FortisBC Inc. Resource Planning Advisory Group (RPAG) Meeting

June 25, 2020

FORTIS BC™

RPAG Purpose and Objective

Purpose:

- Inform, update stakeholders on FBC resource planning
- Get input and feedback from stakeholders on key planning items

Objective:

- Help develop a more informed and robust resource plan

Agenda

8:30 am – 8:45 am	**Introductions**	**Mike Hopkins –** Senior Manager, Price Risk & Resource Planning
8:45 am – 9:15 am	**Reference Case Load Forecast**	**Katie Rice –** Revenue and Margin Analyst **Dan Higginson** – Innovation Specialist
9:15 am – 10:45 am	**Load Scenarios**	**Guidehouse (Navigant) - Peter Steele-Mosey –** Associate Director
10:45 am – 11:00 am	**Break**	
11:00 am – 11:15 am	**Scenarios Slider Tool Demo**	**David Bailey** – Customer Energy & Forecasting Manager
11:15 am – 11:45 am	**Load-Resource Balance**	**Mike Hopkins**
11:45 am – 12:00 pm	**Wrap-Up and Next Steps**	**Mike Hopkins**

Introductions

RPAG Members

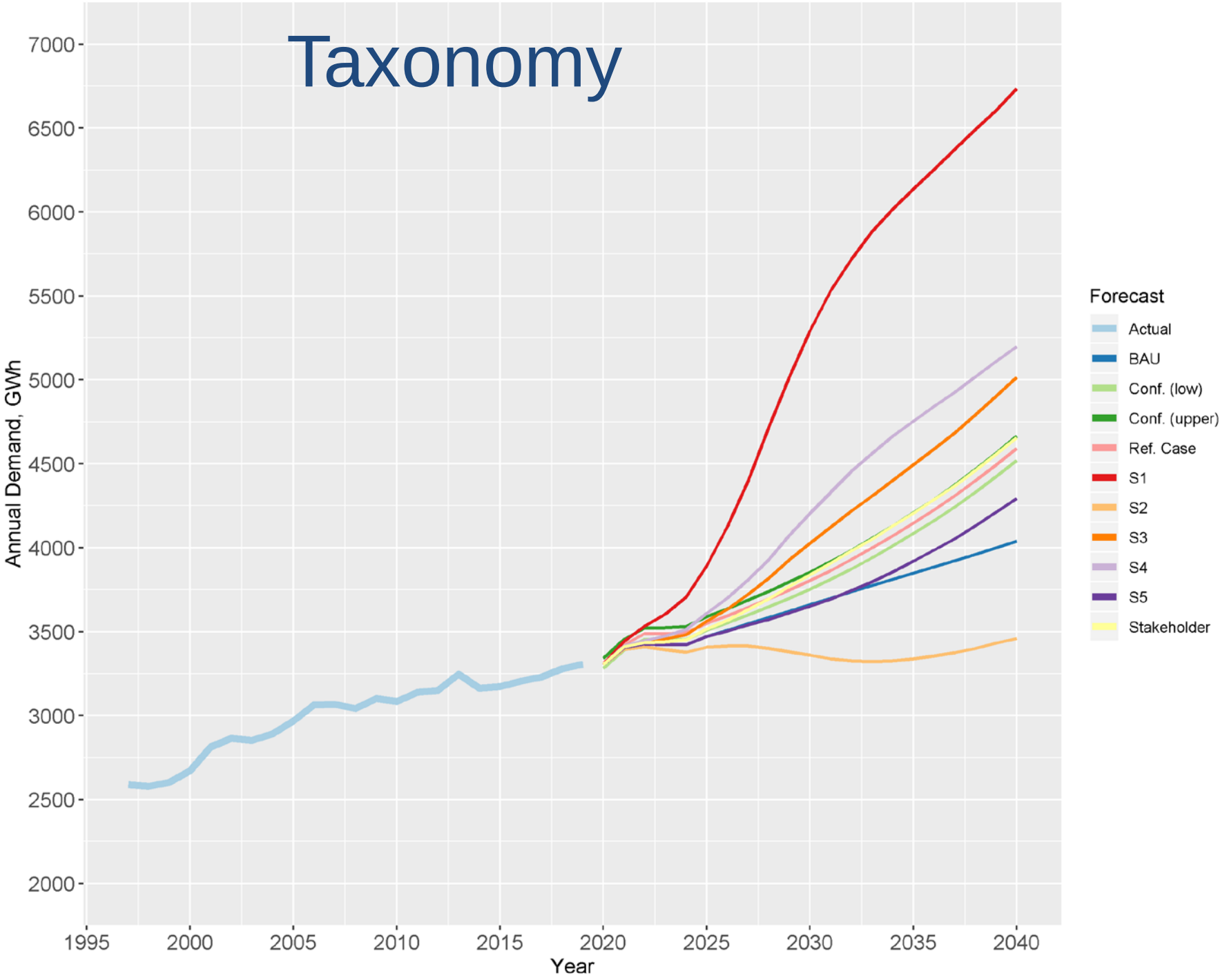
Affiliation	Contact	Title
B.C. Ministry of Energy & Mines - Electricity and Alternate Energy Division	Warren Walsh	Strategic Energy Manager
B.C. Municipal Electric Utilities (BCMEU)	Alex Love	General Manager, Nelson Hydro
B.C. Public Interest Advocacy Centre (BCPIAC)	Leigha Worth	Executive Director & General Counsel
B.C. Sustainable Energy Association (BCSEA)	Tom Hackney	Policy Analyst
B.C. Utilities Commission (BCUC)	Nicola Simon	Executive Director, Facilities and Planning
BC Hydro	Kathy Lee	Resource Planning Specialist
Clean Energy Association of B.C.	Laureen Whyte	Executive Director
Commercial Energy Consumers Association of B.C. (CEC)	David Craig	Executive Director
B.C. First Nations Energy and Mining Council	Paul Blom	Executive Director
Friends of Kootenay Lake Stewardship Society	Camille Leblanc	Assistant Environmental Manager
Industrial Customers Group (ICG)	Robert Hobbs	Council for the ICG
Irrigation Rate Payers Group	Brian Mennell	Chairman, Fairview Heights Irrigation District
Penticton Indian Band	Jonathan Baynes	CEO, K'ul Management Group
Lower Similkameen Indian Band	Trudy Peterson	Team Lead Capital Housing and Public Works
Okanagan Indian Band	Sammy Louie	Communications and Special Events Coordinator
Pembina Institute	Tom-Pierre Frappé-Sénéclauze	Director, Buildings and Urban Solutions
MoveUp	Jim Quail	Legal Director
FortisBC	Mike Hopkins	Senior Manager, Price Risk & Resource Planning
FortisBC	Dan Egolf	Senior Manager, Power Supply & Planning
FortisBC	Keith Veerman	Manager, C&EM
FortisBC	David Bailey	Customer Energy & Forecasting Manager
FortisBC	Katie Rice	Revenue and Margin Analyst
FortisBC	Joyce Martin	Manager, Regulatory Affairs
FortisBC	Ryan Steele	Power Supply Planning Specialist
FortisBC	Ron Zeilstra	Resource Development Manager
FortisBC	Ken Ross	Manager, Integrated Resource Planning & DSM Reporting

Load Forecasts & Scenarios

Taxonomy

Forecast	Description
Business as Usual (BAU)	• Time series method • 2016 LTERP Reference Case • Same as Multi-Year Rate Plan update, extended 20 years • Starting point for 2021 LTERP Reference Case
Reference Case	• Starts with BAU and adds highly certain loads • Includes commitments and legislated policies • Includes uncertainty bands • **LTERP Planning Forecast**
Scenarios	• Include load driver impacts beyond BAU • Upper/lower Bounds set book-ends • Intermediate scenarios provide potential pathways
Stakeholder Scenarios	• Stakeholders use slider tool to develop their own scenario(s)

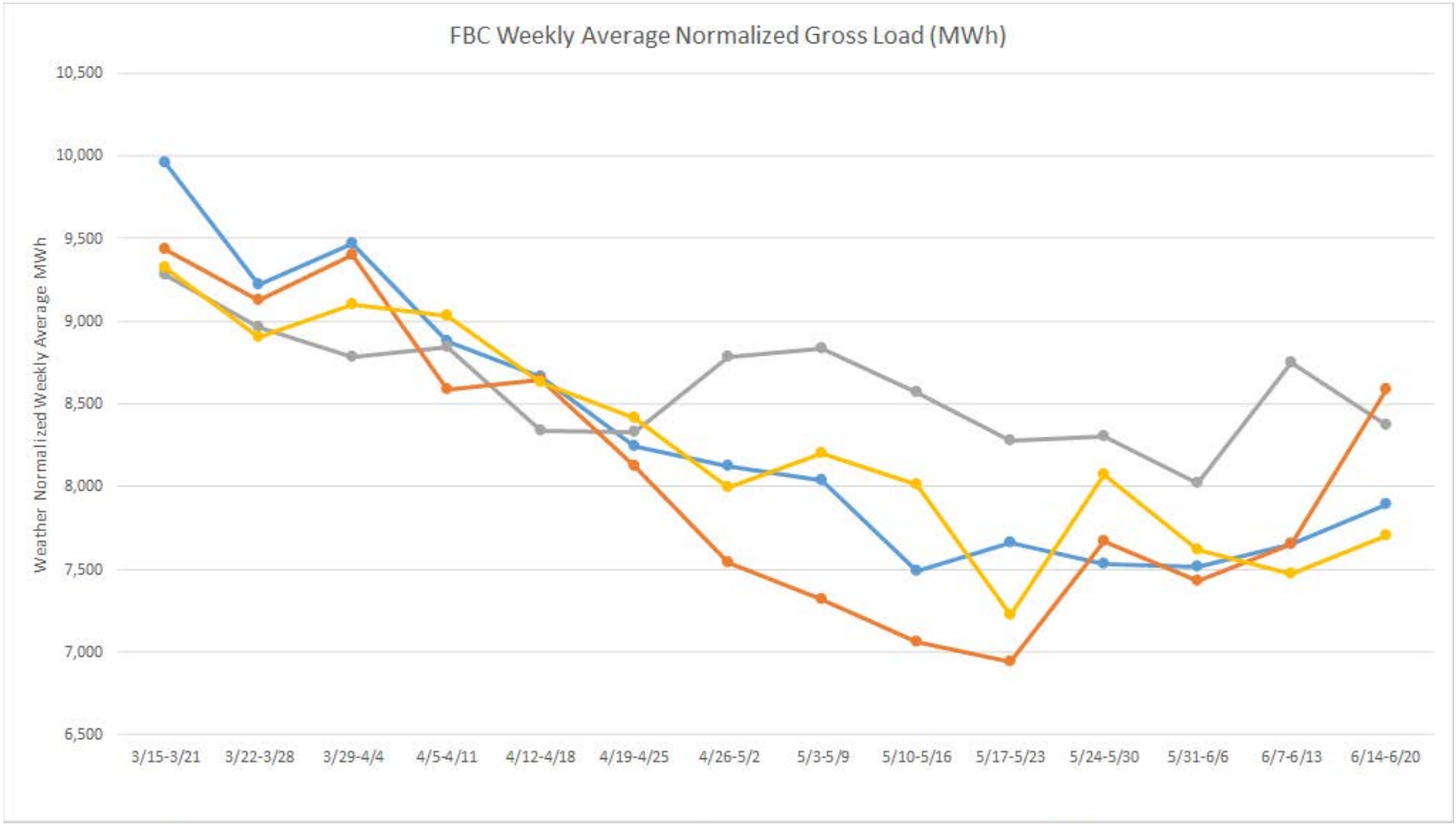
Taxonomy


Annual Demand, GWh
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
Year
Forecast
Actual
BAU
Conf. (low)
Conf. (upper)
Ref. Case
S1
S2
S3
S4
S5
Stakeholder

COVID-19 Impacts

- BAU (and reference case) forecast includes recent CBOC GDP forecast for commercial sector
- Development of scenarios started prior to COVID-19
- Currently FBC has not seen any large changes to the load when compared to prior years
- Uncertainty re long term public policy and behavioral changes
- FBC continues to monitor developments and will asses the load forecast in the fall of 2020 to make sure the current assumption are still valid

COVID-19 Impacts Minimal to Date



Business as Usual Forecast

Residential

- Customers: Regression of BC STATS population
- UPC: Regression of normalized actuals
- Load: Product of customers and UPC

Commercial

- Regression of CBOC GDP

Industrial

- Survey plus growth rates

Wholesale

- Survey plus growth rates

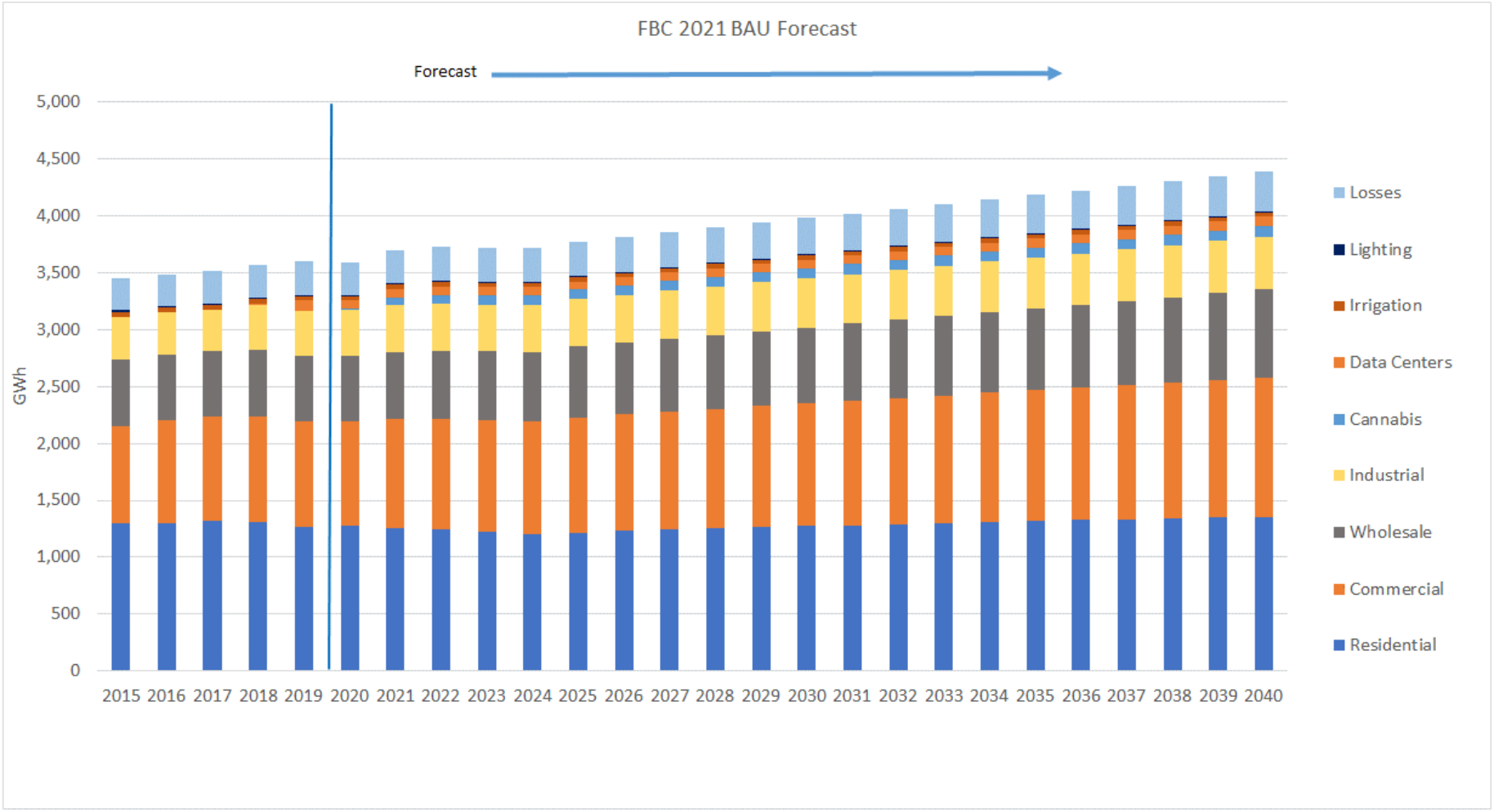
Lighting

- Load: 2019 actuals
- Customers: 5-year regression

Irrigation

- Load and customers: 2019 actuals

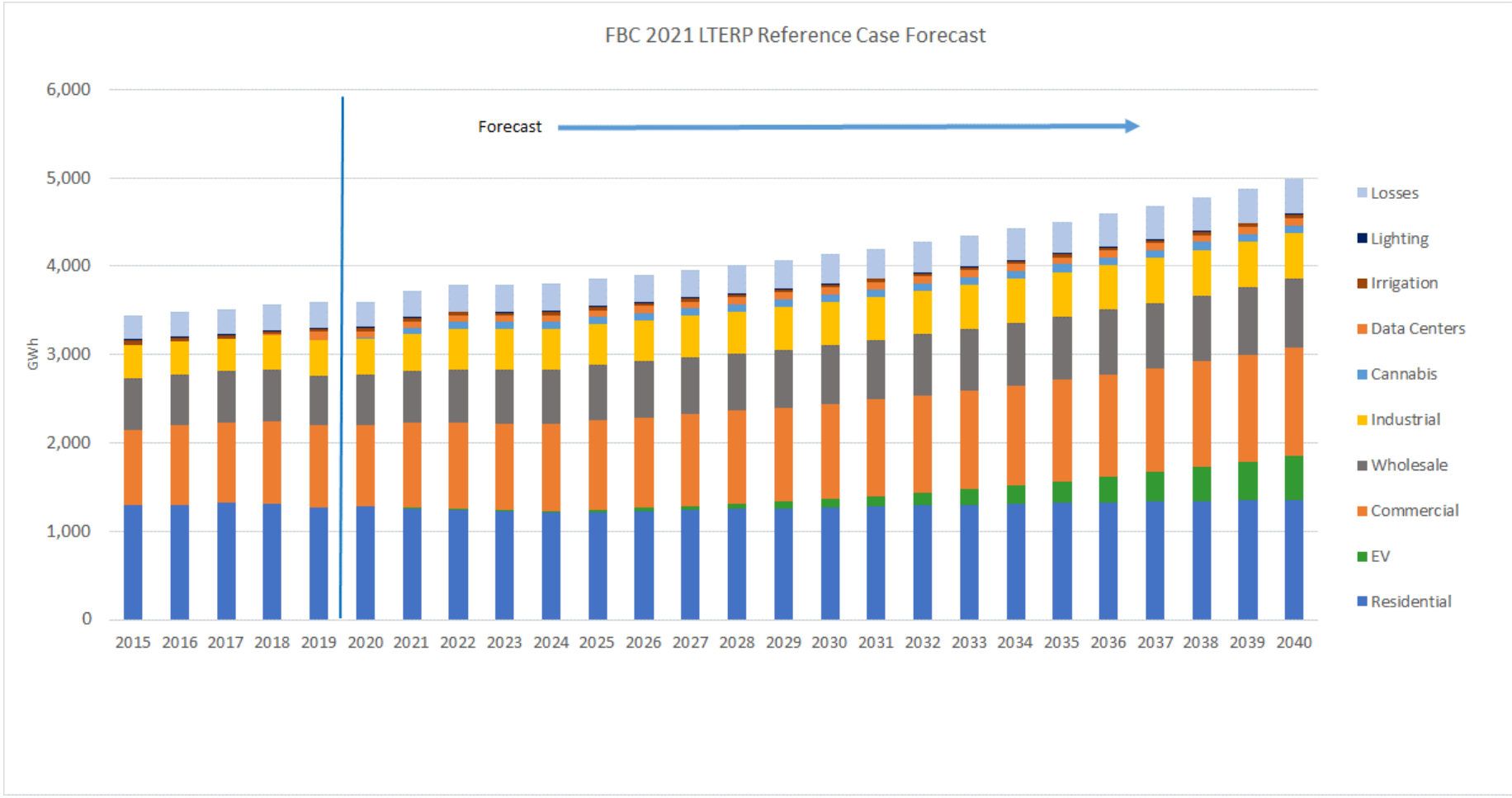
Business as Usual Forecast – Annual Energy



Reference Case Forecast

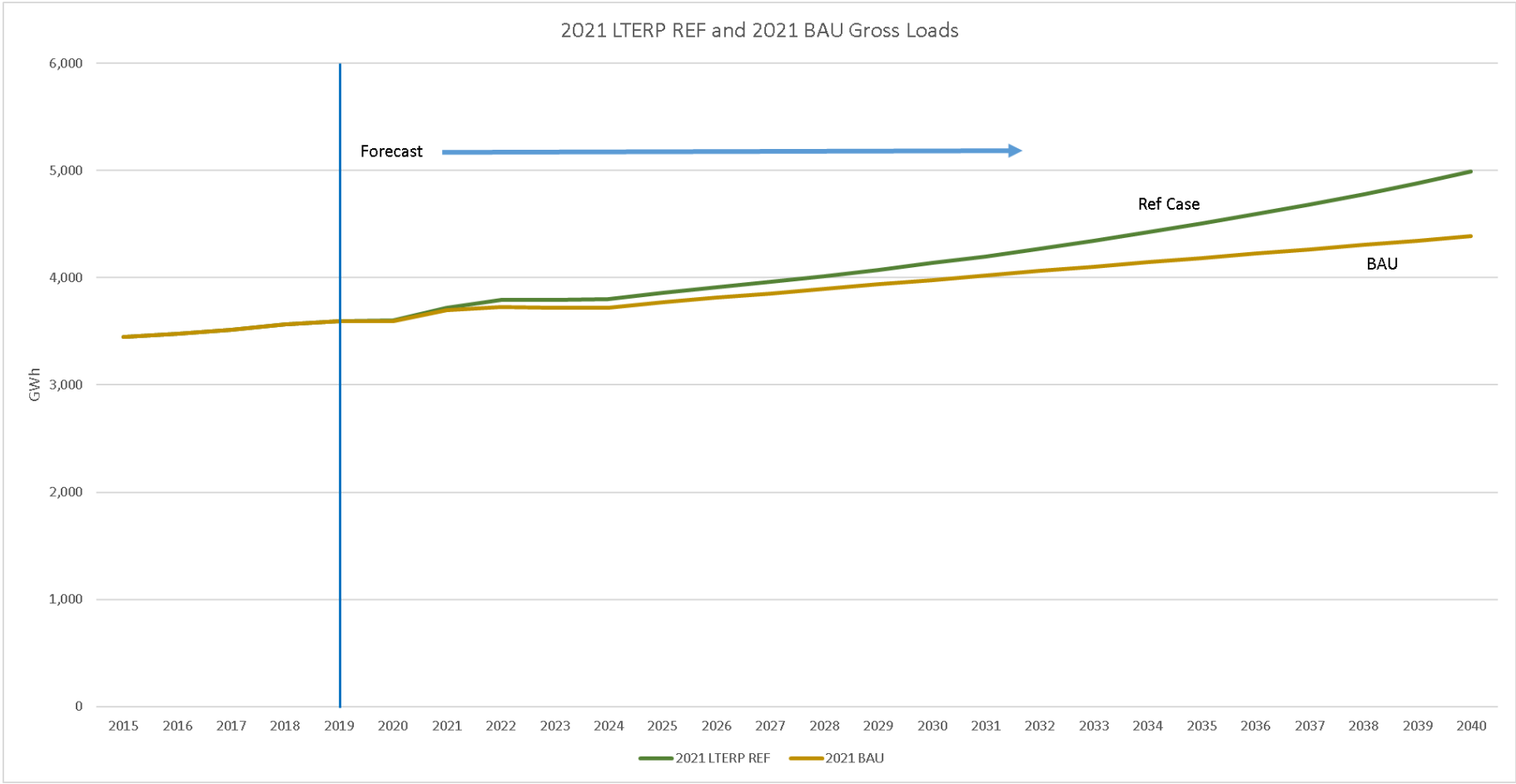
- Builds on BAU forecast with the following additions:
  - BC Zero Emissions Vehicle (ZEV) Act targets
    - 10% of sales by 2025, 30% by 2030 and 100% by 2040
    - Light duty vehicle sales only
  - Large load expectations
    - Highly certain large loads (75% probability)

Reference Case Forecast – Annual Energy



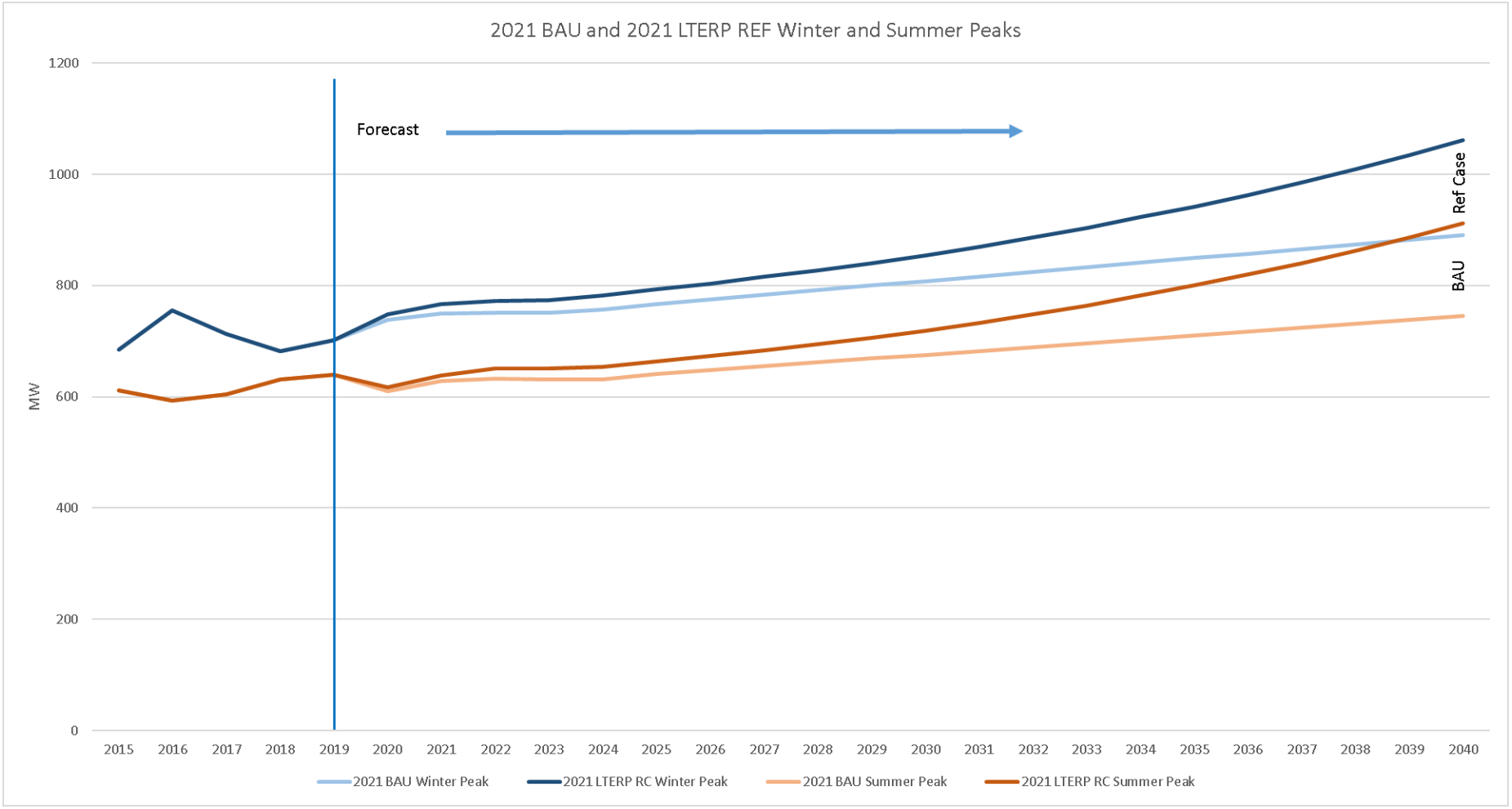
- BAU forecast + Light-duty EV + highly certain industrial loads

Reference Case vs. BAU - Annual Energy



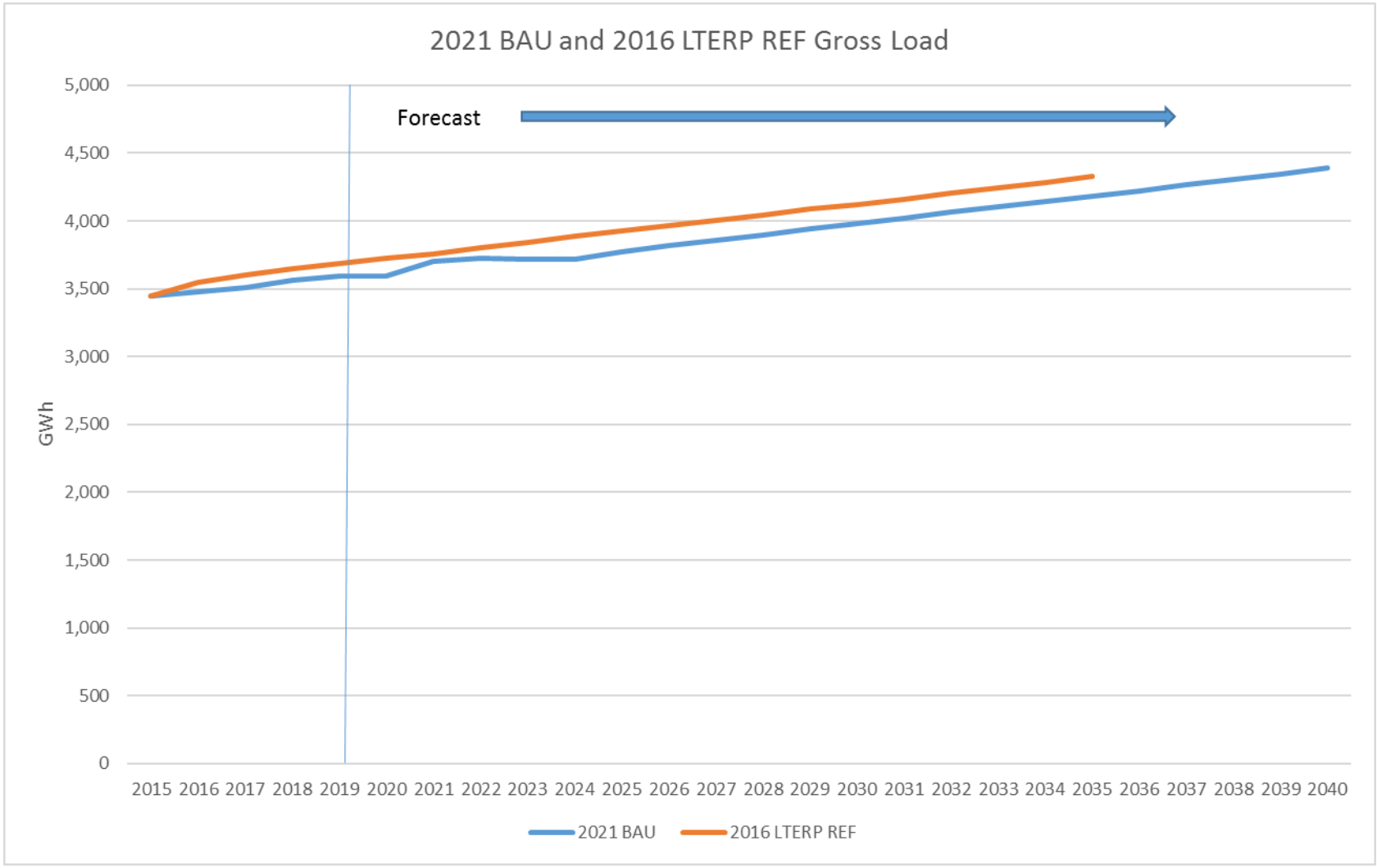
- BAU forecast + Light-duty EV + highly certain large loads

Reference Case vs. BAU Forecast – Capacity

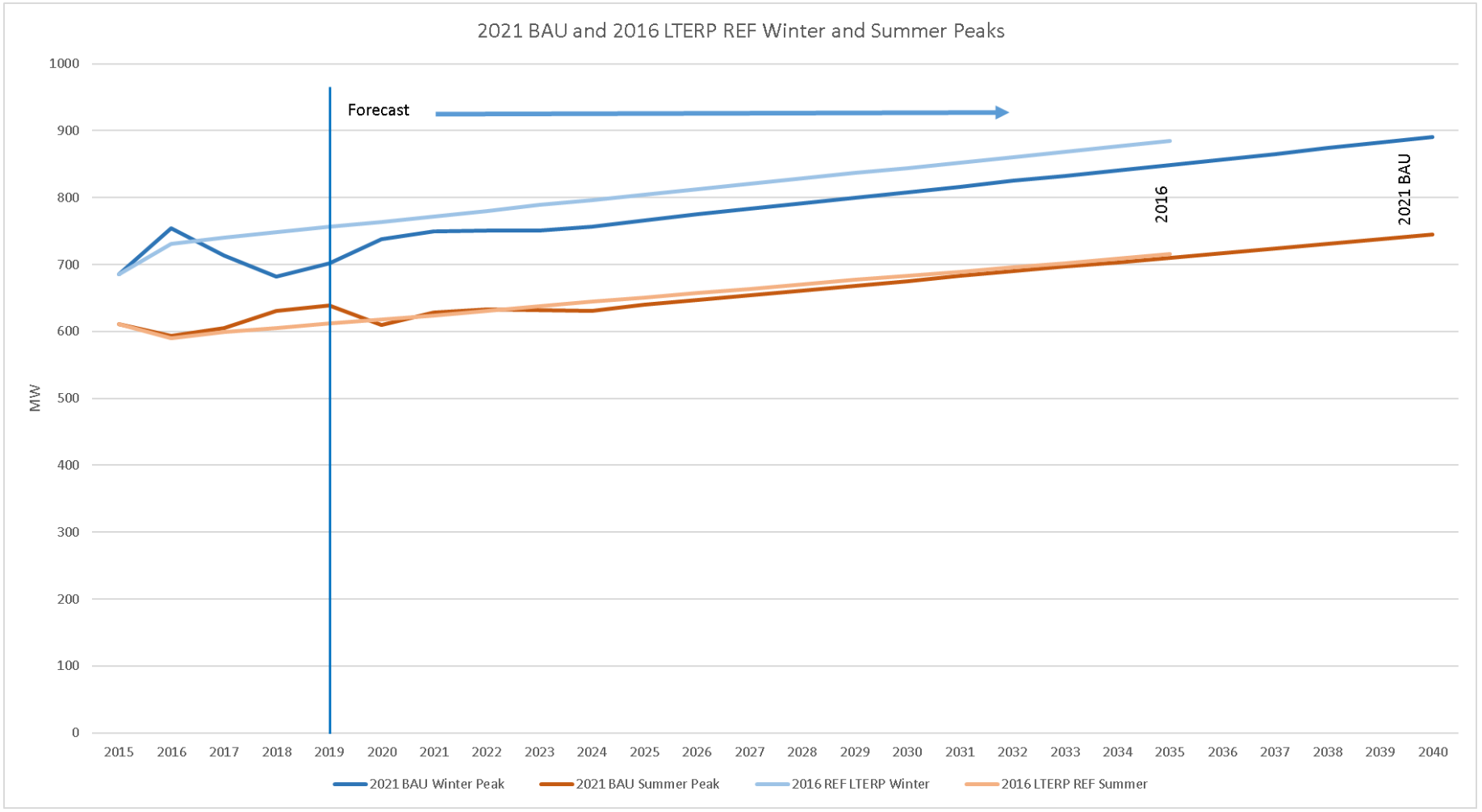


- Excludes any EV charging rate, TOU or other initiatives to shift load off-peak

2021 BAU vs. 2016 Reference Case – Annual Energy



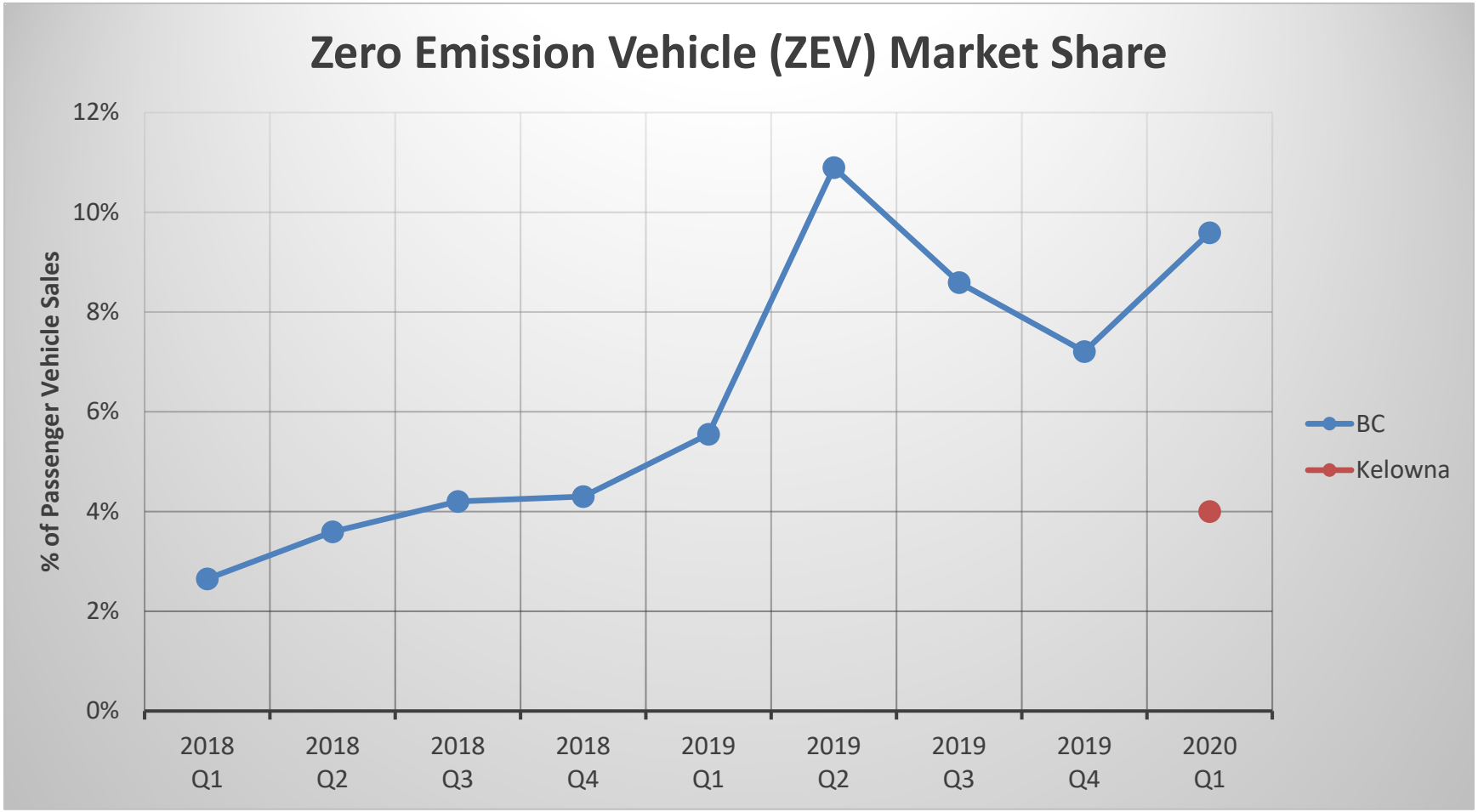
2021 BAU vs. 2016 Reference Case – Capacity



Reference Case Uncertainty Bands

- Planning to develop uncertainty bands
- Can apply Confidence Interval approach to BAU drivers
- Could apply discrete ranges to EV charging impacts:
  - High band: exceeds ZEV Act targets
  - Low band: ZEV Act targets not met

Mitigating Impacts of EV Demand



Mitigating Impacts of EV Demand

- What we are we working on now?
- What are we considering in the near term?
- Possible future actions:
  - Time of Use (TOU) rate
  - Demand Response (DR)
  - Bill credits for charging off-peak

Load Scenarios

FORTISBC LOAD SCENARIO DEVELOPMENT

STAKEHOLDER WORKSHOP: SCENARIO IMPACTS

2020-06-25

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1. LOAD SCENARIO STUDY PURPOSE AND FOCUS

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LOAD SCENARIO STUDY PURPOSE AND FOCUS

Navigant (a Guidehouse Company) is supporting FortisBC in the development of a set of potential future load scenarios to explore the potential impact of structural changes in future utility loads.

STUDY PURPOSE: Quantify the potential impact of major structural changes in FortisBC's electricity load drivers through a scenario analysis.

STUDY FOCUS: Intermediate scenarios that align with the scenarios previously modeled for FortisBC's EnergyVision 2050 report.
(The 2015/2016 load scenarios focused on the two "boundary" scenarios. These continue to be presented here for context, but planning efforts will be informed primarily by the intermediate scenarios).

NB: this is *not* a forecast but an exercise in understanding the consequence of a variety of potential future pathways.

The primary goals of this meeting are to:

- Present stakeholders with Navigant's estimated impacts for each of the five load scenarios developed
- Solicit feedback on Navigant's findings and in particular the scenario assumptions that drive those findings.

2. SCENARIO LOAD DRIVERS

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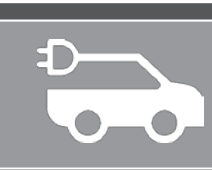
SCENARIO LOAD DRIVERS

1. Integrated Photovoltaic Solar and Storage (IPSS) – Residential

Residential rooftop solar photovoltaic (PV) installations, in some cases supported by energy storage.

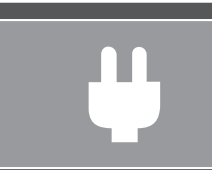
2. Integrated Photovoltaic Solar and Storage (IPSS) – Commercial

Commercial building solar photovoltaic (PV) installations, in some cases supported by energy storage.



3. Electric Vehicles (EV)

- Light duty vehicles (LDV) including: plug-in hybrids (PHEV) and battery electric vehicles (BEV)
- Medium and heavy duty vehicles (MHDV) including: return-to-base fleet vehicles, busses, combination tractors

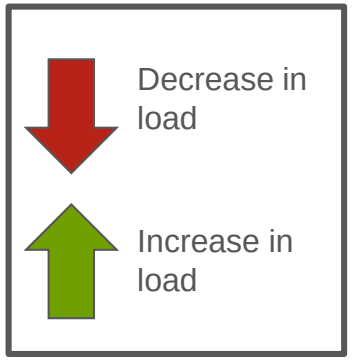


4. Fuel Switching: Gas to Electric (FS G2E)

- Electrification of residential space- and water-heating
- Equipment to reflect the mix of equipment projected in the Technical Potential estimated as part of the Conservation Potential Review (June 2019)

5. Fuel Switching: Electric to Gas (FS E2G)

Replacement of non-heat pump electric residential space- and water- heating with standard efficiency (code-compliant) natural gas fired equipment.



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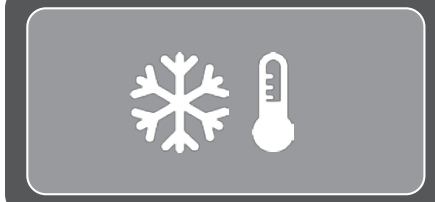
SCENARIO LOAD DRIVERS



6. Climate Change (CC)

Increasing average annual temperatures reduce heating loads in the winter and increase cooling loads in the summer. Assumed "new normal" includes annual winter cold snaps and summer heat waves. Net effect is reduction in energy consumption in all scenarios but increases in peak demand in some scenarios.

7. Large Load Sector Transformation (LLST)

Transformation of the large commercial and industrial (C&I) sector. Specifically: significant growth in the number of data centres and cannabis greenhouses in FortisBC territory.

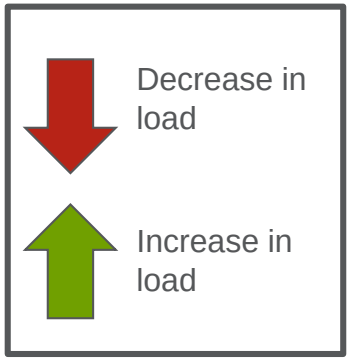
8. Hydrogen Production (HP)

Electricity consumption driven by the production of "green" hydrogen to be injected into natural gas distribution system to partially decarbonize that fuel source.

9. Carbon Capture and Storage (CCS)

Electricity consumption driven by power requirements of CCS technologies used to capture carbon emissions *in situ* from industrial processes

Direction of energy and demand impacts may differ.



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3. LOAD SCENARIOS - SUMMARY

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LOAD SCENARIOS

1. Upper Bound

Includes only load drivers that increase load. Ultimate penetration of all included load drivers set to reasonable extreme.

2. Lower Bound

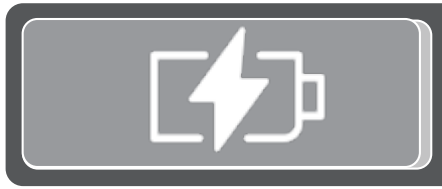
Includes only load drivers that decrease load. Ultimate penetration of all included load drivers set to reasonable extreme.

3. Deep Electrification

Electrification of transportation, residential and commercial space and water heating and industrial process heating. Growth in IPSS (commercial and residential) to support electrification.

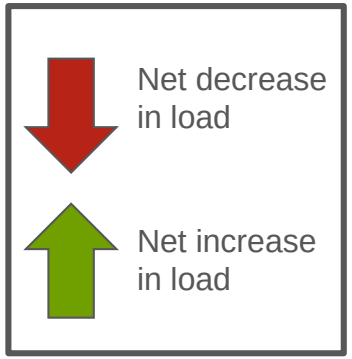
4. Diversified Energy Pathway

Emissions reductions characterized more by decarbonization of fuels than electrification. Includes significant increases in HP, supported by CCS. Surplus generation helps motivate LLST and adoption of EVs.



5. Distributed Energy Future

The falling costs of renewable generation and storage drives growth in residential and commercial IPSS. Increased self-generation reduces utility revenue, increasing retail rates and provoking some E2G fuel switching. Growth in HP and CCS to support growth in NG requirements.



Direction of impact depends on load driver penetration assumptions.

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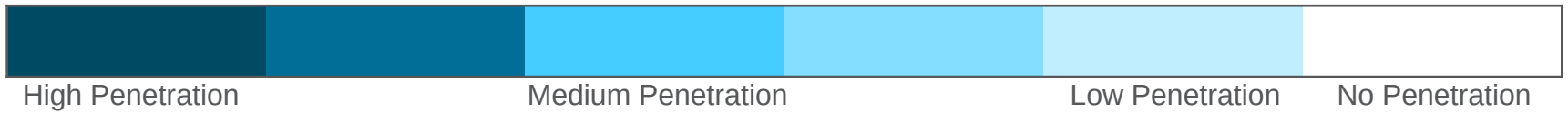
LOAD SCENARIOS AND DRIVERS

Scenarios \ Drivers	IPSS (Res)	IPSS (Com)	EVs	FS G2E	FS E2G	CC	LLST	HP	CCS
Upper Bound									
Lower Bound									
Deep Electrification									
Diversified Energy Pathway									
Distributed Energy Future									



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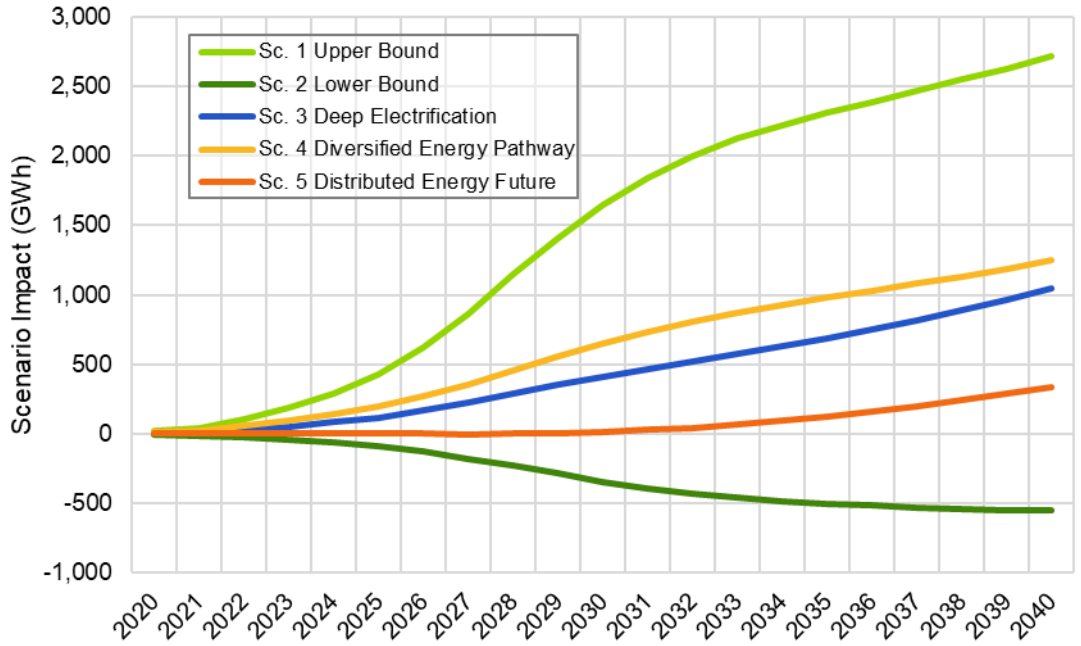
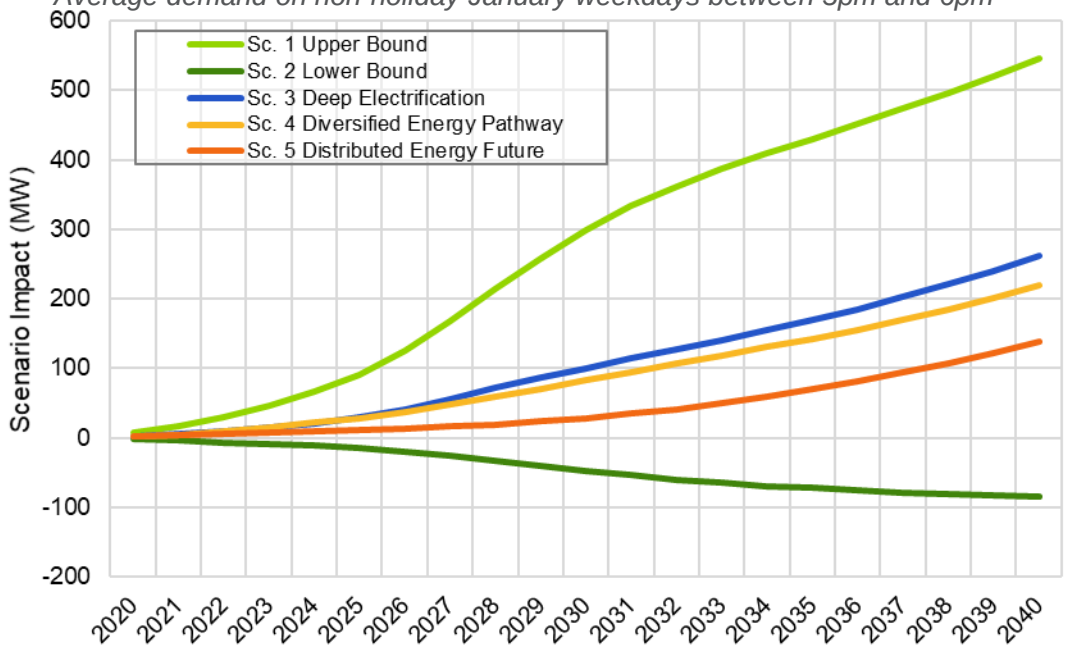
LOAD SCENARIOS IMPACTS

Annual Energy Impacts (GWh)



Annual January Peak Demand Impacts (MW)

Average demand on non-holiday January weekdays between 5pm and 6pm



Scenario Impacts in 2040, and % Change from BAU Projection for 2040

	Sc. 1 Upper Bound	Sc. 2 Lower Bound	Sc. 3 Deep Electrification	Sc. 4 Diversified Energy Pathway	Sc. 5 Distributed Energy Future
GWh	2,720	-554	1,045	1,248	338
%Δ From BAU	62%	-13%	24%	28%	8%

	Sc. 1 Upper Bound	Sc. 2 Lower Bound	Sc. 3 Deep Electrification	Sc. 4 Diversified Energy Pathway	Sc. 5 Distributed Energy Future
GWh	546	-85	262	219	139
%Δ From BAU	61%	-10%	29%	25%	16%

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4. SCENARIO 1: UPPER BOUND

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SCENARIO 1 – UPPER BOUND: KEY ASSUMPTIONS

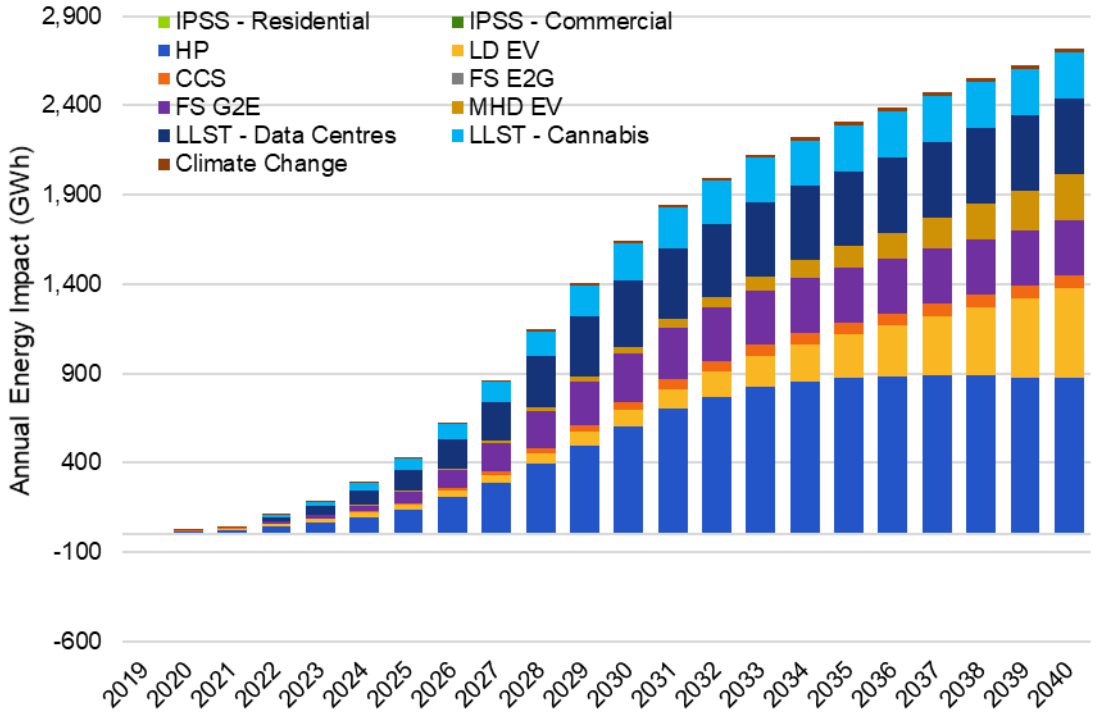
Description

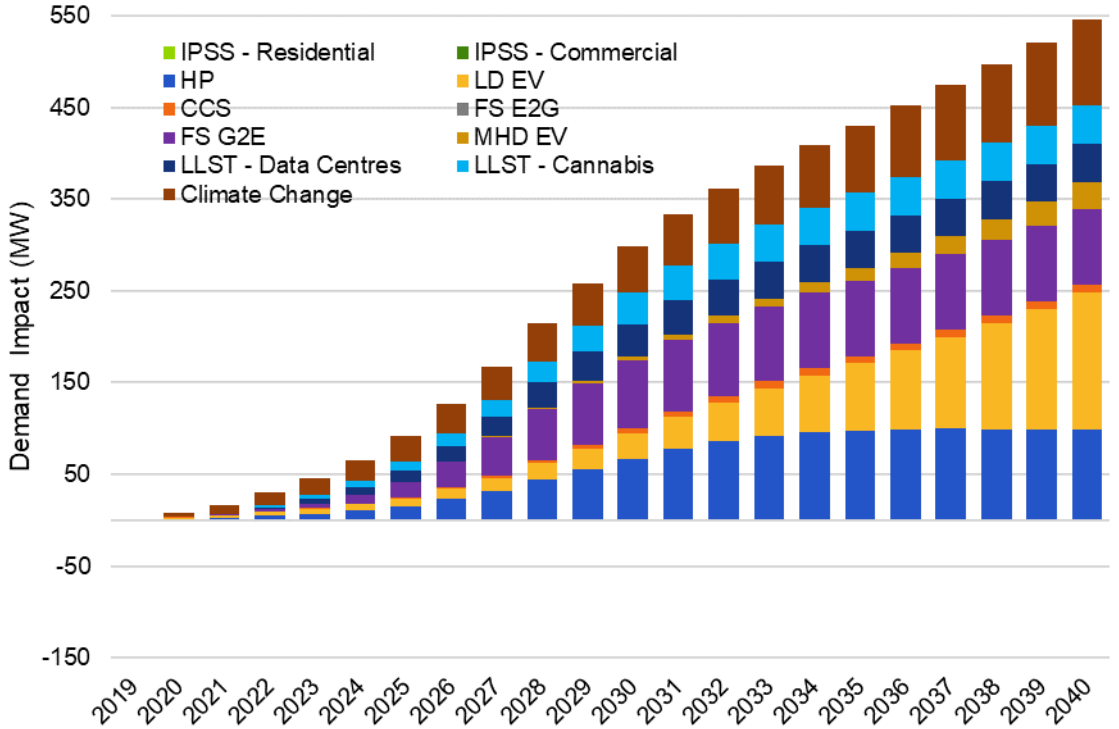
The Upper Bound scenario exists to help FortisBC understand the upper limit of the potential impacts on energy consumption of structural changes in the drivers of electric load. This scenario only includes load drivers that increase load. All load drivers' ultimate penetration (where appropriate) assumed at highest levels ("reasonable extremes"). This scenario has a net **increase** in load.

Key Assumptions in Load Driver Ultimate Penetration

Driver	Key Assumptions (Ultimate Penetration of Load Driver)	
EVs	**Light-Duty EVs**.	Penetration aligns with Zero Emission Vehicle (ZEV) mandate assumptions: by 2025 10% of new vehicle sales are EVs, by 2030 30% of new vehicle sales are EVs, and by 2040 100% of new vehicle sales are EVs.
	Medium/Heavy-Duty EVs.	Assumes that by 2040, 80% of return-to-base vehicle, combination tractor, and bus sales are EVs
FS G2E	Assumes that by 2040, FortisBC will achieve 30% of the residential electrification Technical potential identified by the 2019 Conservation Potential Review electrification potential study for the terminal year of that study.	
LLST	**Data Centres**	Assumed growth (by 2040) of approximately 700,000 ft^2 of floor space from the estimated existing 200,000 ft^2.
	Cannabis Production	Assumed growth (by 2040) of approximately 3 milion ft^2 of floor space from the estimated existing and 100% confidence projected (via connection requests) 1 million ft^2 in 2021.
HP	Assumes an annual production of 3 PJ of hydrogen by 2040. This is approximately 5% of the projected NG consumption in the shared service territory by 2036 projected in the last LTGRP. Further assumes that conversion efficiency increases over time, from 73% (existing, based on FortisBC pilot data) to 95%.	
CCS	Assumes an annual capture of 240 kT per year of industrial-sector GHG by 2040. This is approximately 1.3 x the volume of industrial emissions assumed to be captured by CCS in the "Diversified Pathway" scenario in the Energy Vision 2050 report.	
CC	Assumes an average decrease in daily temperature of 6.2 C^O on the ten coldest days, and an average increase in daily temperature of 2.1 C^O on the ten hottest days.	

SCENARIO 1 – UPPER BOUND: IMPACTS BY LOAD DRIVER





Absolute and Relative Contribution to Total Impacts in 2040

2040 Impact:	IPSS - RES	IPSS - COM	HP	LD EV	CCS	FS E2G	FS G2E	MHD EV	LLST - Data Centres	LLST - Cannabis	Climate Change
GWh	0	0	877	500	72	0	310	254	424	260	24
%	0%	0%	32%	18%	3%	0%	11%	9%	16%	10%	1%

2040 Impact:	IPSS - RES	IPSS - COM	HP	LD EV	CCS	FS E2G	FS G2E	MHD EV	LLST - Data Centres	LLST - Cannabis	Climate Change
MW	0	0	98	150	8	0	83	29	41	42	95
%	0%	0%	18%	27%	2%	0%	15%	5%	8%	8%	17%

NB: the % contribution here is calculated as the absolute value of the level impact for the given driver, divided by the sum of the absolute impacts of all drivers

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SCENARIO 1 – UPPER BOUND: NOTEWORTHY OBSERVATIONS

Under the Upper Bound scenario (Scenario 1), by 2040, both energy consumed and January weekday demand between 5pm and 6pm increase to approximately 60% more than that projected in the Business As Usual forecast.

Key Observations

- **Energy vs. Demand.** The distribution of impacts by driver differs considerably when considering energy compared to demand:
  - Energy: 32% of impact from hydrogen production, 18% from LD EVs, and 11% from G2E fuel-switching.
  - Demand: 27% of impact from LD EVs, 15% from G2E fuel-switching, 18% from hydrogen production, and 17% from assumed cold snap (CC).
- **Light-Duty EVs.** Without some mitigating action to shift loads (e.g., TOU rates, automated DR charging infrastructure, etc.) large-scale LD EV penetration in line with ZEV mandate requirements could push 2040 winter peak demand ~17% higher than BAU.
- **Hydrogen Production.** Replacing conventional natural gas with hydrogen will require substantial incremental electric energy, even with very aggressive efficiency assumptions. Replacing just 5% of the shared service territory NG energy with hydrogen increases 2040 energy consumption ~18% above BAU.
- **Data Centres.** Year-round high energy intensity of this business type means that tech-sector-style growth could result in substantial load increases.

5. SCENARIO 2: LOWER BOUND

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SCENARIO 2 – LOWER BOUND: KEY ASSUMPTIONS

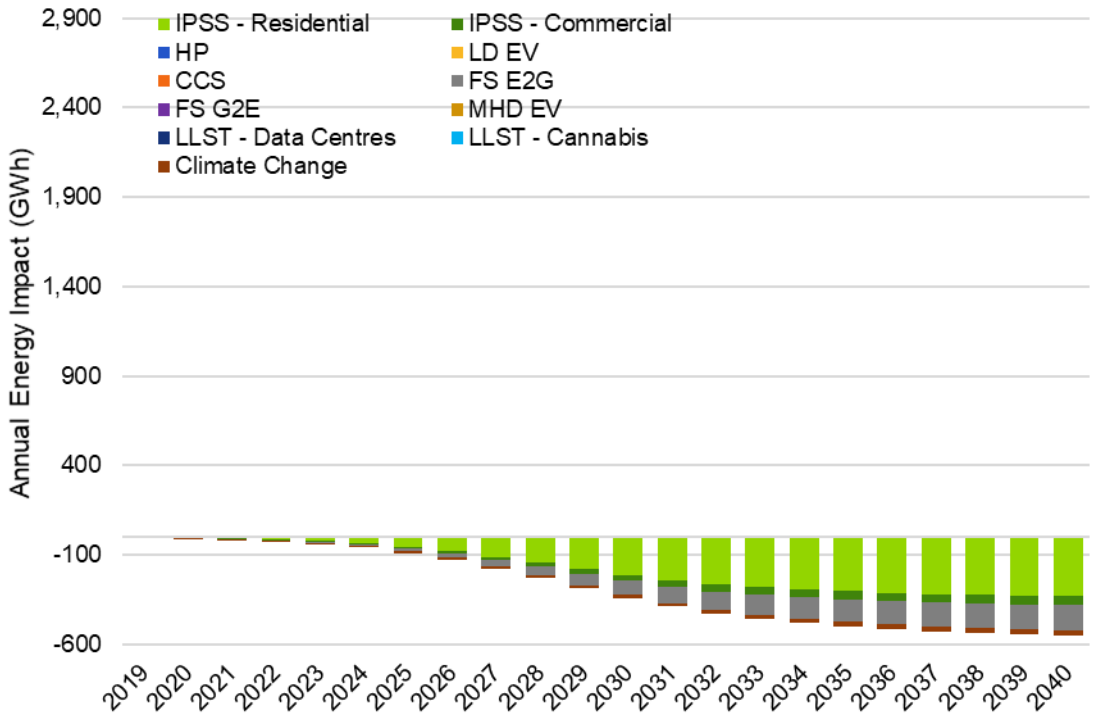
Description

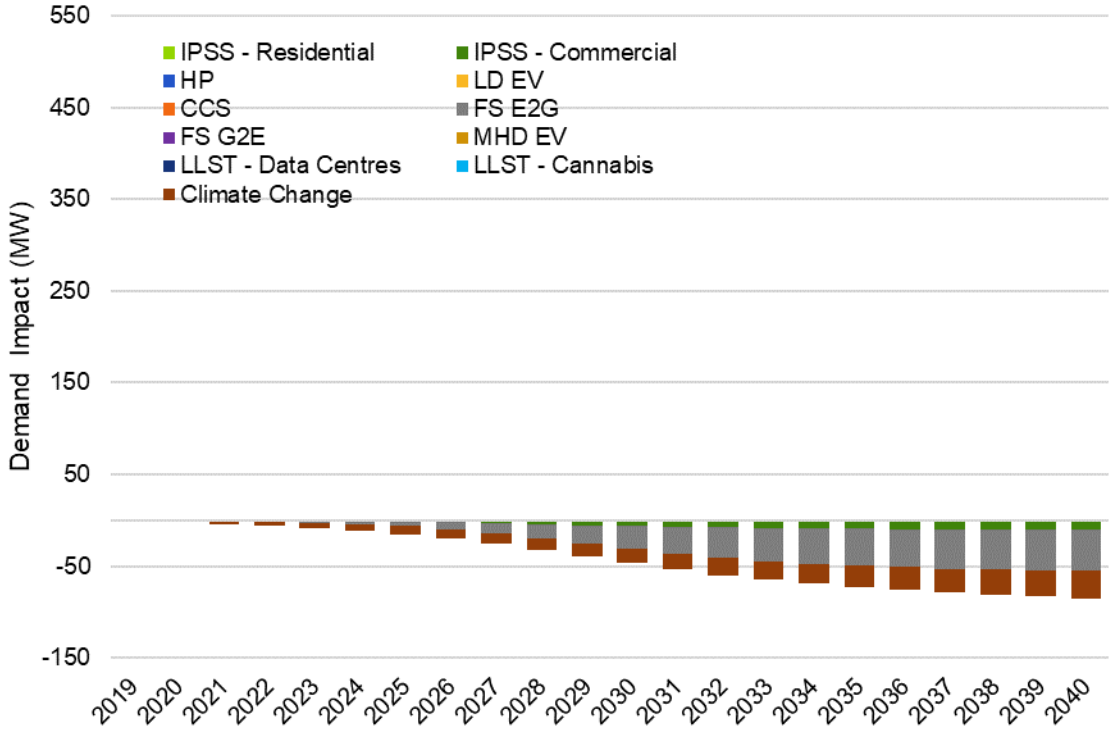
The Lower Bound scenario exists to help FortisBC understand the upper limit of the potential *negative* impacts on energy consumption of structural changes in the drivers of electric load. This scenario only includes load drivers that decrease energy consumption. All load drivers' ultimate penetration (where appropriate) assumed at highest levels ("reasonable extremes"). This scenario has a net **decrease** in load.

Key Assumptions in Load Driver Ultimate Penetration

Driver	Key Assumptions (Ultimate Penetration of Load Driver)
IPSS - Residential	Assumes that by 2040 one third of all residential consumers dwelling in single family homes (65% of all residential customers) in the FortisBC service territory (incl. those that are customers of FortisBC wholesale customers) will have installed 8 kW of rooftop solar PV, each. Further assumes that half of those that install rooftop PV will also (by 2040) install a 5 kW/13.5 kWh energy storage system. Storage is assumed to be charged with excess solar generation, and discharged as required to cover household loads.
IPSS - Commercial	Assumes that by 2040 half of all GS21 commercial customers (~12% of commercial customers and ~65% of commercial loads) in FortisBC service territory (incl. those that are customers of FortisBC wholesale customers) will have installed 20 kW of rooftop solar each. Further assumes that half of those that install rooftop PV will also (by 2040) install a 50 kW/210 kWh energy storage system. Storage is assumed to be charged so as to flatten the average GS21 customer load profile and minimize exposure to demand charges (i.e., charge overnight, discharge during day).
FS E2G	Assumes that by 2040, 50% of residential consumers dwelling in single family homes in the FortisBC service territory, that use electricity as their primary space- or water-heating fuel and that live within 50 m of a natural gas line will have converted from electric to natural gas space- and water-heating.
CC	Assumes an average daily increase in temperature of 2^{O} C.

SCENARIO 2 – LOWER BOUND: IMPACTS BY LOAD DRIVER





Absolute and Relative Contribution to Total Impacts in 2040

2040 Impact:	IPSS - RES	IPSS - COM	HP	LD EV	CCS	FS E2G	FS G2E	MHD EV	LLST - Data Centres	LLST - Cannabis	Climate Change
GWh	-333	-49	0	0	0	-142	0	0	0	0	-30
%	60%	9%	0%	0%	0%	26%	0%	0%	0%	0%	5%

2040 Impact:	IPSS - RES	IPSS - COM	HP	LD EV	CCS	FS E2G	FS G2E	MHD EV	LLST - Data Centres	LLST - Cannabis	Climate Change
MW	0	-10	0	0	0	-45	0	0	0	0	-30
%	0%	12%	0%	0%	0%	53%	0%	0%	0%	0%	35%

NB: the % contribution here is calculated as the absolute value of the level impact for the given driver, divided by the sum of the absolute impacts of all drivers

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SCENARIO 2 – LOWER BOUND: NOTEWORTHY OBSERVATIONS

Under the Lower Bound scenario (Scenario 2), by 2040, both energy consumed and January weekday demand between 5pm and 6pm decrease by approximately 13% and 10% (respectively) that projected in the Business As Usual forecast.

Key Observations

- **Overall Impact.** Most load drivers considered for this analysis *decrease* rather than increase load. There are fewer load drivers in Scenario 2, and the average magnitude of effect is much smaller than for Scenario 1.
- **IPSS - Residential.** Given the assumed use parameters (charge storage with PV output, self-supply from storage as production declines through the day), residential storage is, on average, exhausted by the time of system peak 5pm – 6pm in January, resulting in no demand impact from this driver, despite accounting for ~60% of the scenario's energy impact. In sunniest summer months PV and storage completely offset customer loads in this period.
- **Fuel Switching E2G.** Although a significant share of the scenario's energy impact (26%) this load driver is overwhelmingly driving winter peak demand impacts (53%) due to the seasonal shape of the load.
- **Climate Change.** The assumed $2^{O}C$ increase in temperatures contributes a much larger share of the peak demand impact (35%) than of energy (5%)

6. SCENARIO 3: DEEP ELECTRIFICATION

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SCENARIO 3 – DEEP ELECTRIFICATION: KEY ASSUMPTIONS

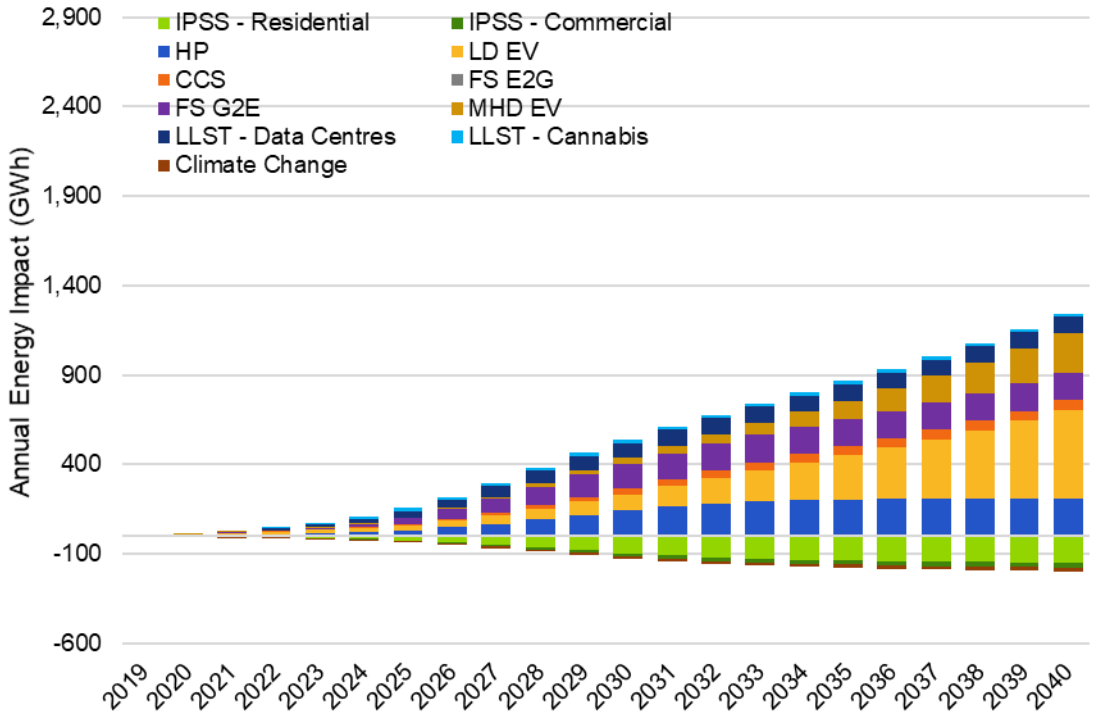
Description

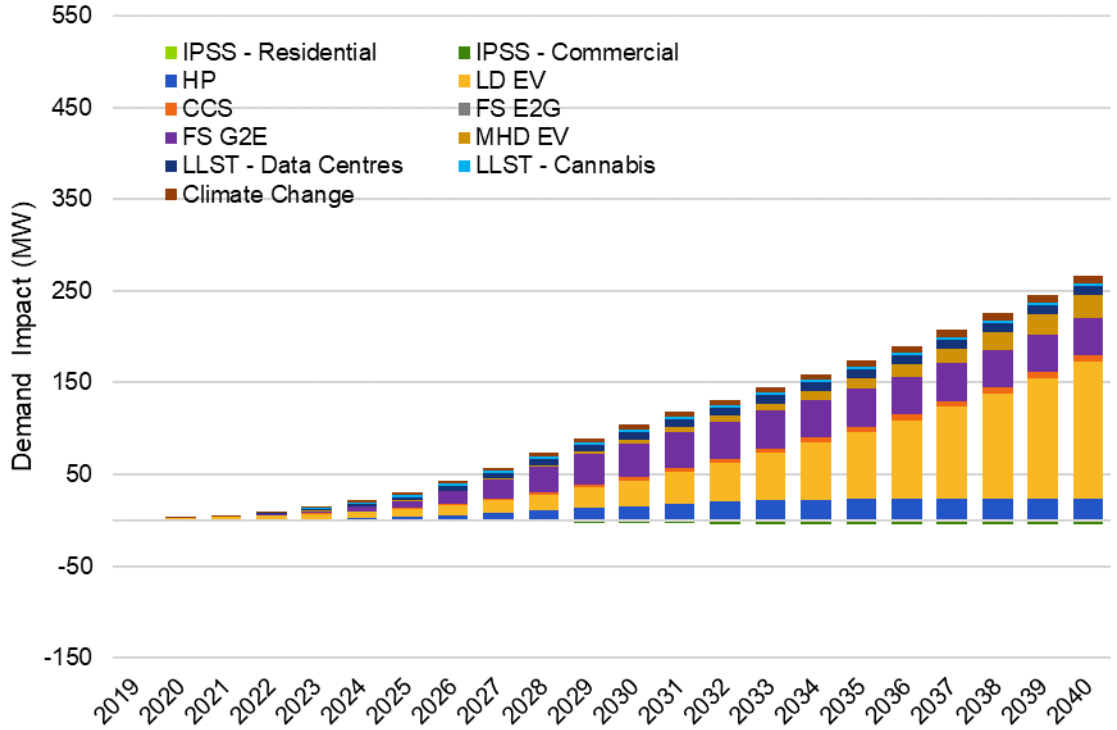
The Deep Electrification scenario exists to help FortisBC understand the potential impacts to demand in a world where solar and storage costs have fallen, the ZEV mandate LD EV targets are met and the associated new charging infrastructure (and falling costs of storage) encourage electrification of medium and heavy duty vehicles. This scenario also assumes a concerted effort to migrate homes from natural gas to electric space- and water-heating. This scenario was designed to align with the Electrification Pathway in FortisBC's EnergyVision 2050 report. This scenario has a net **increase** in load.

Key Assumptions in Load Driver Ultimate Penetration

Driver	Key Assumptions (Ultimate Penetration of Load Driver)	
IPSS - Residential	Assumes that by 2040 15% of all residential consumers dwelling in single family homes in the FortisBC service territory will have installed 8 kW of rooftop solar PV, each. Further assumes that half of those that install rooftop PV will also (by 2040) install a 5 kW/13.5 kWh energy storage system.	
IPSS - Commercial	Assumes that by 2040 25% of all GS21 commercial customers in FortisBC service territory will have installed 20 kW of rooftop solar each. Further assumes that half of those that install rooftop PV will also (by 2040) install a 50 kW/210 kWh energy storage system.	
EVs	**Light-Duty EVs**. **Medium/Heavy-Duty EVs.**	Penetration aligns with ZEV mandate assumptions (same as Scenario 1: Upper Bound). Assumes that by 2040, 60% of return-to-base vehicle, combination tractor, and bus sales are EVs
FS G2E	Assumes that by 2040, FortisBC will achieve 15% of the residential electrification Technical potential identified by the 2019 Conservation Potential Review electrification potential study for the terminal year of that study.	
LLST	**Data Centres** **Cannabis Production**	Assumed growth (by 2040) of approximately 150,000 ft^2 of floor space from the estimated existing 200,000 ft^2. Assumed growth (by 2040) of approximately 250,000 ft^2 of floor space from the estimated existing and 100% confidence projected (via connection requests) 1 million ft^2 in 2021.
HP	Assumes an annual production of 0.7 PJ of hydrogen by 2040.	
CCS	Assumes an annual capture of 180 kT per year of industrial-sector GHG by 2040.	
CC	Assumes an average daily increase in temperature of 2^{O} C, annual 10-day cold snaps with temperatures 2.6^{O}C below average, and 10-day heat waves with temperatures 0.7 C^{O} above average	

SCENARIO 3 – DEEP ELECTRIFICATION: IMPACTS BY LOAD DRIVER





Absolute and Relative Contribution to Total Impacts in 2040

2040 Impact:	IPSS - RES	IPSS - COM	HP	LD EV	CCS	FS E2G	FS G2E	MHD EV	LLST - Data Centres	LLST - Cannabis	Climate Change
GWh	-151	-25	205	500	54	0	155	219	92	18	-22
%	11%	2%	14%	35%	4%	0%	11%	15%	6%	1%	2%

2040 Impact:	IPSS - RES	IPSS - COM	HP	LD EV	CCS	FS E2G	FS G2E	MHD EV	LLST - Data Centres	LLST - Cannabis	Climate Change
MW	0	-5	23	150	6	0	41	25	9	3	9
%	0%	2%	8%	55%	2%	0%	15%	9%	3%	1%	3%

NB: the % contribution here is calculated as the absolute value of the level impact for the given driver, divided by the sum of the absolute impacts of all drivers

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SCENARIO 3 – DEEP ELECTRIFICATION: NOTEWORTHY OBSERVATIONS

Under the Deep Electrification scenario (Scenario 3), by 2040, both energy consumed and January weekday demand between 5pm and 6pm increase by approximately 24% and 29% (respectively) that projected in the Business As Usual forecast.

Key Observations

- **Overall Impact.** In this scenario, the offsetting impacts of the residential IPSS driver mean that peak demand increases more (in relative terms) than energy consumption. Scenarios in which distributed generation offset energy consumption, but not peak demand growth, could result in higher electricity rates.
- **Light-Duty EVs.** The ultimate penetration of LD EVs in this scenario is the same as in the Upper Bound scenarios, approximately aligned with the Zero Emission Vehicle (ZEV) mandate. This driver therefore dominates this scenario, contributing approximately 1/3 of the sum of absolute value of energy impacts, and over half of the sum of the absolute value of demand impacts.
  This observation, along with the demonstrated effectiveness at time-varying rates (and enabling technologies) at shifting EV charging, suggests that – if growth in EV sales is expected to meet the ZEV mandate – FortisBC should consider mitigating measures.

7. SCENARIO 4: DIVERSIFIED ENERGY PATHWAY

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SCENARIO 4 – DIVERSIFIED ENERGY PATHWAY: KEY ASSUMPTIONS

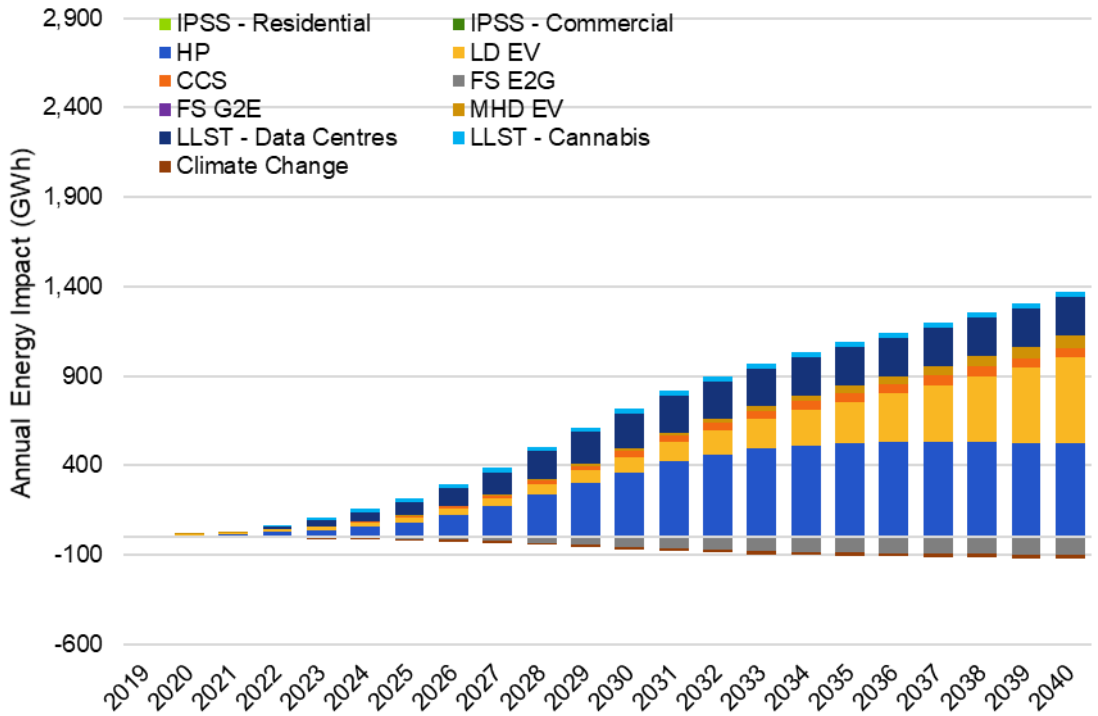
Description

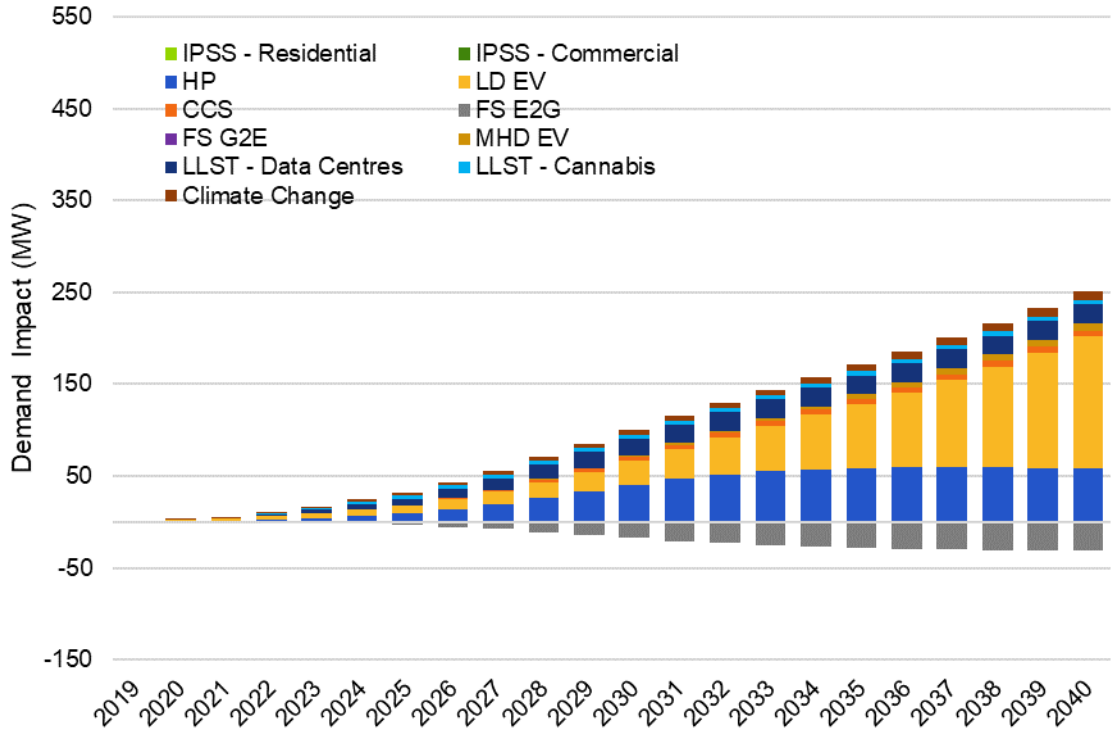
The Diversified Energy Pathway scenario exists to help FortisBC understand the potential impact of a world featuring aggressive decarbonization of transportation (as in other scenarios) where policy attempts to meet increased demand with minimal incremental capacity procurement by converting some residential electric heating to gas. To mitigate increased emissions due this conversion, some hydrogen is injected into the NG distribution system, and some CCS procured. This scenario was designed to align with the Diversified Pathway in FortisBC's EnergyVision 2050 report. This scenario has a net **increase** in load.

Key Assumptions in Load Driver Ultimate Penetration

Driver	Key Assumptions (Ultimate Penetration of Load Driver)	
EVs	**Light-Duty EVs**. **Medium/Heavy-Duty EVs.**	By 2040, 95% of LDV sales are EVs (slightly less than Upper Bound or Deep Electrification). Assumes that by 2040, 20% of return-to-base vehicle, combination tractor, and bus sales are EVs
FS E2G	Assumes that by 2040, 35% of residential consumers dwelling in single family homes in the FortisBC service territory, that use electricity as their primary space- or water-heating fuel and that live within 50 m of a natural gas line will have converted from electric to natural gas space- and water-heating.	
LLST	**Data Centres** **Cannabis Production**	Assumed growth (by 2040) of approximately 380,000 ft^2 of floor space from the estimated existing 200,000 ft^2. Assumed growth (by 2040) of approximately 370,000 ft^2 of floor space from the estimated existing and 100% confidence projected (via connection requests) 1 million ft^2 in 2021.
HP	Assumes an annual production of 1.8 PJ of hydrogen by 2040.	
CCS	Assumes an annual capture of 180 kT per year of industrial-sector GHG by 2040.	
CC	Assumes an average daily increase in temperature of 2^{O} C, annual 10-day cold snaps with temperatures 2.6^{O}C below average, and 10-day heat waves with temperatures 0.7 C^{O} above average	

SCENARIO 4 – DIVERSIFIED ENERGY PATHWAY: IMPACTS BY LOAD DRIVER





Absolute and Relative Contribution to Total Impacts in 2040

2040 Impact:	IPSS - RES	IPSS - COM	HP	LD EV	CCS	FS E2G	FS G2E	MHD EV	LLST - Data Centres	LLST - Cannabis	Climate Change
GWh	0	0	526	475	54	-99	0	70	215	29	-22
%	0%	0%	35%	32%	4%	7%	0%	5%	14%	2%	1%

2040 Impact:	IPSS - RES	IPSS - COM	HP	LD EV	CCS	FS E2G	FS G2E	MHD EV	LLST - Data Centres	LLST - Cannabis	Climate Change
MW	0	0	59	143	6	-32	0	8	21	5	9
%	0%	0%	21%	51%	2%	11%	0%	3%	7%	2%	3%

NB: the % contribution here is calculated as the absolute value of the level impact for the given driver, divided by the sum of the absolute impacts of all drivers

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SCENARIO 4 – DIVERSIFIED ENERGY PATHWAY: NOTEWORTHY OBSERVATIONS

Under the Diversified Energy Pathway scenario (Scenario 4), by 2040, both energy consumed and January weekday demand between 5pm and 6pm increase by approximately 28% and 25% (respectively) that projected in the Business As Usual forecast.

Key Observations

- **Overall Impact.** This scenario is in some ways the obverse of the Deep Electrification scenario, with energy consumption rising slightly more than peak demand (suggesting that rates could decline, or stay steady in real terms, in this scenario). This is due to the peak off-setting impact of the E2G fuel-switching reducing the peak-coincident demand increase from light-duty EVs.
- **Light-Duty EVs.** As in other scenarios, the relative contribution of this load-driver to peak demand is much greater than to energy consumption, suggesting that need for mitigating incentives or tools to shift demand off-peak.
- **Hydrogen Production**. Extensive hydrogen production (1.8 PJ, or approximately 3% of 2016 LTGRP projected 2036 gas consumption for the shared service territory) is the single largest contributor to increased energy consumption in this scenario.

8. SCENARIO 5: DISTRIBUTED ENERGY FUTURE

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SCENARIO 5 – DISTRIBUTED ENERGY FUTURE: KEY ASSUMPTIONS

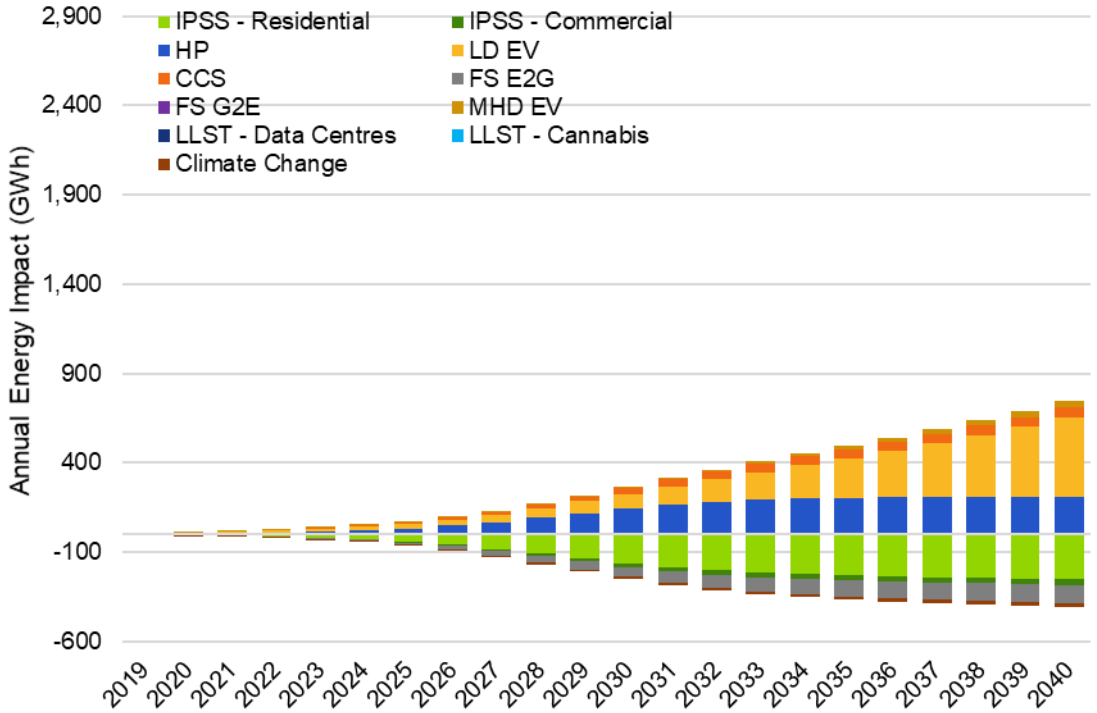
Description

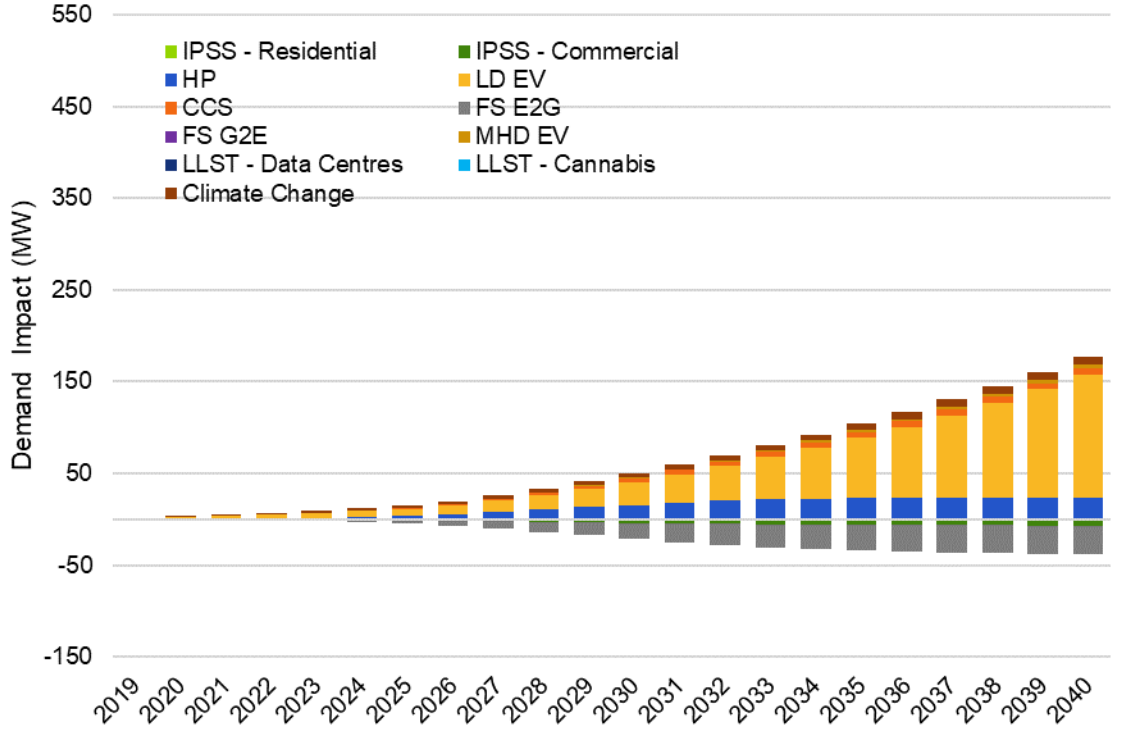
The Distributed Energy Future scenario exists to help FortisBC understand the potential impact of a world where incremental energy requirements from transportation electrification are delivered via E2G fuel switching as well as growth in distributed generation. This scenario has a net **increase** in load.

Key Assumptions in Load Driver Ultimate Penetration

Driver	Key Assumptions (Ultimate Penetration of Load Driver)
IPSS - Residential	Assumes that by 2040 25% of all residential consumers dwelling in single family homes in the FortisBC service territory will have installed 8 kW of rooftop solar PV, each. Further assumes that half of those that install rooftop PV will also (by 2040) install a 5 kW/13.5 kWh energy storage system.
IPSS - Commercial	Assumes that by 2040 33% of all GS21 commercial customers in FortisBC service territory will have installed 20 kW of rooftop solar each. Further assumes that half of those that install rooftop PV will also (by 2040) install a 50 kW/210 kWh energy storage system.
EVs	**Light-Duty EVs**. By 2040, 90% of LDV sales are EVs (slightly less than Diversified Energy Pathway). **Medium/Heavy-Duty EVs.** Assumes that by 2040, 10% of return-to-base vehicle, combination tractor, and bus sales are EVs
FS E2G	Assumes that by 2040, 35% of residential consumers dwelling in single family homes in the FortisBC service territory, that use electricity as their primary space- or water-heating fuel and that live within 50 m of a natural gas line will have converted from electric to natural gas space- and water-heating.
HP	Assumes an annual production of 0.7 PJ of hydrogen by 2040.
CCS	Assumes an annual capture of 180 kT per year of industrial-sector GHG by 2040.
CC	Assumes an average daily increase in temperature of 2^{O} C, annual 10-day cold snaps with temperatures 2.6^{O}C below average, and 10-day heat waves with temperatures 0.7 C^{O} above average

SCENARIO 5 – DISTRIBUTED ENERGY FUTURE: IMPACTS BY LOAD DRIVER





Absolute and Relative Contribution to Total Impacts in 2040

2040 Impact:	IPSS - RES	IPSS - COM	HP	LD EV	CCS	FS E2G	FS G2E	MHD EV	LLST - Data Centres	LLST - Cannabis	Climate Change
GWh	-252	-33	205	450	54	-99	0	35	0	0	-22
%	22%	3%	18%	39%	5%	9%	0%	3%	0%	0%	2%

2040 Impact:	IPSS - RES	IPSS - COM	HP	LD EV	CCS	FS E2G	FS G2E	MHD EV	LLST - Data Centres	LLST - Cannabis	Climate Change
MW	0	-7	23	135	6	-32	0	4	0	0	9
%	0%	3%	11%	63%	3%	15%	0%	2%	0%	0%	4%

NB: the % contribution here is calculated as the absolute value of the level impact for the given driver, divided by the sum of the absolute impacts of all drivers

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SCENARIO 5 – DISTRIBUTED ENERGY FUTURE: NOTEWORTHY OBSERVATIONS

Under the Distributed Energy Pathway scenario (Scenario 5), by 2040, both energy consumed and January weekday demand between 5pm and 6pm increase by approximately 8% and 16% (respectively) that projected in the Business As Usual forecast.

Key Observations

- **Overall Impact.** The off-setting effects of the load drivers yield a net impact that is very small, likely well-within the uncertainty bounds of the Business-As-Usual forecast. The fact that residential IPSS delivers no peak demand reduction means, like the Deep Electrification scenario, that there is less of an increase in consumption than in peak demand.
- **Light-Duty EVs.** As in other scenarios, the relative contribution of this load-driver to peak demand is much greater than to energy consumption, suggesting that need for mitigating incentives or tools to shift demand off-peak.
- **Hydrogen Production**. Even relatively modest hydrogen production (0.7 PJ by 2040) substantially increases forecast consumption, though this driver is off-set by energy produced by residential IPSS.

NAVIGANT CONTACTS

CRAIG SABINE
Director
647-288-5227
craig.sabine@navigant.com

PETER STEELE-MOSEY
Associate Director
416-956-5050
peter.steele-mosey@navigant.com

DIXON GRANT
Senior Consultant
647-288-5211
dixon.grant@navigant.com

KRISTEN MALIK
Consultant
416-777-2449
kristen.malik@navigant.com

APPENDIX A: JULY PEAK DEMAND IMPACTS

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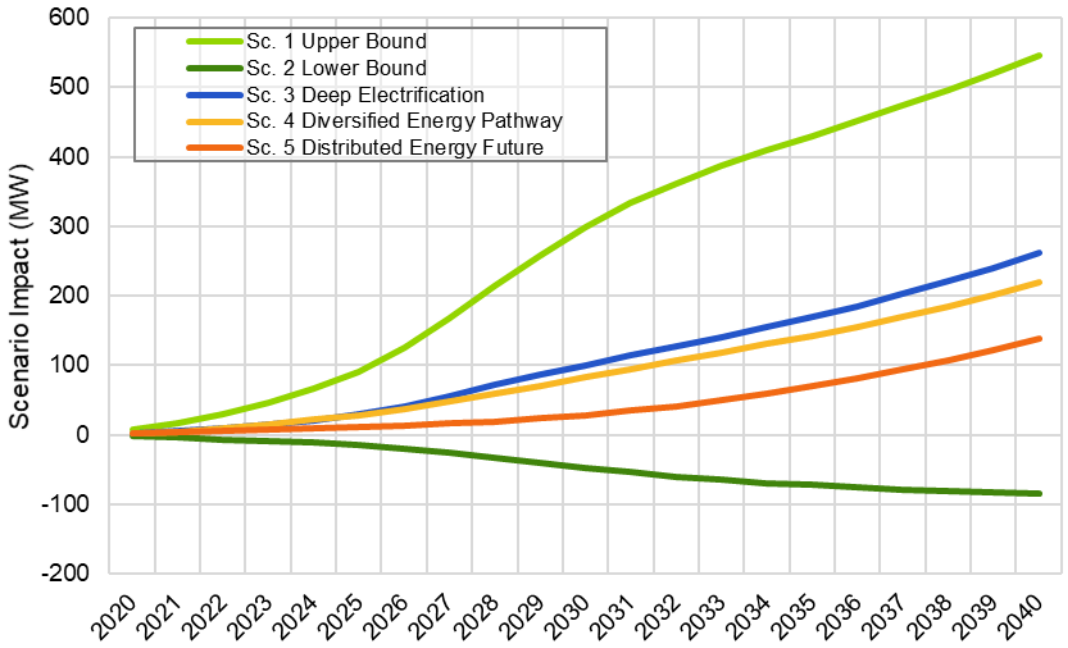
JULY DEMAND IMPACTS – COMPARED WITH JANUARY DEMAND IMPACTS

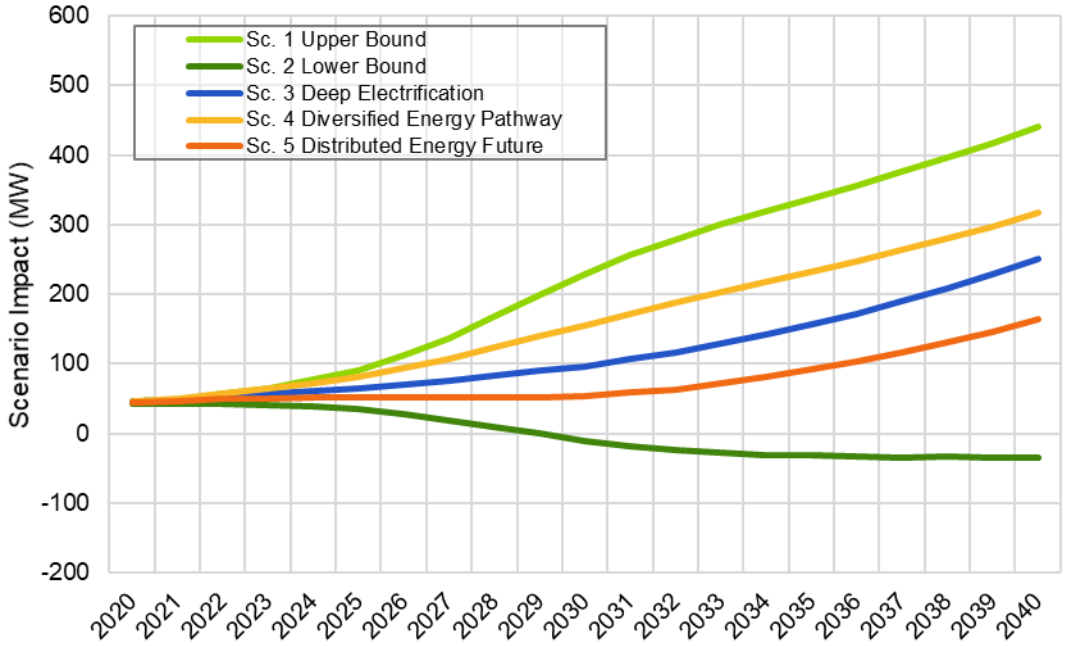
Annual January Peak Demand Impacts (MW)

Average demand on non-holiday January weekdays between 5pm and 6pm



Annual July Peak Demand Impacts (MW)

Average demand on non-holiday July weekdays between 5pm and 6pm



(MW, 2040)	Sc. 1 Upper Bound	Sc. 2 Lower Bound	Sc. 3 Deep Electrification	Sc. 4 Diversified Energy Pathway	Sc. 5 Distributed Energy Future
January	546	-85	262	219	139
July	440	-34	251	317	164

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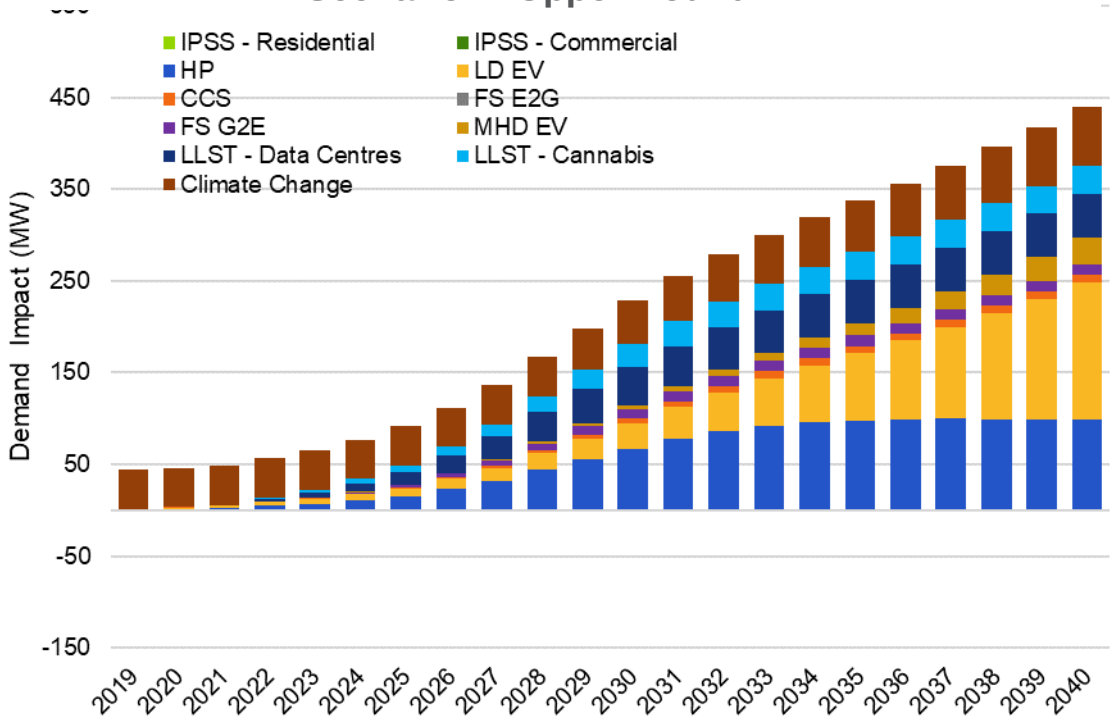
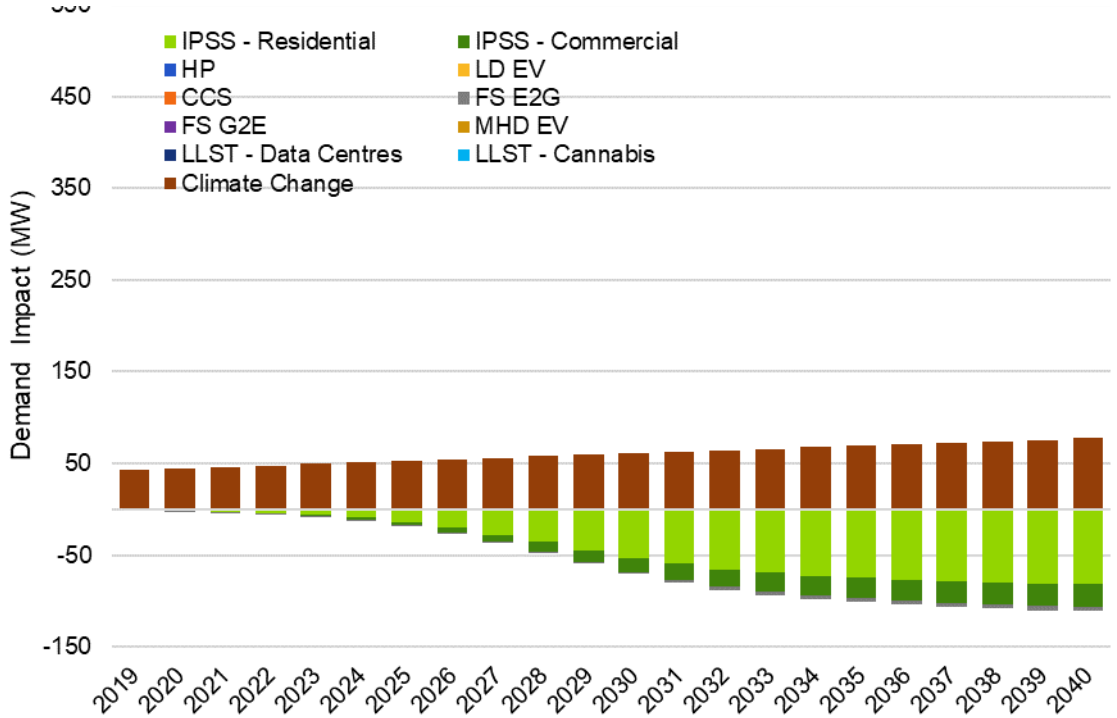
JULY PEAK DEMAND IMPACTS – UPPER AND LOWER BOUND SCENARIOS

Scenario 1: Upper Bound



Scenario 2: Lower Bound



Absolute and Relative Contribution to Total Impacts in 2040

2040 Impact:	IPSS - RES	IPSS - COM	HP	LD EV	CCS	FS E2G	FS G2E	MHD EV	LLST - Data Centres	LLST - Cannabis	Climate Change
MW	0	0	98	150	8	0	11	29	48	30	65
%	0%	0%	22%	34%	2%	0%	3%	7%	11%	7%	15%

2040 Impact:	IPSS - RES	IPSS - COM	HP	LD EV	CCS	FS E2G	FS G2E	MHD EV	LLST - Data Centres	LLST - Cannabis	Climate Change
MW	-82	-25	0	0	0	-5	0	0	0	0	77
%	43%	13%	0%	0%	0%	3%	0%	0%	0%	0%	41%

NB: the % contribution here is calculated as the absolute value of the level impact for the given driver, divided by the sum of the absolute impacts of all drivers

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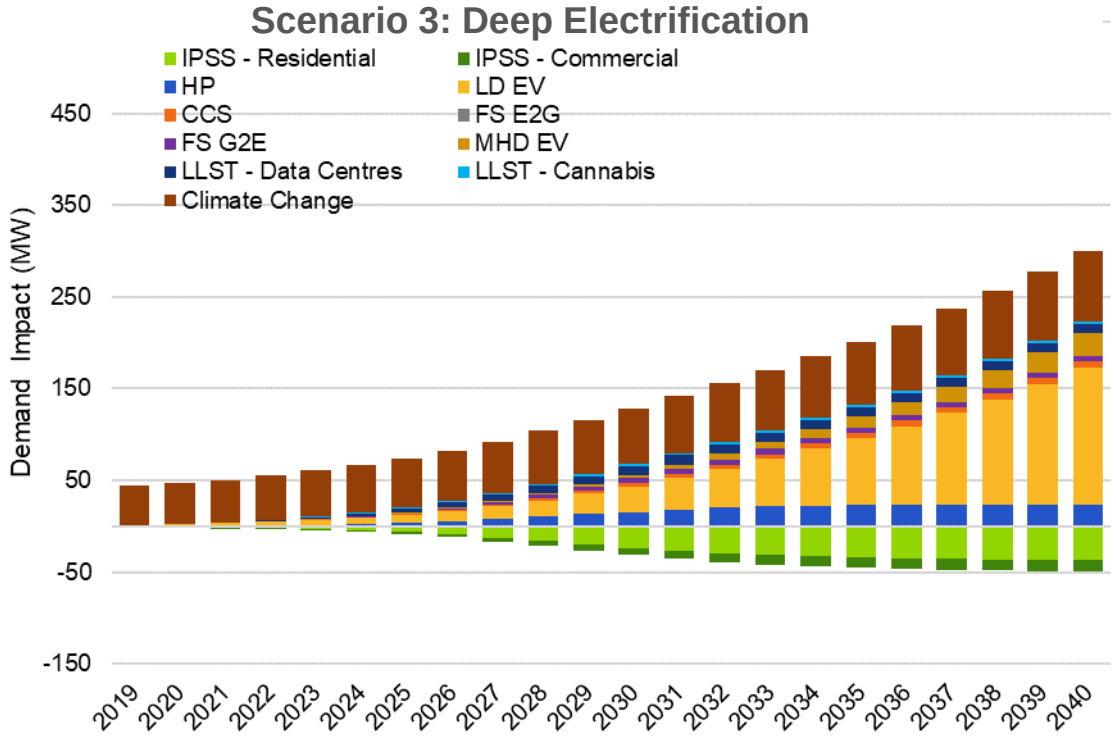
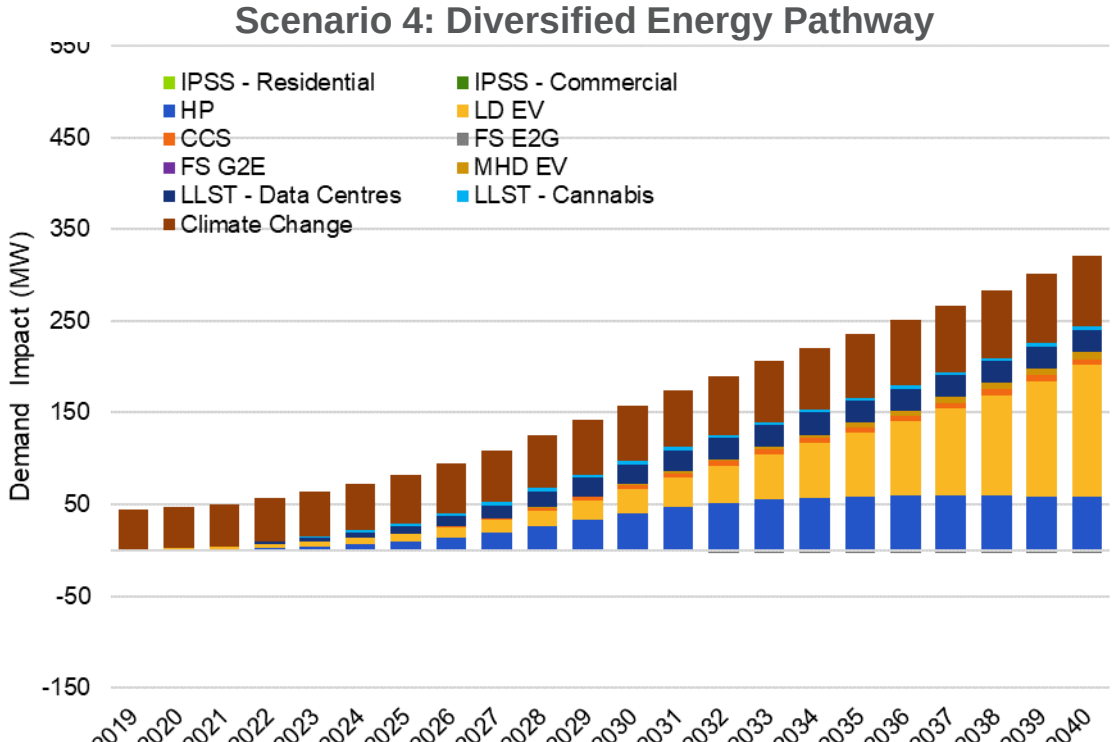
JULY PEAK DEMAND IMPACTS – DEEP ELECTRIFICATION AND DIVERSIFIED ENERGY PATHWAY SCENARIOS





Absolute and Relative Contribution to Total Impacts in 2040

2040 Impact:	IPSS - RES	IPSS - COM	HP	LD EV	CCS	FS E2G	FS G2E	MHD EV	LLST - Data Centres	LLST - Cannabis	Climate Change
MW	-37	-12	23	150	6	0	6	25	10	2	77
%	11%	4%	7%	43%	2%	0%	2%	7%	3%	1%	22%

2040 Impact:	IPSS - RES	IPSS - COM	HP	LD EV	CCS	FS E2G	FS G2E	MHD EV	LLST - Data Centres	LLST - Cannabis	Climate Change
MW	0	0	59	143	6	-3	0	8	24	3	77
%	0%	0%	18%	44%	2%	1%	0%	2%	8%	1%	24%

NB: the % contribution here is calculated as the absolute value of the level impact for the given driver, divided by the sum of the absolute impacts of all drivers

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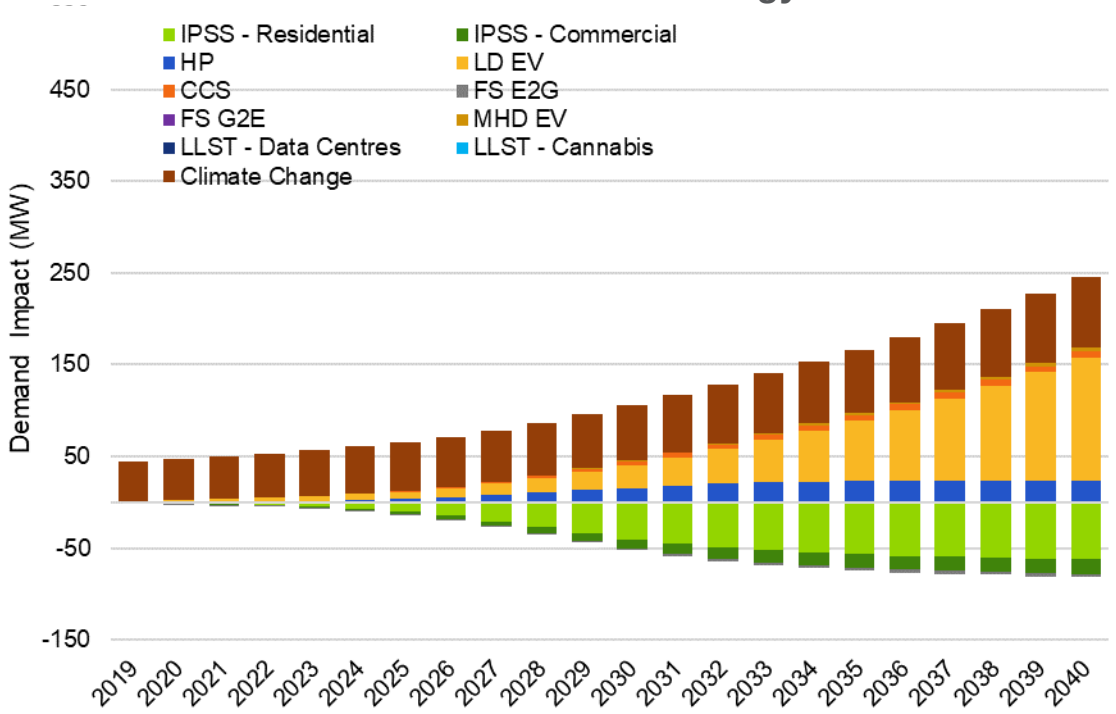
JULY PEAK DEMAND IMPACTS – DEEP ELECTRIFICATION AND DIVERSIFIED ENERGY PATHWAY SCENARIOS

Scenario 5: Distributed Energy Future



Absolute and Relative Contribution to Total Impacts in 2040

2040 Impact:	IPSS - RES	IPSS - COM	HP	LD EV	CCS	FS E2G	FS G2E	MHD EV	LLST - Data Centres	LLST - Cannabis	Climate Change
MW	-62	-16	23	135	6	-3	0	4	0	0	77
%	19%	5%	7%	41%	2%	1%	0%	1%	0%	0%	24%

NB: the % contribution here is calculated as the absolute value of the level impact for the given driver, divided by the sum of the absolute impacts of all drivers

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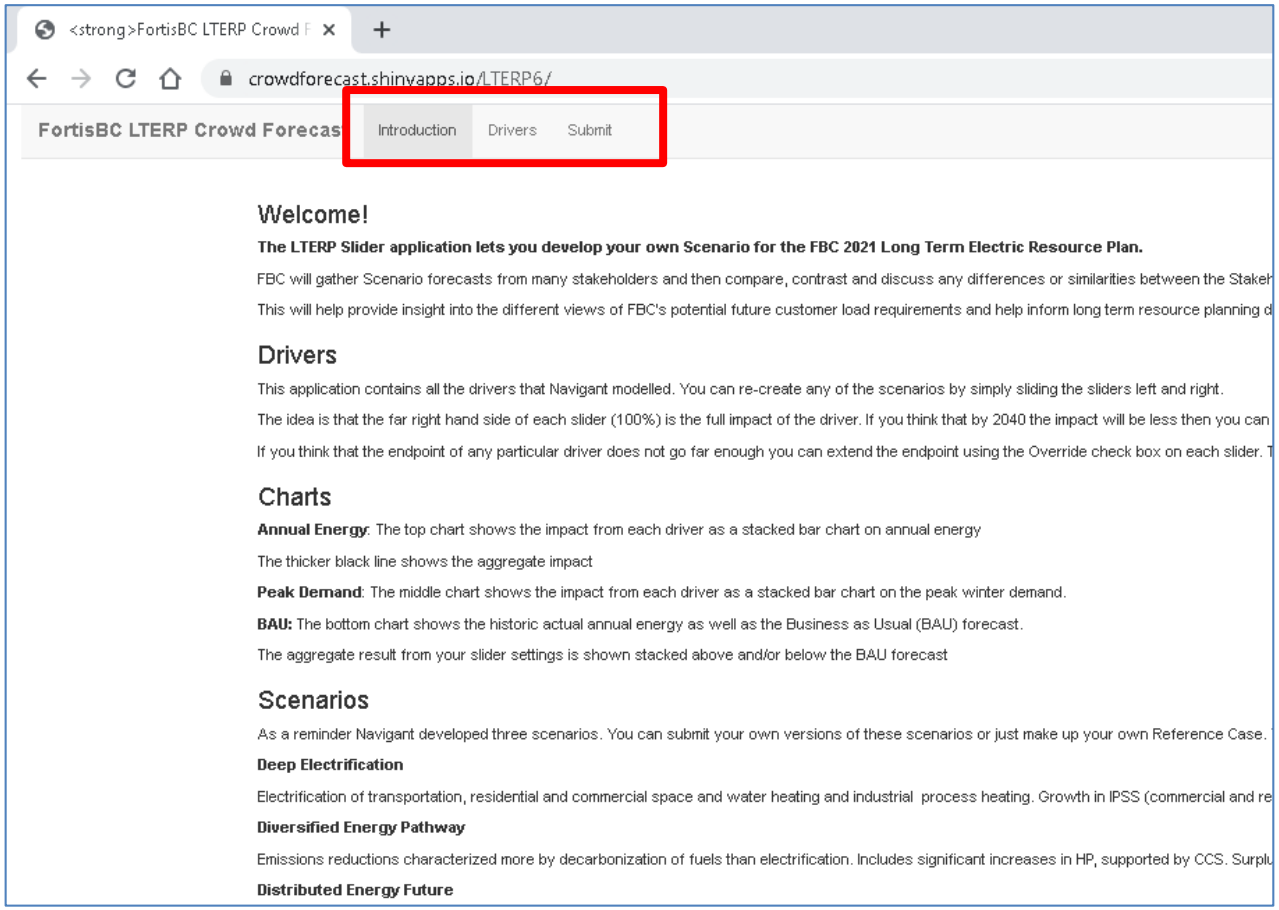
Break

Stakeholder Scenarios

Stakeholder Scenarios

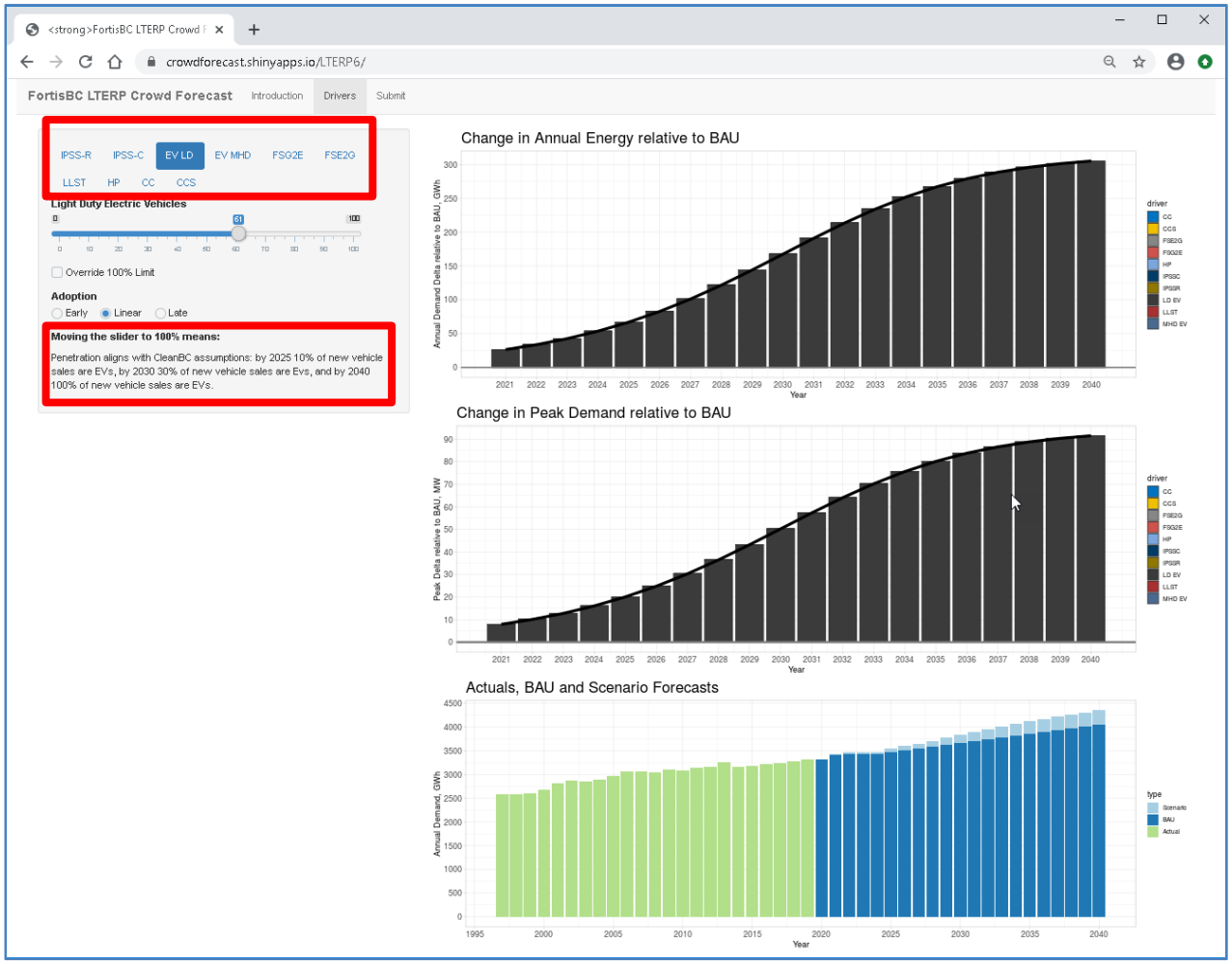
- Last LTERP we provided Advisory Group with a “Slider” tool in Excel
  - This time it is online, but works the same way
- We will collect the responses and compare to FBC scenarios
- Goals:
  - Enable stakeholder input
  - Understand what the future is sensitive to
  - Provide insight and help inform resource planning
- Transparent and simple to use
- Please submit results by July 24
- We will email you this link:
  - https://crowdforecast.shinyapps.io/LTERP6

The Slider App



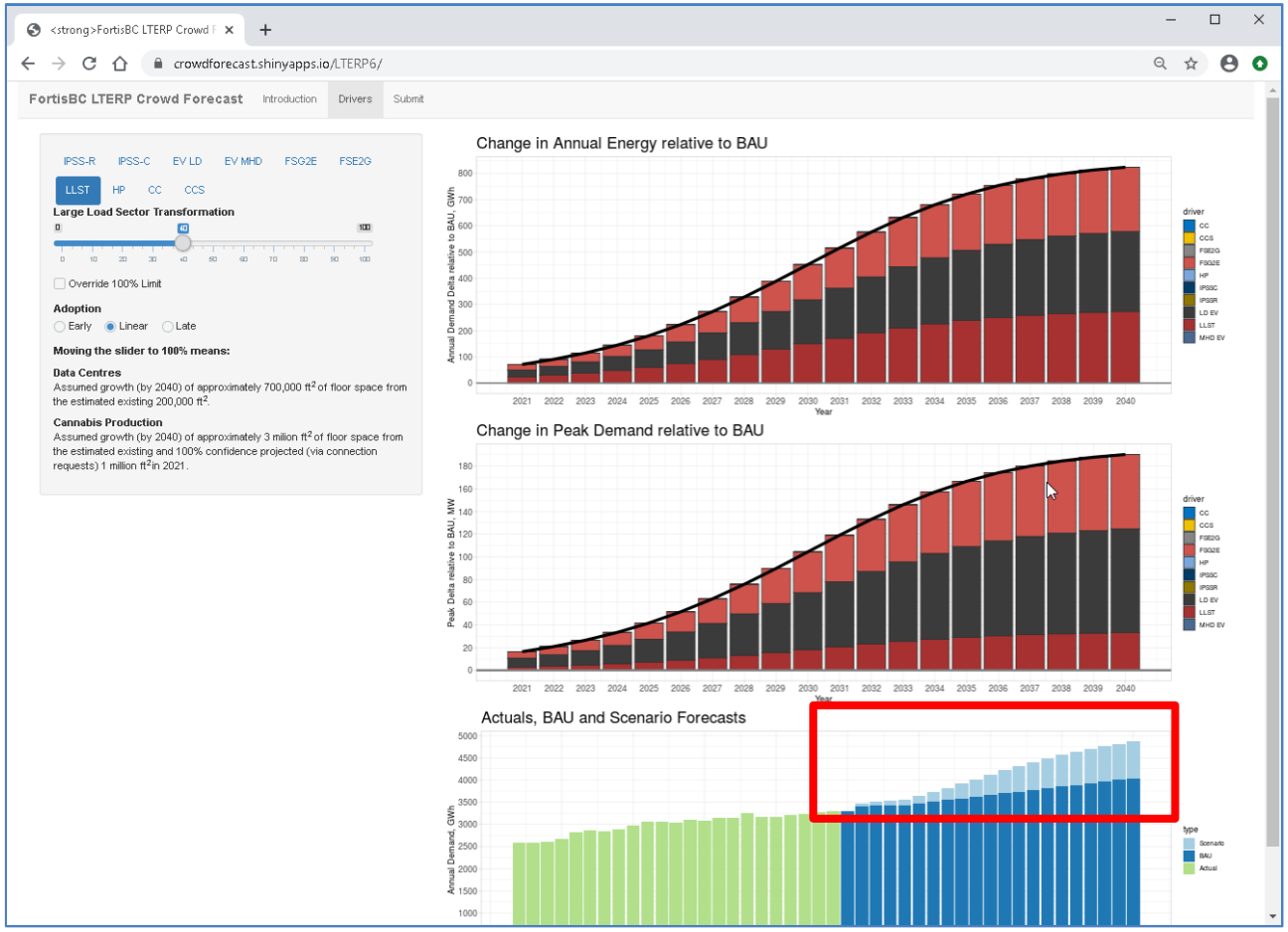
- We will be sending a link
- When you open the link you will see the Intro tab
- The tab has some reminders and explanations, as well as my contact link if you need help
- Note there are three tabs across the top (Intro, Drivers and Submit)

One Slider



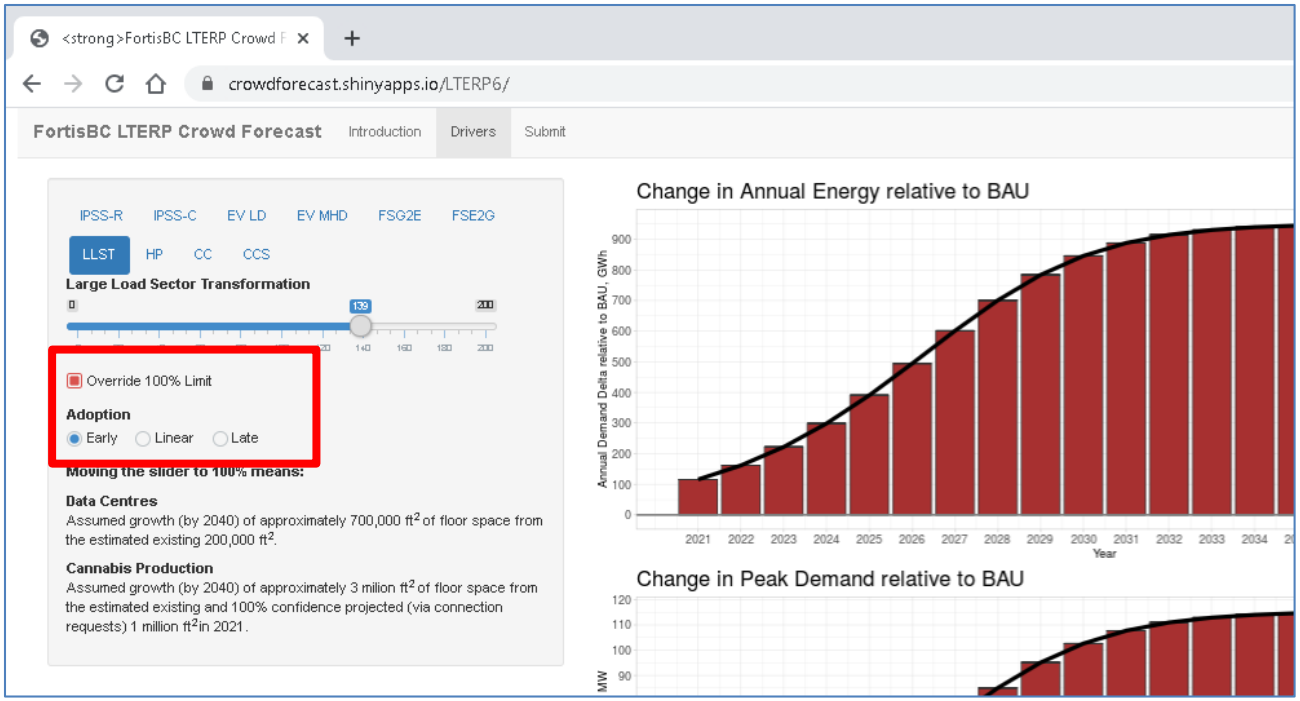
- This is the driver tab
- There are 10 drivers
- The screen shot shows EVs
- The note at the bottom of the panel explains what "Sliding to 100% means"
- If you think by 2040 the impact will be LESS than 100% then slide the slider
- Watch the charts change
- The upper is the annual Energy in GWh
- The middle is the peak in MW
- The lower shows the history (green), the BAU (dark blue) and the net impact from all your slider settings in light blue

Multiple Sliders



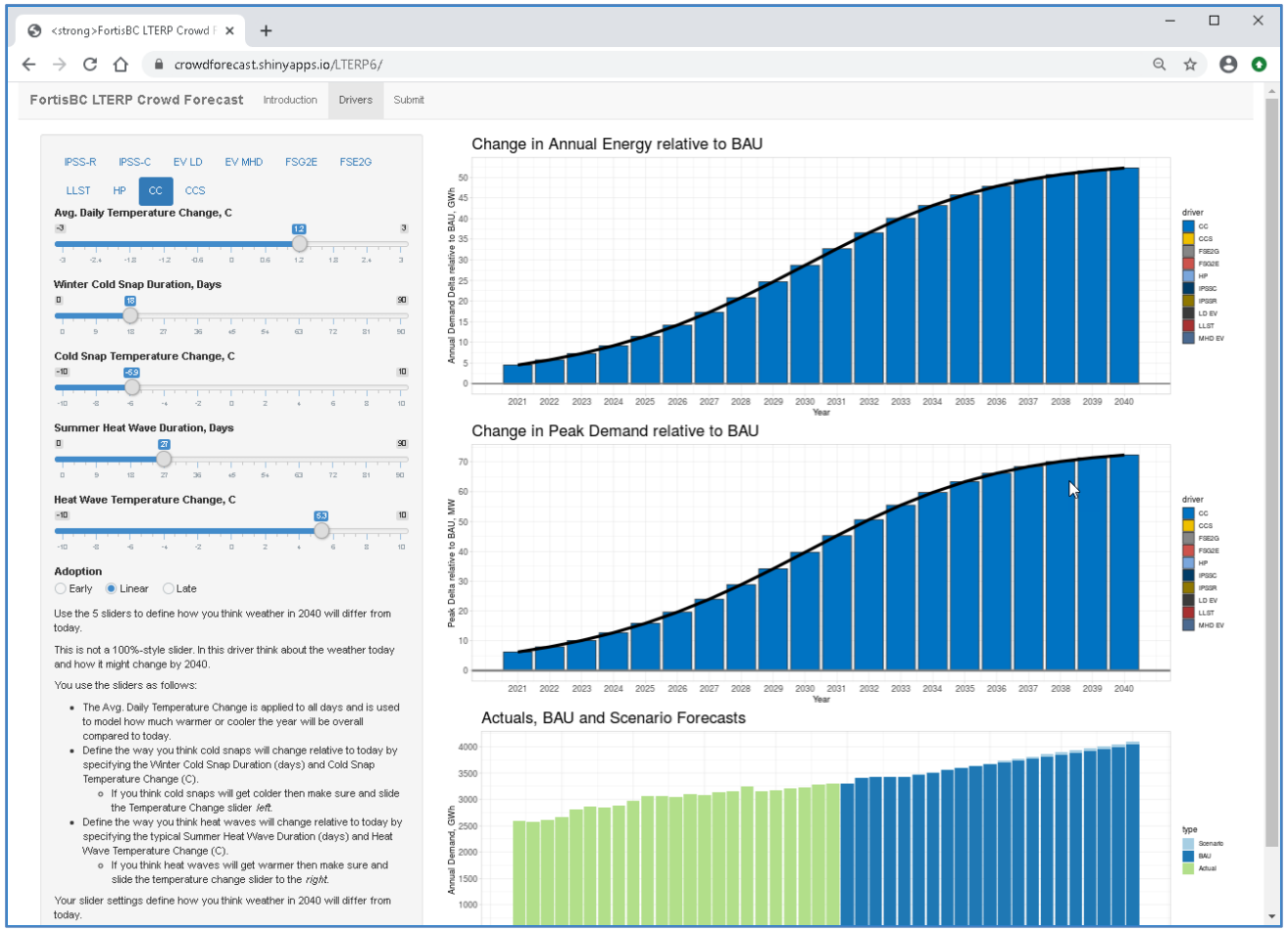
- The effect from setting three sliders
- The lower shows the history (green), the BAU (dark blue) and the net impact from all your slider settings in light blue

Other Features



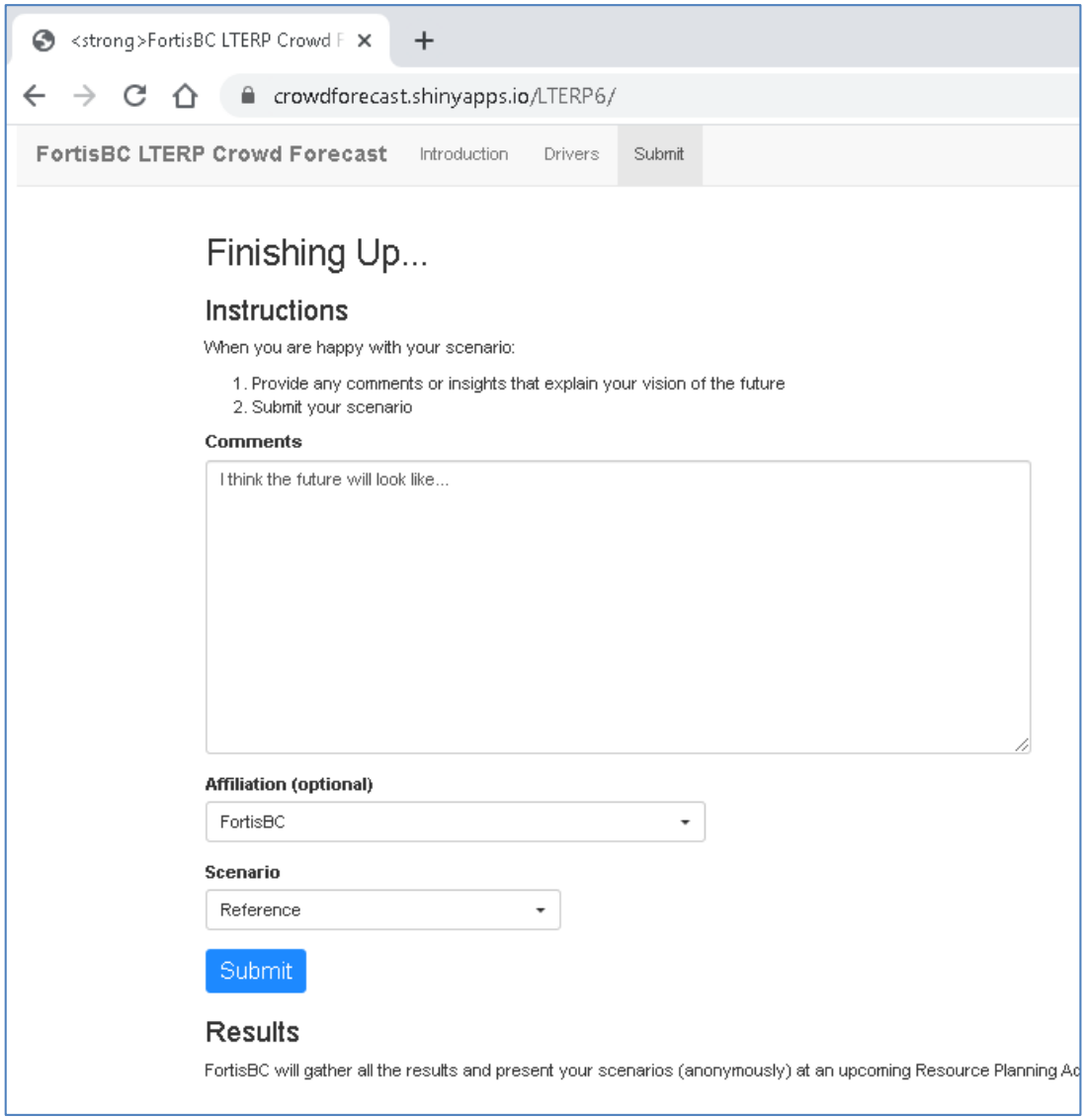
- If you want the slider to go past 100% click the Override check box
- You can control how the load develops with the Adoption button
- Loads can come on linearly over time or you can set them to come on early or late

Climate Change is a Little Different…



- This is not a “100%” slider
- Instead we ask five questions:
  - How much will the average daily temperature change by 2040, relative to today?
  - Will the duration of winter “cold snaps” change? If so by how many days?
  - Will cold snap temperatures be different that today? If so by how much?
  - Will the duration of summer “heat waves” change? If so by how many days?
  - Will heat wave temperatures be different that today? If so by how much?
- Your sliders will define a 2040 weather pattern that is fed in to a model of demand vs temperature
- The result is the change in annual energy and peak relative to today

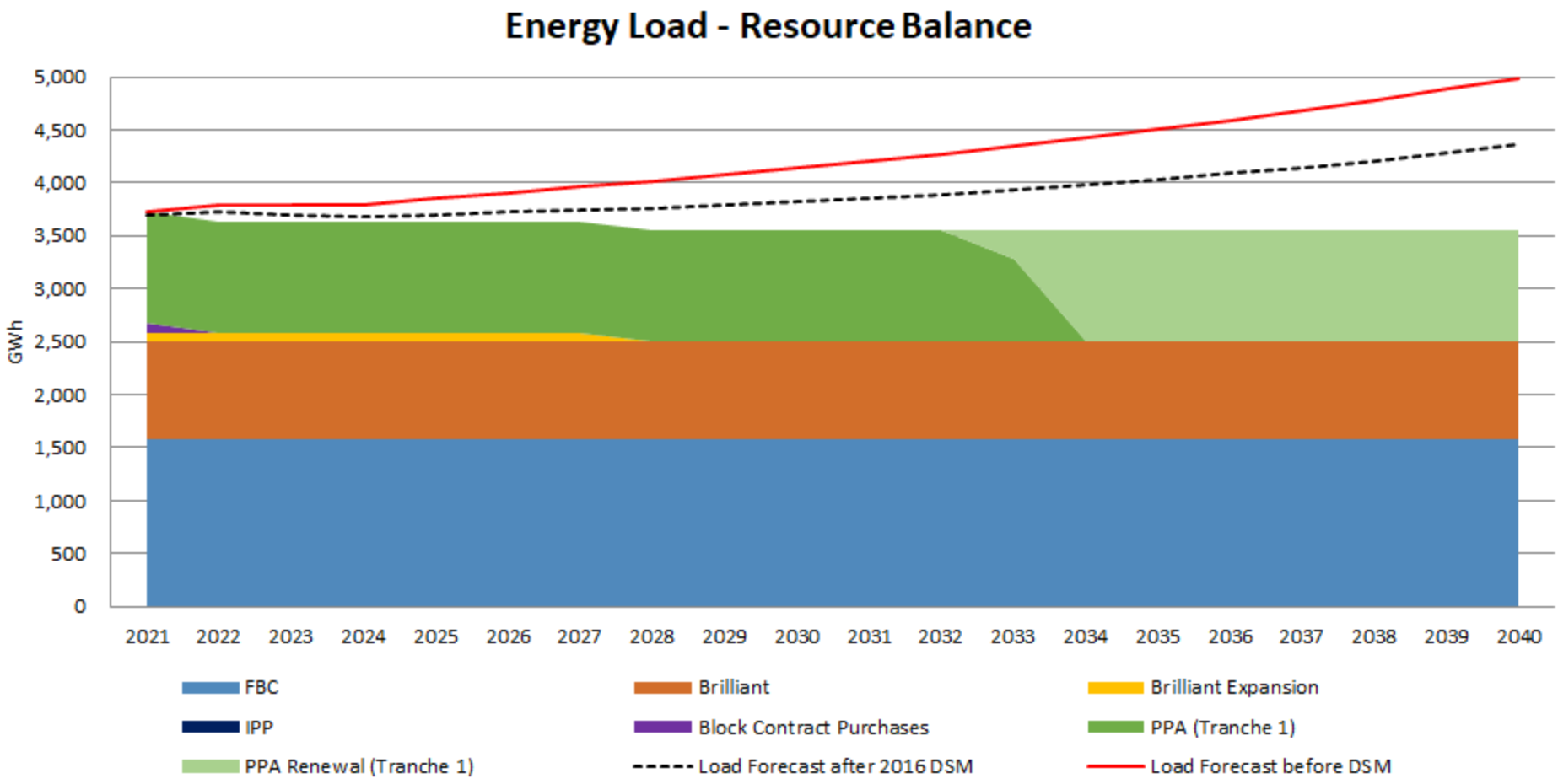
Finishing Up



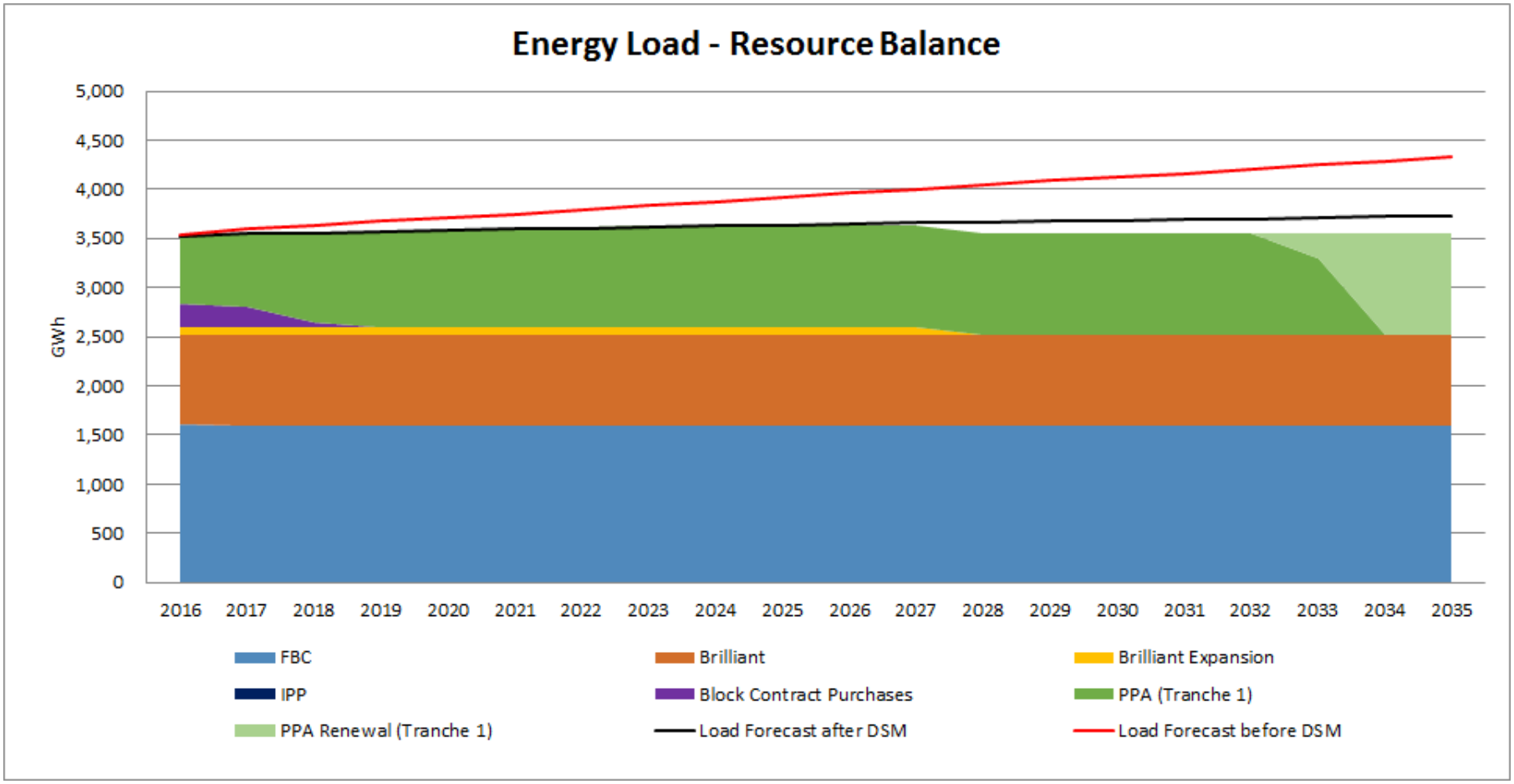
- When you are happy with your sliders go to the Submit tab
- It is helpful to get a few comments about your view of the future
- Your insights are valuable and really offer the “why” behind the “what”
- Identify your affiliation if you want to
- If you are trying to match one of the Navigant scenarios, but with some changes, you can indicate that under “Scenario”
- Click Submit to send us your forecast
- Note that no personal information is collected.
- If you choose to identify your affiliation then that choice will be sent

Load-Resource Balance (before 2021 DSM Plan)

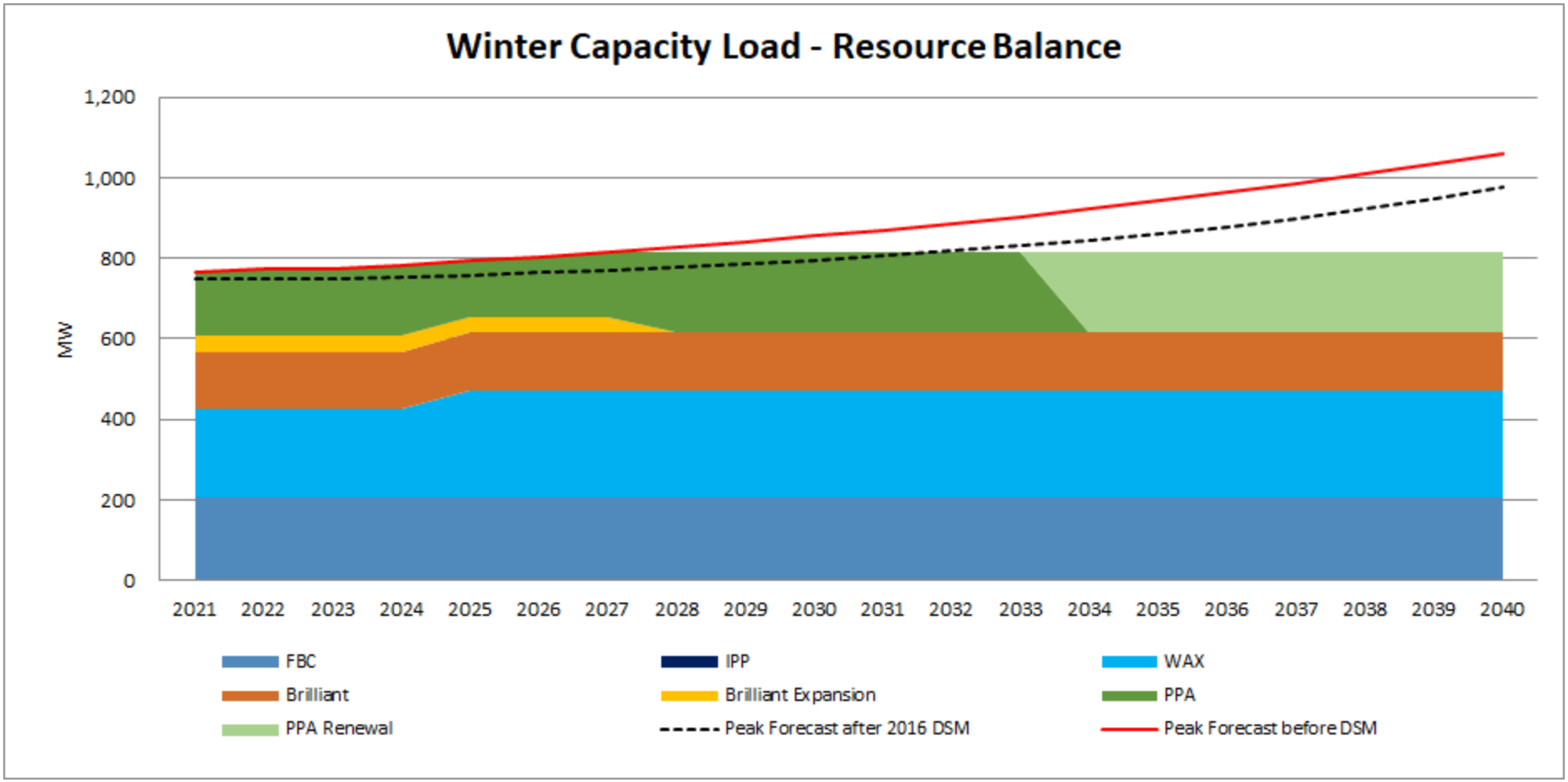
2021 LTERP LRB – Annual Energy



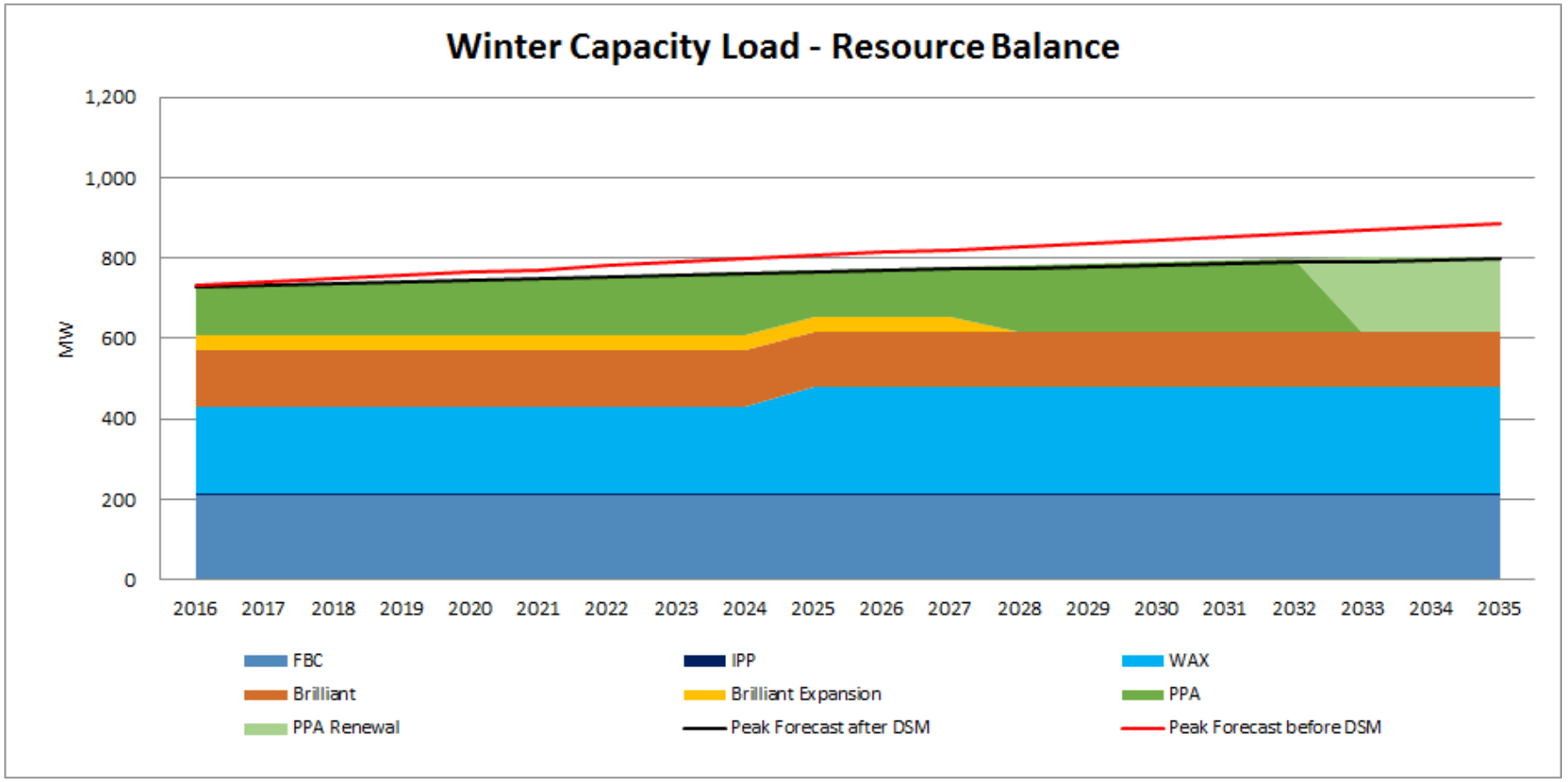
2016 LTERP LRB – Annual Energy



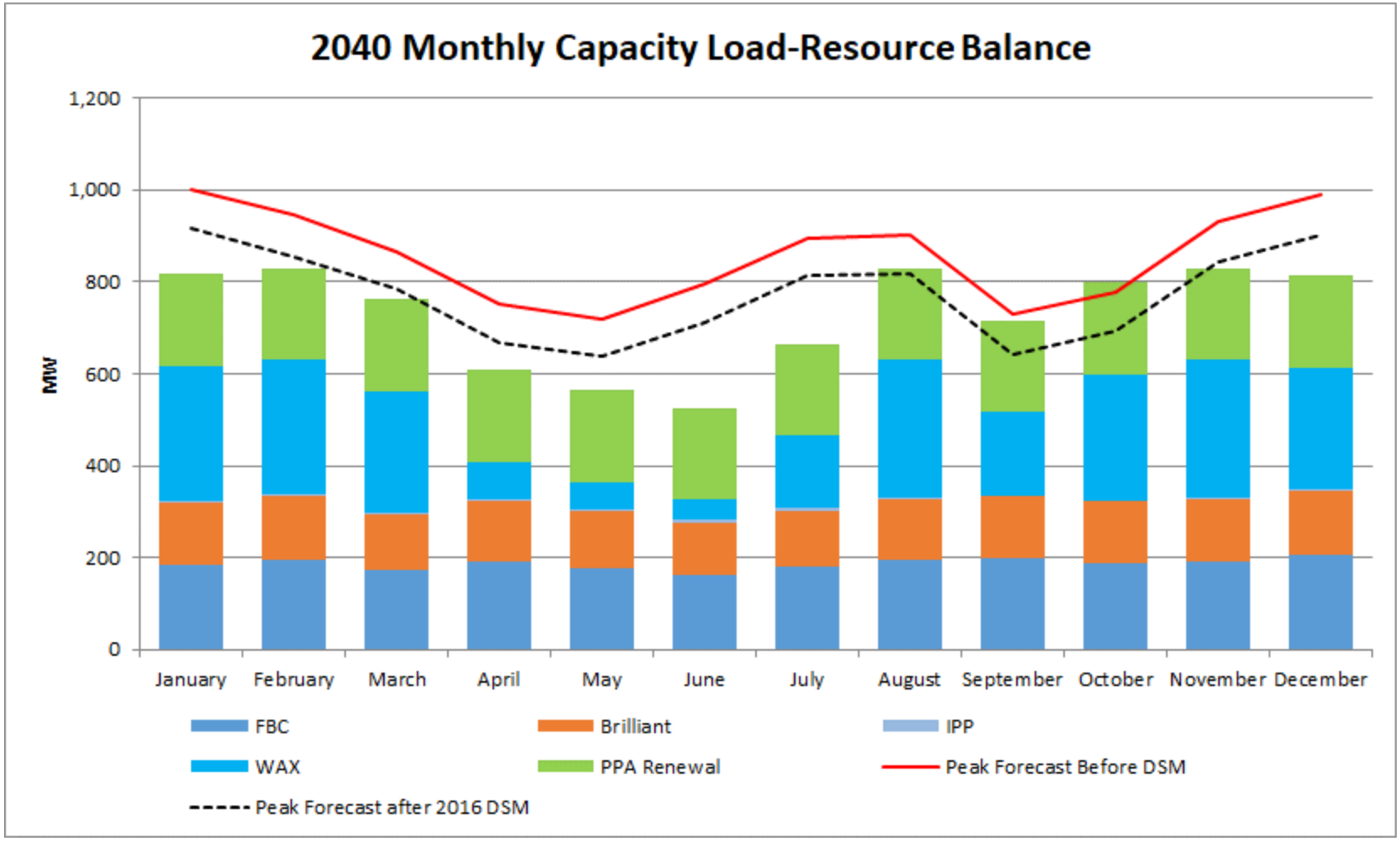
2021 LTERP LRB – Winter Peak Demand



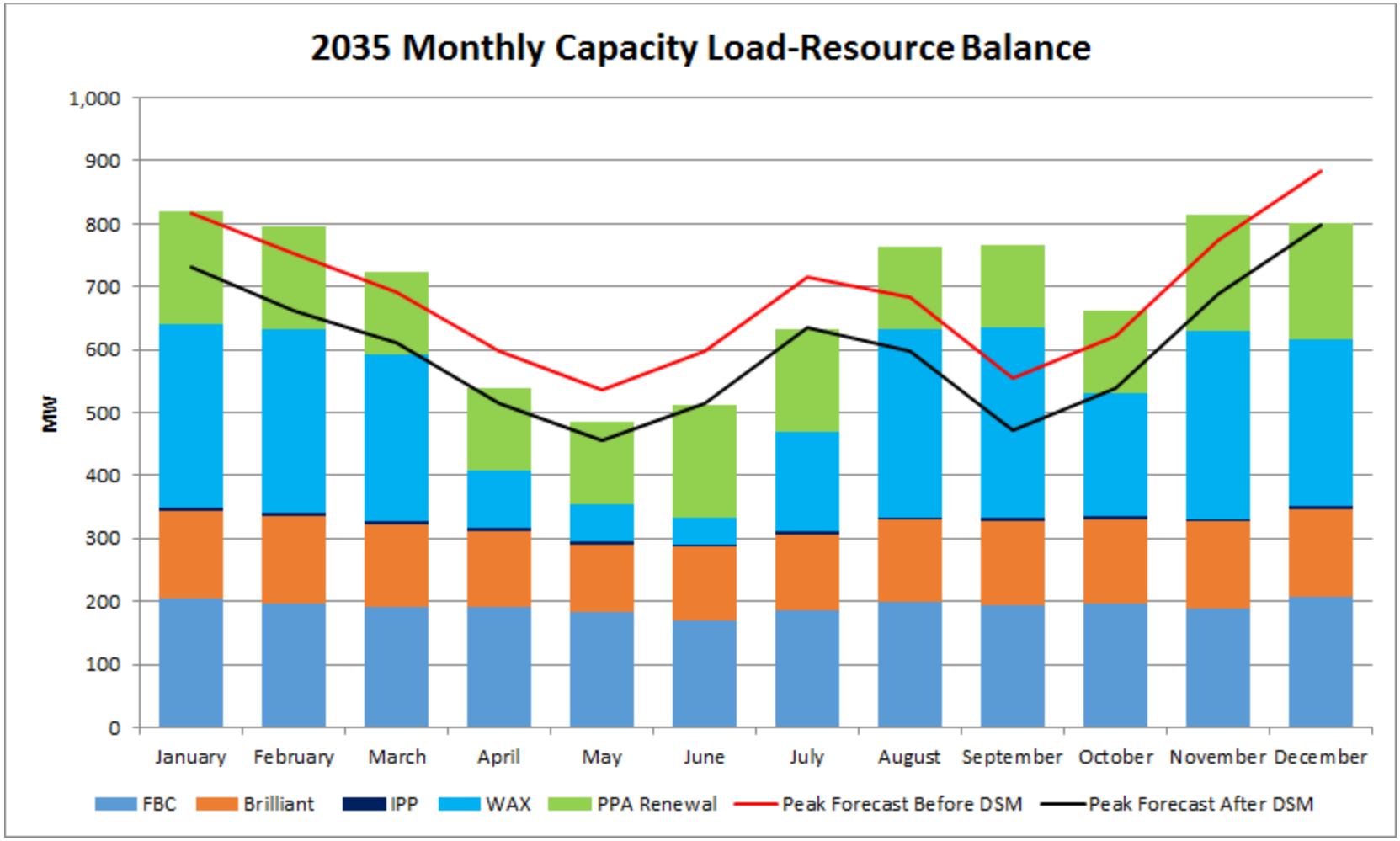
2016 LTERP LRB – Winter Peak Demand



2021 LTERP LRB – 2040 Monthly Capacity



2016 LTERP LRB – 2035 Monthly Capacity



Wrap Up & Next Steps

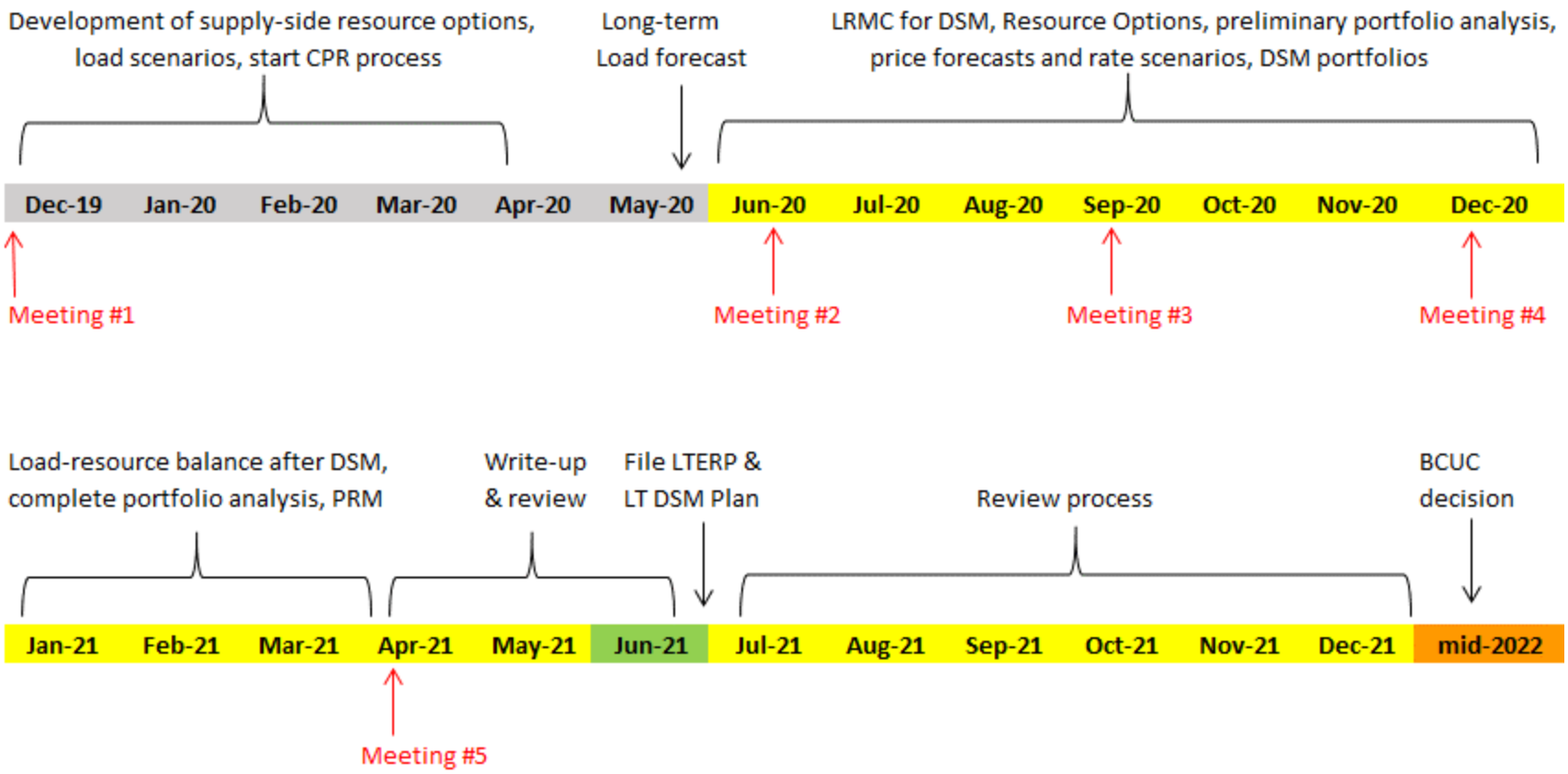
FBC Next Steps

- Send out email for Slider Tool (please submit results by July 24)
- Upload presentation and meeting notes to FortisBC website
- Review and consider feedback
- Assess supply-side resource options (collaboration with BC Hydro)
- Develop Long Run Marginal Cost (LRMC) for DSM purposes
- Plan next RPAG meeting - Q3 2020

Next Meeting Topics

- Review stakeholder scenario results
- Supply-side resource options costs and attributes
- Market price and rate forecasts and scenarios
- LRMC for DSM purposes
- Portfolio analysis approach and portfolio evaluation framework
- Long Term DSM Plan update

LTERP Development Timeline



Feedback and Questions

- Please fill out the Feedback form
- Feel free to email any questions, comments

For further information, please contact:

Mike Hopkins
Mike.Hopkins@fortisbc.com
604-592-7842

www.fortisbc.com/about-us/projects-planning/electricity-projects-planning/electricity-resource-planning

Find FortisBC at:

Fortisbc.com

604-676-7000