

McCULLOUGH RESEARCH

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PRINCIPAL

Date: November 2, 2017
To: PVLA and PVEA
From: Robert McCullough
Subject: What we have learned from the BCUC's Final Report

Executive Summary:

On August 3, 2017, Mr. Horgan's government gave the British Columbia Utilities Commission an impossible charge. They were to review the then \$8 billion Site C project (now the \$10 billion site C project) in three grueling months. Little information was available about Site C. The calculations were opaque and idiosyncratic; the underlying forecasts confidential; and the cost components unknown outside the Crown Corporation.

The BCUC's first step was to assign the fact finding to the well-respected Deloitte firm which did an excellent job. Their first report clarified the morass the project was sinking into – identifying a likely year delay and the presence of massive cost overruns. Never has a prediction been so immediately validated when BC Hydro announced the delay of the river diversion and an additional \$610 million cost overrun.

On Wednesday, at 10:00 A.M. my staff and I started reading the two hundred and ninety-nine-page Final Report. To put it mildly, we were impressed. Actually, we were more than impressed. The Commission had digested and reviewed the thousands of pages of submissions, winnowed the wheat from the chaff, and made some courageous decisions:

While the Commission did not make a formal recommendation, a careful review of the Final Report makes it clear that termination of Site C is less expensive and less risky than the alternatives, and the actual content of the full report makes that very clear.

The BCUC states that:

1. Site C is over budget and behind schedule. The BCUC estimates costs are now at \$10 billion.

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2. BC Hydro's load forecast is highly doubtful and the BCUC has recommended the use of the low forecast.
3. The export assumptions are unrealistic. Again, the BCUC has recommended a much lower forecast.
4. Wind, solar, and geothermal are realistic alternatives. Prices have declined significantly and will continue to fall.
5. The alternative resources cost less and are more deployable
6. BC Hydro's planning methodology is undocumented and inaccurate.
7. There is an excellent source of hydro-electric storage in the non-treaty storage agreement -- 25 times the storage of Site C.

Background:

On August 2, 2017, the government of British Columbia issued an Order-in-Council directing a fast track proceeding to review the ongoing Site C project. Like lightning chess tournaments, the last three months have been a grueling test of endurance and hard work. British Columbia Hydro has filed one thousand five hundred and ninety-one pages in its direct submissions and many, many more documents in responses to Commission questions.¹

The Commission's final report is two hundred and ninety-nine pages long and addresses many different points raised in this proceeding. Overall, the Commission and their staff have earned an excellent grade for work under a debilitating schedule. Our testimony contributed to the final report in a variety of ways. The Commission accepted some of our comments and rejected others – as is completely appropriate. The result is that the BCUC sees no compelling reason to continue with this \$10 billion-dollar project.² Many of their decisions are conservative, erring on the side of caution, but this is also appropriate.

While the Commission did not make a formal recommendation, a careful review of the Final Report makes it clear that termination of Site C is less expensive and less risky than the alternatives. The actual content of the full report makes that very clear.

On August 30, 2017, BC Hydro tabled its eight-hundred-page primary submission. The Executive Summary states the primary findings recommended to the BCUC:

BC Hydro has performed the analysis to respond to the Terms of Reference. We conclude that:

- The best option for ratepayers is to complete Site C by 2024 as currently planned;
- Terminating the Site C Project, remediating the site and acquiring alternative resources would cost ratepayers \$7.3 billion on a present value basis;

¹ BC Hydro submissions F1-1 through F1-22.

² Final BCUC Site C Report, Executive Summary, page 7.

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- Suspending the Site C Project, acquiring alternative resources for the period of suspension, and then resuming and completing construction would cost ratepayers \$1.1 billion on a present value basis. The project cost in this scenario would be \$12.9 billion when the assets enter service;
- There are substantial risks that the Project would not be able to resume following a period of suspension and would be terminated. Suspension would forego the benefits of a fully-staffed project team, awarded contracts and benefit agreements, advanced design, and the permits and authorizations for current work. Re-establishing these benefits is time-consuming, costly, and may not be possible. A scenario where the Project is suspended and then terminated would cost ratepayers \$7.3 billion on a present value basis.

On the specific questions in section 3 of the Terms of Reference, this filing shows that:

- BC Hydro expects to complete Site C on time and on budget, and we have the appropriate level of schedule and cost contingency;
- Site C provides a long-term supply of low cost, clean energy. No other portfolio of commercially feasible generating projects and demand-side management initiatives could provide similar benefits (including firming; shaping; storage; grid reliability; and maintenance or reduction of 2016/17 greenhouse gas emission levels) to ratepayers at similar or lower cost as the Site C project;
- When considered together, developments since BC Hydro prepared our Current Load Forecast suggest a net increase in our energy and capacity requirements; and
- Site C is a flexible resource that enables the integration of new renewable intermittent resources like wind, solar and run-of-river hydro, which require the support of dependable and flexible resources like storage hydro.³

The British Columbia Utilities Commission’s Final Report has rejected nearly every component of BC Hydro's submission.

We believe the BCUC’s conclusions are sound, but a bit conservative. The bottom line is that the dividend that British Columbia citizens will receive is \$2 to \$4 billion dollars – approximately \$1,000 for each adult in the province.

Comparison of Alternatives:				
	Commission Scenarios			
Site C	Low LF	Medium LF	High LF	

³ Submission F1-1, Executive Summary, pages 1 and 2.

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Original Cost	\$ 8,775			
Plus, Cost Overrun	\$ 610			
Minus, Sunk Costs	\$ (2,100)			
Cost of				
Continuation	\$ 7,285	\$ 1,851	\$ 2,889	\$ 3,441
Termination Cost		\$ 1,800	\$ 1,800	\$ 1,800
Actual Cost	\$ 7,285	\$ 3,651	\$ 4,689	\$ 5,241
Termination				
Dividend		\$ 3,634	\$ 2,596	\$ 2,044

Site C is over budget and behind schedule

Site C was approximately \$400 million over budget when this proceeding began. Since then the announcement that the project will miss the river diversion date has added another \$610 million to the cost of completion. The Commission review concludes:

The Panel finds that the project is not within the proposed budget of \$8.335 billion. Further, the Panel finds that the total cost at completion may be in excess of \$10 billion as there are significant risks remaining that could lead to further budget overruns.⁴

BC Hydro has stated that its purchase of interest rate derivatives (\$4.4 billion so far) will lead to interest rate savings that will offset the early cost overruns.⁵ These undocumented speculations may well do so, but even more likely is the scenario that it may fall in value if BC Hydro's assumptions turn out to be incorrect.

The BCUC also concluded that the project is behind schedule:

The Panel finds that, on September 30, 2017, the Site C project is currently on schedule for completion by November 2024. However, BC Hydro was working towards an in-service date of 2023, and with regard to that in-service date, the project is one year behind BC Hydro's PMB schedule.

⁴ BCUC Final Report, November 1, 2017, page 121.

⁵ Quarterly Progress Report No. 7 F2017 Fourth Quarter – January 2017 to March 2017, page 33.

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In addition, the Panel finds there are significant risks that could prevent the project from remaining on schedule and we are not persuaded that it will remain on schedule for a November 2024 in-service date. In the Panel's view, the fact that the project is still on schedule should not be interpreted as suggesting that the project is expected to remain on schedule.⁶

BC Hydro's load forecast is highly doubtful and the BCUC has recommended the use of the low forecast

The Final Report concludes:

Overall, the Panel finds BC Hydro's mid load forecast to be excessively optimistic and considers it more appropriate to use the low load forecast in making our applicable determinations as required by the OIC. In addition, the Panel is of the view that there are risks that could result in demand being less than the low case.⁷

Contrary to BC Hydro's submissions, extensive testimony before the BC Utilities Commission clearly demonstrates that:

- demand for electricity will not increase by the up to 40% claimed by BC Hydro; and
- energy conservation programs are being scaled back by BC Hydro.

Deloitte LLP concluded that BC Hydro has historically overstated forecast vs. actual electricity load growth by 30% on average.

Other key points:

- Site C is not needed for electric vehicles because charging will occur primarily in off-peak hours.
- Demand from the pulp and paper sector is dropping rapidly as the move to digital media continues.
- LNG energy demand will be limited because it is much less costly to burn natural gas to power LNG operations and still meet the climate change targets set for BC LNG.
- If potential LNG projects require electricity from Site C, the price of Site C electricity will need to be deeply discounted with BC ratepayers picking up the difference.
- Alberta has access to much less costly electricity than Site C and so any export of energy or capacity to Alberta will need to be heavily subsidized by BC ratepayers.

⁶ BCUC Final Report, November 1, 2017, page 108.

⁷ BCUC Final Report, November 1, 2017, page 77.

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The export assumptions are unrealistic

BC Hydro has relied on a variety of vintaged forecasts that diverge so decisively from current prices that a fortune in arbitrage is available for anyone who shares BC Hydro's beliefs.⁸ The BCUC concludes:

Given the current low market prices and the likelihood of increasing supply, the Panel is persuaded that a conservative approach for the estimation of future market pricing is warranted and finds that BC Hydro's proposed Mid C forecast should not be relied upon. Accordingly, the Panel finds that for the purposes of this assessment the future market price for 2024 and beyond should be considered to be at a point mid-way between BC Hydro's proposed Mid C forecast and the low end of the ABB range.⁹

Wind, solar, and geothermal are realistic alternatives

BC Hydro has continuously argued that wind stops being commercially viable at the British Columbia border.¹⁰ The Commission does not share its view:

The Panel finds the capital and operating costs and capacity assumptions used for wind generation in the Illustrative Draft Alternative Portfolio to be reasonable.¹¹

Similarly, BC Hydro has rejected the viability of solar in British Columbia.¹² The Commission does not agree:

The Panel finds that utility scale solar projects have the potential to reduce the NPV of the Illustrative Alternative Portfolio, and notes that 'behind-the-meter' residential and commercial solar also have the potential to place downward pressure on BC Hydro's load forecast over time.¹³

And finally, the Commission concludes that geothermal is viable as well:

⁸ F1-1, BC Hydro, Executive Summary, page 10.

⁹ BCUC Final Report, November 1, 2017, page 95.

¹⁰ F1-1. BC Hydro. August 30, 2017. Appendix F. Page 5

¹¹ Ibid., page 32.

¹² F1-1. BC Hydro. August 30, 2017. Page 58

¹³ Ibid., page 52.

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There is evidence in this Inquiry that a commercially viable geothermal resource may exist. Furthermore, the regulatory process in BC in 2017 has seen much improvement, moving toward a single-window environment with the BC Oil and Gas Commission to assist with fast tracking of geothermal land access and drilling permits. For instance, the Ministry of Energy and Mines indicated that a permit expansion is forthcoming for one of the identified projects.¹⁴

BC Hydro has argued – without evidence – that renewables cannot be relied upon.¹⁵ Here are three of options to firm up wind and solar:

1. BC already has some of the largest reservoirs in North America which can be used to back-up wind. Importantly, BC Hydro's own submissions have made clear that Site C's storage – only 4/10ths of 1% of Williston - is incapable of supporting seasonal operations.¹⁶
2. We could build geothermal power to back-up wind. The Canadian Geothermal Energy Association (CanGEA) presented convincing evidence to the BCUC that geothermal is a viable low-cost solution.¹⁷
3. BC will have access to an extra 2.5 million-acre feet (MAF) of backup storage at the Mica dam in 2024 when BC Hydro says we will need more power (this is due to the Columbia River non-treaty storage agreement ending, putting this storage capability back into the BC Hydro reserve). This is 25 times the backup storage provided by Site C. The opportunity cost of this new energy backup is estimated to cost only \$125 million, a small fraction of the cost of Site C.¹⁸

Other options include re-activating Burrard Thermal gas generated power for peak power needs instead of exporting natural gas to other jurisdictions. Amendments to the Clean Energy Act could open up still further options.

The alternative resources cost less and are more deployable

BC Hydro has consistently tabled cost figures for renewables that are at odds with industry sources for the rest of North America^{19,20}. The Panel's findings do not agree:

The Panel notes that BC Hydro believes the assumed unit energy cost figure for wind to be too low. However, it also considers that other submissions have highlighted further cost reductions that may be possible beyond the levelized costs assumed in the Illustrative Draft

¹⁴ BCUC Final Report, November 1, 2017, Appendix A. Page 19.

¹⁵ F1-1. BC Hydro. August 30, 2017. Appendix F. Page 5

¹⁶ F35-5. McCullough Research. September 13, 2017. Page 24

¹⁷ F66-1. CanGea. August 30, 2017. Page 4

¹⁸ BCUC Final Report, November 1, 2017, Appendix B – Columbia River Treaty Entitlement.

¹⁹ F1-1. BC Hydro. August 30, 2017. Page 63.

²⁰ F35-5. McCullough Research. September 13, 2017. Page 21.

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Alternative Portfolio (for example, CanWEA, CEABC, McCullough)^{21,22}. The Panel agrees with CanWEA and CEABC in finding that the NREL 2017 Annual Technology Baseline represents an appropriate resource for estimating the levelized cost of wind, and believes that this estimate strikes an appropriate balance with regard to future cost forecasts.²³

All parties, other than BC Hydro, noted that the wind data is out of date:

“The Panel shares the concern raised by CEABC concern that wind integration cost estimates provided by BC Hydro are out of date²⁴, and that the cost of wind integration is set by BC Hydro based on “a theoretical value in a somewhat distant market.” The Panel also notes BC Hydro’s submission regarding participation in the Western Energy Imbalance Market that it currently expects participation will not frequently be limited by the capacity or flexibility of the BC Hydro system, but rather by the level of market opportunities and the transmission transfer capability.”²⁵

Solar, also, has the potential to be cost effective:

“The Panel finds that utility scale solar projects have the potential to reduce the NPV of the Illustrative Alternative Portfolio, and notes that ‘behind-the-meter’ residential and commercial solar also have the potential to place downward pressure on BC Hydro’s load forecast over time.”²⁶

This is an area where the Commission has been very conservative. Their estimates for wind are now higher than actual projects near the British Columbia border – and significantly higher than industry forecasts. It is wise to be conservative, but it is also important to keep in mind that the wind blows freely across the 49th parallel without additional cost.

BC Hydro's planning methodology is undocumented and inaccurate

The BCUC final report notes that BC Hydro’s methodology to determine the feasibility of site C is largely opaque. They dismissed BCH’s measure of energy prices in terms of “unit energy cost” due to its heterodox nature: “the Panel found that the adjusted “block unit energy cost” of the BC Hydro Alternative Portfolio is too opaque to be of value in a comparison of costs of Site C to an

²¹ F35-10, McCullough Research. September 27, 2017. Page 4.

²² F104-3, CEABC & CanWea. October 18, 2017. Page 4

²³ Final BCUC Site C Report. November 1, 2017. Appendix A. Page 32

²⁴ F35-10, McCullough Research. September 27, 2017. Page 2.

²⁵ Ibid. Appendix A. Page 33

²⁶ Ibid. Appendix A. Page 53

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alternative portfolio and that adjustments to the Site C UEC financing costs result in an “apples to oranges” comparison to the alternative block.”²⁷

The panel also states that BCH’s load forecast contains a number of curious features that need further explanation.

The Panel finds the GDP and disposable income estimates used by BC Hydro in its Current Load Forecast are higher than similar Conference Board of Canada estimates, and these differences have not been fully explained. The Conference Board of Canada forecast projects the real GDP will grow by 2.6 percent on average between 2016 and 2020 and then drop to an average of 2.3 percent between 2021 and 2025. In Site C Inquiry | Final Report 79 of 187 contrast, BC Hydro’s projection results in an average growth rate of 3.5 percent over the same five years.²⁸

The BCUC wasn’t impressed by the unjustified assumptions BCH made about the alternative portfolio.

[BCH] assumed need to build three \$1.3 billion pumped storage facilities... BC Hydro’s model is opaque as to whether the portfolio is charged with the full cost of this facility the moment a small capacity gap appears. The Panel also considers that the lack of consideration of demand side options is a key driver of the difference between BC Hydro’s model results and that of the Commission.²⁹

Even some of the data that BCH put forward in their initial submission seems to have been changed quietly behind closed doors.³⁰

The Panel notes that there is no clear linkage between the \$/MWh revenue estimates provided in the table above, those provided in the F17-F19 RRA and BC Hydro’s ABB based Mid-C forecast graph provided in the BC Hydro’s initial submission.³¹

There is an excellent source of hydro-electric storage in the non-treaty storage agreement

²⁷ Final BCUC Site C Report. November 1, 2017. Page 136

²⁸ Ibid. Page 78

²⁹ Final BCUC Site C Report. November 1, 2017. Page 158

³⁰ F1-1. BC Hydro. August 30, 2017. Page 64

³¹ Final BCUC Site C Report. November 1, 2017. Page 153

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The non-treaty storage at the Mica Dam is considered an attractive option for shaping alternative energy sources:

The Panel also notes McCullough's evidence regarding the additional storage at the Mica dam that has been sold to Bonneville Power Authority under a contract expiring in 2024, and that it could subsequently be used by BC Hydro to meet domestic needs (provided its use does not reduce CRT flood control and power benefits).³²

The BCUC goes on to question BC Hydro's assertion that the Columbia Treaty is an unreliable source of energy and capacity:

[Without taking Mica into account] the amount of energy and capacity available to the province in the treaty is approximately equal to the amount of energy and capacity that Site C will provide.³³

And further:

...the Panel considers that the additional Mica storage may have the potential to reduce the PV cost of the Illustrative Alternative Portfolio.³⁴

The BCUC concludes that Site C is not necessary to help shape an alternative portfolio.

The Illustrative Draft Alternative Portfolio includes 444 MW (low load forecast) and 591 MW (high load forecast) of wind generation. BC Hydro states that Site C (capacity 1,145 MW) can integrate 900 MW of wind. However, the Panel notes that BC Hydro's existing modest level of wind penetration (780 MW) and high levels of hydro generation providing reserves (GM Shrum, Mica and Revelstoke with a combined capacity around 8,000 MW) means that BC Hydro would not be expected to need Site C to integrate these additional wind farms.³⁵

³² Final BCUC Site C Report. November 1, 2017. Appendix B. Page 7.

³³ Final BCUC Site C Report. November 1, 2017. Appendix B. Page 7.

³⁴ Final BCUC Site C Report. November 1, 2017. Appendix B. Page 7.

³⁵ Final BCUC Site C Report. November 1, 2017. Appendix A. Page 32.

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Conclusion

To sum up, BC Hydro's entire submission has been rejected – piece by piece and page by page – in the British Columbia Utility Commission's Final Report. Site C is behind schedule and massively over budget. Lower cost alternatives do exist and are viable. And perhaps most importantly of all, the continued capabilities of the Columbia River – either within the Treaty or outside of the Treaty – make Site C unnecessary.

To put this last point another way, the non-treaty access to Mica dam storage which can be accessed at minimal cost in 2024 provides sufficient firming for as much low-cost wind and solar as we need to deploy to meet BC's laudable climate change targets.

The full BCUC Report can be found at www.peacevalleyland.com/siteinquiry.

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Expert Biography

Robert McCullough is Principal of McCullough Research in Portland, OR, and for over thirty-seven years has advised governments, utilities, and aboriginal groups on energy, metals, paper, and chemical issues. He has testified repeatedly in state, federal, and provincial courts as well as before Congress and regulatory bodies. His testimony in front of the Senate Energy Committee is credited with initiating the Enron trading investigations during which he worked for the U.S. Department of Justice and three western attorneys general. He has consulted for U.S. and Canadian clients on hydroelectric issues in many states and provinces, including on many occasions, presenting on issues before Canadian regulators.