Integrated Resource Planning and the Site C Project:

Implications for Newfoundland and Labrador

Muskrat Falls Public Symposium
Labrador Institute

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PROGRAM ON WATER GOVERNANCE

CENTRE HELIOS

Outline

1. Overview of research findings
2. Integrated Resource Planning
3. Modeling the Site C Project
4. Implications for Newfoundland and Labrador

1. Overview of research findings

Site C Project

- Earthfill dam 60 m high and 1,050 m long
- Reservoir inundating 93 km^2 of the Peace River valley
- Realignment of several highway sections
- Expropriation of homes, farms and families

Site C Project

Site C Project

- 1950s – Two Rivers Policy and flood reserve
  - Two dams developed upstream
- 1980s – BCUC formed to review Site C
  - Need not demonstrated; no approval granted
- 2000s – renewed studies
- 2010 – Environmental Assessment
- 2012 – BC Hydro Integrated Resource Plan
- 2014 – Approvals

Site C Research

- UBC Program on Water Governance
  - Dr. Karen Bakker, Co-director
  - http://watergovernance.ca/projects/sitec/
- Some key questions by early 2016
  - What issues remained to be investigated?
  - What had changed from the IRP?
  - What had changed since the approvals?
  - Was the project past "the point of no return"?
  - Was further review merited by the BCUC?
  - Who else needs to be engaged?

Study #1 – First Nations

- Key issue not addressed
  - Did Site C Project constituted an <u>infringement</u> of First Nation rights under Treaty No. 8?

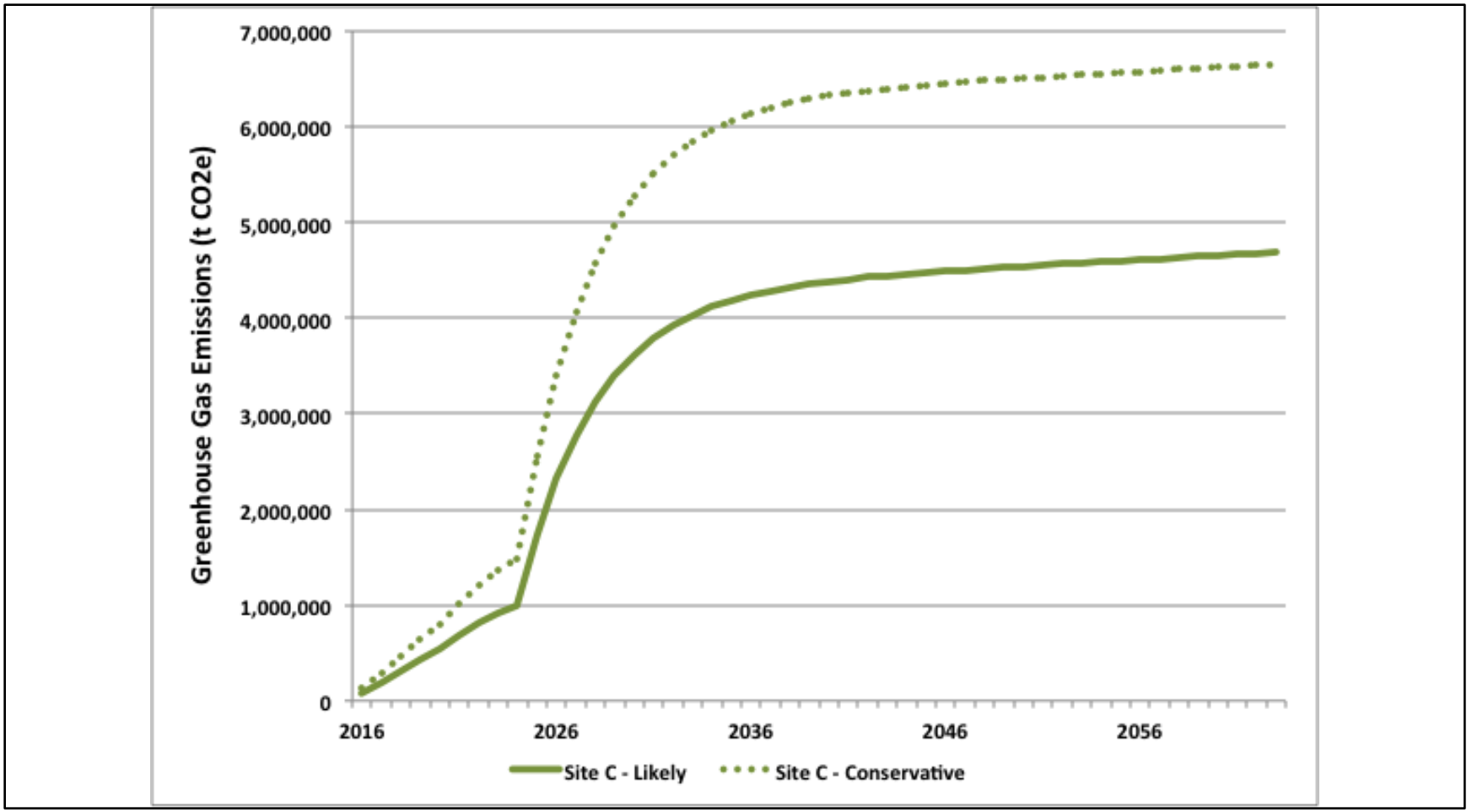
Study #2 – Environmental Effects

Projects assessed under the CEAA	Number of Significant Environmental Effects
Site C Project	20
Lower Churchill Hydroelectric Generation Project	5
New Prosperity Gold and Copper Mine Project	5
Jackpine [Oilsands] Mine Expansion Project	5
Pacific Northwest LNG	3
Cheviot Coal Project	2
Encana Shallow Gas Infill Development Project	2
Kemess North	2
Labrador-Island Transmission Link	1
LNG Canada	1
Northern Gateway Project	1
White Pines Quarry	1

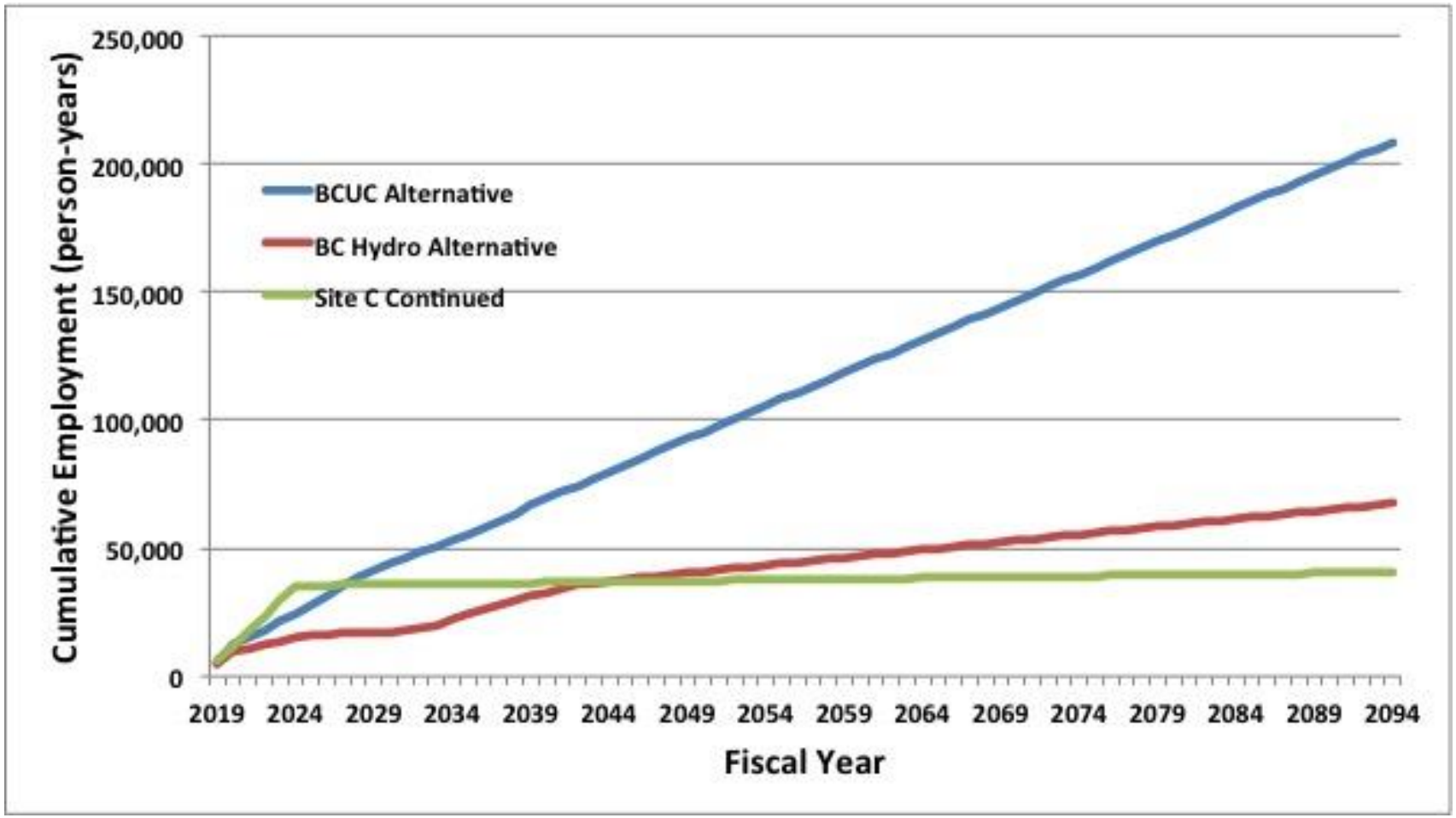
Study #3 – Regulatory Context

- *Clean Energy Act* (2010)
  - Exempted Site C from review by the BCUC
  - Required 93% “clean” energy
  - No review of IRP by the BCUC
- Joint Panel Review environmental assessment
  - Limited capacity to address energy economics
  - Load forecasts, project costs, and revenue requirements recommended for BCUC review
    - Recommendation ignored by government

Study #4 – GHG Emissions



Study #5 – Employment



Study #6 – Reassessing the Need

- Update the assessment of alternatives
- Would Site C be the optimum choice if it had not yet been started?
- Taking into account monies already spent, which is economically preferable
  - Continue
  - Suspend
  - Cancel
- Recommendation: refer to BCUC

2. Integrated Resource Planning

Integrated Resource Planning

- An electricity planning process meant to ensure least-cost choices
  - Consider demand-side and supply-side resources on equal footing
- Originated in the 1980s U.S. Northwest
  - In wake of high-cost nuclear overbuild
  - Utility “death spiral”

Integrated Resource Plan (IRP)

- *Clean Energy Act*: BC Hydro submits IRP to Government every 5 years
- 2013 IRP Process
  - 2011 – Initial engagement
    - Public, stakeholder and Indigenous consultations
    - Technical working groups with expert support
  - 2012 – Draft IRP
    - Further engagement
    - Opportunity to submit comments
  - 2013 – Final IRP
    - Government required changes
    - No role for the BCUC

BC Hydro's IRP Process

- Step 1: Establish planning objectives
- Step 2: Develop load resource balances
- Step 3: Complete resource options inventory
- Step 4: Identify key risks and uncertainties
- Step 5: Assess market
- Step 6: Perform portfolio and other analysis
- Step 7: Seek First Nations and stakeholder input
- Step 8: Develop recommended actions

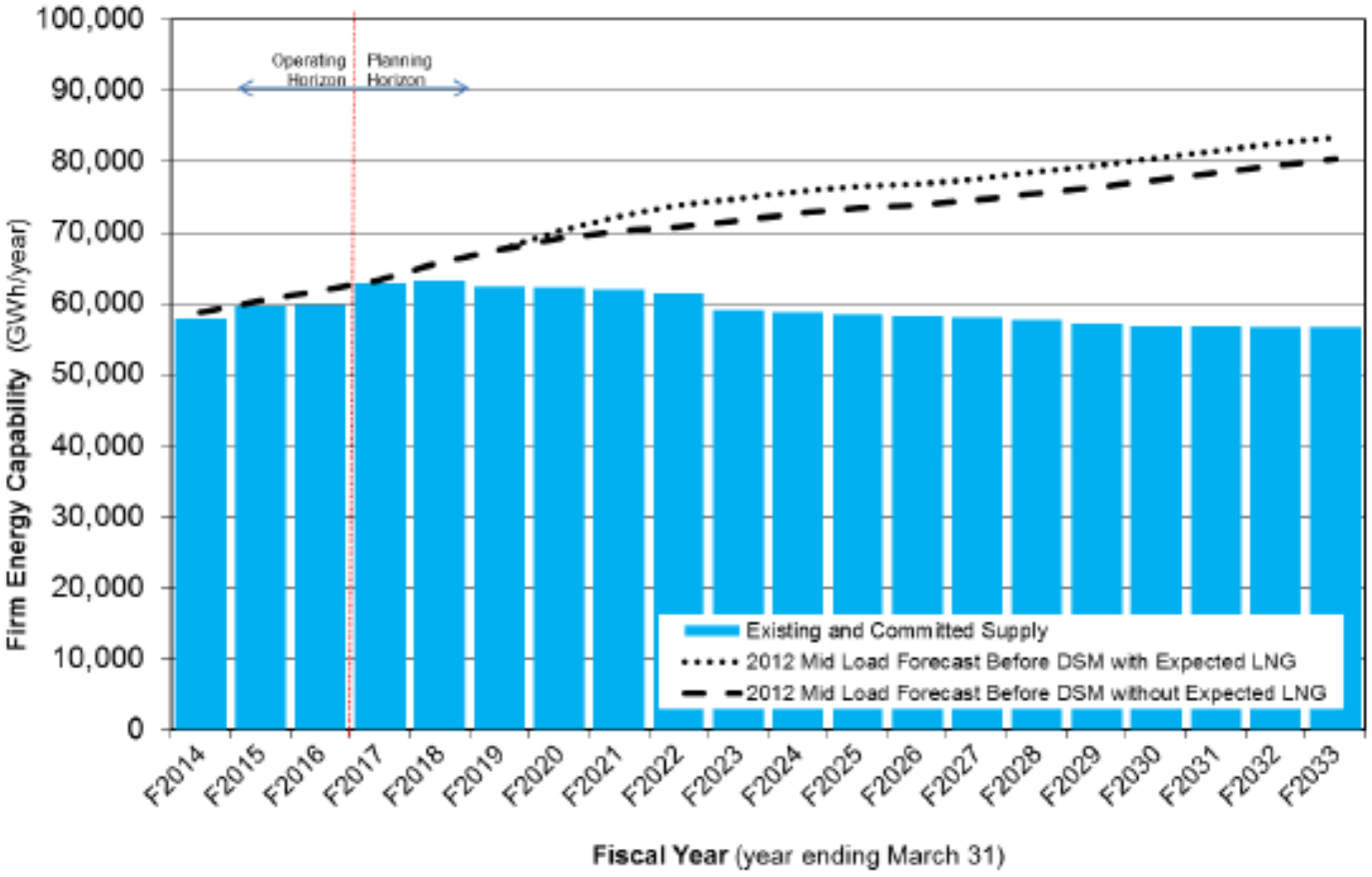
Step 1: Planning Objectives

- Meet forecast needs
  - Firm energy (GWh/year)
  - Capacity (MW)
- Meet *Clean Energy Act* objectives
  - Self-sufficiency (i.e. limits on imports)
  - DSM to provide 66% of new energy requirements
  - 93% of energy from "clean" resources
  - No nuclear
- Perception: "the fix is in" for Site C

Step 2: Load Resource Balances (LRBs)

- Illustrate the relationship between
  - 20-year load forecasts
  - Existing and committed resources
- Separate LRBs for low, medium and high forecasts
- Identify future energy and capacity requirements

Load Resource Balance



Step 3: Resource Options

- Supply-side resources
  - Site C, wind, solar, gas, hydro upgrades, etc.
- Demand-side resources
  - Traditional DSM (programs, codes, standards)
  - Capacity-focused DSM (load curtailment, rate structures, etc.)
- Attribute evaluation
  - Technical (energy and capacity), financial, environmental, economic
- Screening

Step 4: Risks and Uncertainties

- Load growth
  - High, medium and low scenarios
- Supply-side resource risks
  - Cost, production
- Demand side management risk
  - Program performance
- Market prices
  - Exports
  - Fuels

Step 6: Portfolio Analysis

- Identify least-cost resource portfolios based on different scenarios
- Identify year-by-year differential costs
  - Costs common to all scenarios are ignored
- Compare present value of these cost streams

Model Different Scenarios

Parameter	Sub-parameter	Variants
Load	Load growth scenario	high, medium, low
	Liquefied natural gas load	with or without
Demand-side resources	DSM Option	1, 2 or 3
	DSM deliverability	low, medium; no high
Supply-side resources	Site C	with or without
	Site C costs	-10%, base, +10%, +15%, +30%
	Site C timing	2024 or 2026
	Natural gas	with or without
	Wind integration costs	$5, $10, $15
Financial	Cost of capital	(5%, 6%, 7%)
	Market price scenario	(high, medium, low)

Sample Resource Plan

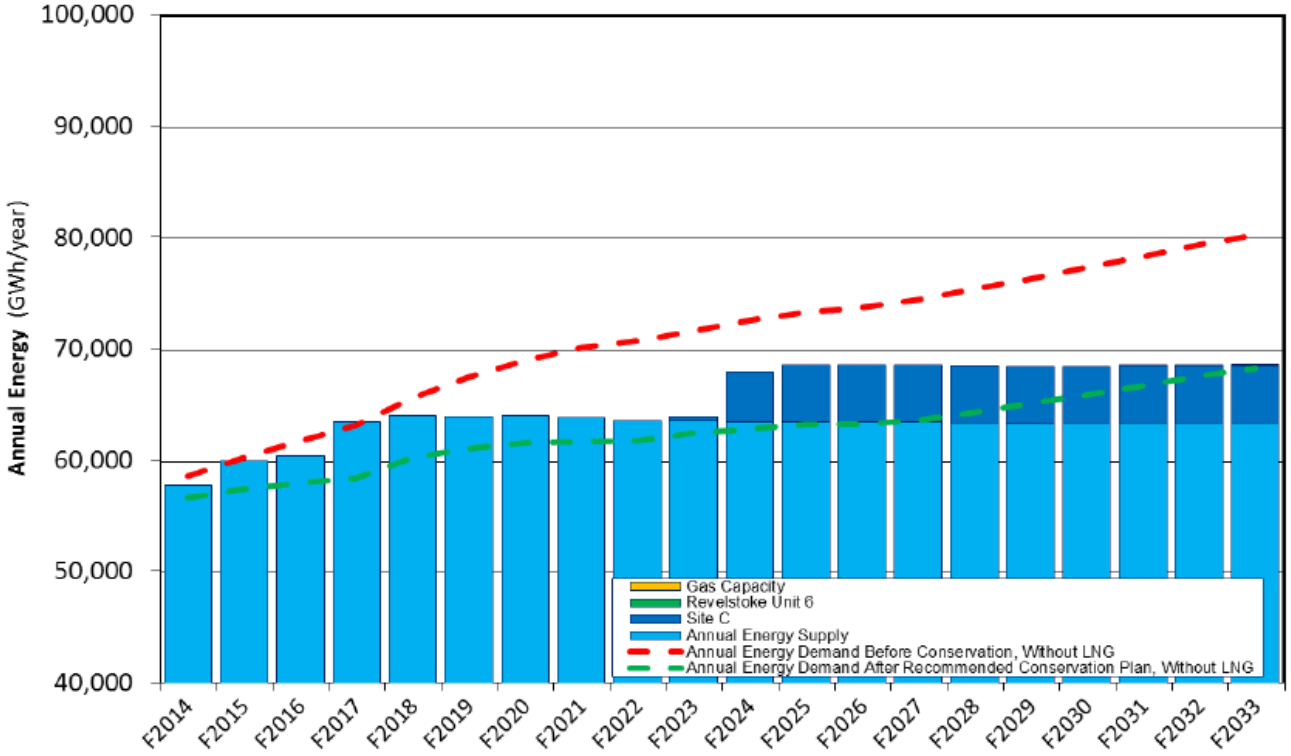
	F2018	F2019	F2020	F2021	F2022	F2023	F2024	F2025	F2026
Existing and Committed Heritage Resources	11,410	11,416	11,416	11,416	11,480	11,480	11,480	11,480	11,480
Existing and Committed IPP Resources	1,673	1,621	1,572	1,490	1,461	1,167	1,132	1,069	1,025
Future Supply-Side Resources									
IPP Renew als	23	55	79	120	135	419	441	450	486
Revelstoke Unit 6	0	0	0	0	0	0	0	0	0
Site C	0	0	0	0	0	0	0	540	1,132
Wind	0	0	0	0	0	0	0	0	0
SCGT	0	0	0	0	0	0	0	0	0
Pumped Storage 1	0	0	0	0	0	0	0	0	0
Biomass	0	0	0	0	0	0	0	0	0
Battery Storage	0	0	0	0	0	0	0	0	0
Total Supply	13,106	13,092	13,067	13,026	13,076	13,066	13,052	13,540	14,122
Load Forecast before DSM	10,469	10,531	10,547	10,598	10,659	10,692	10,819	10,947	11,083
Total Capacity Requirements	**10,487**	**10,549**	**10,618**	**10,801**	**10,862**	**10,895**	**11,022**	**11,150**	**11,286**
DSM & Other Measures									
Total DSM	518	637	823	1,014	1,154	1,268	1,397	1,514	1,632
Surplus / Deficit (capacity)	**1,378**	**1,401**	**1,495**	**1,466**	**1,600**	**1,665**	**1,648**	**2,126**	**2,623**

Sample Resource Plan

Resources Selected

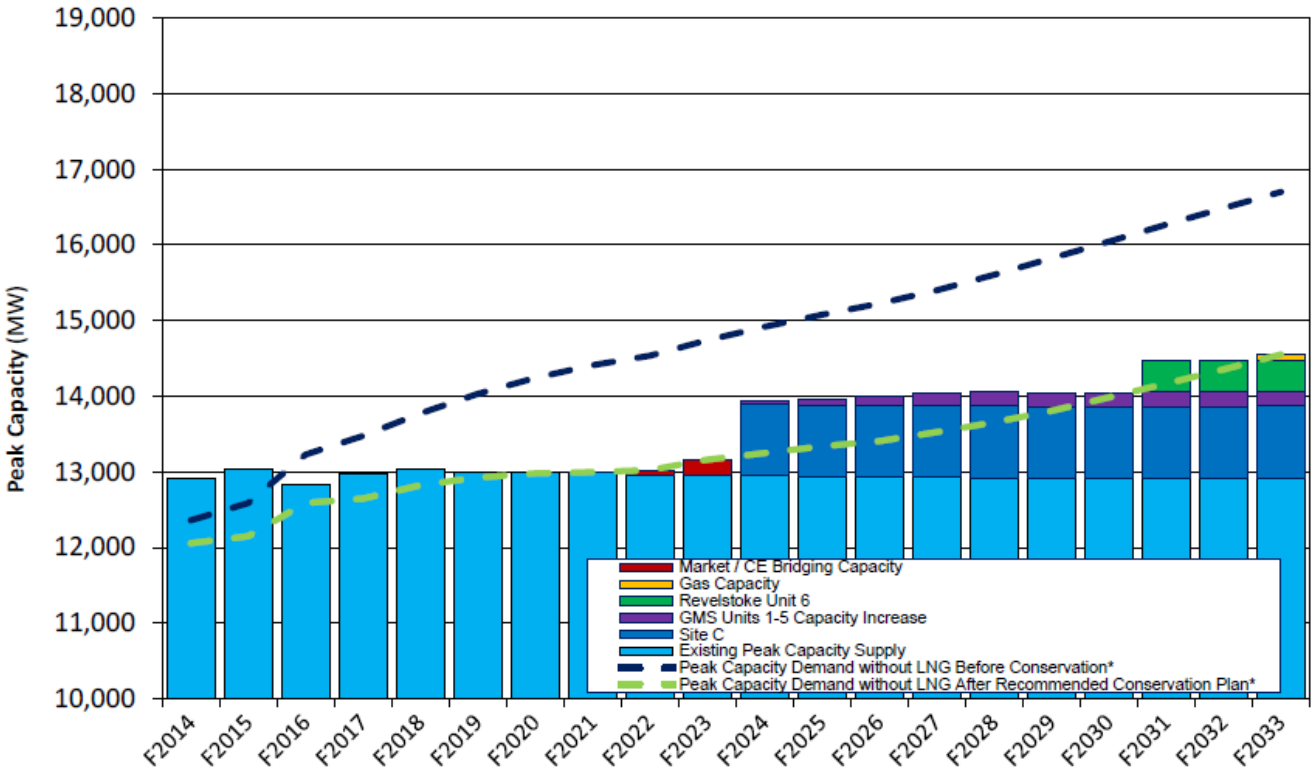
			Capacity - MW		Energy - GWh		UEC / UCC
Year	Zone	Resource	Installed	Dependable	Firm	Total	$/MWh or $/kW-year
2023	BCH_PR	Site C	1100	1,100	5,100	5,100	79
2029	BCH_PR	GMS Units 1-5 Cap Increase	220	220			35
2030	BCH_REV	Revelstoke Unit 6	500	488	26	26	50
2032	BCH_LM	Pumped_Storage_LM	1000	1,000			126
2034	BCH_PR	Wind_PC28	153	40	591	591	111
2034	BCH_LM	MSW2_LM	25	24	208	208	92
2035	BCH_PR	Wind_PC19	117	30	441	441	113
2035	BCH_PR	Wind_PC21	99	26	371	371	112
2036	BCH_PR	Wind_PC16	99	26	377	377	116
2037	BCH_PR	Wind_PC13	135	35	541	541	113
2037	BCH_VI	MSW1_VI	12	12	100	100	127
2038	BCH_VI	Biomass_VI	30	30	239	239	142
2038	BCH_LM	Biomass_LM	30	30	239	239	143
2039	BCH_PR	Wind_PC14	144	37	527	527	117
2040	BCH_PR	Wind_PC10	297	77	1,023	1,023	118
2040	BCH_PR	Wind_PC41	45	12	155	155	122

BC Hydro Resource Plan with Site C – Energy



- Site C 100% surplus to needs at in-service
- Market value of Site C energy far below unit cost

BC Hydro Resource Plan with Site C – Capacity



- Site C capacity not fully used until 2030
- Little or no market value for surplus capacity

Portfolio Cost Comparison ($M)

Portfolio Type	PV Costs (No Site C)	PV Costs (With Site C)	PV Differential Costs
Clean	6,766	6,138	630
Clean + Natural Gas	6,030	5,883	150

- Difference in portfolio costs was very modest:
  - 10% for clean resources
  - 2.5% when including natural gas

Observations

- BC Hydro excluded
  - Low load growth scenarios
  - DSM Option 3 (all cost-effective DSM)
  - Capacity-focused DSM
  - Site 7b (a smaller-scale hydro development on the Peace River)
  - Declining wind and solar costs
- Little attention to financial consequences of surplus
- Would including these options lead to a different conclusion?

3. Economic Analysis of Site C

a) Go/no-go (Joint Review Panel)
b) Point of no return (BCUC Inquiry)

a) Go/No-go Analysis

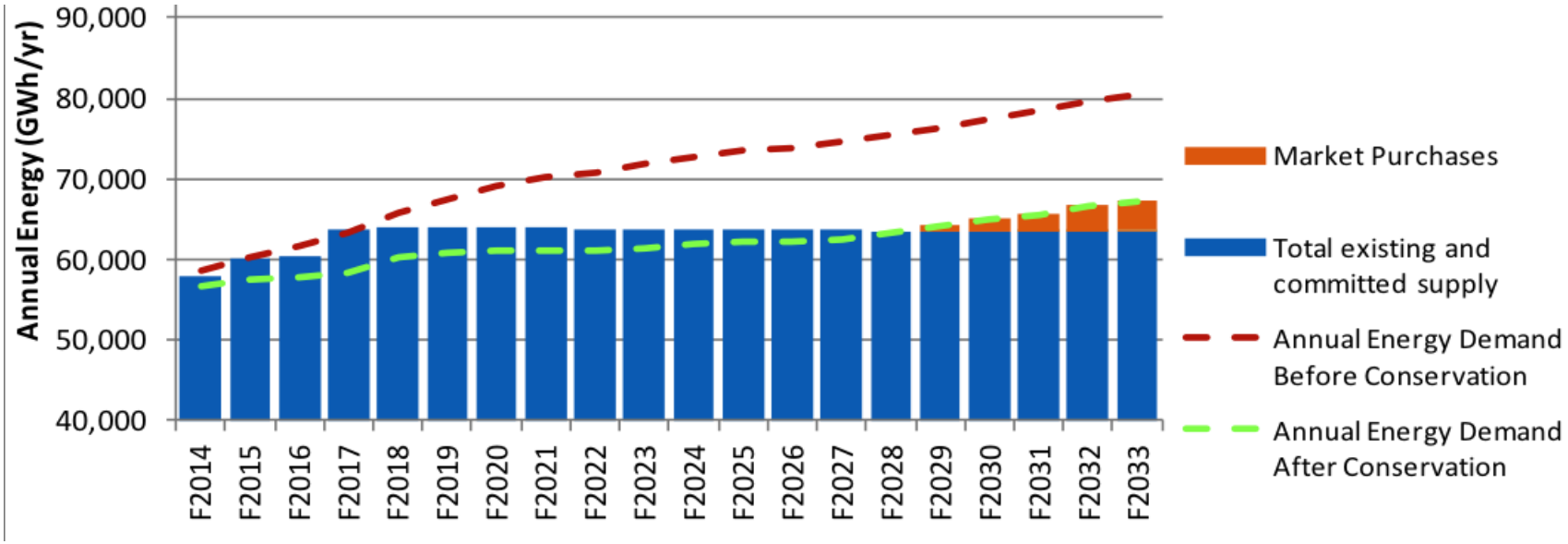
- Context: environmental assessment process
- BC Hydro application relied heavily on IRP
  - Background documentation from IRP made in-depth analysis possible

Review of Alternatives

- Explore key planning scenarios with and without Site C
  - Medium scenario (Base Resource Plan)
  - High scenario (Contingency Resource Plan)
  - Low scenario (not studied in IRP)
- Include resources not addressed in IRP
  - DSM Option 3
  - Capacity-focused DSM
  - Site 7b, a smaller-scale hydro development on the Peace River
- How would the analysis change?

High DSM Scenario

- Rebuild resource stacks without Site C for each key scenario
  - Additional DSM options
  - No need for new supply-side resources

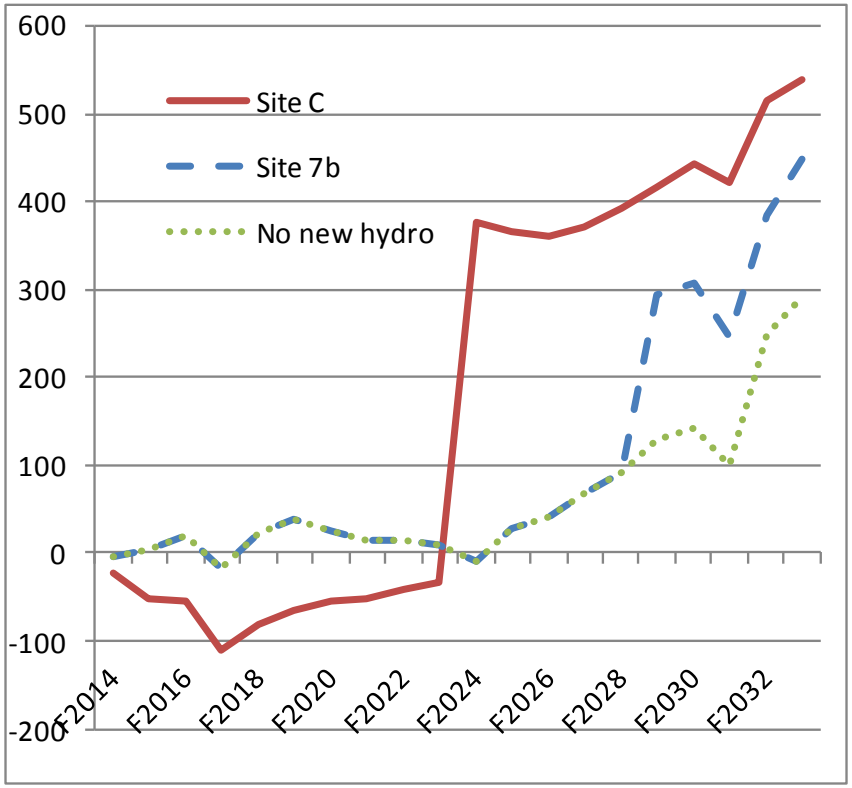


Costs

- For each key scenario, compare *differential costs* year by year of the Site C vs. no-Site C resource stacks
  - Capacity costs
  - DSM costs
  - Energy costs and revenues
  - All other costs remain unchanged
- Compare *present value* of cost streams

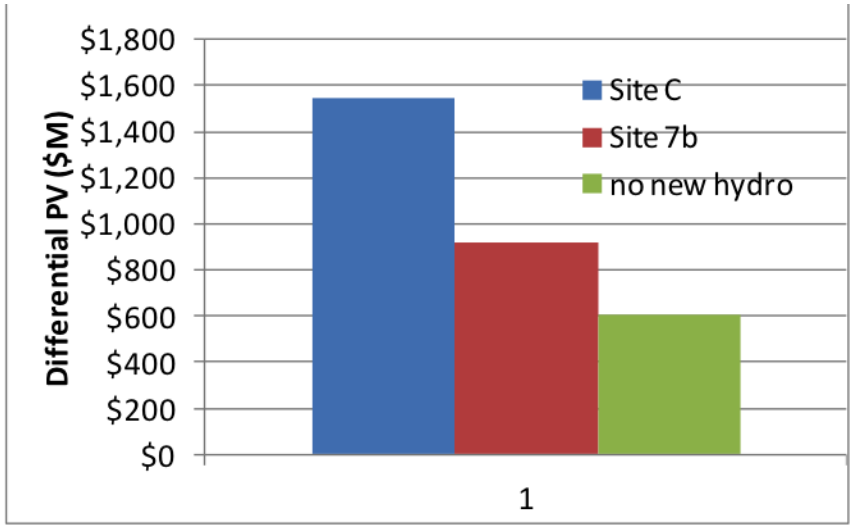
Mid Load Resource Plan – Year-by-Year Costs

- Calculated for each cost category
  - DSM costs
  - Energy costs
    - Import costs
    - Gas costs
  - Capacity costs
  - Export revenues
- Costs common to all options are ignored



Mid Load Resource Plan – Present Value Costs

- Site C the most expensive of the three options
- "No new hydro" the least expensive

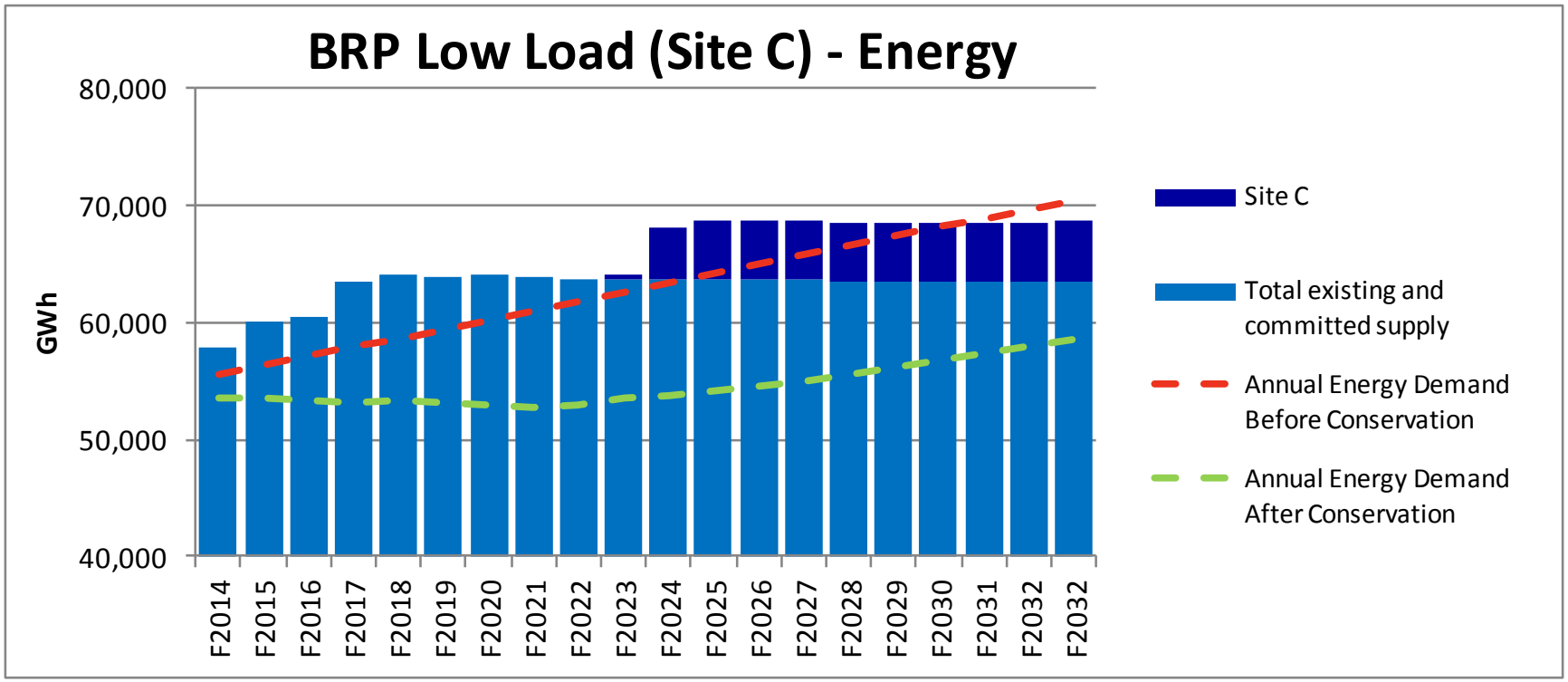


Low Load Resource Plan

- No analysis provided in environmental assessment
  - "BC Hydro plans to medium scenario"
- Very limited analysis in IRP
  - Only 4 scenarios out of 58
  - Site C scenario costs $1 billion more than without Site C

Low Load Resource Plan

Site C energy is 100% surplus well beyond 2040



Conclusions

- Key resource options omitted from BC Hydro's analysis
- For medium and high loads, forecast needs can be met at significantly lower costs without Site C
- For low loads, Site C results in long-term, large and costly surplus

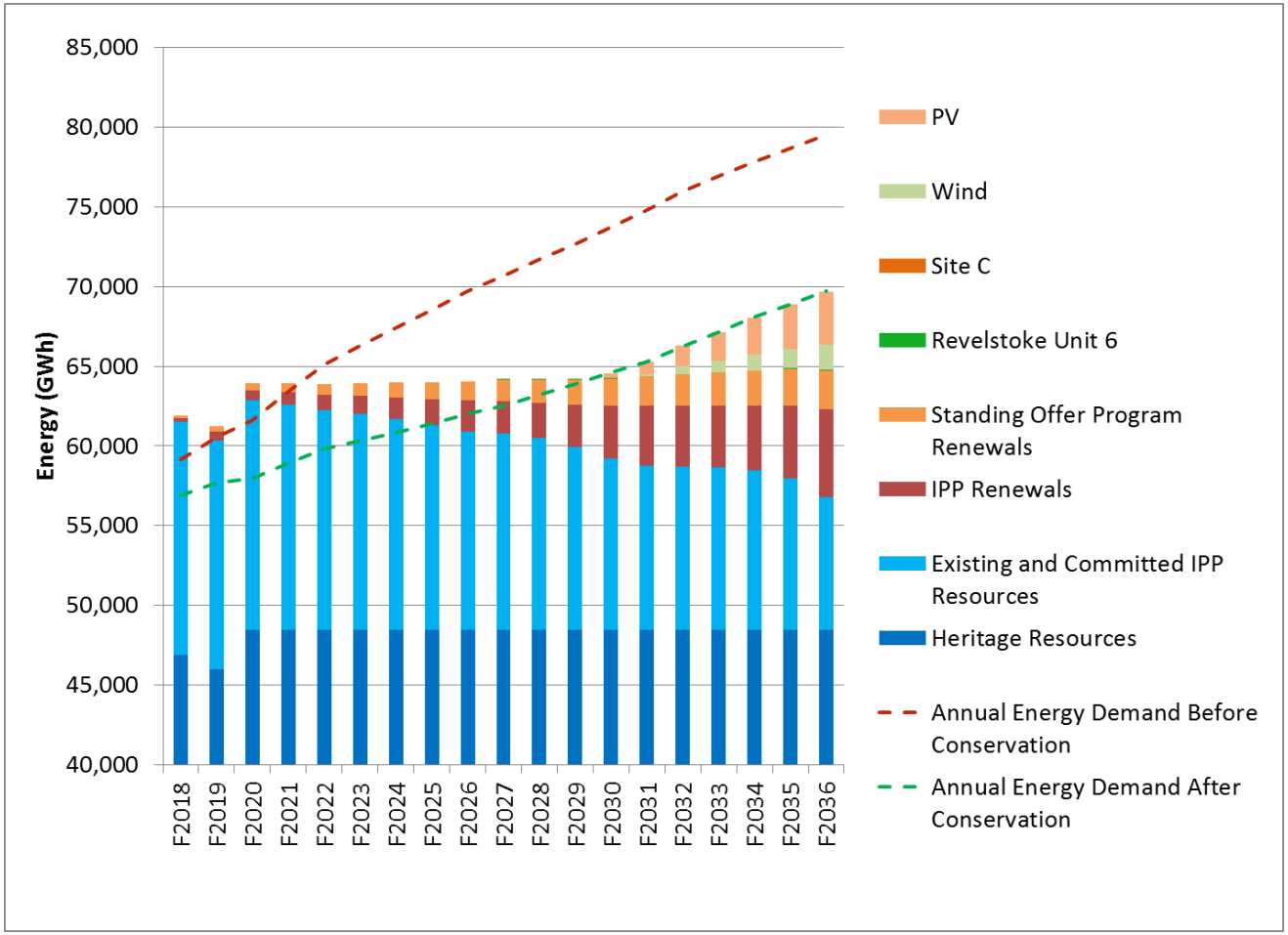
b) Point of no return analysis – Context

- New NDP government (with Green support)
- Reference to BCUC to compare three options
  - Continue Site C
  - Cancel Site C
  - Suspend Site C
- Accelerated review process with construction underway
  - Final report in 90 days

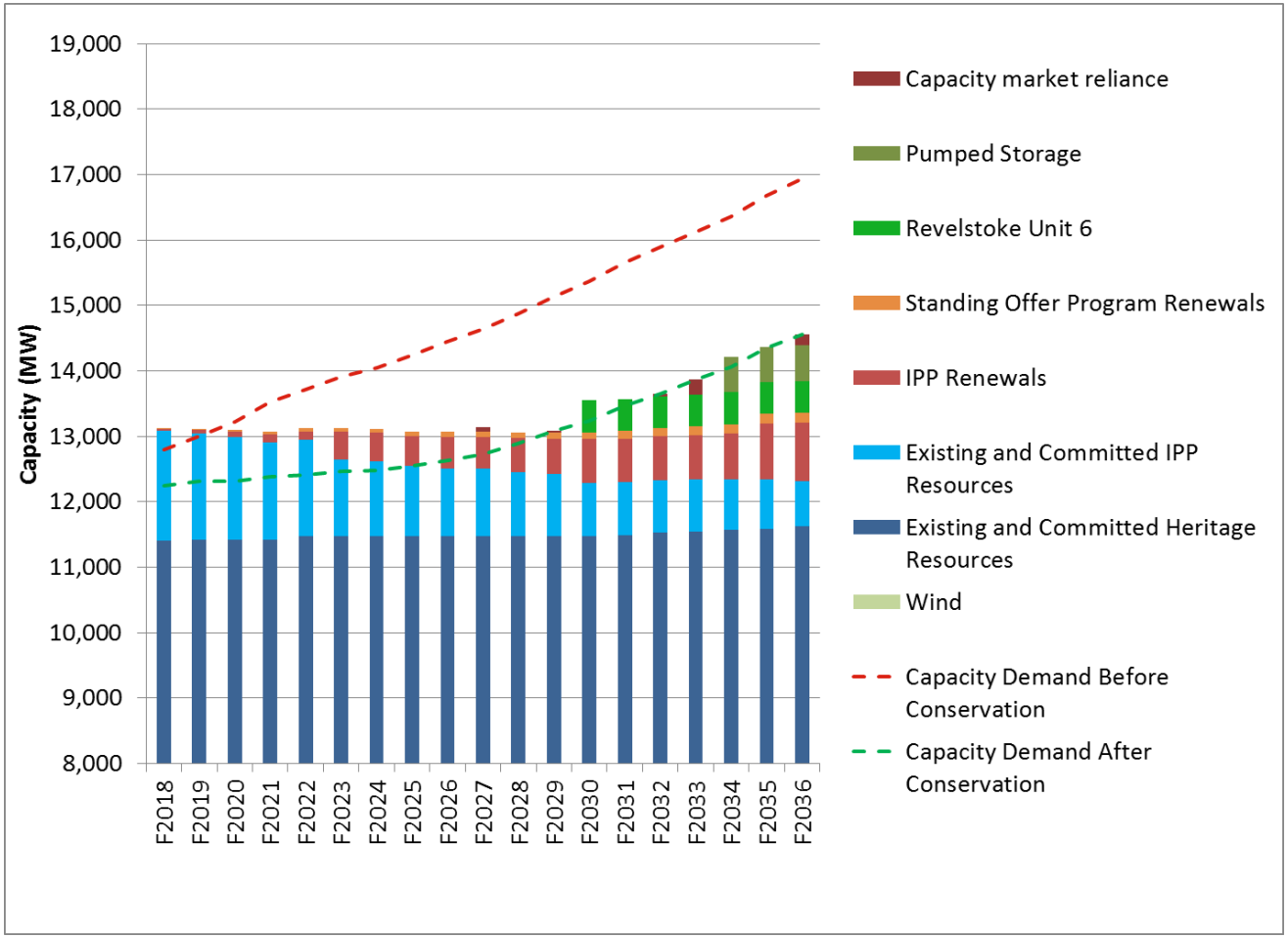
Alternative Portfolio (mid load)

- Energy resources
  - Return to DSM plan from IRP
  - 300 GWh of solar in 2030; 3,300 GWh in 2036
  - 500 GWh of wind in 2032; 1,600 GWh in 2036
- Capacity resources
  - Capacity DSM starting in 2018; 600 MW by 2036
  - 110 MW of battery storage in 2027
  - 500 MW of pumped storage in 2034

Mid Load Alternate Portfolio – Energy



Mid Load Alternate Portfolio – Capacity



Conclusions

- Site C should be cancelled
- Continuing Site C would be more costly than the alternatives, taking into account cancellation costs:
  - Low load: $1,722 million
  - Mid load: $734 million
  - High load: $212 million

4. Implications for Newfoundland and Labrador

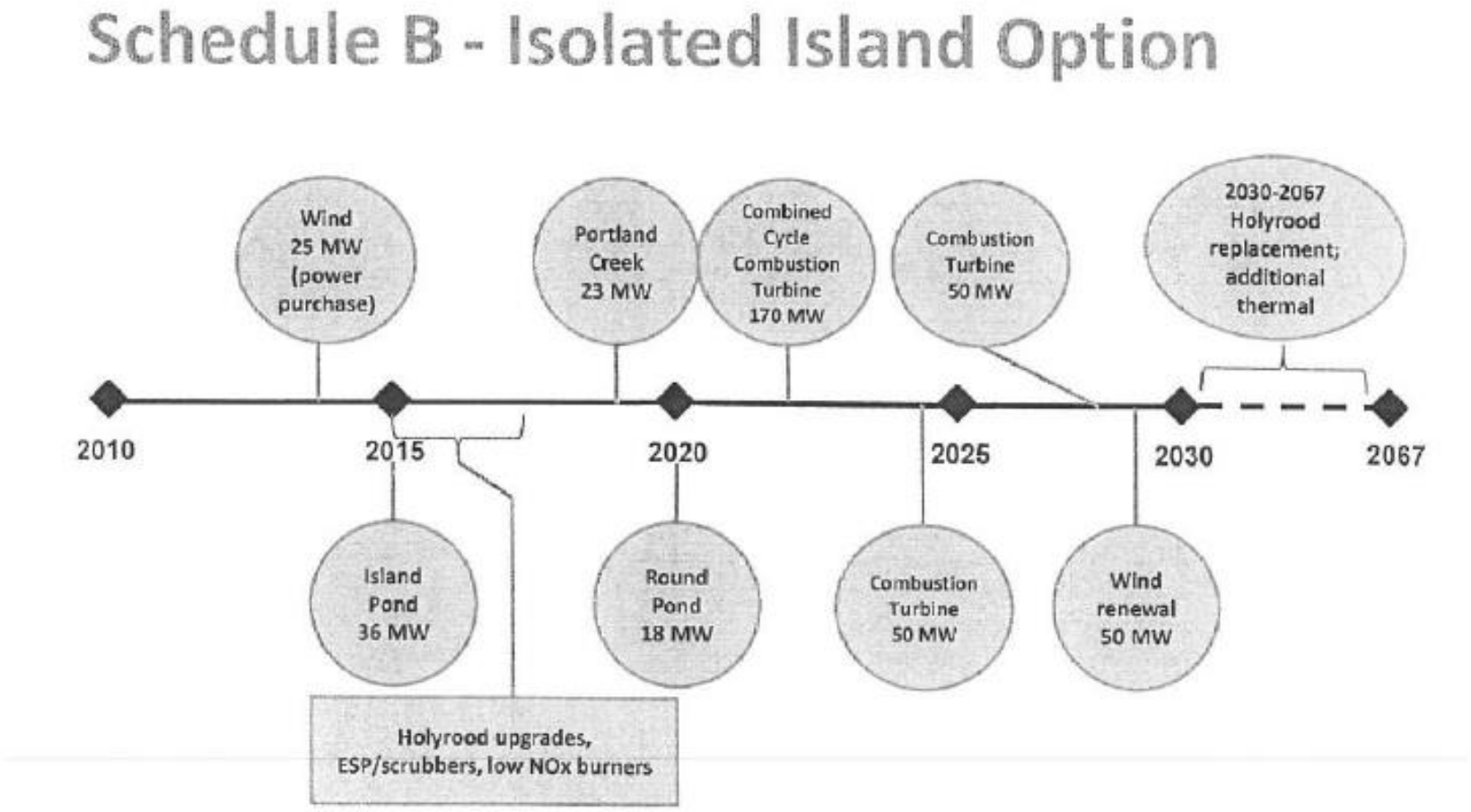
Electricity planning in NL

- PUB in 2004:
  - « IRP may present sound opportunities for coordinated planning and improved regulation »
- PUB in 2007:
  - « The Board is not prepared to proceed with an IRP exercise given the pending release of the [2007] Energy Plan …. In the Board's view, the province's future policy direction respecting energy supply will be a key ingredient in formulating an IRP »
- NLH in 2015:
  - « At this time, Hydro does not intend to implement IRP unless requested to do so by the Board. »
- Still no integrated long-term planning process in place

Muskrat Falls – PUB Reference (2011)

- Compared Muskrat Falls to "Isolated Island option":
  - Holyrood upgrades
  - 25 MW wind
  - 77 MW hydro
  - 170 MW combined cycle
  - 100 MW gas turbines
- No conservation options
- No significant wind power development
- Pessimistic fuel price forecasts
  - MHI: "Fuel price forecasts have a very short shelf life"

Isolated Island Option



Manitoba NFAT (2014)

- Government ordered PUB review of two proposed large-scale hydroelectric projects
  - Included DSM options
  - Included wind and natural gas
  - Extensive export market analysis
  - Independent experts
- PUB found:
  - One project (Keeyask) justified
  - Other project (Conawapa) shelved indefinitely

Muskrat Falls – "Point of no return"

- Ball, Marshall quickly concluded Muskrat Falls "past point of no return"
  - No indication that detailed analysis performed
    - Load forecast scenarios
    - Alternative resource plan (conservation, elasticity)
    - Comparison of present value costs
- No public information to allow third party review
  - No IRP process

Muskrat Falls – PPA

- Fixed annual amounts to be paid by NLH
  - Amounts to be finalized depending on final Muskrat Falls costs
  - Amount due regardless of energy used
  - Remainder exported
- Rate impact depends on load growth
  - Rate increases discourage load growth (elasticity)

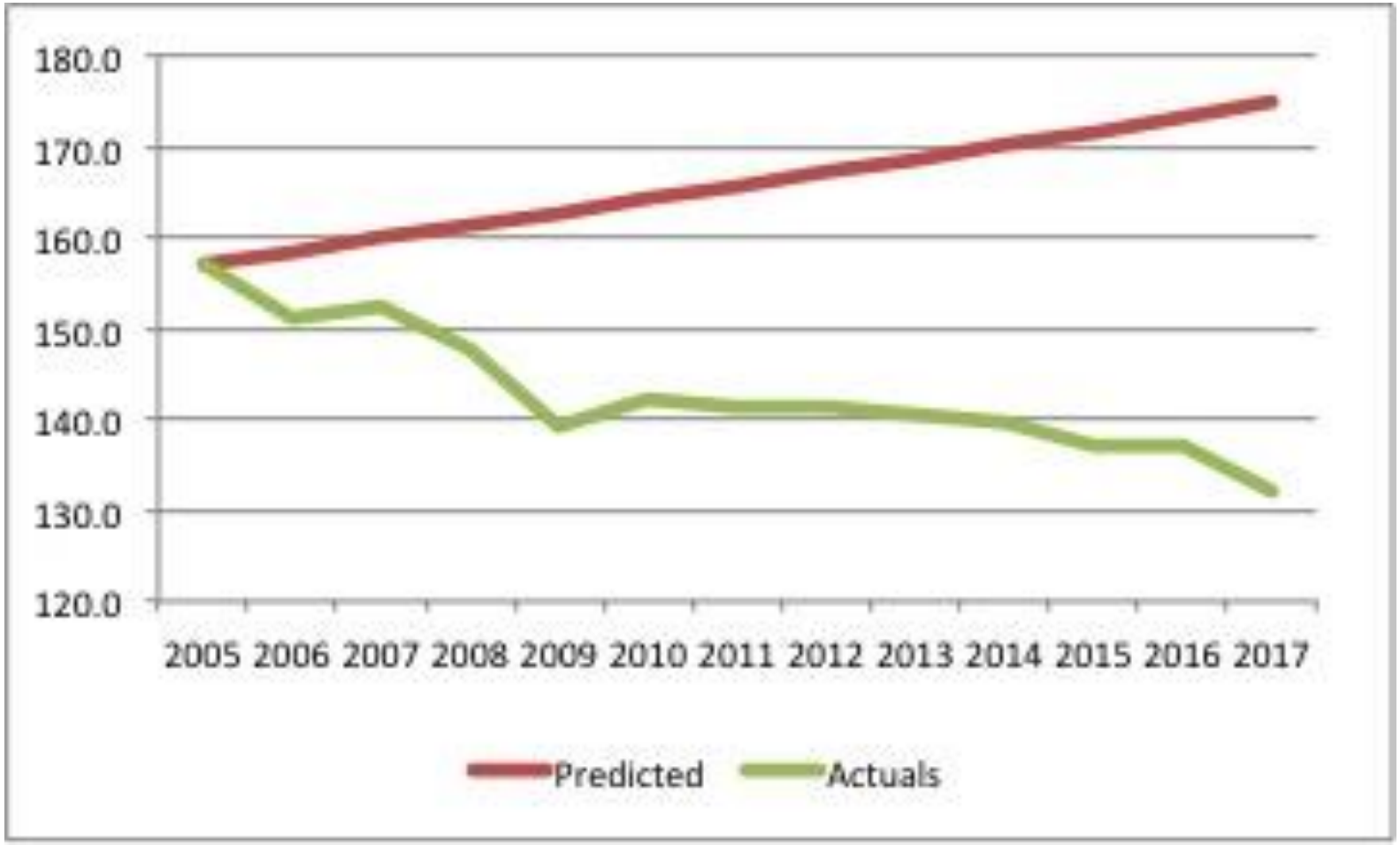
Muskrat Falls – PPA

Operating Year	Number of months in Operating Year	Base Block Capital Costs Recovery ($ millions)
1	7	$ 82.4 million
2	12	$ 148.5 million
3	12	$ 147.3 million
4	12	$ 156.1 million
5	12	$ 167.8 million
6	12	$ 179.8 million
7	12	$ 189.6 million

Demand Elasticity

- As the price of electricity increases, demand decreases
- As demand decreases, rates must increase more to cover revenue requirements
- "Death spiral"
  - Often invoked, but rarely occurs
  - The risk appears to be real

Ontario – Electricity Demand (TWh/year)



Once Muskrat Falls is in service

- NLH requests rate increase to pay for the PPA
- PUB grants the increase
  - Arrears and collection costs likely to increase
  - Demand likely to fall
- What if revenues still fall short, despite rate increases?
  - Federal loan guarantee kicks in

…Once Muskrat Falls is in service

- If the PUB does not grant the full increase…
  - NLH unable to pay Nalcor
  - Nalcor unable to pay creditors
  - Canada pays creditors
  - Canada seeks to recover costs from NL
  - NL unable to pay… insolvent?

Possibilities

- Churchill post 2041 is a significant asset
  - Hydro-Québec could make an offer
  - Cash today in exchange for favourable conditions post 2041?
- Other assets?

Site C vs Muskrat Falls – Similarities

Topic	Issues
Environmental	Significant environmental issues Reducing GHG emissions significant in justification
Indigenous	Significant impacts on treaty and other rights Unresolved historical claims (upstream hydro) Downstream issues
Regulatory	JRP Review found justification inadequate Exempted from regulatory oversight
Economic	Export market collapsed making project potentially uneconomic
Engagement	Little academic or public involvement before project launched Growing public concern once construction underway

Site C vs Muskrat Falls – Differences

Site C	Muskrat Falls
Modest in context of BC Hydro system and BC economy	Huge in context of NLH system and NL economy
Supported by detailed IRP studies	No solid information base
New government called regulatory inquiry re point of no return	New government assumed that point of no return was past
Local academics with Royal Society engaged early in construction phase	Local academics starting to engage …
Strong interconnections to external markets	No interconnection to external markets (Island)
Oil prices irrelevant	Oil prices critical to justification
Methylmercury not a major issue	Methylmercury a major issue
	Historical grievance (HQ contract)

Questions and Discussion