

Knee Deep in the Big Muddy: Presentation to the British Columbia Utilities Commission

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OCTOBER 13, 2017

Policy and Behavioral Economics:
Nobel Laureate Richard Thaler: Pete Seeger's Knee Deep in
the Big Muddy is the anthem of the Sunk Costs Fallacy



Economics and Policy Inertia

- Site C was planned and eventually started with data that now is seriously vintaged
- Energy economics have shifted dramatically since 2008
 - Fracking and horizontal drilling have reduced oil and natural gas prices by over 70%
 - Bulk power markets are robust and encourage vast economic optimization from Edmonton to Tijuana
 - Renewable resources like wind and solar have reduced in price by 66% and 85%
- Site C's economics have simply been overtaken by events

McCullough Research

- We have clients from Québec to California
- We work for industry, governments, utilities, and aboriginal groups
- Our testimony at the U.S. Senate opened the Enron trading investigations and we worked with the U.S. Department of Justice on the criminal indictments
- We have many years of experience with hydroelectric projects – both supporting or opposing based on the economics
- Our fourteen submissions in this inquiry have been restricted to three major areas where we have a comparative advantage

Primary Areas of Analysis:

- Load Forecast
 - LNG
 - Pulp and paper
- Alternative Resources
 - Wind
 - Solar
- Export Markets
 - Market Structure
 - Forecasting

Load Forecast

- The industrial components of the load forecast are terribly weak
- British Columbia's plans for LNG have stalled and now face operating LNG terminals with dramatically lower costs
 - Cheniere – now the market leader – can add capacity at US\$500 to US\$600/mtpa
 - LNG Canada has capital costs at US\$1,222/mtpa
 - Our Monte Carlo model indicates LNG Canada's chance to reach a Final Investment Decision has fallen to 3%
- Pulp and Paper is in steep decline with numerous closures reported in both the U.S. and Canada

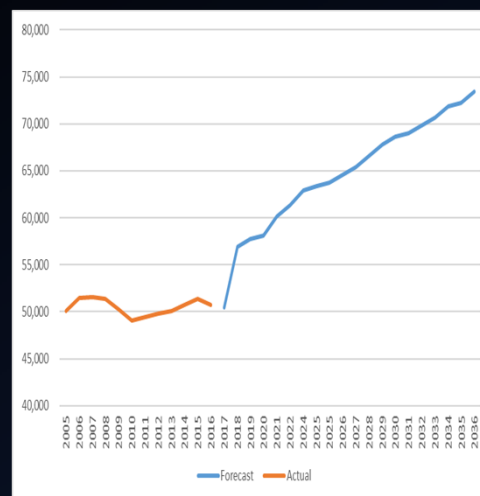
The demand forecast of BC Hydro is highly overstated

“5.2 Demand for Electricity is Increasing

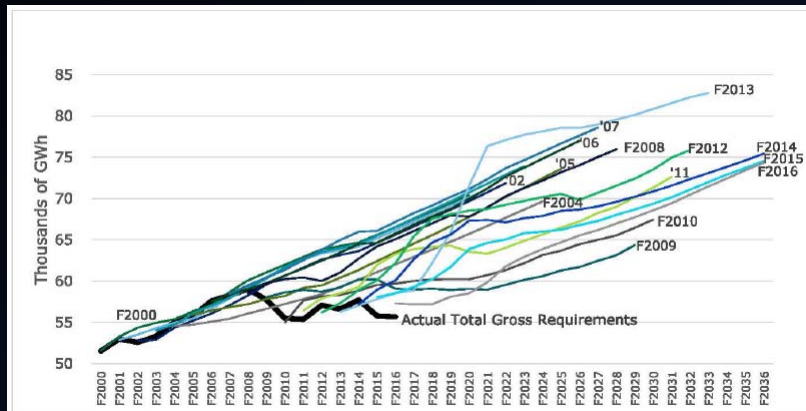
In this section we set out our expectations for customer load. Our Current Load Forecast identifies continued load growth. As shown by Figure 8, while the recession of 2008 resulted in a decrease to customer load, since that time load growth has resumed and has been substantial on a before-DSM basis. Please see **Appendix H** for a discussion of BC Hydro’s load history.”

BCH Submission, page 44

British Columbia Hydro’s forecast resembles a hockey stick where the blade is the past ten years and the shaft is the forecast



Past demand forecasts of BC Hydro have been highly overstated



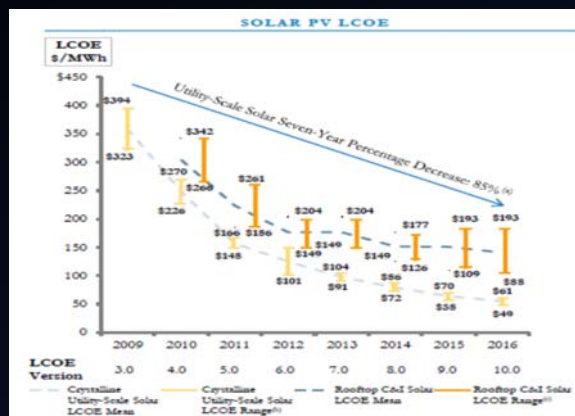
Alternative Resources

- On Alternatives to Site C – There are environmentally friendly and less costly alternatives to Site C – primarily geothermal and wind
- Deloitte used their revised electricity demand forecast and power generation options to produce an environmentally friendly and less costly power generation portfolio existing hydro upgrades, geothermal, and wind.
- In its power generation portfolio, Deloitte used a price for wind power that is higher than the price achieved elsewhere in North America – even as close as Washington and Oregon
- Renewables are deployable: planned, permitted, and generating in less than two years

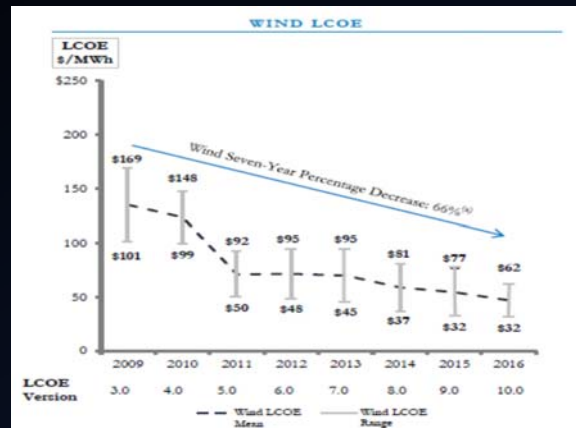
The real cost of Geothermal and Wind are a fraction of the real cost of Site C making termination the correct decision.

- Renewables are in the midst of a world wide revolution – outside of British Columbia
- Oregon and Washington – the two U.S. states most similar to British Columbia have ten times the wind capacity of British Columbia (6,288 MW)
- Ontario and Quebec have almost as much wind capacity (4,302 MW)
- Economies of scale have caused a tremendous price reduction

Lazard's History of Solar Cost Reductions



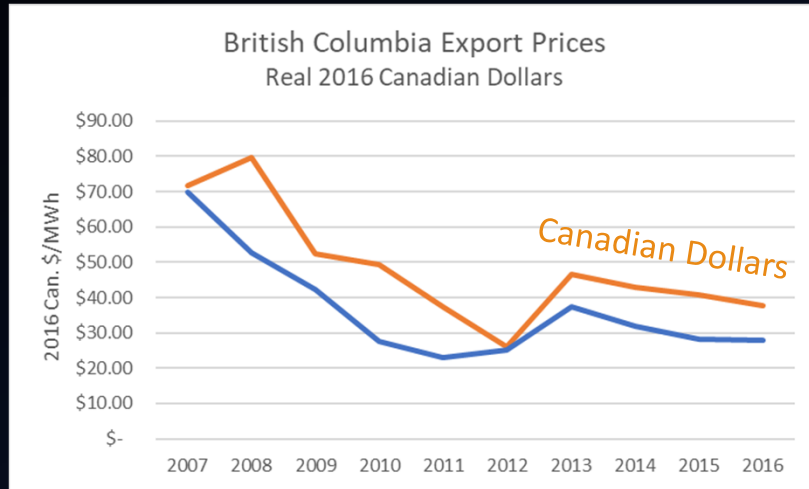
Lazard's History of Wind Cost Reductions



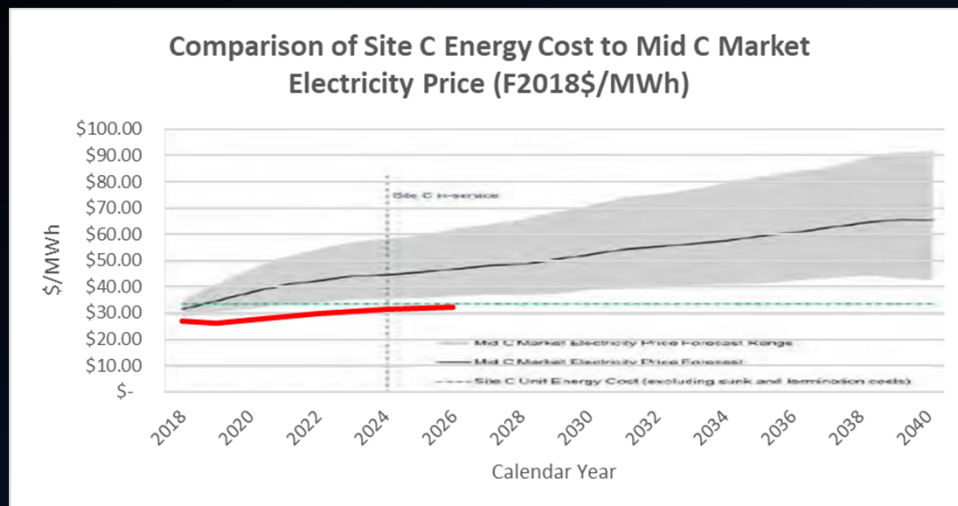
Can British Columbia Export C\$100/MWh LCOE Energy in a C\$27/MWh Market?

- The Mid-Columbia hub is mature (thirty years), liquid, and deep
- It has futures and derivatives on all the major exchanges
- This year has been the lowest average price in history
- Next year and the year following have even lower prices
- Low natural gas and increasing renewables continue to force prices down

Any excess Site C power cannot be sold at a profit to the US.



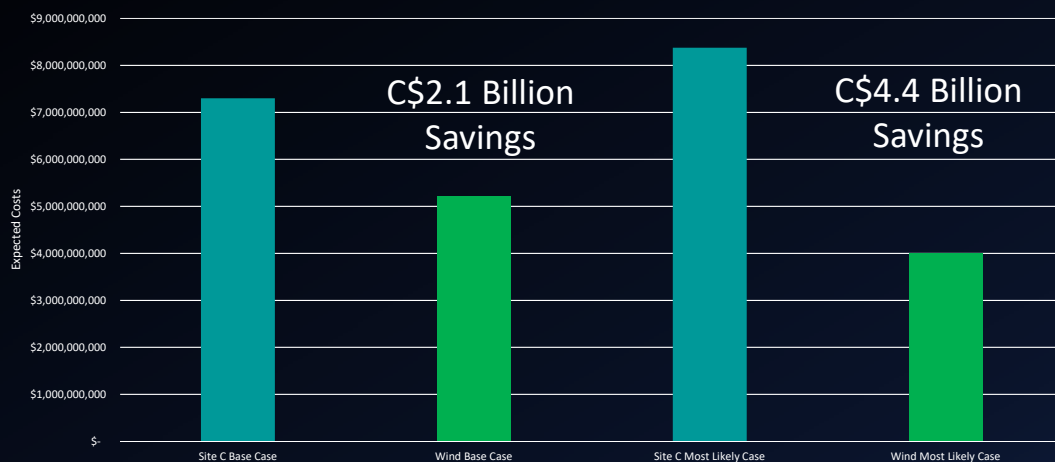
British Columbia Hydro's Forecast Is Wildly Inconsistent with Actual Forward Prices



The Bottom Line

- Site C is now over budget by almost \$1 billion dollars – partially offset by assumed interest rate forecasts
- The load forecast is overstated and optimistic
- British Columbia's resource costs are inconsistent with real evidence from projects as close as Washington and Oregon
- Overall, there is a case of behavioral economics where institutional inertia is facing a dramatic change in the economic facts
- Paul Samuelson, the Nobel laureate from the Massachusetts Institute of Technology, recalled that John Maynard Keynes once was challenged for altering his position on some economic issue. "When my information changes," he remembered that Keynes had said, "I change my mind. What do you do?"

Site C Versus Renewables: Base Case and Most Likely Case



Thank you. I will be available both today and tomorrow if you wish comments or clarifications.

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