INTEGRATED RESOURCE PLAN TECHNICAL ADVISORY COMMITTEE MEETING #7

September 23, 2013

BC hydro

FOR GENERATIONS

TAC MEETING OBJECTIVES

BC hydro
FOR GENERATIONS

- To introduce the draft plan, provide clarifications and promote understanding in preparation for seeking your written feedback

- At this juncture, to request written feedback from TAC members on the draft IRP:
  - to inform the final IRP that will be re-submitted for government's approval by November 15, 2013
  - **Due no later than October 18, 2013**
  - Excerpt of Minister's Letter (August 23, 2013):

    "While the consultations should cover the IRP in its entirety, of particular interest is feedback on the changes to the IRP since BC Hydro undertook consultations in the spring and summer of 2012, and on uncertainty over the 20-year period and the contingency plans BC Hydro is proposing to deal with that uncertainty"

AGENDA

BC hydro
FOR GENERATIONS

Time	Agenda Item	Presenter
8:30 – 9:00	Coffee and Refreshments	
9:00 – 9:15	Welcome – Review Agenda & Meeting Objectives	Anne Wilson
9:15 – 9:45	IRP Overview & Recommended Actions	Randy Reimann
9:45 – 10:30	Managing Resources	Doug Little
10:30 – 10:45	Break	
10:45 – 11:15	Load Forecast	David Ince
11:15 – 11:45	Load Resource Balance	Lindsay Fane
11:45 – 12:15	Analytical Framework and Uncertainties	Basil Stumborg
12:15 – 12:45	Lunch	
12:45 – 1:00	Role of Gas for Non-LNG Load	Kathy Lee
1:00 – 1:45	Conserving First	Kristin Hanlon
1:45 – 2:15	Meeting Future Electricity Needs	Kathy Lee
2:15 – 2:30	Break	
2:30 – 3:00	Meeting LNG and the North Coast Supply Needs	Sanjaya DeZoysa
3:00 – 3:30	Planning for the Unexpected	Lindsay Fane
3:30 – 4:30	Roundtable/Close	Anne Wilson / All

IRP OVERVIEW & RECOMMENDED ACTIONS

RANDY REIMANN

BC hydro

FOR GENERATIONS

PURPOSE OF IRP

BC hydro
FOR GENERATIONS

Long-term plan to meet customers' growing electricity requirements

(Focused on next 20 years, with 30-year view of transmission)

- Consistent with good utility practice, enables BC Hydro's Board to fulfill its fiduciary responsibility
- Provides vehicle to consult First Nations and public on BC Hydro's long-term plans
- Enables government, through its review and approval of the IRP, to ensure BC Hydro's plans contribute to B.C.'s energy objectives
- Supports future regulatory filings with the BCUC and other regulatory agencies

Good utility practice

- Obligation to supply customers' requirements
- Meet reliability criteria
  - Capacity – one day in10-year loss of load expectancy
  - Energy – firm energy carrying capability
- Minimize rates
- Minimize environmental impacts/footprint

CLEAN ENERGY ACT
IRP PROCESS & REQUIREMENTS

BC hydro
FOR GENERATIONS

BC Hydro submits IRP to Minister for Cabinet approval

- First IRP filing was due and submitted August 3, 2013
- At least every 5 years thereafter or can be amended in the interim

Prescribed requirements for self-sufficiency

- Energy and capacity – mid level load forecasts
- Water conditions for heritage assets – average water

Transmission needs for 30 years in 2013 IRP

- Assessment of clean resource development grouped by geographic area

Exports: demand, opportunities, and expenditures

Report respecting IRP consultation

CLEAN ENERGY ACT EXEMPTIONS

BC hydro
FOR GENERATIONS

Exempted Projects, Programs, Contracts and Expenditures

- Mica Units 5 and 6
- Northwest Transmission Line

- Bio-Energy Phase 2 – up to 1000 GWh/yr
- Integrated Power Offer – up to 1200 GWh/yr
- Clean Power Call – up to 5000 GWh/yr (actual: 3266 GWh)
- Standing Offer Program
- Feed-in Tariff Program

- Installation of smart meters by end of 2012
- Installation of a smart grid

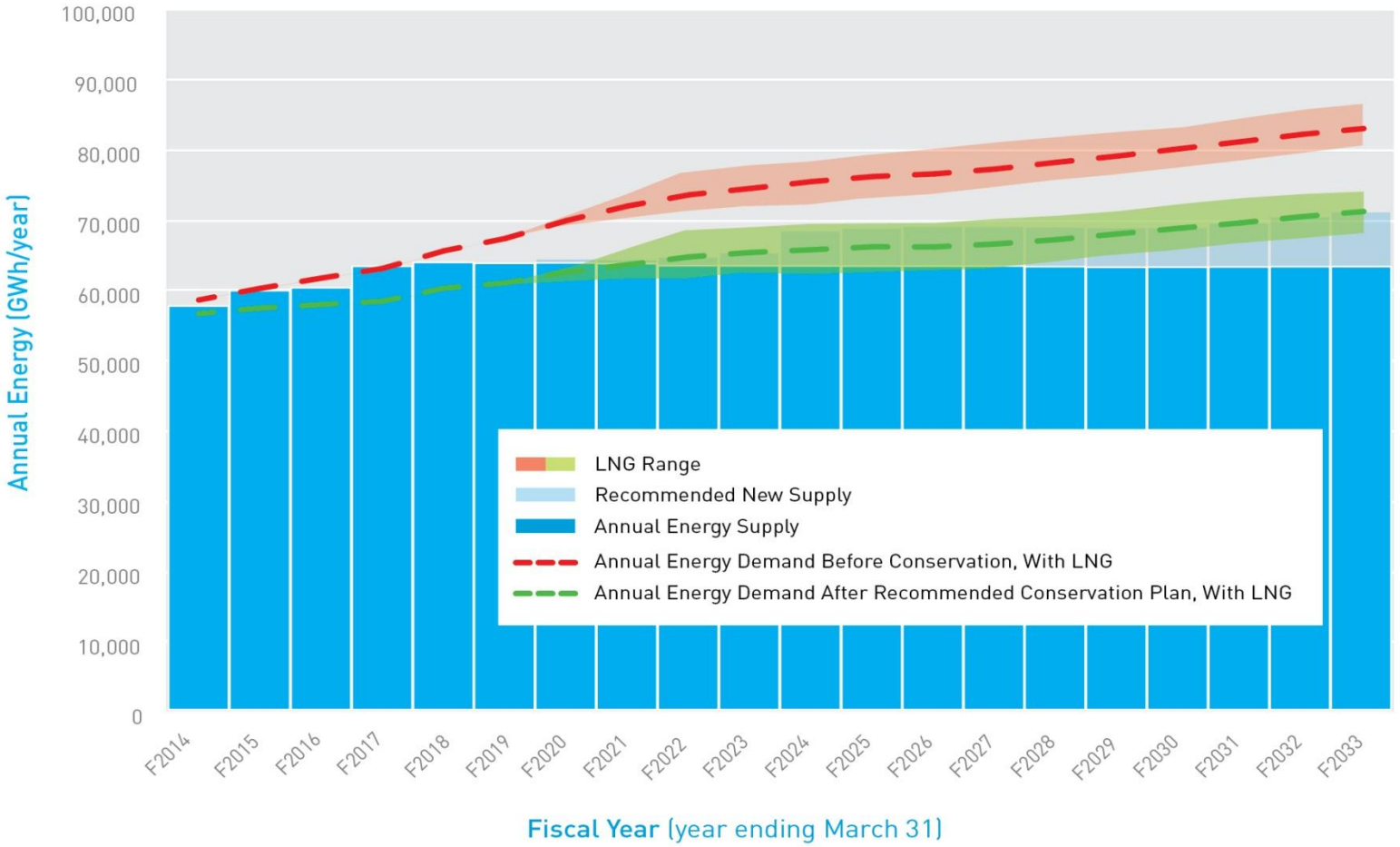
- Revelstoke Unit 6
- Site C (currently in stage 3 of 5)

CLEAN ENERGY ACT
16 OBJECTIVES

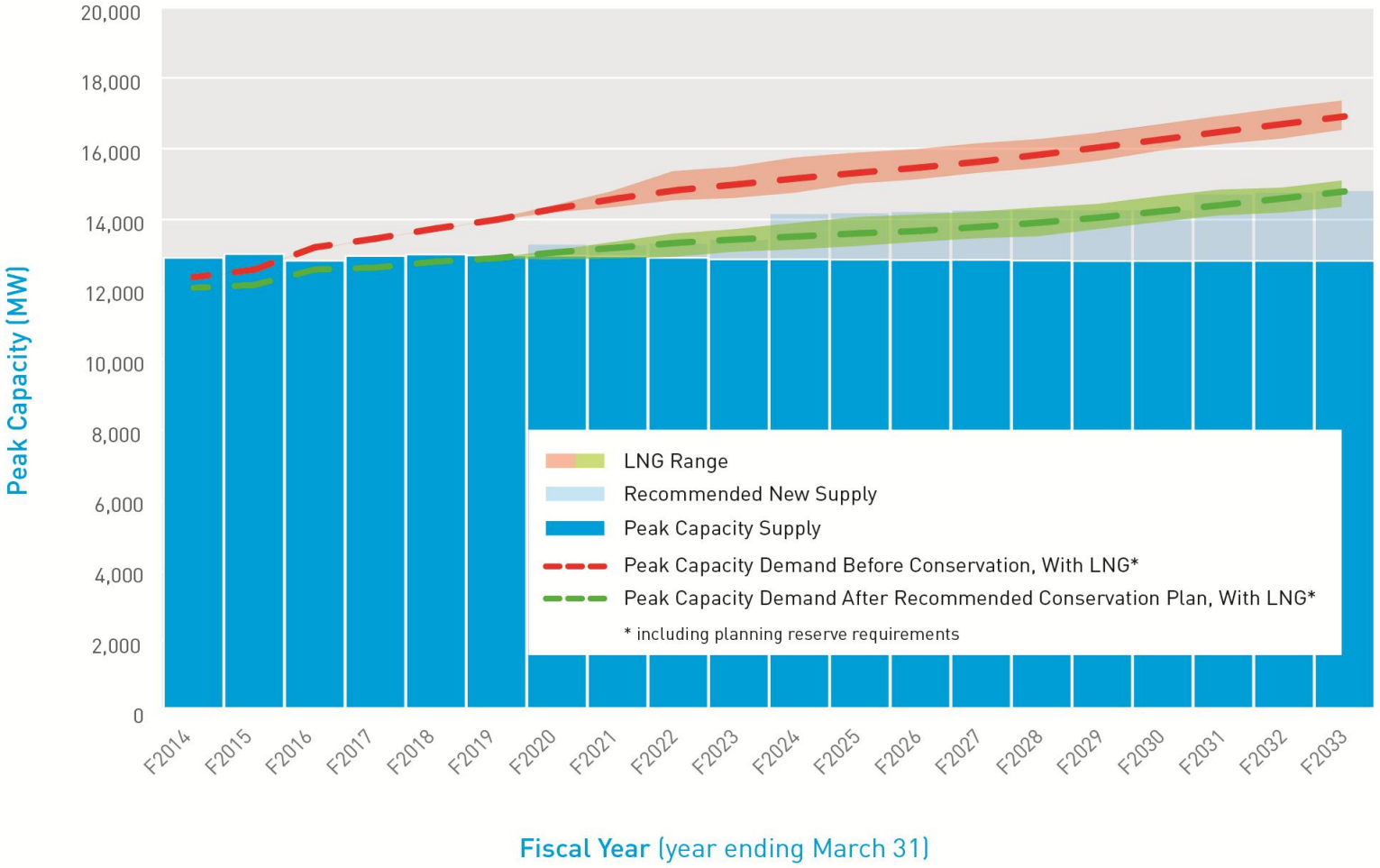
BC hydro
FOR GENERATIONS

- Self-sufficiency requirement by 2016
  - Amendment to CEA in February 2012 removed critical water and changed critical to average water conditions
- 93% of all electricity from clean or renewable resources
  - Except export LNG facilities
- Keep rates competitive
- 66% of increased demand through conservation/efficiency
- Use renewables to help achieve GHG reduction targets
- Foster development of First Nations and rural communities through use of and development of clean or renewable resources

ENERGY SUPPLY-DEMAND OUTLOOK



PEAK CAPACITY SUPPLY-DEMAND OUTLOOK



CLOSING THE GAP

BC Hydro's IRP recommends DSM, clean electricity generation, and careful management of current energy supply resources.

- Conserving first
- Meeting future electricity needs
- Managing resources
- Planning for the unexpected
- Meeting LNG supply needs

CONSERVING FIRST

BC hydro
FOR GENERATIONS

Conservation is the first and best choice to meet future demand growth.

- BC Hydro plans to save 7,800 GWh per year through conservation and energy efficiency by F2021 – the equivalent of reducing new demand by approximately 75%

Recommended actions include:

- Moderate current spending and maintain long-term target
- Implement a voluntary industrial load curtailment program
- Explore more opportunities to leverage off codes and standards

MEETING FUTURE ELECTRICITY NEEDS

BC Hydro is planning to address long-term need for energy and capacity.

Recommended actions include:

- Continue to advance Site C for earliest in-service date of F2024
- Pursue bridging options for capacity (e.g., market purchases and power from the Columbia River Treaty)
- Advance reinforcement along existing GM Shrum-Williston-Kelly Lake 500 kV transmission lines for F2024
- Reinforce South Peace Regional Transmission Network

MANAGING RESOURCES

BC Hydro is managing costs to keep rates among the lowest in North America.

- IPP power currently provides about 20% of customer electricity needs
- Recommended actions include:
  - Optimize existing portfolio of IPP resources
  - Investigate customer incentive mechanisms

PLANNING FOR THE UNEXPECTED

BC Hydro will continue to explore and advance capacity resource options for contingency purposes.

Recommended actions include:

- Advance Revelstoke 6 for F2021 to add 500 MW
- Advance GM Shrum upgrades for F2021 to add 220 MW
- Investigate natural gas generation for capacity
- Investigate Fort Nelson area supply options

MEETING LNG SUPPLY NEEDS

BC Hydro will continue to prepare to meet further load requirements for LNG as they emerge.

Recommended actions include:

- Explore natural gas supply options on the north coast
- Explore clean energy solutions, should the LNG industry's needs exceed existing and committed supply
- Advance reinforcement of 500 kV transmission line from Prince George to Terrace
- Explore options for Horn River Basin and northeast gas industry

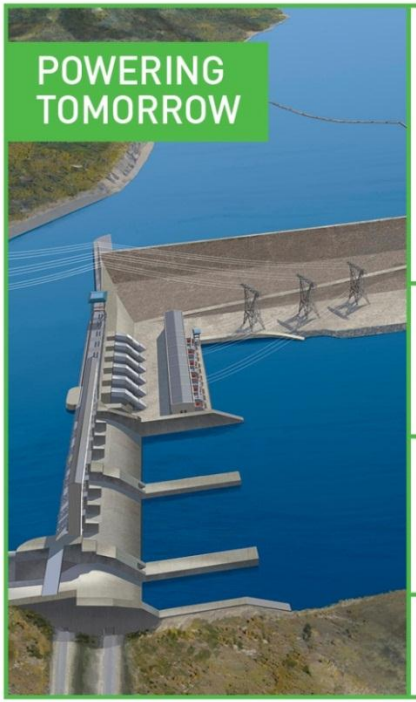
IRP RECOMMENDED ACTIONS

BC hydro
FOR GENERATIONS

		RECOMMENDED ACTIONS
	1. Moderate current spending and maintain long-term target	Target expenditures of $445 million on conservation and efficiency measures during the fiscal years 2014 to 2016. Prepare to increase spending to achieve 7,800 gigawatt-hours per year in energy savings, and 1,400 MW in capacity savings, by F2021.
	2. Pursue DSM capacity conservation	Implement a voluntary industrial load curtailment program from F2015 to F2018 to determine how much capacity savings can be acquired and relied upon over the long term.
	3. Explore more codes and standards	Explore additional opportunities to leverage more codes and standards to achieve conservation savings at a lower cost and to gain knowledge and confidence about their potential to address future or unexpected load growth.
	4. Optimize existing portfolio of IPP resources	Optimize the current portfolio of IPP resources according to the key principle of reducing near-term costs while maintaining cost-effective options for long-term need.
	5. Investigate customer incentive mechanisms	Investigate incentive-based pricing mechanisms over the short term that could encourage potential new customers and existing industrial and commercial customers looking to establish new operations or expand existing operations in BC Hydro's service area.

IRP RECOMMENDED ACTIONS

BC hydro
FOR GENERATIONS



	RECOMMENDED ACTIONS
6. Continue to advance Site C	Build Site C to add 5,100 GWh/year of annual energy and 1,100 MW of dependable capacity to the system for the earliest in-service date of F2024 (for all six generating units) subject to: environmental certification; fulfilling the Crown's duty to consult, and where appropriate, accommodate Aboriginal groups; and Provincial Government approval to proceed with construction.
7. Pursue bridging options for capacity	Fill the short-term gap in peak capacity with cost-effective market purchases first and power from the Columbia River Treaty second.
8. Advance reinforcement along existing GMS-WSN-KLY 500 kV transmission line	Advance reinforcement of the existing GM Shrum-Williston-Kelly Lake 500 kV transmission lines to be available by F2024.
9. Reinforce South Peace transmission	Review alternatives for reinforcing the South Peace Regional Transmission Network to meet expected load.

IRP RECOMMENDED ACTIONS

BC hydro
FOR GENERATIONS

	RECOMMENDED ACTIONS
10. Explore natural gas-fired generation for the north coast	Working with industry, explore natural gas supply options on the north coast to enhance transmission reliability and to meet the expected load.
11. Explore clean energy supply options, if LNG demand exceeds available resources	Explore clean or renewable energy supply options and be prepared to advance a procurement process to acquire energy from clean power projects, as required to meet LNG needs that exceed existing and committed supply.
12. Advance reinforcement of the transmission line to Terrace	Advance reinforcement of the existing 500 kV transmission line from Prince George to Terrace, which includes development of three new series capacitor stations and improvements in the existing BC Hydro substations to be available by F2020.
13. Horn River Basin and northeast gas industry	Continue discussions with B.C.'s northeast gas industry and undertake studies to keep open electricity supply options, including transmission connection to the integrated system and local gas-fired generation.

IRP RECOMMENDED ACTIONS

BC hydro
FOR GENERATIONS

	RECOMMENDED ACTIONS
14. Advance Revelstoke 6 Resource Smart project	Advance the Revelstoke Generation Station Unit 6 Resource Smart project to preserve its earliest in-service date of F2021 with the potential to add up to 500 megawatts of peak capacity.
15. Advance GM Shrum Resource Smart project	Advance Resource Smart upgrades to GM Shrum Generating Station Units 1–5 with the potential to gradually add up to 220 MW of peak capacity starting in F2021.
16. Investigate natural gas generation for capacity	Working with industry, explore natural gas supply options to reduce their potential lead time to in-service and to develop an understanding of where and how to site such resources, should they be needed.
17. Investigate Fort Nelson area supply options	Investigate procurement options to serve future Fort Nelson load.

NEXT STEPS

- **August 2:** Submit IRP to Province
- **August 23:** IRP released publicly
- **August 27:** Written comment form posted to website
- **Sept 3 to Oct 18:** Public and First Nations consultation period
- **November 15:** Re-submit IRP to Minister for final approval

MANAGING RESOURCES OVER THE SHORT TO MID-TERM

DOUG LITTLE

BC hydro

FOR GENERATIONS

MANAGING RESOURCES OVER THE SHORT TO MID-TERM

BC hydro
FOR GENERATIONS

Three areas were identified for potential reductions in cost commitments:

- Spending on IPP resources
- Spending on DSM activities
- Incentive mechanisms for customers

Decisions regarding how to reduce spending in these areas turned on:

- Costs
- Implementation Risk
  - Including impacts on relationships and litigation risk
- System Benefits
- Economic Development
- Added consideration for DSM activities – equity for all customer classes

SPENDING REDUCTIONS ON IPP RESOURCES

BC Hydro identified three areas of potential spending reduction on EPAs:

- Pre-COD EPAs
- EPA Renewals
- New (future) EPAs

PRE-COD EPAs

Status	# of Projects
TOTAL EPAs	**130**
In-Service	**81**
Pre-COD Projects	**49**
Under Construction	20
Pre-COD not Under Construction	
Terminated *	10
Deferred *	9
Potential for Deferral	6
Potential for Termination	4
Total Pre-COD not Under Construction	29

* NOTE: "Terminated" and "Deferred" include projects where an Agreement in Principle is in place to terminate or defer COD.

PRE-COD EPAs RESULTS (DELIVERED AND EXPECTED)

BC hydro
FOR GENERATIONS

Anticipated changes if implementation plan is carried out:

- A reduction in contracted energy of roughly 1,800 GWh by F2021
  - From terminations and down-sizing
  - This reduces firm energy supply (attrition adjusted) by roughly 160 GWh/yr
- A deferral of approximately 1,500 GWh by 0.5 – 2 years
- A reduction in the PV of contractual commitments of more than $1 billion

EPA RENEWALS

BC hydro
FOR GENERATIONS

As EPAs with IPPs expire, BC Hydro will seek to renew these contracts:

- At a lower cost (to reflect fully or largely recovered capital investment)
- Governed by seller's opportunity cost (the market)
- Taking into account cost of service for the seller's plant
- Also considering other attributes of the product and project

BC Hydro has also updated its renewal assumptions:

- Previously assumed:
  - Renew no biomass projects (due to fuel risk issues)
  - Renew all other EPAs
- Now assume:
  - Renew half of biomass projects
  - Renew 75% of small hydro projects expiring in next 5 years
  - Renew all small hydro projects expiring beyond 5 years
  - By F2021 an additional 526 GWh/yr, 73 MW

NEW (FUTURE) EPAS

BC hydro
FOR GENERATIONS

Acquisition of new energy will be minimized, limited to need; however:

- BC Hydro must honour prior commitments to negotiate EPAs

Previous commitments to IBAs with First Nations:

- 170 GWh/y and 25 MW, starting in F2020 have not been changed

Commitment to negotiate EPAs with certain parties:

- Part of broader economic development opportunities and First Nations initiatives
- Impact not known at this time

Standing Offer Program (SOP):

- A legislated requirement
- Maintained, but altered
- Changes reflected in LRBs (by F2021 360 GWh/yr, 15 MW reduction)

STANDING OFFER PROGRAM

BC hydro
FOR GENERATIONS

To manage the reduced need for new energy supplies prior to Site C, BC Hydro has made amendments to the SOP.

Recent Program Changes

- Eliminate the participation of clustered projects that exceed 15 MW
- Introduce BC Hydro option to extend commercial operation dates by up to two years
- Extend the wait period for projects with terminated EPAs from three years to five

Proposed Additional Change

- Address participation of high efficiency cogeneration projects
- Price reduction

SPENDING REDUCTIONS ON DSM

BC Hydro considered options to reduce spending on DSM in the near to mid term.

- Recommending to continue the current DSM target
  - 7,800 GWh/y by F2021
- Previous plans as shown in Revenue Requirement Applications had BC Hydro ramping up spending in F2014-F2016 timeframe
- Needs for savings are more moderate now, hence, BC Hydro recommends maintaining spending levels in F2014 to F2016 timeframe at levels consistent with recent years
- Ramp up will be post F2016
  - BC Hydro is still confident it will be able to meet the F2021 target

CUSTOMER INCENTIVES

Internal analysis was done on TSR (Transmission Service Rate) customers.

Examples could include:

- New operating lines, restarting shut down plants, production of more energy intensive products; or even
- New customer loads such as shore-power

Design considerations for incentive mechanism:

- Eligibility
- Duration
- Pricing
- Alignment with conservation messaging and activities

LOAD FORECAST

DAVID INCE

BC hydro

FOR GENERATIONS

HIGHLIGHTS

- 1.7% annual average growth in energy demand over next 20 years before LNG and before DSM savings (40% growth over that period).
  - Expected DSM savings reduce energy growth rate to 0.9% over the next 20 years.
  - Expected LNG growth adds 5% to BC Hydro load – equivalent to three times the size of current largest industrial customer demand

- Electricity forecast reflects continued slower general economic growth post-recession. Most North American utilities have revised long-term economic and load growth rates downwards.

HIGHLIGHTS - CONTINUED

BC hydro
FOR GENERATIONS

- The load forecast anticipates significant industrial (oil and gas, mining, LNG) demand growth within the next 10 years. Any rate impacts of these developments will be small in the near term.

- Accuracy of load forecasts:
  - Government review noted well-planned, accurate, reliable
  - Load forecasts have typically been within 2% of actual demands (RRA test period)
  - 2008-09 Recession – significant reduction in industrial demand → reduction of long-term load projections

FORECASTING PRINCIPLES

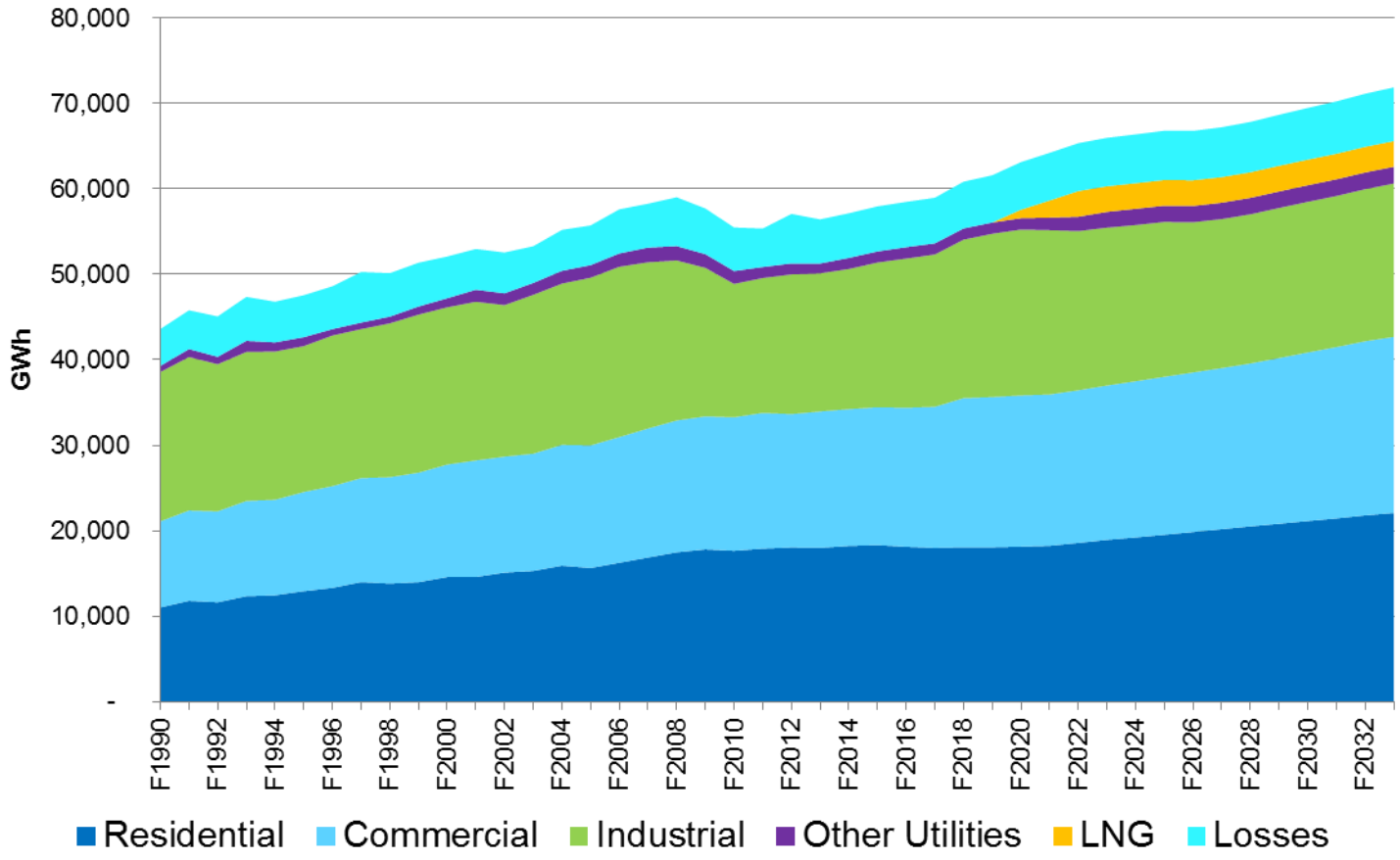
- BC Hydro reference (mid) energy forecast represents the most likely (P50) outcome
- BC Hydro system and asset planners apply reserve margins to forecast to account for contingencies (weather, generation and transmission outages)
- Forecast is constructed using credible, independent third-party inputs
- “Evidence” principle – not speculative:
  - Add and subtract loads to the forecast based on concrete evidence
  - Forecasts are built using multiple credible sources of information
  - Defensible before the BCUC

PAST & FORECAST ENERGY DEMAND BY CUSTOMER GROUP

BC hydro
FOR GENERATIONS

Including Expected LNG and after DSM

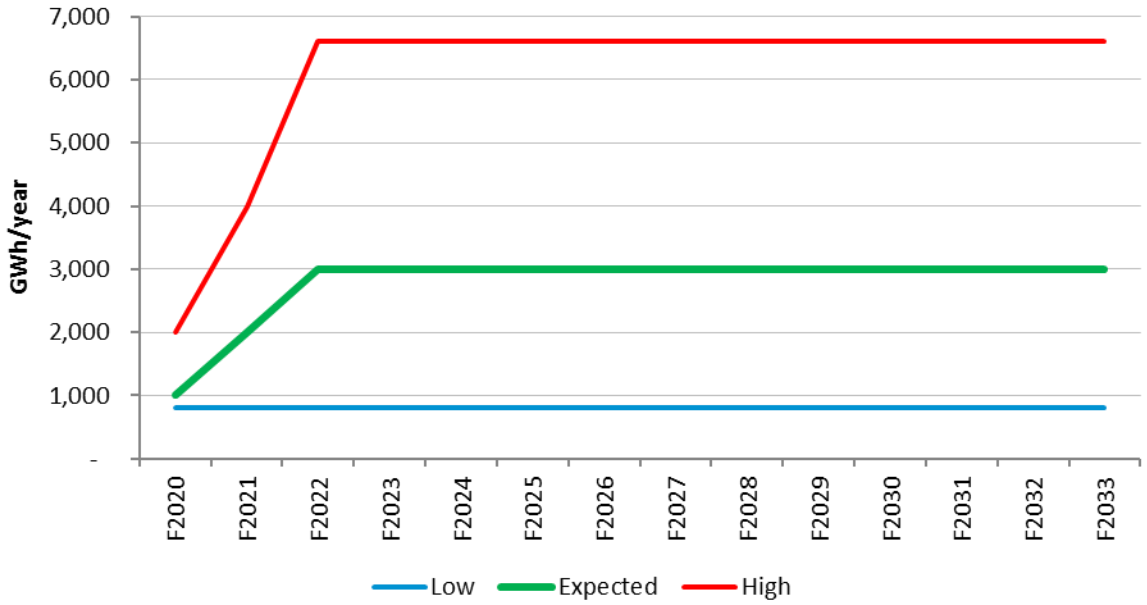
ENERGY:



LNG RANGE

BC hydro
FOR GENERATIONS

ENERGY:



Beyond F2022:

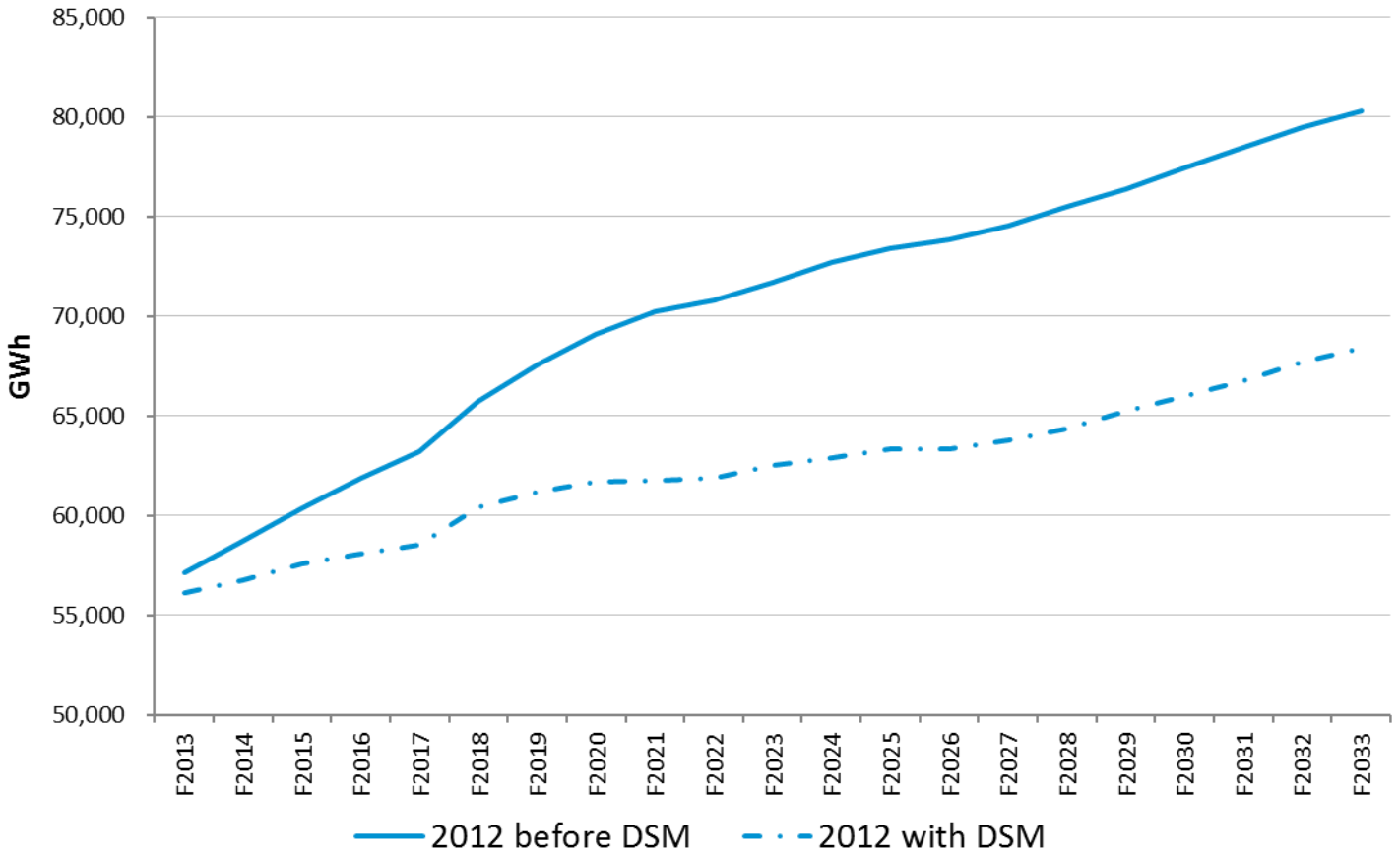
- High LNG scenario: 6,600 GWh/year
- Expected LNG: 3,000 GWh/year
- Low LNG scenario: 800 GWh/year

BC Hydro continues to work with the government and the LNG industry to understand the LNG requirements in the case that these demands are higher or come sooner than expected.

IMPACT OF PLANNED DSM

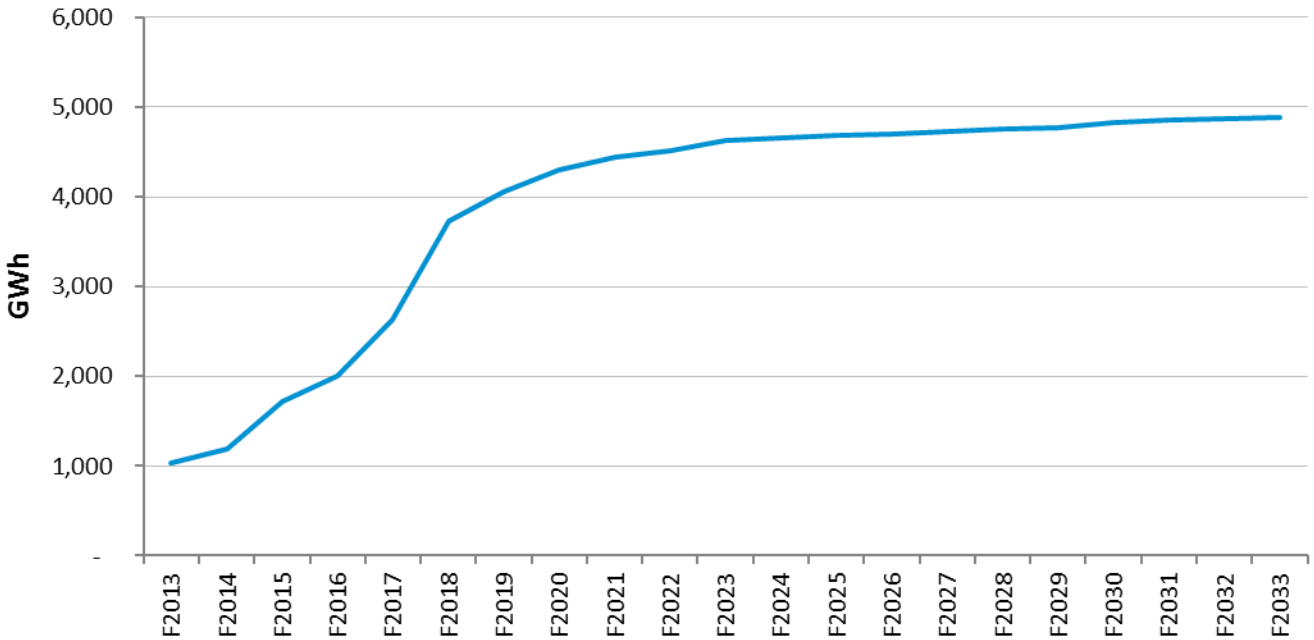
BC hydro
FOR GENERATIONS

ENERGY:



OIL AND GAS SUBSECTOR

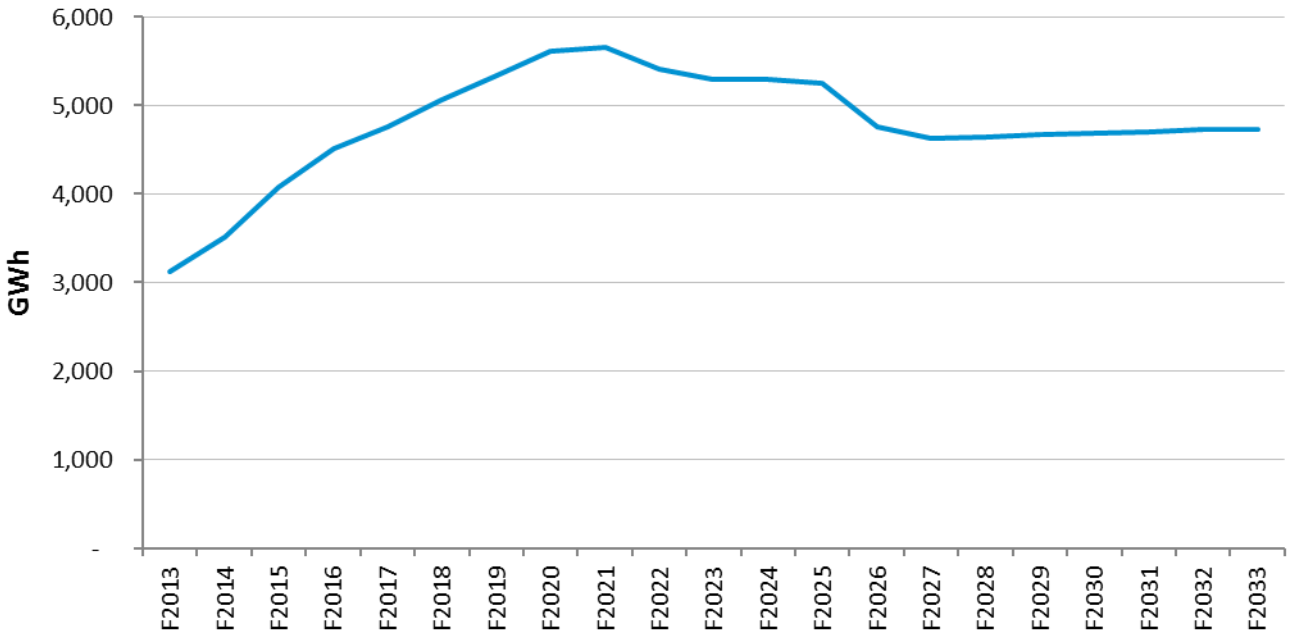
ENERGY:
Before DSM



- The forecast anticipates substantial natural gas development potential, particularly in the Montney (Dawson Creek to Chetwynd) region
- LNG is expected to foster this potential

MINING SUBSECTOR

ENERGY:
Before DSM



- The forecast anticipates new mines and mine expansions
- Announced shutdowns in existing mines are also reflected in the forecast (example: Highland Valley Copper in F2026)

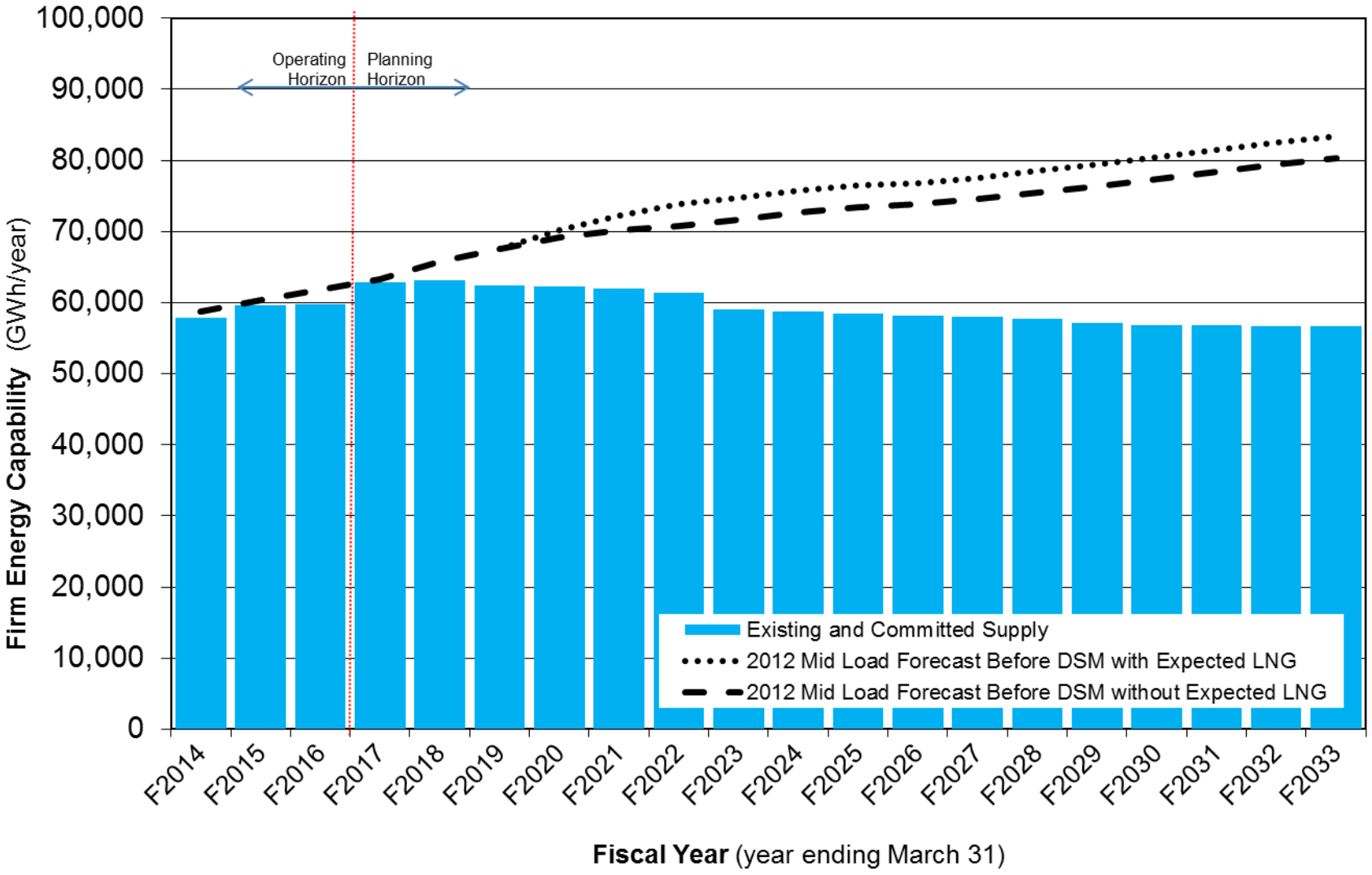
LOAD RESOURCE BALANCE (LRB)

LINDSAY FANE

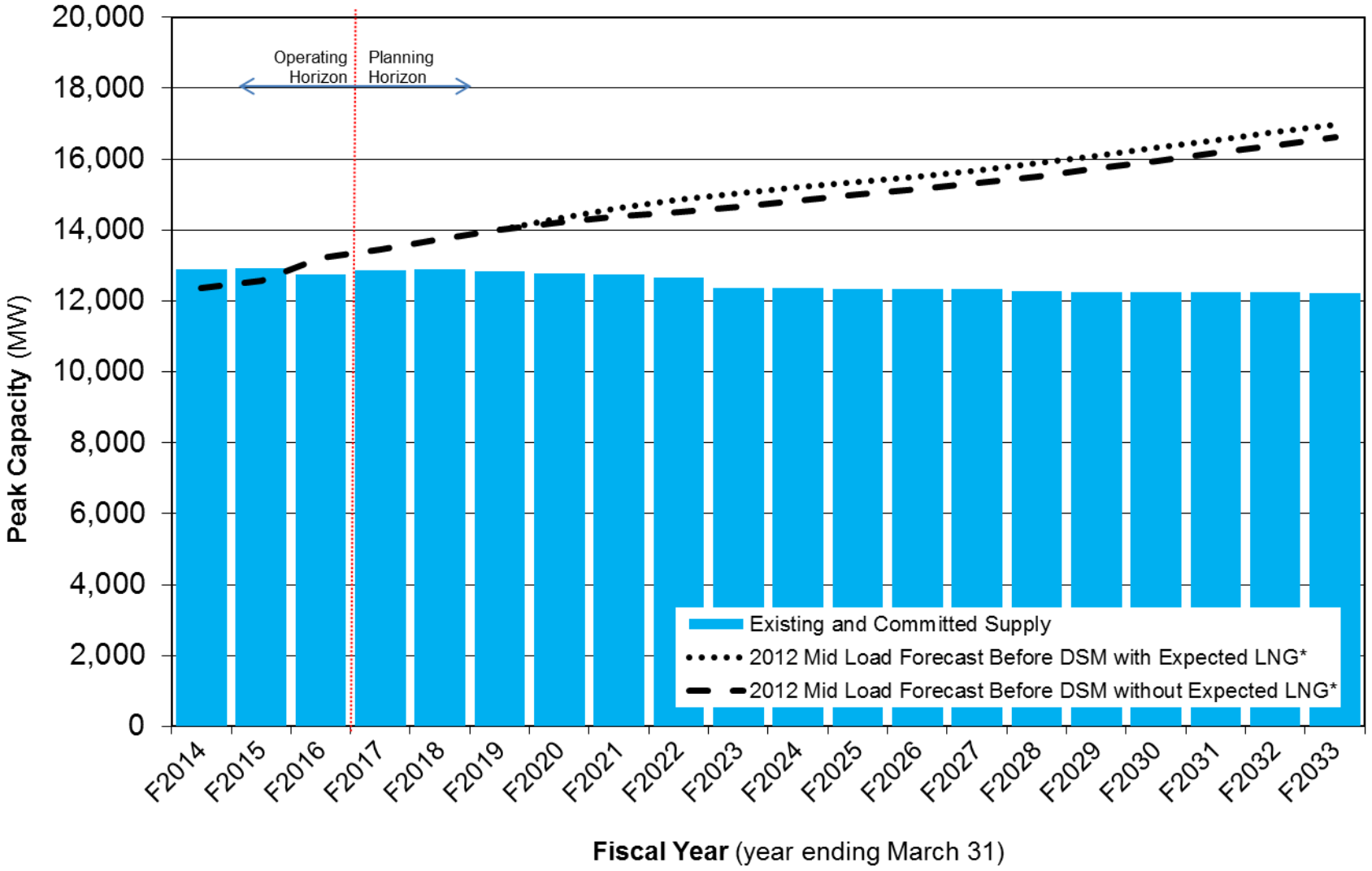
BC hydro

FOR GENERATIONS

ENERGY LRB (FIGURE 2-6)



CAPACITY LRB (FIGURE 2-7)



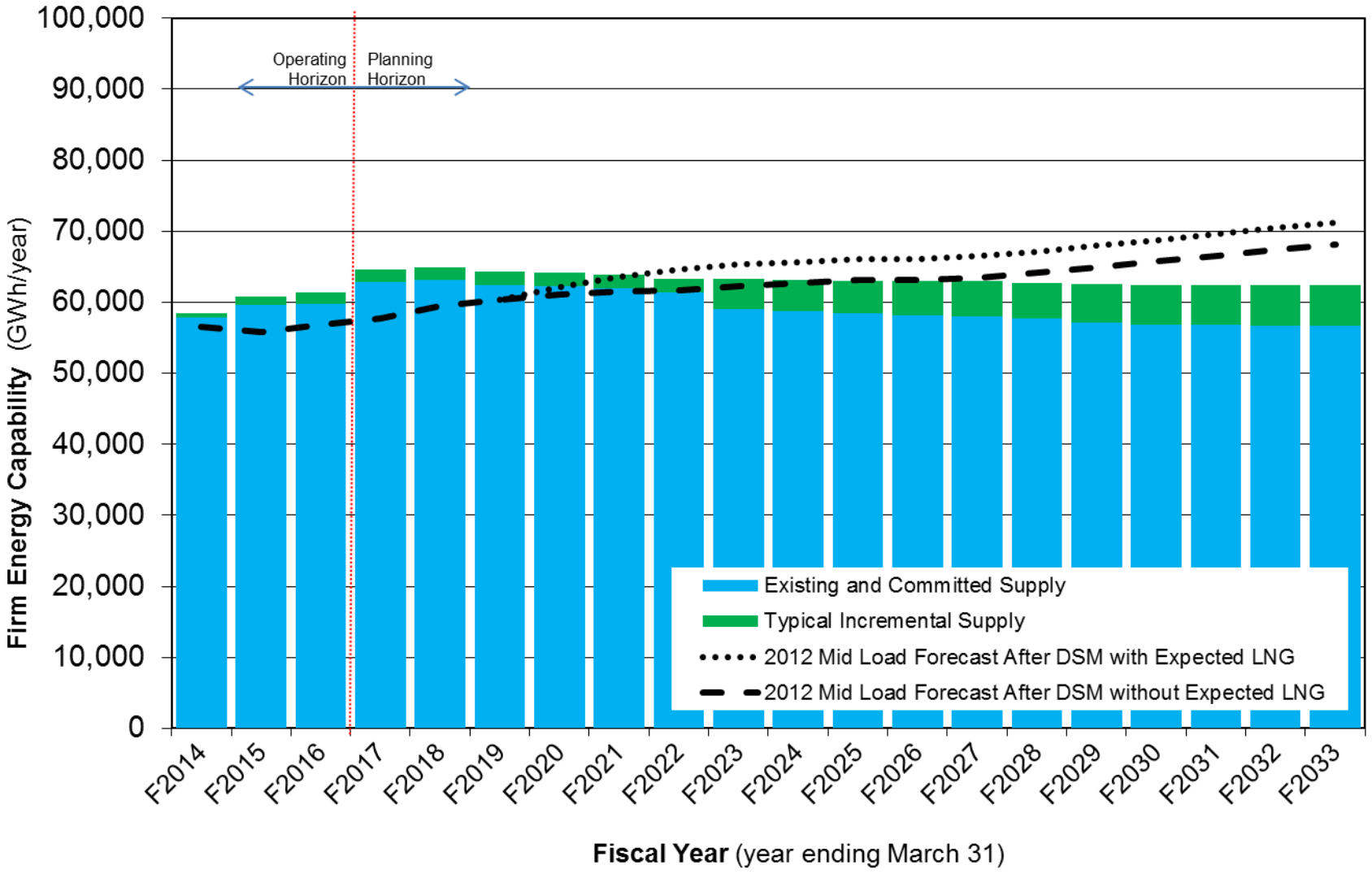
* including planning reserve requirements

DETAILED ASSUMPTIONS REGARDING INCREMENTAL RESOURCES IN F2017

BC hydro FOR GENERATIONS

Resources	Contracted Energy (GWh/year)	Firm Energy (post-attrition, GWh/year)	Effective Load Carrying Capability (ELCC): (post-attrition, MW)	Notes
Supply-Side				
New EPAs: SOP	1,000	520	29	Incremental EPAs awarded under BC Hydro's SOP
New EPAs: Impact Benefit Agreements (IBAs)	0	0	0	
IPP EPA Renewals	1,243	1,205	137	
Demand-Side				
Smart Metering and Infrastructure (SMI) Program	n/a	65	9	Commencing in F2017, forecast theft detection benefits are expected as a result of the SMI program.
Voltage and Var Optimization (VVO)	n/a	359	1	Reduced energy consumption by optimizing the distribution-supply voltage for distribution customers.
DSM	n/a	5,127	781	These are incremental savings that are targeted as part of pursuing the 2008 LTAP DSM target

ENERGY LRB (FIGURE 4-1)

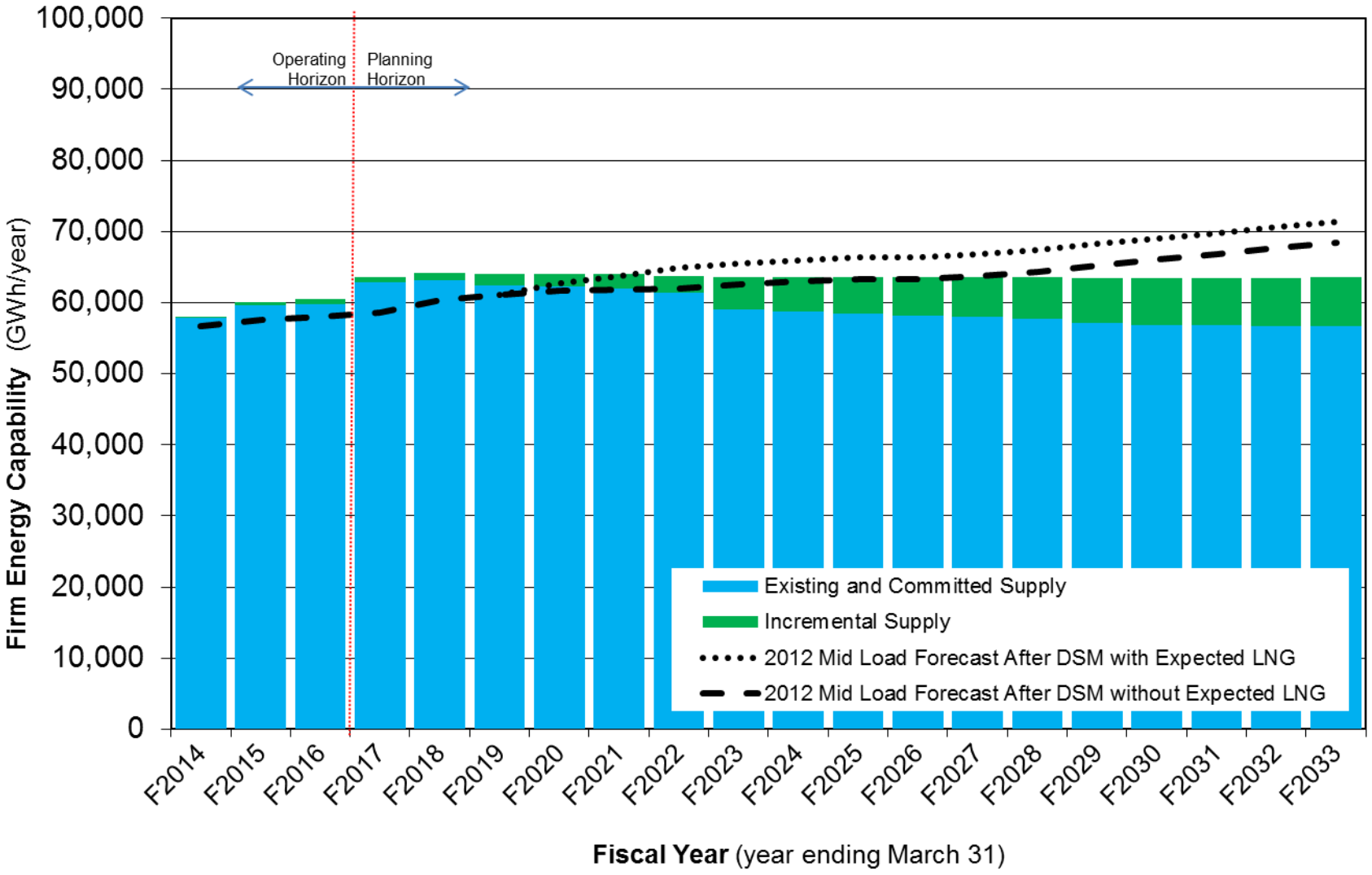


SHORT-TERM ENERGY SUPPLY MANAGEMENT (TABLE 4-16)

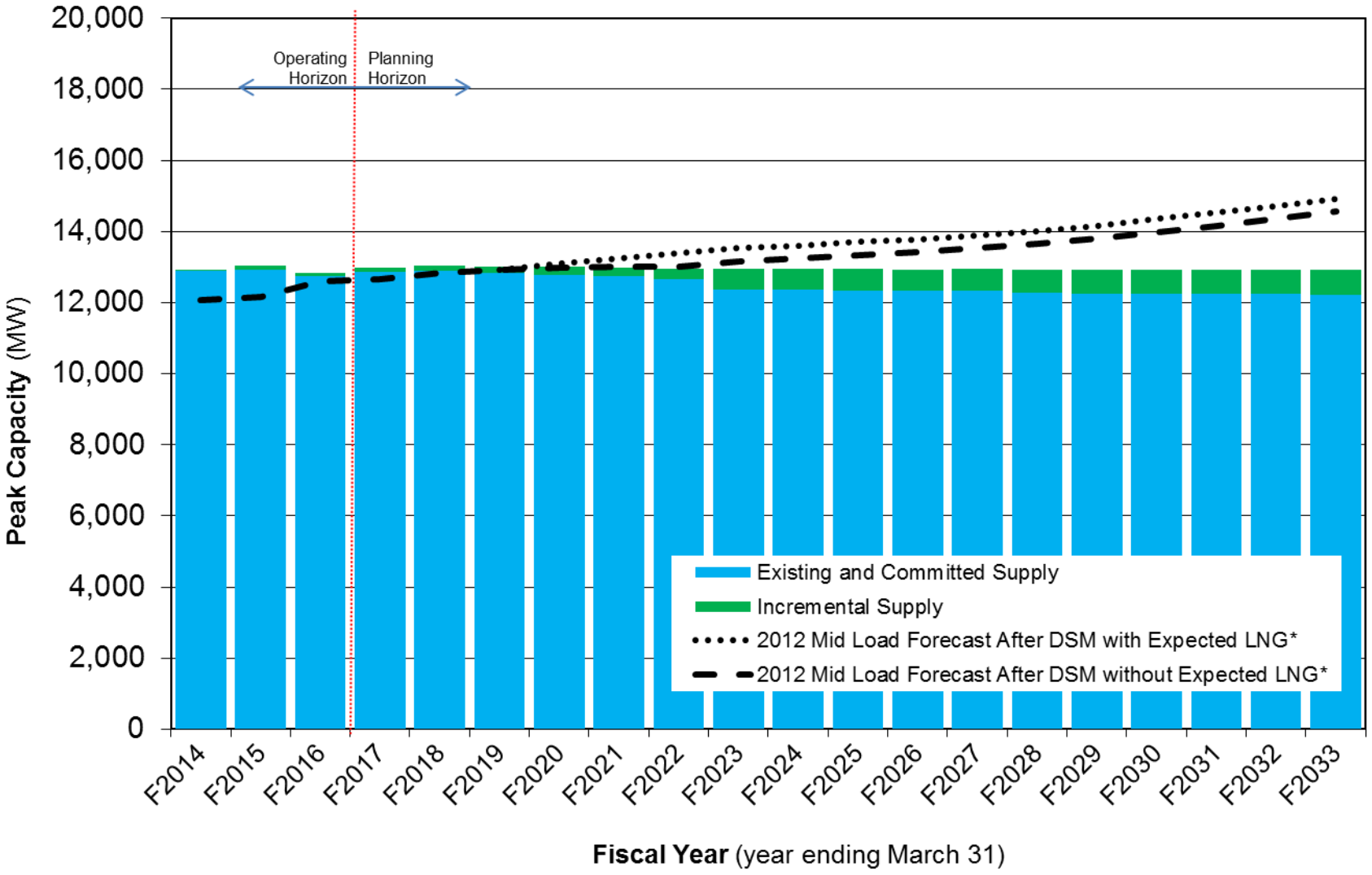
BC hydro
FOR GENERATIONS

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2028	F2033
EPA Terminations and Deferrals	-497	-257	-156	-156	-156	-156	-156	-157	-156
EPA Renewals	-58	-52	273	385	526	819	889	1,147	1,270
New EPAs (SOP)	-467	-440	-414	-387	-361	-334	-308	-175	-46
DSM	-763	-747	-582	-352	0	0	0	0	0
VVO	-86	-129	-193	-225	-235	-248	-256	-252	-248
Net Change	**-1,872**	**-1,626**	**-1,072**	**-735**	**-226**	**81**	**170**	**563**	**820**

ENERGY LRB (FIGURE 4-3)



CAPACITY LRB (FIGURE 4-4)



* including planning reserve requirements

SURPLUS/DEFICIT FIGURES (TABLE 4-18 AND 4-19)

BC hydro
FOR GENERATIONS

ENERGY (GWh)

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2028	F2033
Surplus/Deficit with Incremental Resources and Expected LNG	5,041	3,725	2,828	1,366	179	-1,216	-1,886	-3,864	-7,886
Surplus/Deficit with Incremental Resources without Expected LNG	5,041	3,725	2,828	2,366	2,179	1,784	1,114	-864	-4,886

CAPACITY (MW)

	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2028	F2033
Surplus/Deficit with Incremental Resources and Expected LNG	332	204	77	-100	-244	-431	-576	-1,095	-1,993
Surplus/Deficit without Incremental Resources and Expected LNG	332	204	77	21	-4	-71	-216	-735	-1,632

ANALYSIS AND ANALYTICAL FRAMEWORK

BASIL STUMBORG

BC hydro

FOR GENERATIONS

FRAMEWORK

BC hydro
FOR GENERATIONS

Given the emerging gaps for energy and capacity

- From previous presentation

What's the best way to fill the gap between supply and demand

- Where "best" is within existing legislation and a combination of:
  - Clean Energy Act objectives
  - Good utility practice
  - Stakeholder interests

Resource Options available were outlined in Chapter 3

FRAMEWORK

BC hydro
FOR GENERATIONS

Key planning assumptions (updated since 2012)

- Load Resource Balance (discussed in the morning)
- BC Hydro WACC/Discount Rate (6%, 5%) (s. 4.4.3.2, s. 6.4.4.1)
  - BCH/IPP Cost of Capital differential (6%/6%, 5%/7%)
- Market price scenarios (gas, electricity, GHGs, RECs) (s. 4.3.4.4, s. 6.4.4.2)
- Site C ISD scenarios (all units by F2022, all units by F2024 and F2026)
- Resource Options (2010 ROR, 2013 ROR)
  - Key update: DSM Options 4 and 5 seen as not viable for planning purposes at this time (s. 3.7.3)
  - Key update: Wind (s. 4.3.4.5, s. 4.4.6.2, s. 6.4.4.4)
  - Minor updates: Gas, Biomass, MSW, Run of River, Pumped Storage (cost of energy)

FRAMEWORK

BC hydro
FOR GENERATIONS

Key uncertainties and risks (Section 4.3.3):

- Load growth
- DSM under delivery
- BC Hydro system and operations (including water variability)
- Natural gas and electricity prices
- REC and GHG emission prices
- Regulatory and policy development
- IPP development and transmission support
- IPP attrition rates
- Site C timing and approval to proceed to construction
- Natural gas siting, permitting, and time to develop
- Ability of new transmission to meet new demand , and
- Ability of non-thermal resources to meet capacity requirements.

FRAMEWORK (TABLE 4-22)

BC hydro
FOR GENERATIONS

Approach	Description	Examples
Parameterization of Historical Observations	Uses sequences of past data to derive a statistical description of the range of uncertainty	Load forecast inputs, such as economic growth, housing starts, population growth
Subjective Probability Elicitation	Where good historical data does not exist, uses knowledgeable specialists to construct a description of the range of uncertainty	Savings from various DSM tools including codes and standards, and programs IPP attrition rates for possible future calls
Monte Carlo Analysis	Mechanical way to jointly calculate the influence of several uncertain variables through simulation of thousands of combinations	Load forecasting DSM savings (bottom-up analysis
Scenario Analysis	An alternative way to jointly calculate the influence of several uncertain variables, but only using a few, select combinations	Market price scenarios Load/resource gap
Sensitivity Analysis	Testing one variable at a time to see whether different values within the range of uncertainty impact policy considerations	Wind integration cost
Conservative Point Estimates / Managed Costs	Incorporates uncertainty by taking a single point estimate, chosen in a “conservative” fashion	Firm energy expected from IPP hydro projects
Best Estimates	Does not take into account uncertainty in any fashion; usually reserved for variables where uncertainty is assumed to have a small or manageable impact	Energy from wind projects

FRAMEWORK (FIGURE 4-11)

BC hydro
FOR GENERATIONS

Figure 4-11 Modelling Map and Base Modelling Assumptions

Modelling Map				
Uncertainties/Scenarios				
Market Prices	Scenario 2 Low	Scenario 1 Mid	Scenario 3 High	
Load Forecast	Low	Mid	High	
DSM deliverability	Low	Mid	High	
LNG Load Scenarios	Prior to Expected LNG	800 GWh	3000 GWh	6600 GWh
Resource choices				
Usage of 7% non-clean	Yes	No		
DSM Options	Option 1	Option 2/DSM Target	Option 3	
Site C (all units in) timing	F2024	F2026	No Site C	
Modelling Assumptions and Parameters				
BCH/IPP Cost of Capital	5/7	5/6		
Pumped Storage as Option	Yes	No		
Site C Capital Cost	Base	Base plus 10%		
Wind Integration Cost	$5/MWh	$10/MWh	$15/MWh	
	shows the modeling assumptions			

FRAMEWORK

BC hydro
FOR GENERATIONS

How to fill the gap breaks into a sequence of smaller questions which were examined without LNG first then with expected LNG

- What is the role of gas?
- Additional long term resources?
  - DSM
  - Site C
  - IPPs
- How to fill remaining capacity deficits?
  - Market/DSBs
  - Rev 6
  - GMS
  - Other

ROLE OF GAS

KATHY LEE

BC hydro

FOR GENERATIONS

ROLE OF GAS

BC hydro
FOR GENERATIONS

Policy context from CEA objectives:

- At least 93% clean
- Reduce Greenhouse Gas Emissions
- Encourage energy efficiency and clean or renewable electricity

Planning assumptions:

- SCGTs - be capable of running 18% of the time during the year
- CCGTs - be capable of running 90% of the time during the year

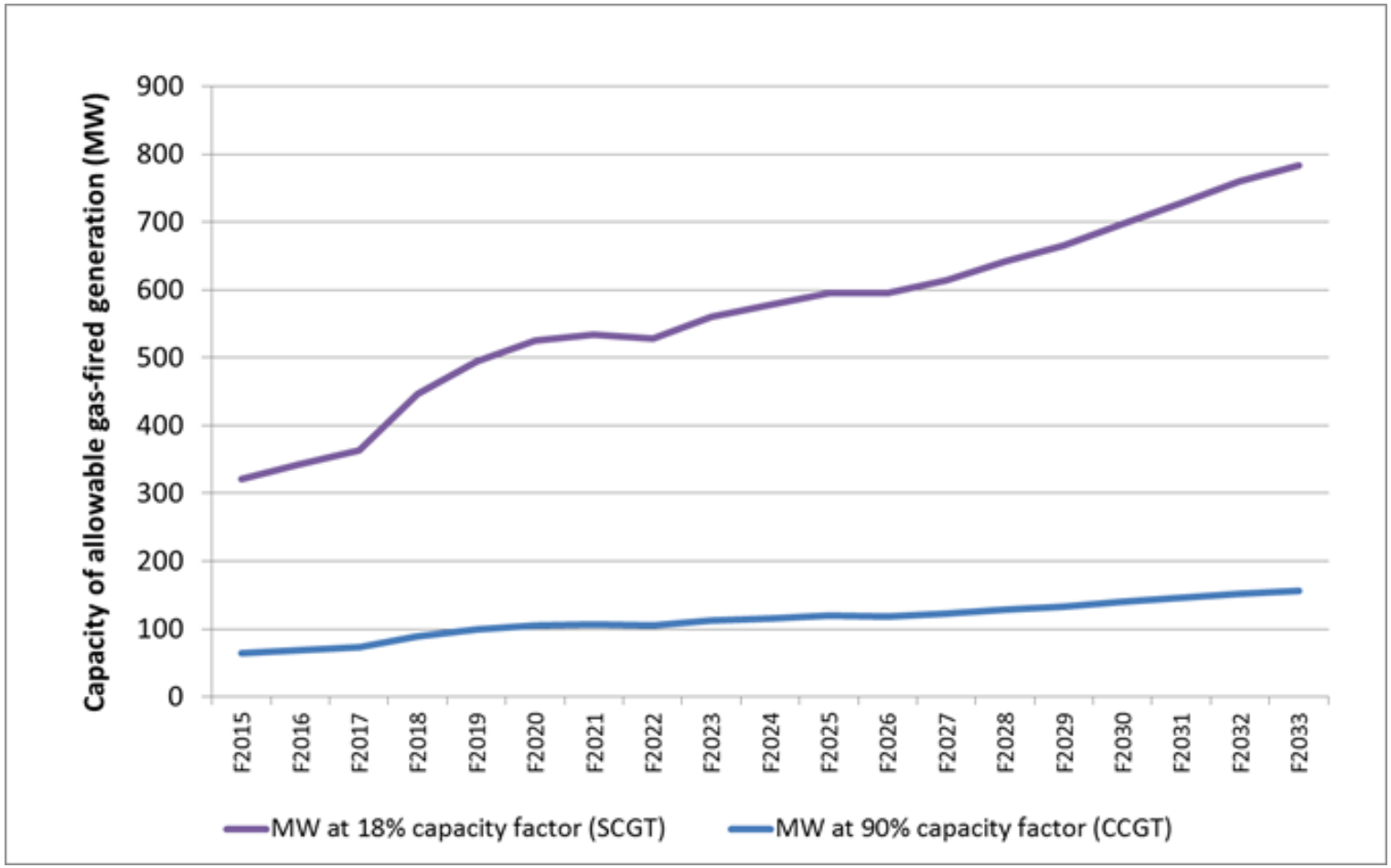
This helps determine natural gas “headroom” within policy boundaries

See next slide

ROLE OF GAS (NON-CLEAN HEADROOM, BASED ON NON-LNG LOAD)

BC hydro
FOR GENERATIONS

Some, but limited, room for gas as energy (Figure 6-1) or capacity source (below, Figure 6-2). Will revisit this again in context of LNG question.



ROLE OF GAS

BC hydro
FOR GENERATIONS

Key questions explored:

- Optimal use of 7% non-clean headroom
- As an alternative capacity resource?
  - Site C
  - Rev 6
  - Pumped Storage
  - DSM
    - Technical aspects to alternatives highlighted
- As an alternative to Transmission?
  - North Coast
  - Fort Nelson / HRB
  - Lower Mainland / Vancouver Island
  - South Peace Region
    - Costs of transmission highlighted
- As a contingency resource?

Recommendation to use as:

- Alternative to transmission; capacity contingency discussed later today

CONSERVING FIRST

KRISTIN HANLON

BC hydro

FOR GENERATIONS

IRP RECOMMENDED ACTIONS: DSM

BC hydro
FOR GENERATIONS

RECOMMENDED ACTION #1: Moderate current DSM spending and maintain long-term target

- Target expenditures of $445 million ($175 million, $145 million, $125 million per year) on conservation and efficiency measures during F2014 to F2016
- Prepare to increase spending to achieve 7,800 GWh/year in energy savings and 1,400 MW in capacity savings, by F2021

RECOMMENDED ACTION #2: Pursue DSM capacity conservation

- Implement a voluntary load curtailment program from F2015 to F2018 to determine how much capacity savings can be acquired and relied upon over the long term.
- Pilot voluntary capacity-focused programs (direct load control) for residential, commercial and industrial customers over two years, starting in F2015.

RECOMMENDED ACTION #3: Explore more codes and standards

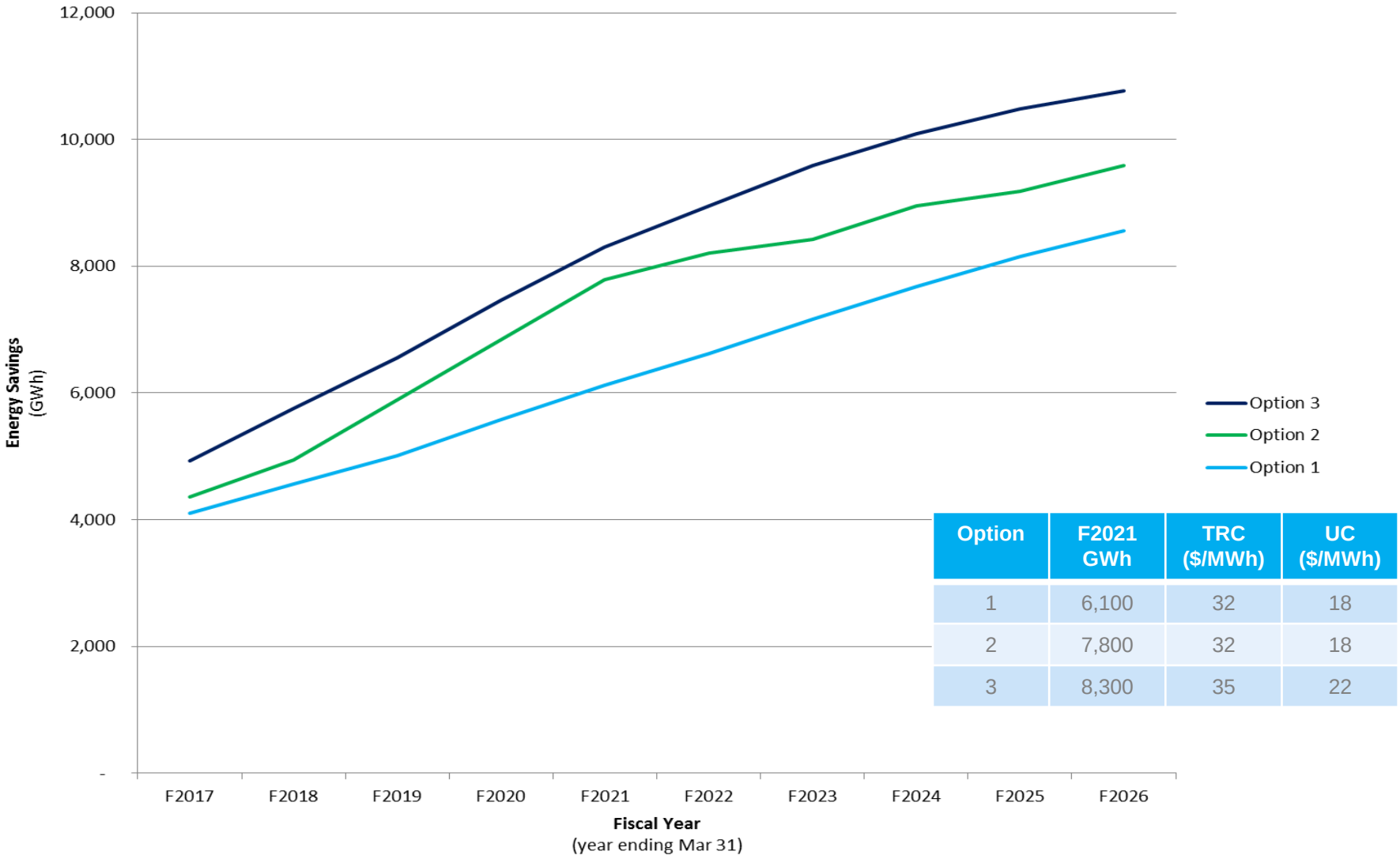
- Explore additional opportunities to leverage more codes and standards to achieve conservation savings at a lower cost and to gain knowledge and confidence about their potential to address future or unexpected load growth.

DSM ENERGY OPTIONS (SECTION 3.3.1)

Targeted updates to reflect new information including: 1) economic/market conditions, 2) customer participation, and 3) load forecast and economic conservation potential.

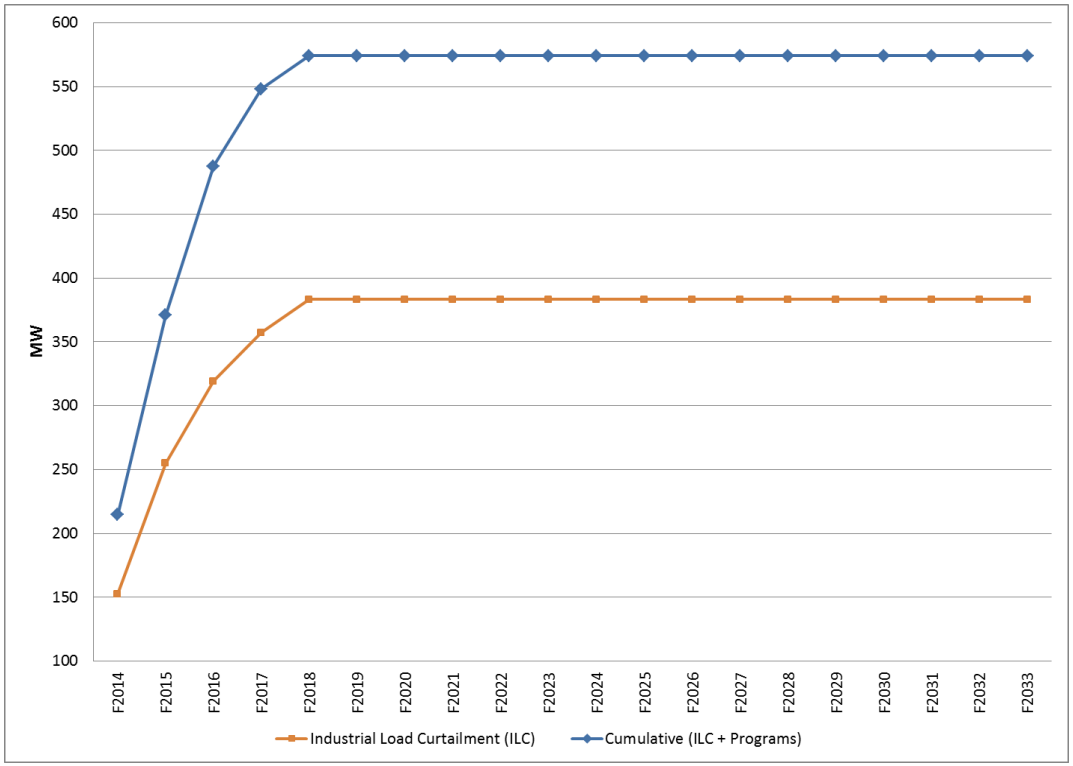
Option 1	Option 2	Option 3	Option 4	Option 5
Updated	Updated	Updated	Not updated	
Option 1 continues to be designed to meet the CEA subsection 2(b) 66 per cent target.	BC Hydro's current DSM target of 7,800 GWh/year and 1,400 MW is DSM Option 2, which was built from the DSM targets established in the 2008 LTAP.	Option 3 continues to target more electricity savings than Option 2 by expanding program efforts while keeping the level of activity for codes and standards, and conservation rate structures, consistent with Option 2.	Options 4 and 5 were not updated for the 2013 ROR Update, because they have been found to not be viable for long-term planning purposes at this time.	

DSM OPTIONS 1-3: ENERGY SAVINGS (FIGURE 3-1)



Option	F2021 GWh	TRC ($/MWh)	UC ($/MWh)
1	6,100	32	18
2	7,800	32	18
3	8,300	35	22

DSM CAPACITY-FOCUSED OPTIONS (FIGURE 3-5)



Option	TRC ($/kW-yr)	UC ($/kW-yr)
Industrial Load Curtailment	31	45
Capacity-Focused Programs	55	69

NEAR-TERM ADJUSTMENTS: DSM PLANNING FRAMEWORK (SECTION 4.2.5.2)

BC hydro FOR GENERATIONS

Consider Cost Effectiveness

Reduce Rate Impacts

Minimize Lost Opportunities

Maintain Flexibility to Ramp Up/Down

While maintaining principles, consider:

1. Eliminate projects or activities that only contribute to the surplus period,
2. Withdraw or change offers where energy savings can be deferred and opportunities can be recaptured in the deficit period,
3. Reduce activities to a level that minimizes the impact on lost opportunities and retains the ability to still ramp back up to long term savings targets.

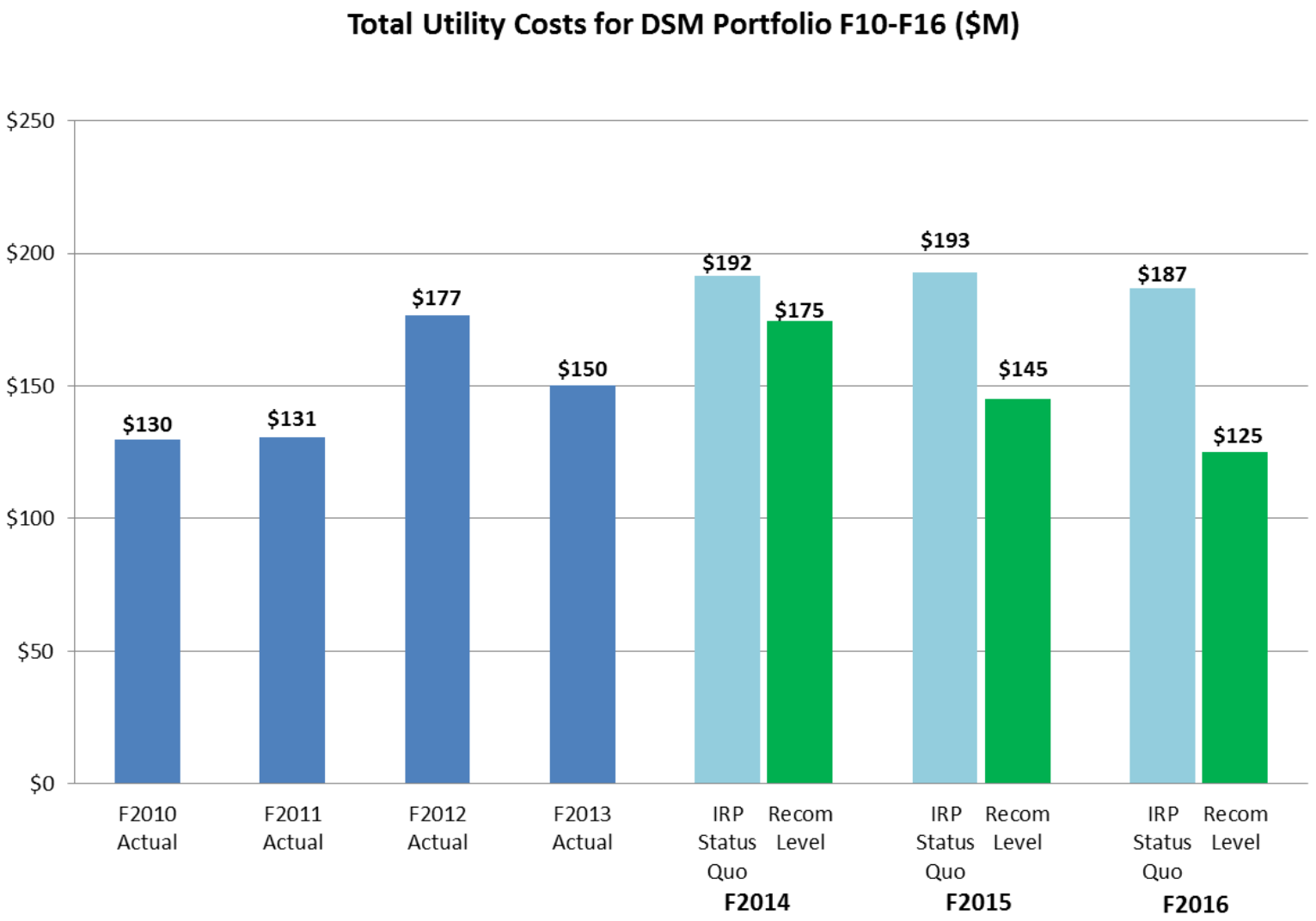
Maintain Customer and Partner Engagement

Respect Agreements

Provide Opportunities for Participation Across Customer Classes

PROPOSED F14-F16 DSM PLAN

BC hydro
FOR GENERATIONS



MEETING FUTURE ELECTRICITY NEEDS

KATHY LEE

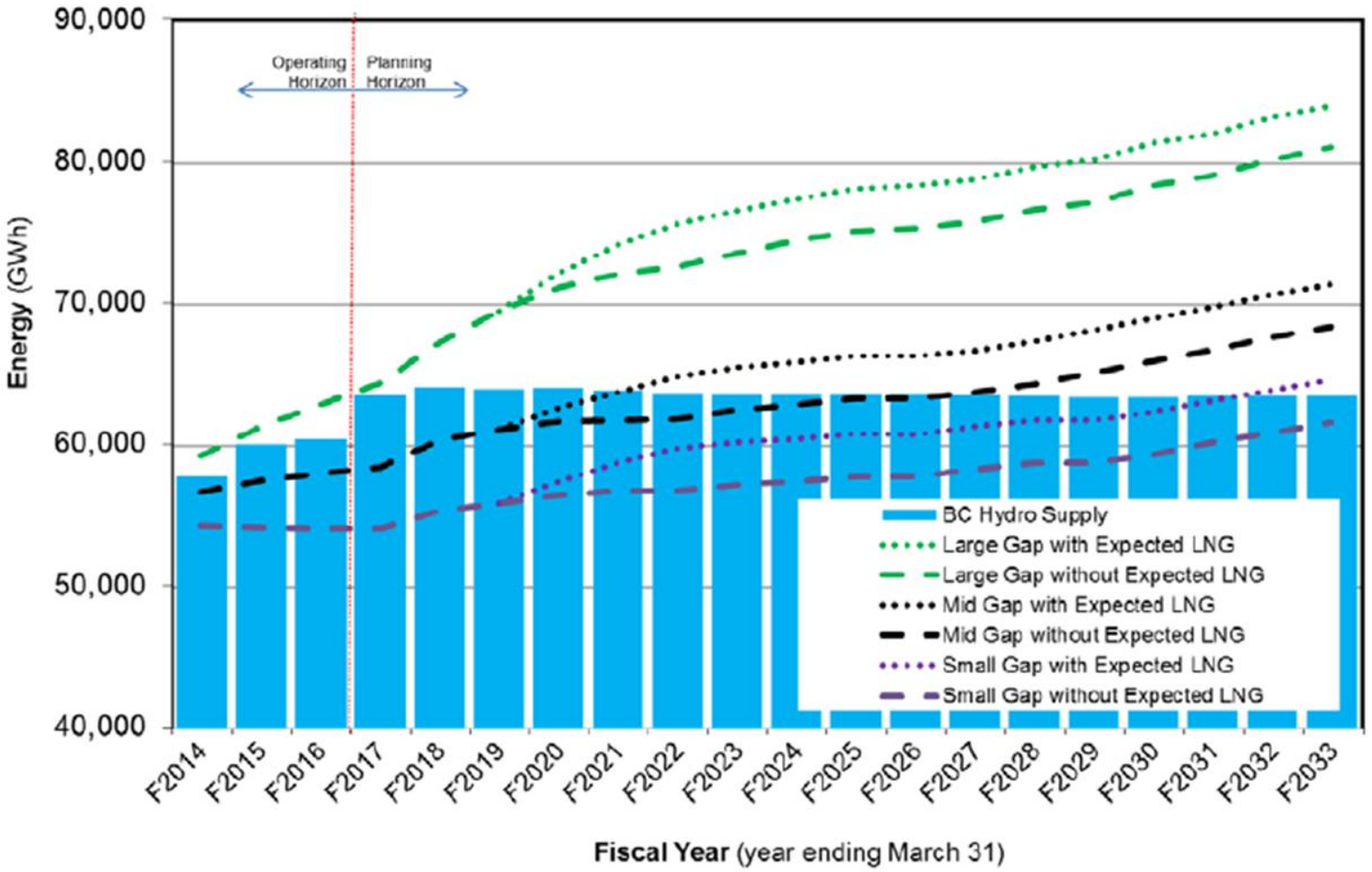
BC hydro

FOR GENERATIONS

PLANNING CONTEXT

BC hydro
FOR GENERATIONS

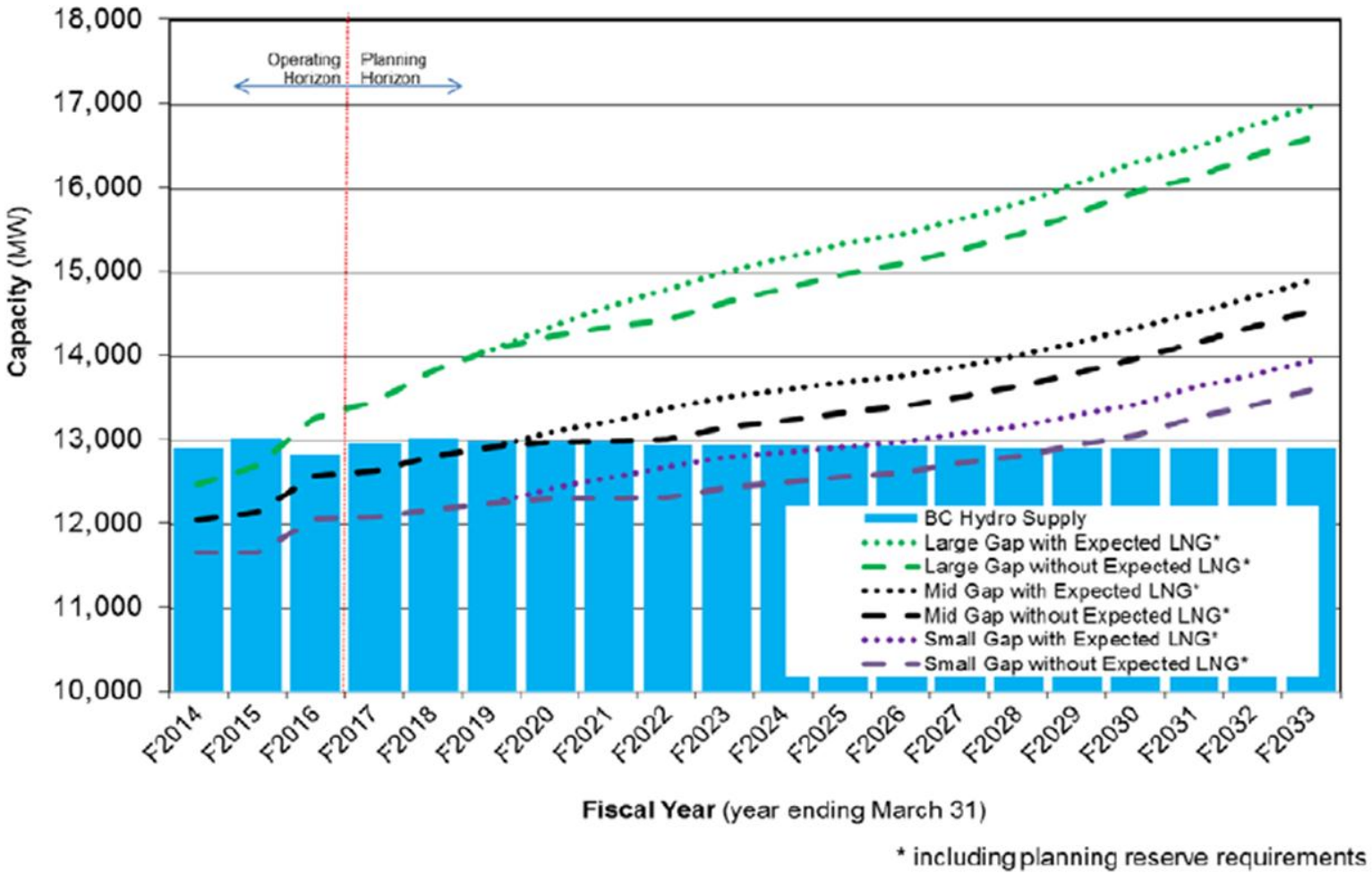
Figure 4-9 Energy Gap[18]



PLANNING CONTEXT

BC hydro
FOR GENERATIONS

Figure 4-10 Capacity Gap



* including planning reserve requirements

PLANNING CONTEXT

BC hydro
FOR GENERATIONS

As highlighted in the analysis framework description

- Three elements in the mix
  - DSM
  - Site C
  - IPPs

Gas reserved for Transmission alternatives, capacity, contingency

Modeling assumptions for Site C

- Site C ISD scenarios (all units by F2024 and F2026)
- Site C alternatives:
  - Capacity: Rev 6, GMS Units 1 – 5 capacity increase, gas peaker within 7% (where applicable), pumped storage
  - Energy: Mostly wind with biomass, run-of-river

DSM LONG-TERM TARGET ANALYSIS

BC hydro FOR GENERATIONS

Three ways to compare Options 1, 2 (DSM Target) and 3:

- With Site C, Without Site C, Option 2 with Site C vs. Option 3 without Site C
  - All clean or with some thermal

	Clean Generation Portfolio		Clean + Thermal Generation Portfolio	
PV	+ Site C	No Site C	+ Site C	No Site C
Option 3	$7,478 M	$7,955 M		$7,204 M
Option 2 (DSM Target)	$7,215 M	$7,967 M	$6,886 M	
Option 1	$7,308 M	$8,293 M		

Conclusions Regarding DSM

- Option 2 (DSM Target) continues to remain the most cost effective option

SITE C – SENSITIVITY ANALYSIS

BC hydro
FOR GENERATIONS

	Clean Generation Portfolio		Clean & Thermal Generation Portfolio	
Site C benefits (w/o Site C portfolio – w Site C portfolio)	F2024	F2026	F2024	F2026
BASE CASE	$630 M	$880 M	$150 M	$390 M
Sensitivity **Cost of Capital Differential (1% differential)**	$420 M		$20 M	
Market Prices (hi)	$830 M		$470 M	
Market Prices (lo)	$450 M		$(90) M	
Site C Capital Cost (+10% over contingency)	$360 M	$650 M	$(120) M	$170 M
Wind Integration Cost (15)	$720 M			
Wind Integration Cost (5)	$530 M			
Large Gap			$2,260 M	
Small Gap	$(1,040) M		$(1,280) M	
LNG Scenario	$1,850 M		$1,260 M	

CONCLUSIONS AND CONSIDERATIONS REGARDING – SITE C

BC hydro
FOR GENERATIONS

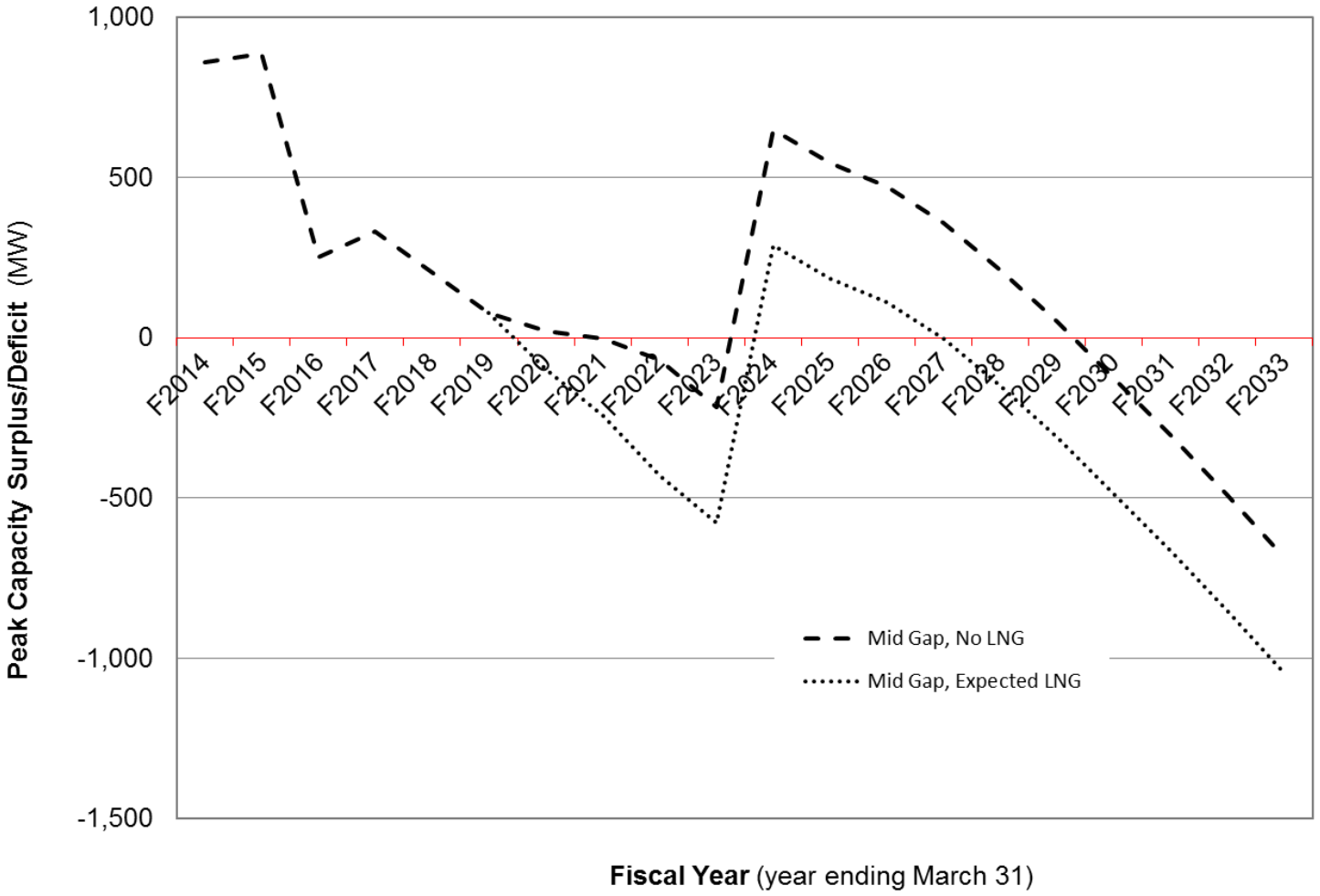
- Site C continues to be a cost-effective resource option
- Excluding Site C from a portfolio increases costs
- Based on mid estimates
- Dispatchability / Integration Capability
- Environmental and Economic Development Benefits Attributes

Non-wire reinforcement GMS to KLY

- Dispatch of new generation resources from the Peace Region will exhaust the existing capacity of the GMS to KLY 500 kV transmission
- Incremental transmission capacity will be needed to accommodate the new generation resources
- The required incremental transmission capacity can be provided by network upgrades such as series and shunt compensation of the existing 500 kV GMS-WSN-KLY lines
- Non-wire network upgrades can be triggered by Site C or by other new resources additions in the Peace Region
- Site C advances the non-wire transmission upgrades to the GMS-WSN-KLY corridor from F2029 to F2024

CAPACITY RESOURCES

Bridging to Site C (Figure 6-17)



CAPACITY RESOURCES (TABLE 6-31)

BC hydro
FOR GENERATIONS

Resource Option	Potential (MW)	Lead Time (years) or Earliest In-Service Date	Cost at Point of Interconnection ($F2013/kW-yr)	Reference Sections & Key Considerations
Market purchase backed by Canadian Entitlement (**CE**)	Up to 500	n/a	varies	Section 3.4.2.4 Low cost- bridging option Prescheduled capacity
Revelstoke Unit 6	500	F2021	50	Section 3.4.2.3 Low cost long-term option, clean Dispatchable capacity with fast response time
GMS Units 1-5 Capacity Increase	220	F2021 first unit	35	Section 3.4.2.3 Low cost long-term option, clean Dispatchable capacity with fast response time
Natural Gas-fired Generation	100 (per unit)	4 – 5	>=84	Section 3.4.2.2 Long term option, but not clean Dispatchable capacity with ramp rate restrictions
Pumped Storage (LM/VI)	500 – 1000 (per unit)	8	>=118	Section 3.4.2.1 High cost long term option, clean Dispatchable capacity with fast response time

MEETING LNG AND THE NORTH COAST SUPPLY NEEDS

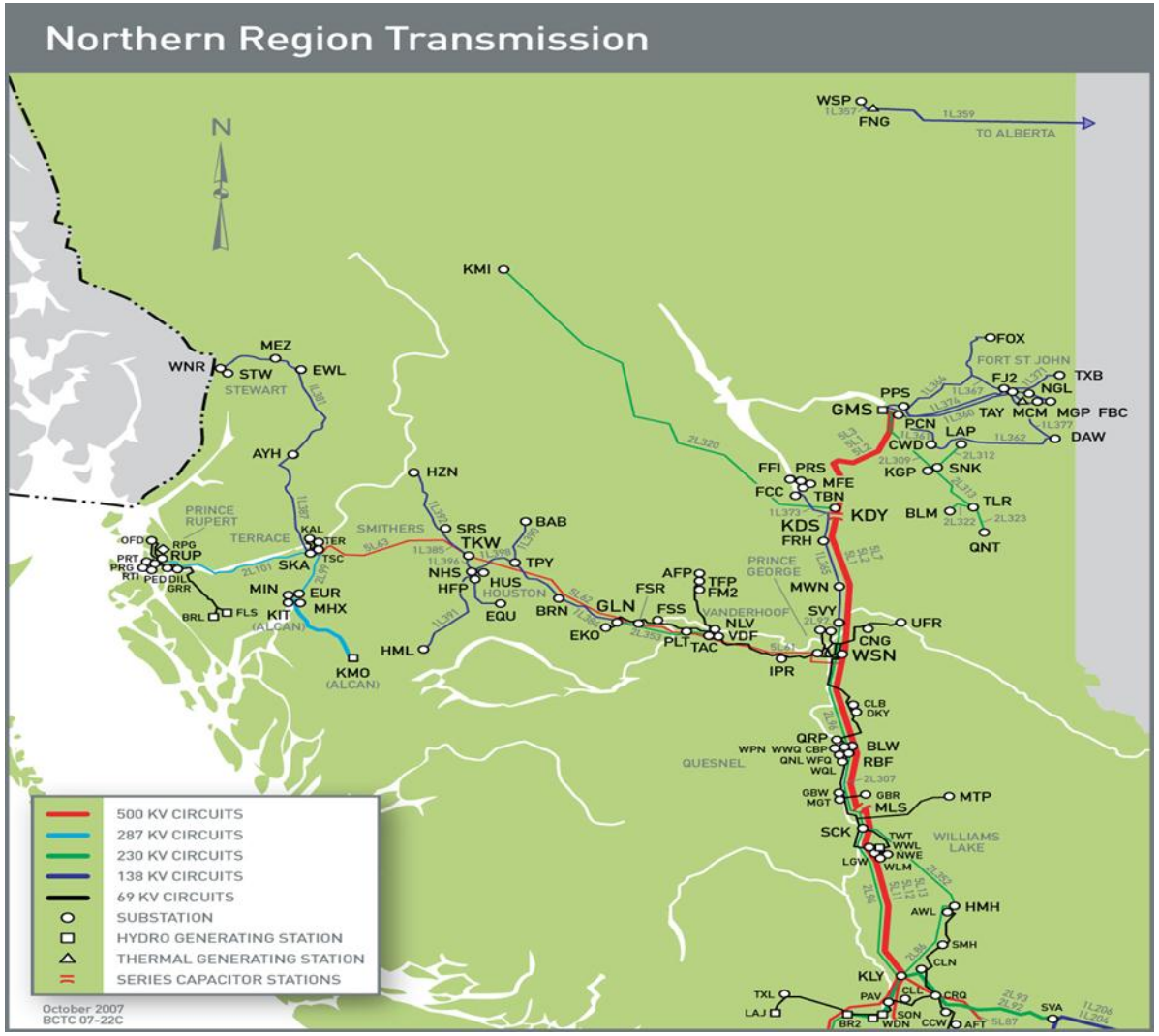
SANJAYA DE ZOYSA

BC hydro

FOR GENERATIONS

THE NORTH COAST

BC hydro
FOR GENERATIONS



NORTH COAST PLANNING CONSIDERATIONS

BC hydro
FOR GENERATIONS

KEY QUESTION

What actions are needed and what supply options need to be maintained to ensure that BC Hydro is able to supply Expected LNG, additional LNG load above expected and other loads in the North Coast while considering the specific planning challenges of this region?

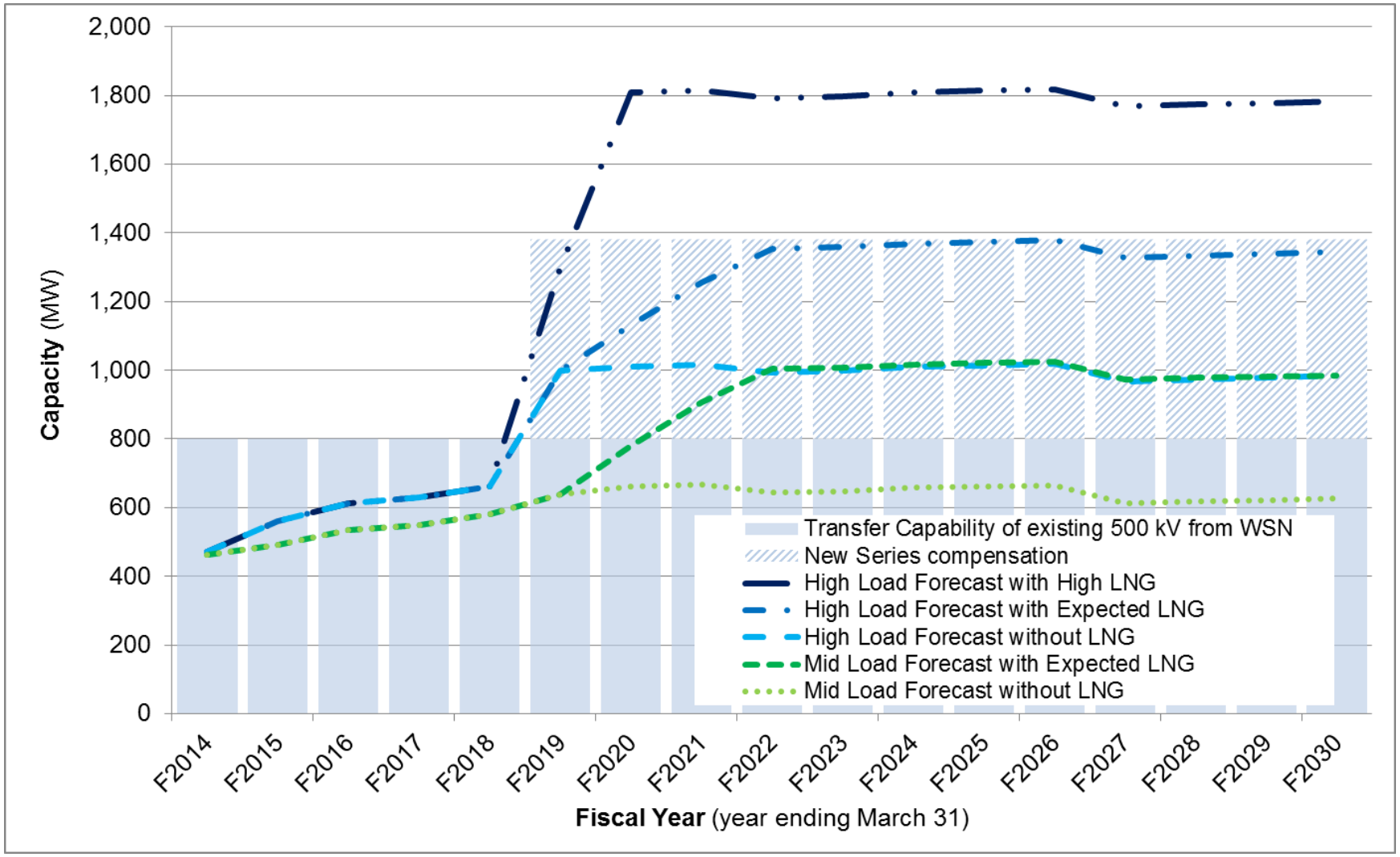
LOAD GROWTH

- Expected LNG Electrification Load is 3,000 GWh/360 MW
  - Higher range of 6,600 GWh/800 MW has also been considered
- Mining loads along the NTL corridor and other areas of the North Coast

PLANNING CHALLENGES

- Few local supply options with dependable capacity
- Limited transfer capability of 500 kV line from WSN
- Transmission stability issues and maintenance difficulties

NORTH COAST LOAD SCENARIOS & CAPABILITY OF 500 KV FROM WSN (FIGURE 6-12)



SUPPLY OPTIONS (SECTION 6.5.4)

BC hydro
FOR GENERATIONS

Options to serve future load growth in the North Coast are:

- Integrated system supply
  - Strengthen transmission and develop generation resources broadly across the province
- Local supply
  - Develop dependable generation in the North Coast
- An economic combination of integrated supply and dependable local resources

RECOMMENDED ACTIONS

- Explore Natural gas-fired Generation for the North Coast
- Advance reinforcement of the transmission line from prince George to Terrace
- Explore clean energy supply options, if LNG demand exceeds available resources

PLANNING FOR THE UNEXPECTED

LINDSAY FANE

BC hydro

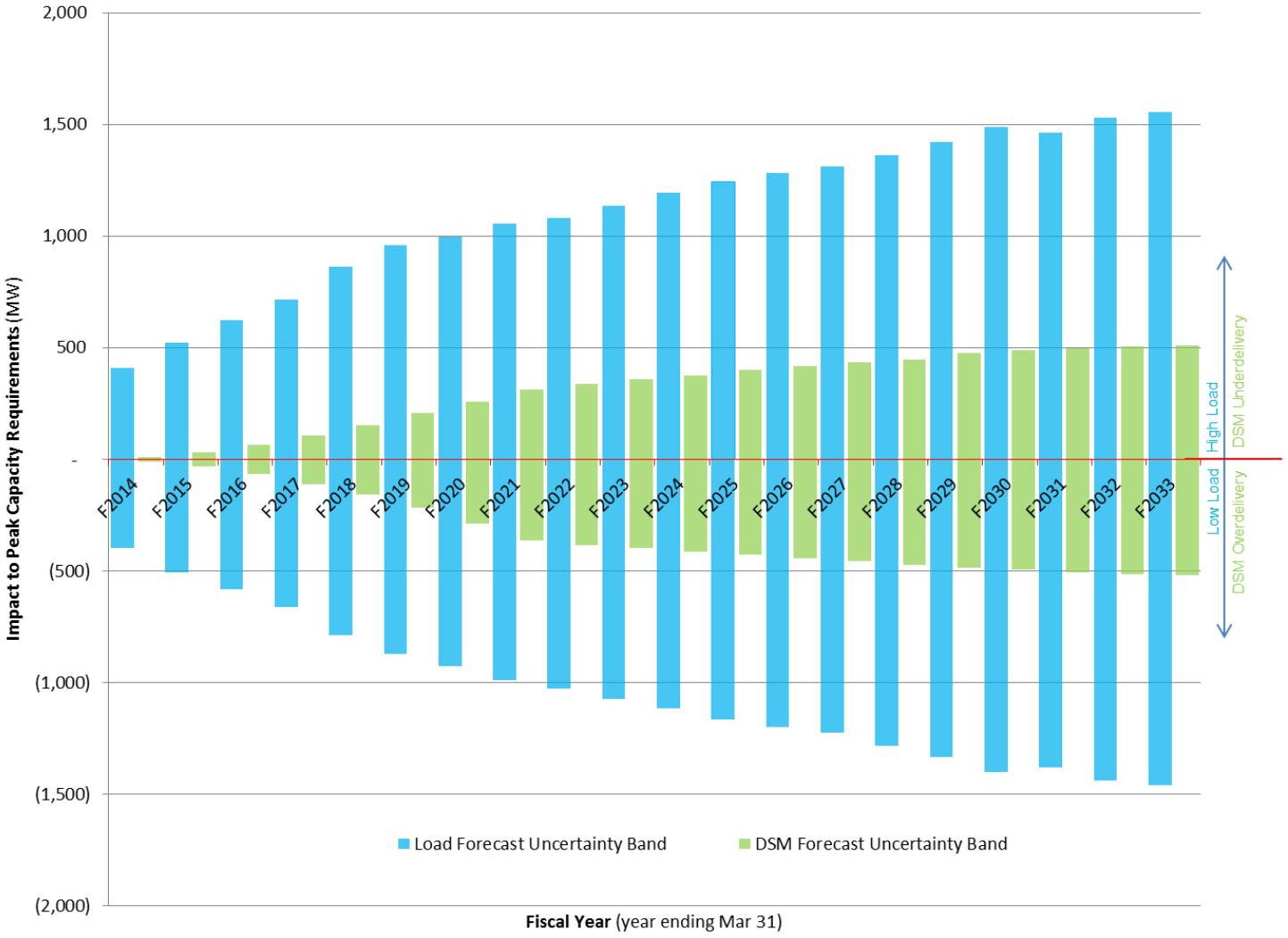
FOR GENERATIONS

CAPACITY NEED UNCERTAINTIES (TABLE 6-32)

BC hydro
FOR GENERATIONS

Category	Uncertainty	Potential Impact on Capacity Gap Size	Leading Indicator	Number of Years of Advance Warning
Near-Term, Possible Insufficient Reaction Time, Gradual	Load (incl. Mining + Oil & Gas)	+1,050 MW in F2021	Year-by-year load growth	1-4
	DSM	+300 MW in F2021	Year-by-year load growth	1-4
Near-Term, Possible Insufficient Reaction Time, Signpost	Wind ELCC	Up to about +150 MW in F2021	Experience & Internal analysis	1-4
Near-Term, Sufficient Reaction Time, Signpost	LNG	+ 500 MW in F2021	Customer requests	4
	High FN/HRB	+ 1,000 MW in F2021	NETL commitment	4
Long-Term, Sufficient Reaction Time, Signpost	Site C	Material delay in delivery of Site C's +1,100 MW	Approvals to proceed; ISD	4
Long-Term, Sufficient Reaction Time, Gradual	General Electrification	Growing to +400 MW in F2021 (E3)	Gov't policy, load growth, technology	3-6

LOAD AND DSM UNCERTAINTY BANDS (FIGURE 6-18)



CONTINGENCY RESOURCE PLANS

BC hydro
FOR GENERATIONS

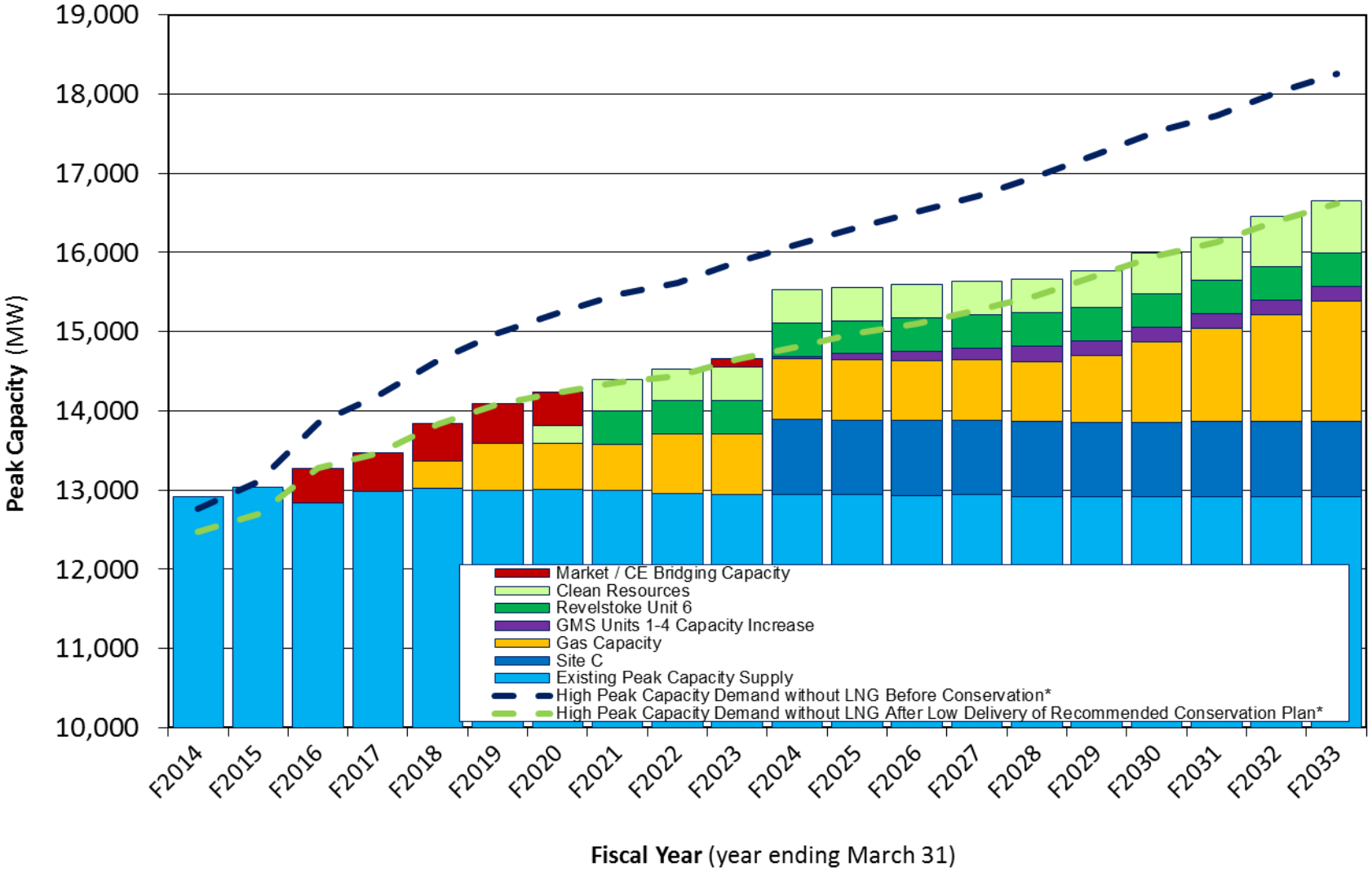
REGULATORY

- Submitted to BCUC pursuant to the OATT
  - Establish queue position for transmission service

CONSIDERATIONS

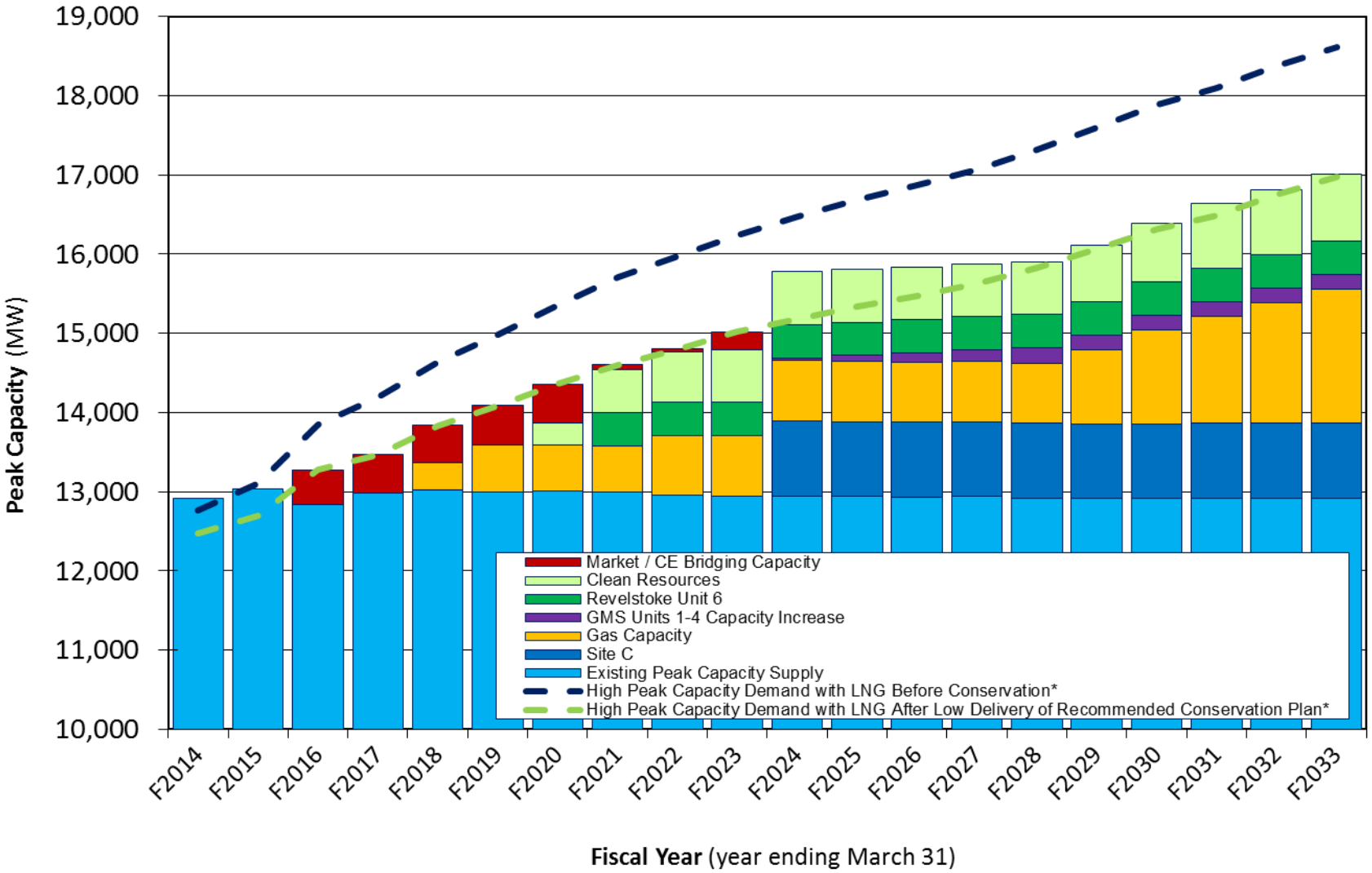
- Preserve capacity options
- Test transmission pathways (long lead time)
- Energy requirements
- Minimize costs

CONTINGENCY RESOURCE PLAN WITHOUT LNG (FIGURE 8-8)



* including planning reserve requirements

CONTINGENCY RESOURCE PLAN WITH LNG (FIGURE 8-10)



* including planning reserve requirements

MEETING CLOSE/ROUNDTABLE

ANNE WILSON / ALL

BC hydro

FOR GENERATIONS