRRP Q101 Reference: Resource Planning

a) With reference to the response to SRRP first round Q138 from the 2018 rate review process, please provide an update on the status of SaskPower's renewable integration study and a summary of key findings or results.
b) Please explain how SaskPower considers renewable integration costs in its resource planning.

Response:

a) The first phase of the renewable integration study was completed in Q1 2018 and a second phase was completed in Q3 2019. Below are the key findings from the studies.
   i. At expected prices for wind power and with a CO_2 tax policy, wind becomes cost effective
   ii. Ramping and cycling of conventional generators will increase as wind is added to the system, increasing wear and tear and maintenance costs
   iii. Operational challenges related to managing the uncertainty and variability of wind generation increase as wind is added to SaskPower's system. Increasing the flexibility of existing and future units will be important to successfully integrating wind. Some options for increasing flexibility could be building fast responding gas turbines, energy storage and increased interconnections to external markets.
b) Integration costs are typically related to the increased ramping and cycling of the conventional generators, but the method of calculation is inconsistent across the industry. When economic analysis is performed to evaluate different levels of wind power on the SaskPower system, integration costs aren't included as a separate cost, but are inherent in the maintenance cost assumptions related to usage of each generator on the SaskPower system.

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2022 AND 2023 RATE APPLICATION
SRRP INTERROGATORIES

SRRP Q102 Reference: Resource Planning

a) Please provide an update to the response to SRRP first round Q141 for the years 2022 through 2050.

Response:

System peak demand and system energy

Year	Potential peak (MW)	Total Energy (GWh)
2021-22	3,910	25,071
2022-23	3,910	25,535
2023-24	3,910	25,504

Capacity

	2022		2023		2024	
(in MW)	installed capacity	winter capacity	installed capacity	winter capacity	installed capacity	winter capacity
Coal	1,531	1,531	1,390	1,390	1,390	1,390
Natural Gas	2,159	2,159	2,064	2,064	2,421	2,421
Wind	617	123	817	163	817	163
Hydro	864	864	864	864	864	864
Imports	290	290	290	290	290	290
Other Renewable	136	48	177	68	179	68
Total Renewable	1,908	1,326	2,148	1,386	2,151	1,386
Total Non-Renewable	3,689	3,689	3,453	3,453	3,811	3,811
Total	5,597	5,015	5,602	4,839	5,961	5,196

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2022 AND 2023 RATE APPLICATION
SRRP INTERROGATORIES

Energy

	2020-21	2021-22	2022-23	2023-24
Coal	33.1%	36.6%	27.1%	26.4%
Gas	42.8%	42.8%	40.7%	38.6%
Wind	3.7%	6.6%	9.2%	10.1%
Hydro	17.4%	10.6%	14.1%	13.7%
Imports	2.6%	2.8%	6.7%	7.4%
Other	0.5%	0.6%	2.2%	3.8%
Total renewable	24.1%	20.6%	32.2%	35.0%
Tota non-renewable	75.9%	79.4%	67.8%	65.0%

2022 AND 2023 RATE APPLICATION
SRRP INTERROGATORIES

SRRP Q103 Reference: Resource Planning

a) Please describe the supporting infrastructure, including transmission and distribution upgrades, required to implement SaskPower's preferred resource supply plan.

Response:

This response contains commercially sensitive information and cannot be released publicly. A copy of the full response has been provided to the Saskatchewan Rate Review Panel for their review.

SRRP Q104 Reference: Electric Vehicles

a) Please provide details of SaskPower's Electric Vehicle Infrastructure Program including any business case prepared in support of the $2 million investment toward the program.
b) What rates does SaskPower charge electric vehicle charging stations?
c) Has SaskPower considered developing rate structures for electric vehicle charging either at residences or commercial locations?

Response:

a)

The SaskPower Electric Vehicle Infrastructure Program (EVIP) will provide funding to 20 EV fast charging projects throughout Saskatchewan. The program's focus is to fund projects that build chargers on the most travelled highways in the province where there is a lack of charging. Increasing the availability of fast charging on Saskatchewan highways will facilitate EV travel in the province and eliminate one of the key barriers to EV adoption in Saskatchewan – range anxiety due to a lack of EV charging. The fast chargers will be built, owned and operated by third parties selected through the program's application process.

Eligible projects can receive funding of 75% of total project costs to a maximum of $200,000. Complete program information is available on saskpower.com

SaskPower was awarded funding through the Natural Resource Canada (NRCan) Zero Emissions Vehicle Infrastructure Program with the funding agreement signed in December 2021. NRCan will match SaskPower's $2 million investment in the program.

In 2019, SaskPower commissioned the development of an EV business plan to project the financial impacts of electric vehicle growth in Saskatchewan. Taking a proactive approach to managing EV charging suggested a positive financial return for SaskPower, while taking a passive or reactive approach suggested a financial loss for SaskPower.

b) SaskPower currently charges electric vehicle charging stations at their appropriate general service or small commercial rate.

c) SaskPower is considering developing rate structures for electric vehicle charging for both commercial and residential locations and is currently analyzing potential options and developing strategies.