Clean Power 2040

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2021 Integrated Resource Plan (IRP) Technical Advisory Committee (TAC) Meeting #8

January 27, 2021

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Welcome & meeting context

Kathy Lee, BC Hydro

Basil Stumborg, BC Hydro

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Agenda overview

Meeting purpose – to present updated load forecast and climate change adaptation considerations in the IRP

9:00 START		TBD BREAK	12:00 END
Welcome & meeting context	**Dec 2020 Load Forecast & updated system load resource balance**	**Climate change adaptation**	**Meeting close**
Kathy Lee **Basil Stumborg**	**Amanda Young** **Magdalena Rucker**	**Magdalena Rucker** **Stephanie Smith** **Doug Robinson** **Jim Papadoulis**	**Basil Stumborg**

Virtual meeting etiquette

These principles should make our meetings more effective

- As with in-person meetings, continue to have members participate and alternates observe
- Keep the conversation respectful by focusing on ideas, not the person
- Stay curious about new ideas
- Share the air time – to ensure everyone gets heard

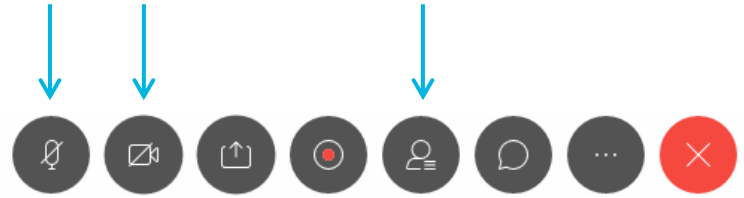
- To minimize distractions – keep yourself on mute
- We'll use the chat box to seek input and ask questions
- We'll not be recording these sessions, and ask for others not to record

Cisco Webex reminders

We'll be using a few basic tools, which you can find if you hover your mouse over the bottom of the screen

Mute/unmute your mic & turn your video on/off

View the participant list



Open the chat panel:

- to ask questions
- to provide feedback

Audio connection trouble?

See the alternative options here

IRP project updates

We have a few updates to relay to TAC members

1. Reminder that submissions on the IRP public survey (distributed via email December 14, 2020) are due January 31, 2021
2. Notice of IRP interim filing of current planning context to BC Utilities Commission submitted January 15, 2021
3. Based on feedback and internal review, we are expanding our DSM and rate options
4. We will be rescheduling the February meeting to the week after the March break to incorporate new DSM and rate options into our analysis

December 2020 Load Forecast

Amanda Young, Hootan Jarollahi, & John Rich, BC Hydro

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Purpose

Provide overview of December 2020 Load Forecast

Today we will cover:

- Key forecast assumptions
- December 2020 Reference Case
- December 2020 Uncertainty Bands
- Electric Vehicles Forecast
- Updated Load Resource Balance

Setting the stage

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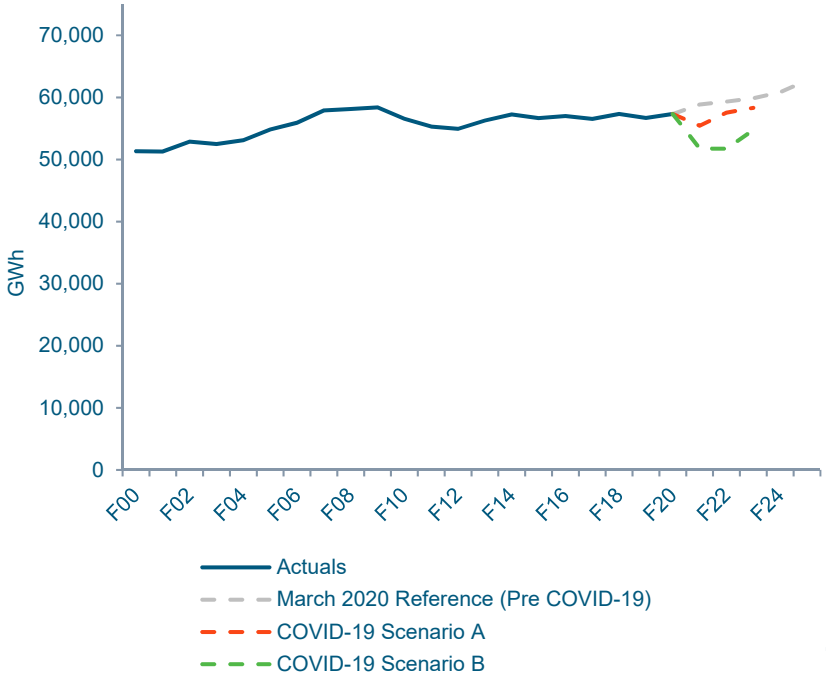
COVID-19 Impacts

In June we presented these scenarios to you…. Where are we now?



COVID-19 impacts the short-term and expands long-term uncertainty

- COVID-19 Scenario B adopted for April 2020 Reference for preliminary IRP modelling
- F21 actuals are tracking to COVID-19 Scenario A
- COVID-19 Scenario A adopted for F22 RRA
- December 2020 Load Forecast is closer to Scenario A
- These short term impacts do not change long term IRP
- Significant uncertainty remains

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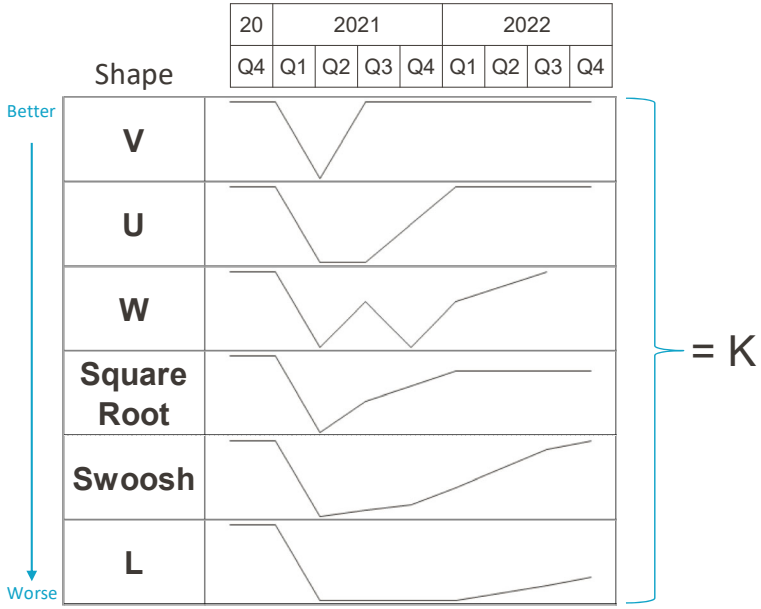
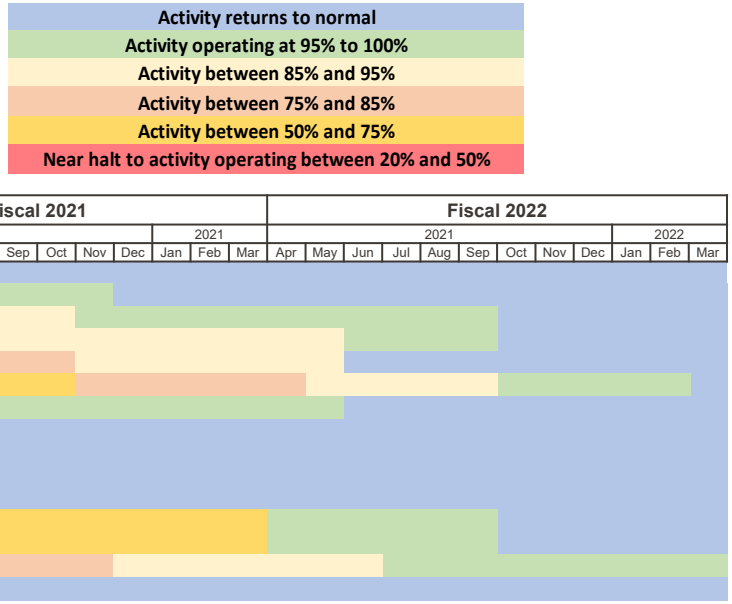
COVID-19 Potential Recovery Paths

Different sub-sectors will recovery differently so we worked with CBoC on 3 cases





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Discussion

Let's check in on the section that was just presented

Please share any questions or comments you may have:

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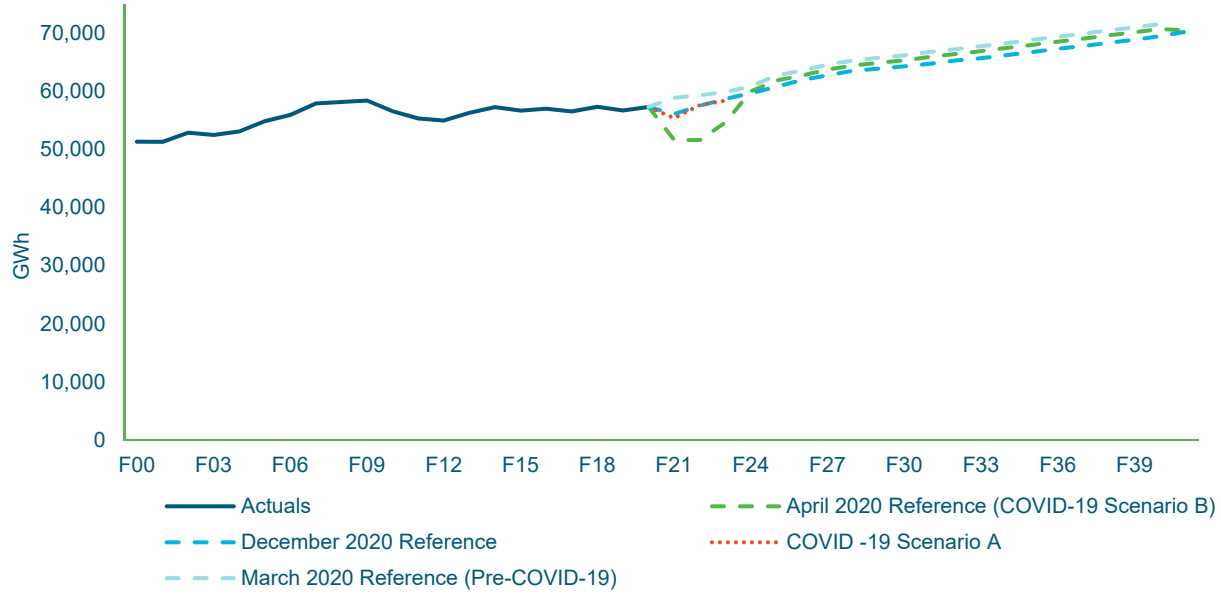
Reference Load Forecast

Total Integrated System Energy

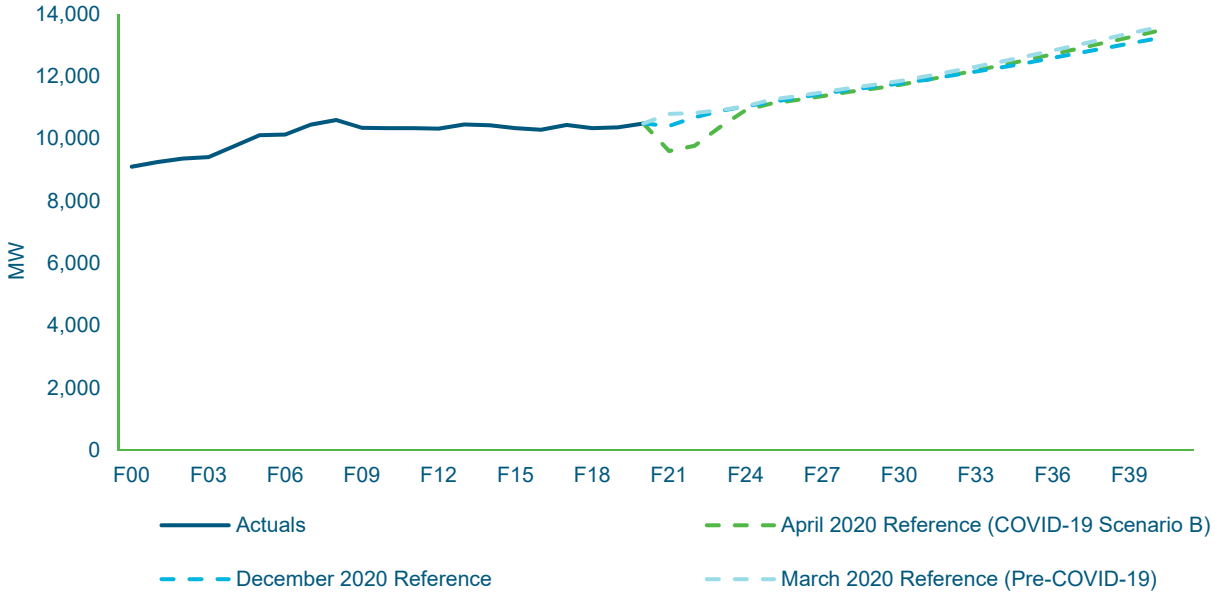
Moderate long-term growth. 2% lower than April 2020 reference in fiscal 2040.



Change from April 2020 Reference Case (energy after adj.)		
Sector/ Sub-Sector	F2030 (GWh)	F2040 (GWh)
Commercial	(382)	(480)
Oil & Gas	(230)	(165)
Other Large Ind.	(209)	(215)
Light Ind.	(160)	(161)
Mining	159	123
Forestry	114	71
Residential	23	72
LNG	(4)	(4)
Total Integrated Gross System Requirements	(1,023) (2%)	(1,236) (2%)

Total Integrated System Peak

Moderate long-term growth. 2% lower than April 2020 reference in fiscal 2040.



Change from April 2020 Reference Case (energy after adj.)		
	F2030 (MW)	F2040 (MW)
Total Integrated System Peak	45 0.4%	(232) (1.7%)

Discussion

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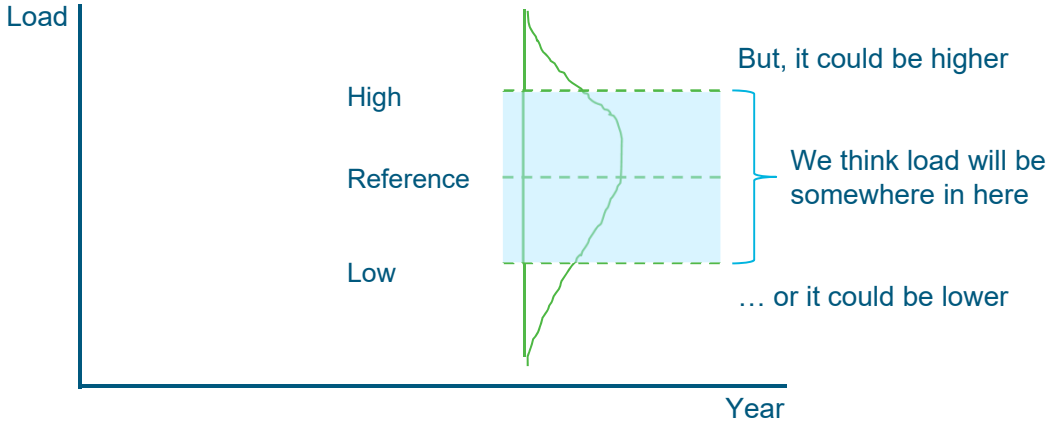
Uncertainty Bands

Uncertainty Bands

We develop a low, reference, and high forecast to reflect uncertainty



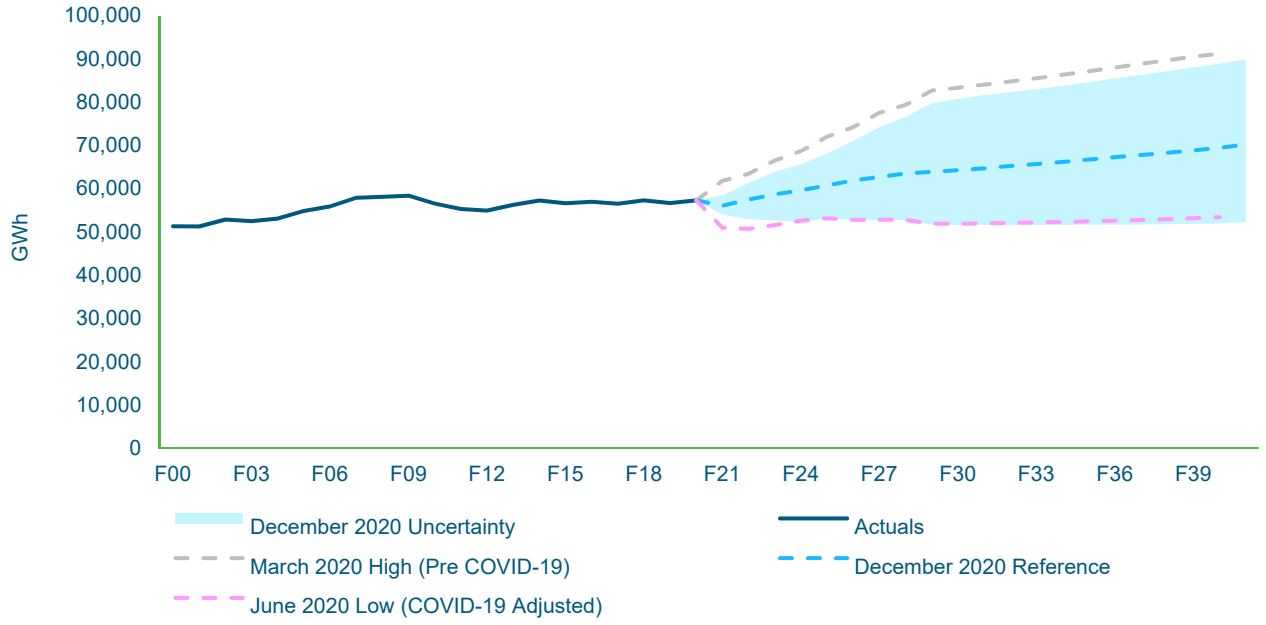
Uncertainty Bands

How we develop the high/low forecasts has been evolving

	MAY 2016		OCT 2018		JUN 2019		MAR 2020		DEC 2020	
	Monte Carlo	Discrete	Monte Carlo	Discrete	Monte Carlo	Discrete	Monte Carlo	Discrete	Monte Carlo	Discrete
Residential	✔		✔		✔		✔			✔
Commercial	✔		✔		✔		✔			✔
Light Industrial	✔		✔		✔		✔			✔
EVs	✔		✔			✔		✔		✔
Large Industrial	✔		✔		✔			✔		✔
LNG		✔	✔		✔			✔		✔

Total Integrated System Energy

High case 3% lower than pre COVID-19 March 2020 high case in fiscal 2040



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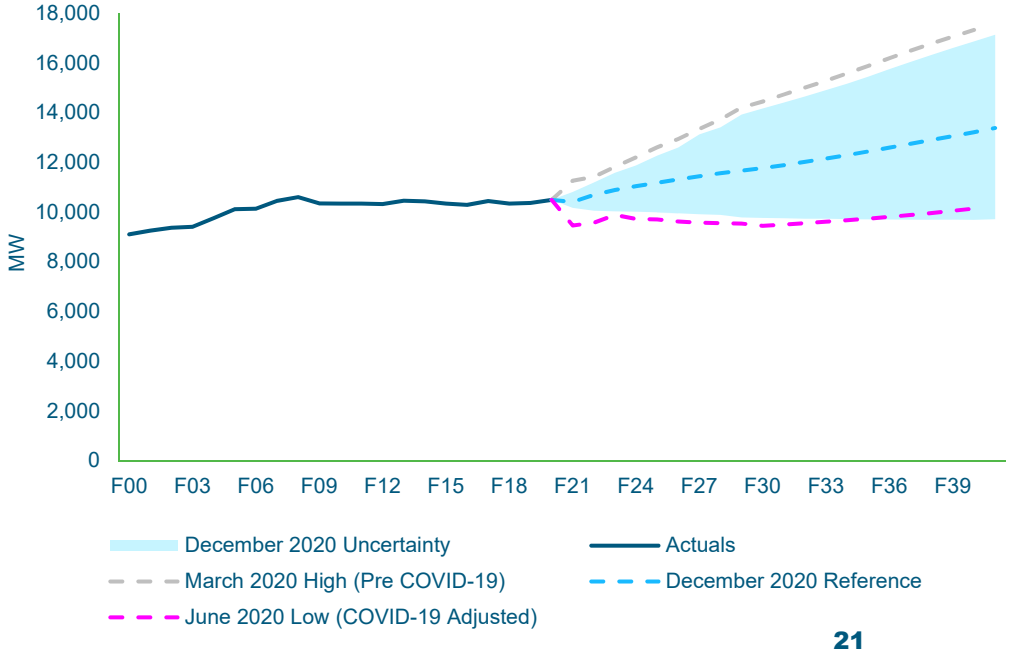
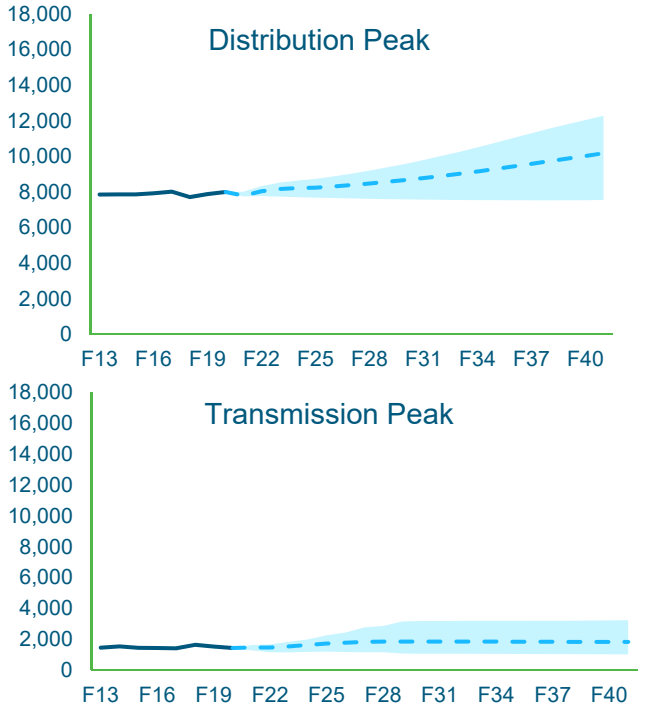
Total Integrated System Peak

High case 3% lower than pre-COVID-19 March 2020 high case in fiscal 2040





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Area of Interest

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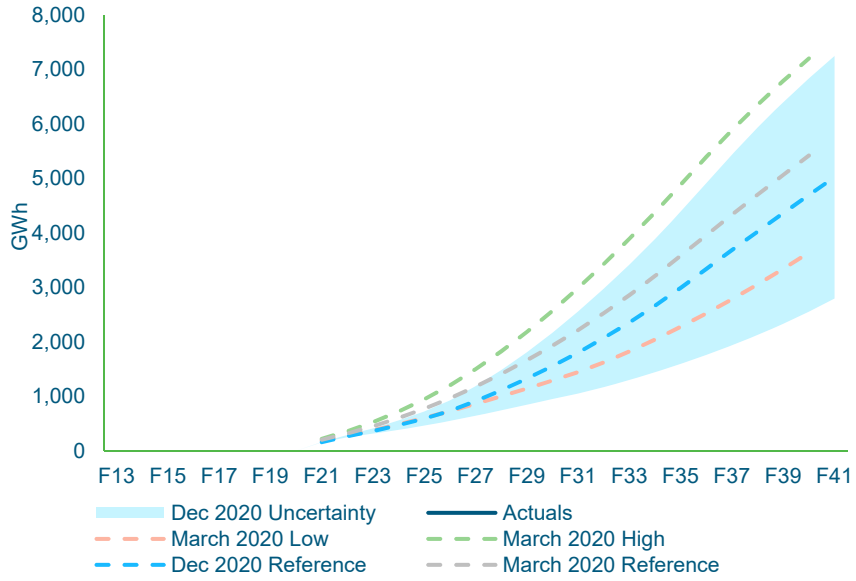
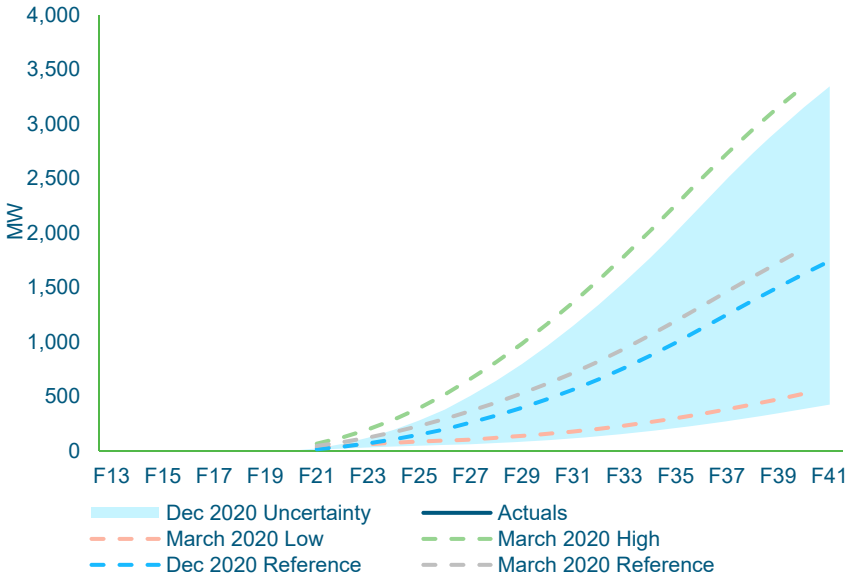
Electric Vehicles

Lower projection than March due to lower vehicle sales and EV market share





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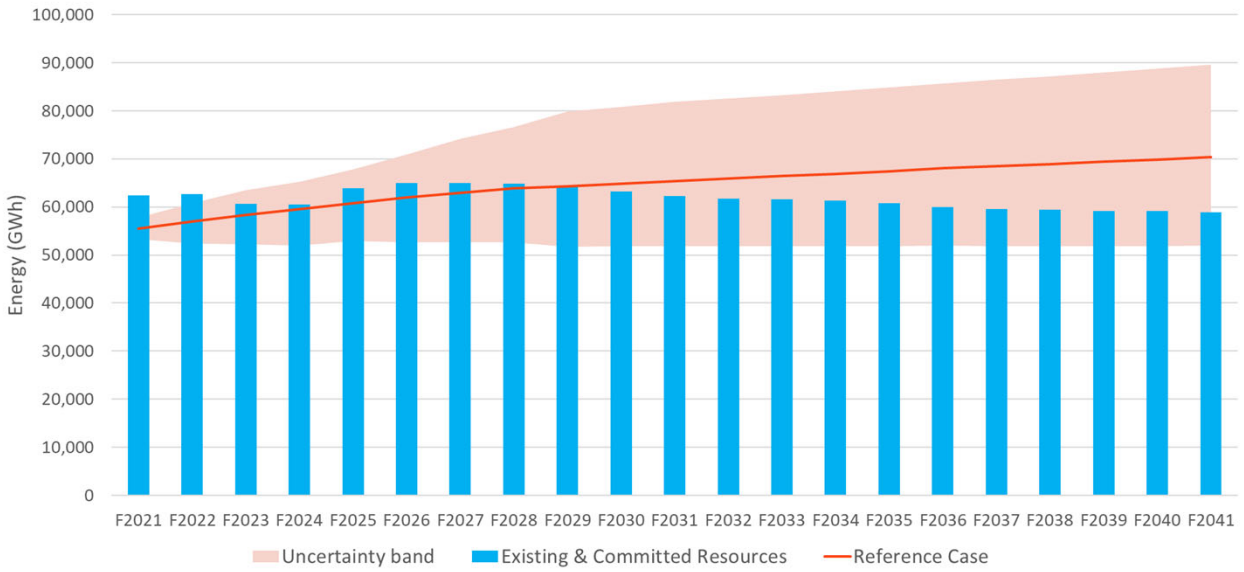
What this means for the IRP

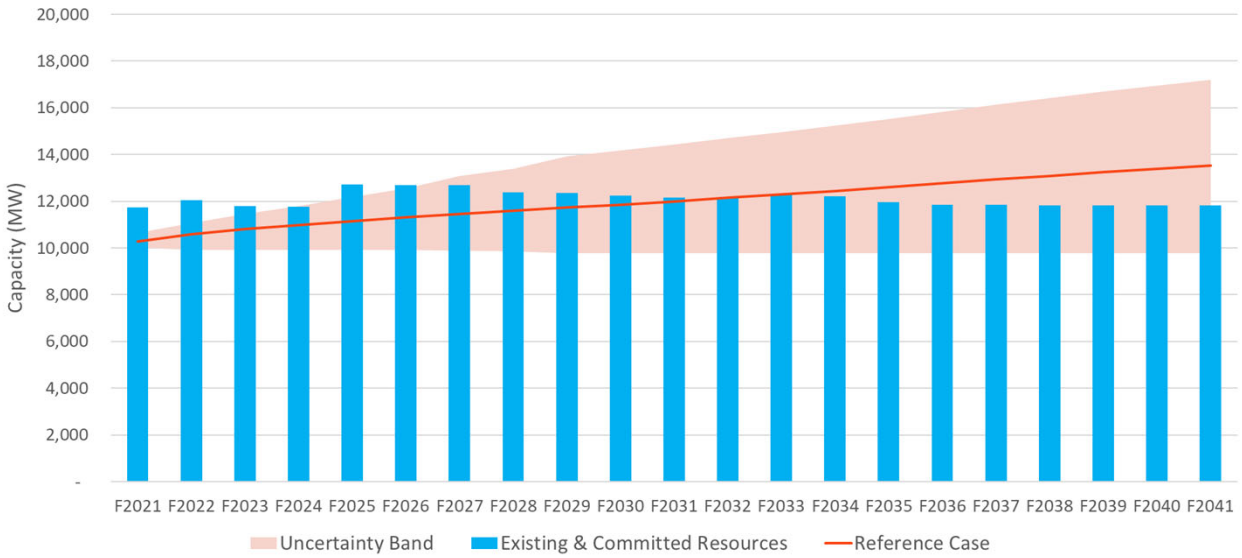
Energy Load Resource Balance

The first year of need for energy shifts from F2028 to F2030



Capacity Load Resource Balance

The first year of need for capacity remains unchanged (F2032)



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Climate Change Adaptation

Magdalena Rucker, Stephanie Smith, Doug Robinson,
and Jim Papadoulis, BC Hydro

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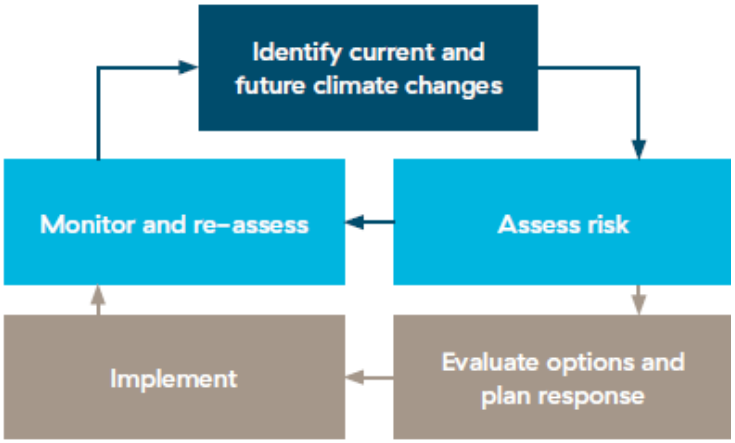
Outline

1. Climate change adaptation at BC Hydro
2. Climate change data – what do we know about climate change in B.C.?
3. Adaptation – potential areas of climate change impacts that could impact IRP
    a. Impact on electricity demand
    b. Impact on load shape
    c. Impact on system capability
    d. Risk to transmission infrastructure due to extreme weather/wildfire

Climate Change Adaptation at BC Hydro

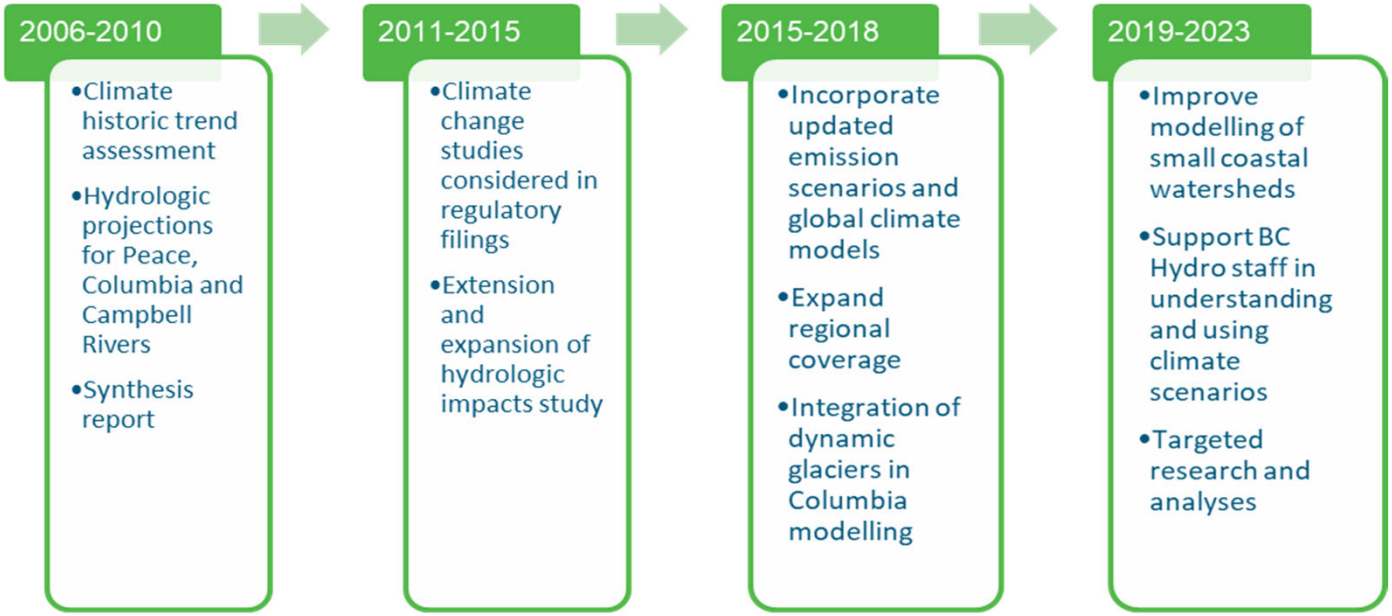
Adaptation strategies are being integrated into BC Hydro's business processes and asset and resource planning disciplines



- BC Hydro follows an adaptation strategy framework to identify climate change risks and adaptation actions
- Adaptation is a continuous and evolving process
- The IRP considers the potential areas of climate change impacts that could impact long-term planning

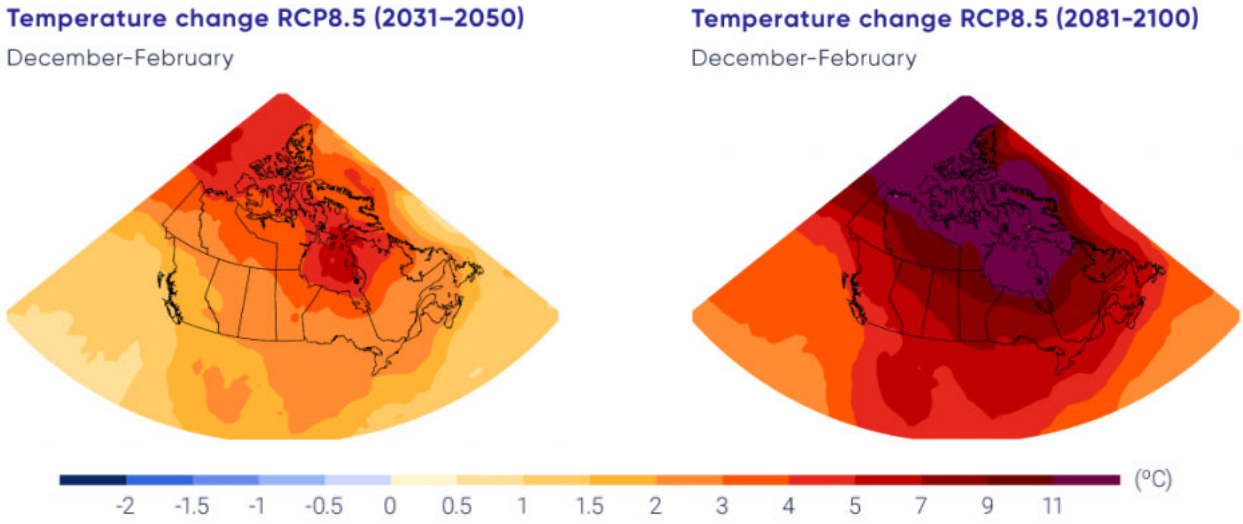
Climate Change Data

Climate change data form the basis for our climate change impact assessments



Climate Projections – Temperature

Temperatures are rising and more quickly in the north

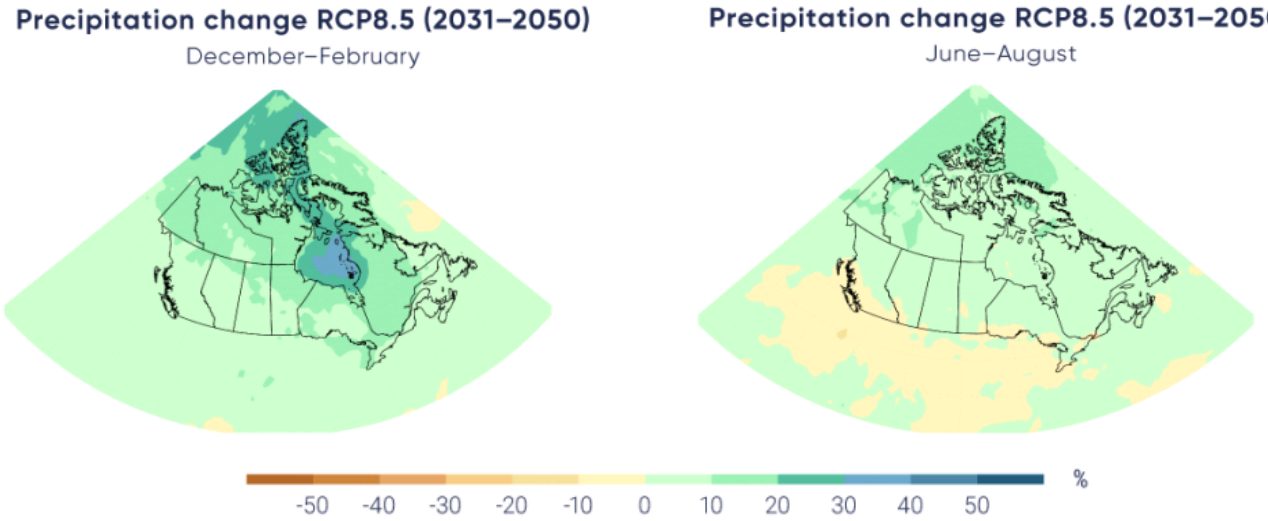


Temperature change in °C relative to 1986-2005

Source: Reproduced from Figure 4.6 of Canada's Changing Climate Report. (2019)

Climate Projections – Precipitation

Weather will become wetter overall on average, but a bit drier in summer

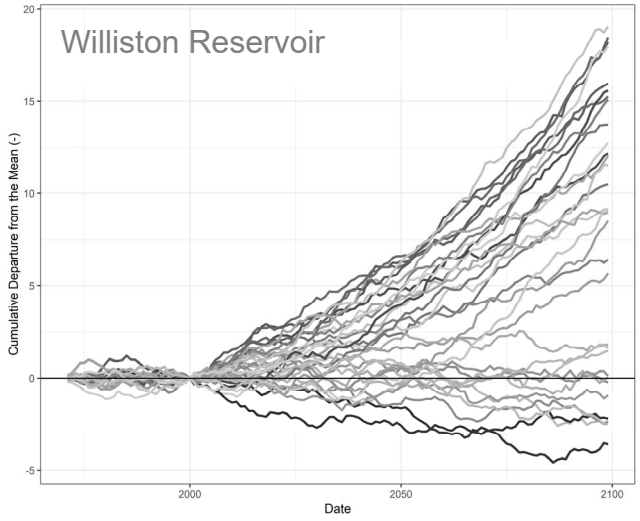


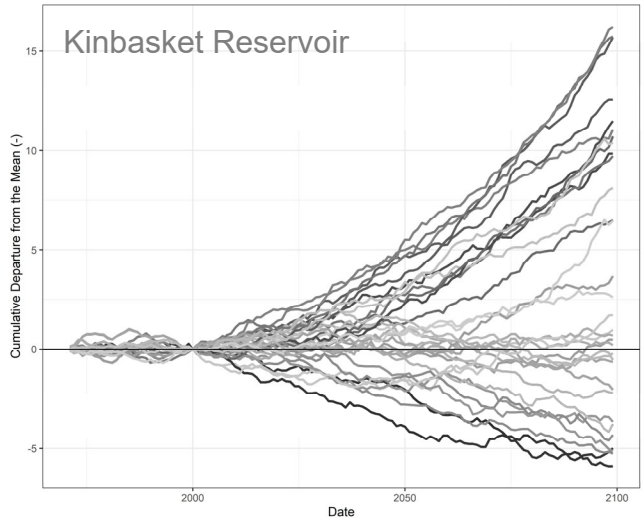
Percent change in precipitation relative to 1986-2005

Source: Reproduced from Figure 4.18 of Canada's Changing Climate Report. (2019)

Climate Projections – Annual Inflows

Using a number of climate models creates a broad range of possible futures for annual inflows, with each line representing a separate projection



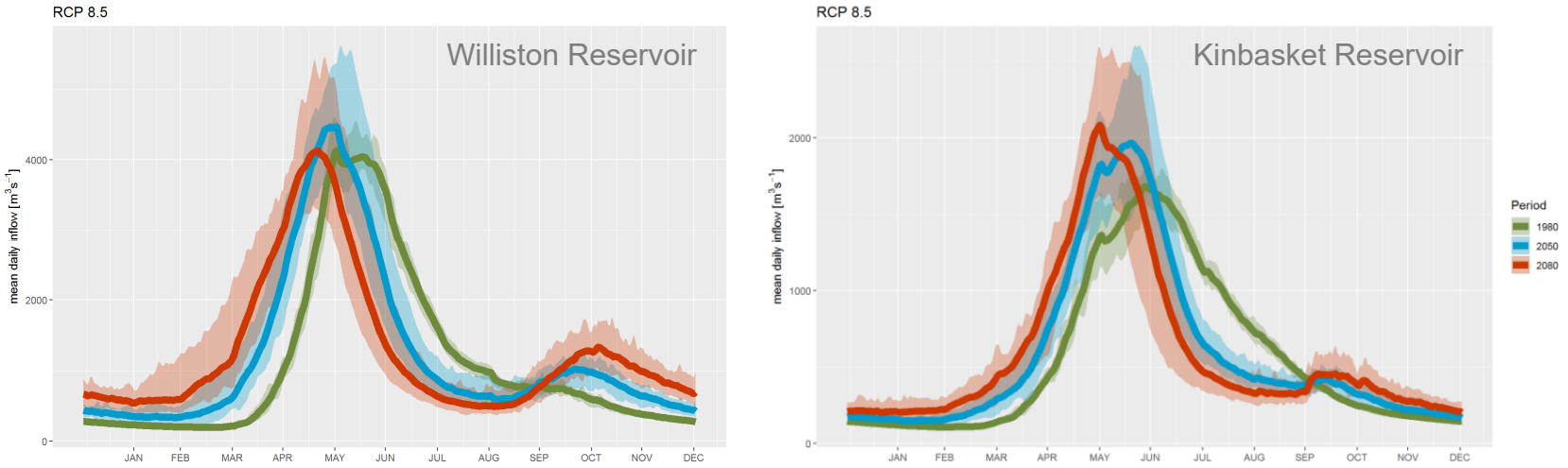


Annual inflow cumulative departure from 1971-2000 average

Source: Pacific Climate Impacts Consortium

Climate Projections – Timing of Inflows

A shift to earlier spring runoff has already been observed and is expected to continue



Baseline (1971-2000), 2050s and 2080s mean daily flows averaged over six Global Climate Models (GCMs) for Williston and Mica under the highest global emission scenario. The shaded areas denote the uncertainty bounds between all six GCMs for the respective periods.

Discussion & feedback

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Impact on Electricity Demand

In 2015, BC Hydro participated in national study to examine the impact of climate change on electricity demand for residential and commercial customers

- Projected temperature profiles from a range of climate models and GHG emission scenarios were applied to BC Hydro's load forecast models used to estimate impact on electricity demand (both annual energy demand and peak demand)
- The study considered the impact of climate change on residential and commercial sectors, but not industrial sector
- All other factors (housing starts, retail sales, employment and other economic drivers, end use efficiencies/shares) were held constant

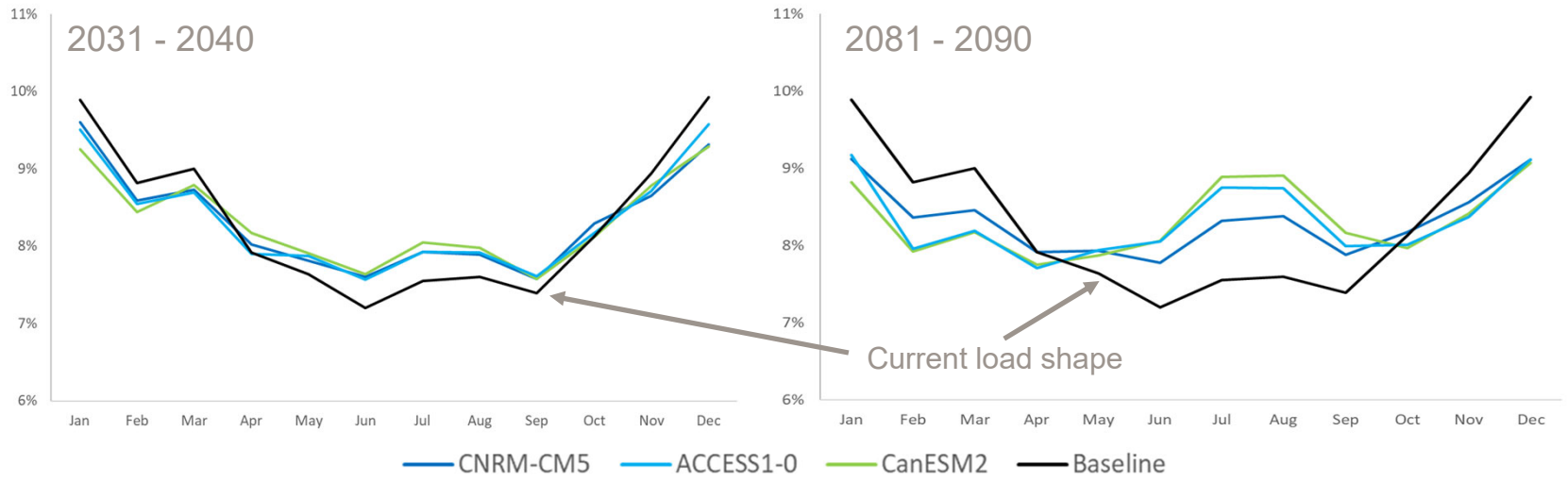
Impact on Electricity Demand

Climate change impact is projected to be about a 2% decrease on average for the P50 case for both energy and peak demand

Period	Scenario	Energy	Peak
F14-F40 (2030 period)	P10	-0.8%	-0.4%
	P50	-1.5%	-1.3%
	P90	-1.8%	-1.4%
F41-F70 (2050 period)	P10	-1.4%	-1.2%
	P50	-2.1%	-1.9%
	P90	-1.7%	-1.8%

Impact on Load Shape

Projections indicate load shape shifting from a winter peak to a dual peak (winter and summer peak) in the long-term as heating / cooling load decreases / increases



Average monthly Load Shape (% of annual) for baseline and three Global Climate Models under the RCP 8.5 emission scenario

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Impact on system capability

A study is underway to determine how climate change is impacting the load carrying capability of the integrated system

- A long-term system capability study is underway to determine how much load the BC Hydro system can support (and the corresponding capability of the generation) based on climate change impact projections
- The study assumes a given planning criterion (e.g. self-sufficiency in average water)
- Key climate change impact inputs are water inflows and load shape (discussed in previous slides)

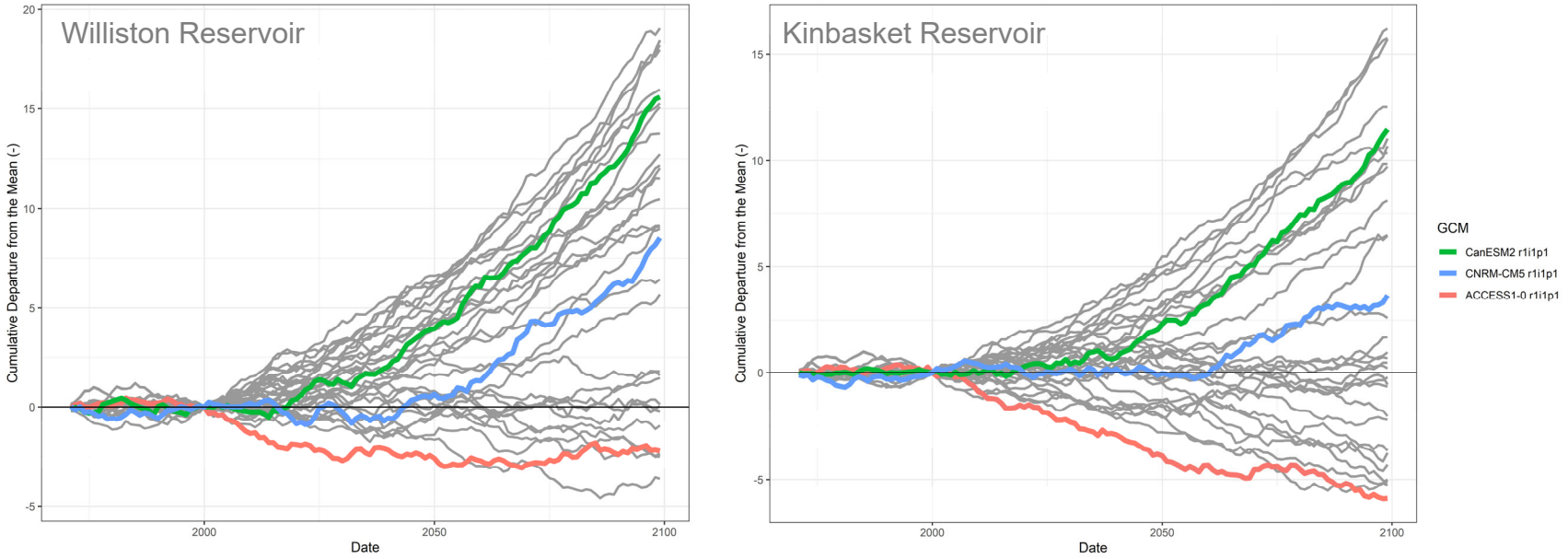
Modelling approach

The study approach uses the same capability assessment process as a regular system capability study, but incorporates climate-changed inputs

- The study approach ‘pretends’ it is 70 years from now
  - Projected data becomes historical data
- Climate projections cover a range of potential conditions
- Everything else stays the same, e.g. resource portfolio, planning criterion

Model inputs – large BC Hydro reservoirs

Inflow projections selected for the study cover a range of outcomes



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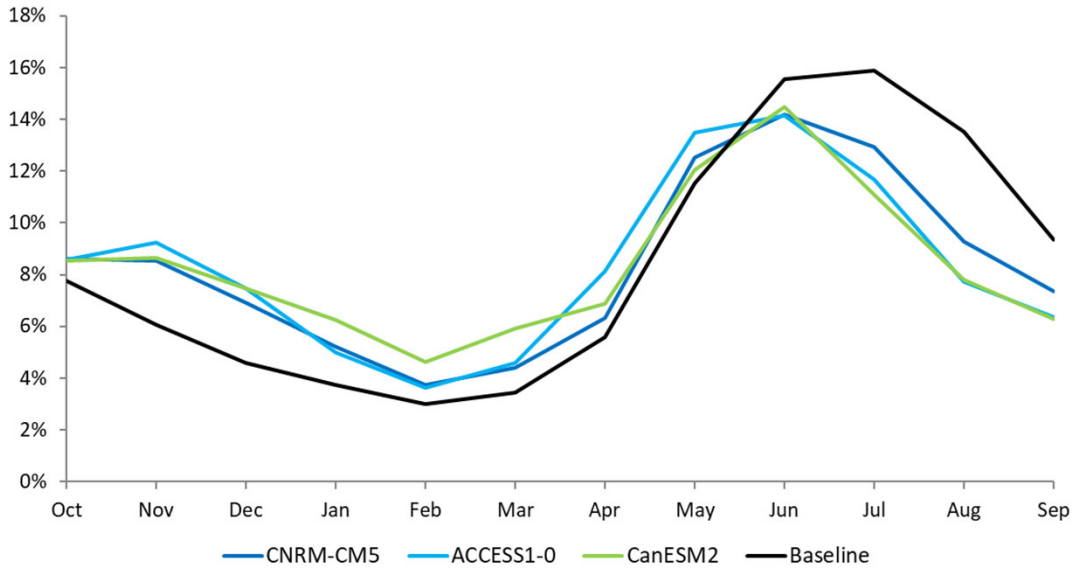
Model inputs – Run-of-River projects

Projected inflow trends for Run-of-River projects were also incorporated into the study



Impact on system capability

Preliminary results show changes in the range of +/- 5% at end of century

- System capability change: +/- 3,000 GWh on 67,000 GWh base
- Changes correlate to annual inflow volume changes – higher capability with more inflow, lower capability with less inflow
- Study will continue to be refined

Discussion & feedback

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Impact on transmission infrastructure

Increased risk from wildfire activities and extreme weather on transmission and distribution (T&D) infrastructure expected

- BC Hydro is planning detailed T&D vulnerability assessment that will incorporate future climate projections
    1. Climate vulnerability study - identify key areas of concern for specific hazards, e.g. river erosion, avalanches, wildfires
    2. Value assessment – assess risk to specific assets and estimate costs for change adaptation measures or risk mitigation investments
    3. Make recommendations on adaptation measures and risk mitigation investments
- Costs of recommended adaptation measures/risk mitigation investments and/or impact on T&D reliability to be considered in future capital plans

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Summary of Impacts on Long-Term Planning

See some modest impacts within the planning horizon, but within existing bounds of uncertainties – and we'll continue to study

Impact on electricity demand	Study suggests ~2% reduction in both energy and capacity on average for the 2050 period (F41 – F70)
Impact on load shape	Gradual shift towards dual peak (arriving far outside the planning period; i.e. ~F2080)

...continued

Summary of Impacts on Long-Term Planning

See some modest impacts within the planning horizon, but within existing bounds of uncertainties – and we'll continue to study

Impact on System capability (inflows/generation)	Shift towards earlier run-off period Total inflows into reservoirs could increase or decrease, relative to historical norms Preliminary study results show impact on system capability in the range of +/- 5% by end of century
Impact on transmission infrastructure	Existing asset planning risk management approach well positioned to utilize updated climate data

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