COMMENTARY **BC HYDRO**

SOME CONSIDERATIONS IF WIND POWERS BC HYDRO'S NEW CLEAN ELECTRICITY SUPPLY

In June 2023, BC Hydro advised that it intends to contract for additional clean electricity supply sooner than originally planned to meet increased demand. The higher demand results from the BC government's ambitious greenhouse gas reduction targets. The forecast's Baseline scenario called for the acquisition of some 3,000 GWh of new clean or renewable energy as early as 2028/29, as well as approximately 700 GWh in new power from existing facilities.[1]

The Baseline forecast did not include any significant capacity for the new proposed LNG and hydrogen plants that are in various stages of development. The Accelerated scenario would call for a total of 5,900 GWh by 2029/30, and 14,000 GWh by 1034/35, after deducting savings from significant conservation (demand side management) measures.[2] As noted earlier, 700 GWh of the total would be gained from existing facilities.

1 Sourcing the New Supply

In the BC Utilities Commission's (BCUC) current review of the new load forecast, many questions were posed as to the source of the new supply of clean energy. Currently, approximately 80% of BC Hydro's electricity comes from owned or contracted stored hydro, while another 10% comes from non-stored (run-of-the-river) hydro power. Wind power comprises only 1,660 GWh, or 2.5% of BC Hydro's power capacity.[3]

BC Hydro indicated that: "For the purpose of estimating the capacity contribution of the 3,000 GWh per year of new energy from greenfield facilities, BC Hydro made the simplifying assumption that all of the new energy would be wind energy."[4] It noted that land-based wind resources are likely the lowest cost energy resource in the near-term.[5]

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[1] BCUC, BC Hydro IRP June 2023 Update, Appendix B1, p. 14; https://docs.bcuc.com/documents/proceedings/2023/doc_71932_b-39-bch-signposts-update.pdf pdf 194/368.
[2] See Table 3 in https://www.bcpolicyperspectives.com/media/attachments/view/doc/occasional_paper_no_89_bc_hydro_supply_and_demand_14_august_2023_2/pdf/occasional_paper_no_89_bc_hydro_supply_and_demand_14_august_2023_2.pdf
[3] Table 1 in https://www.bcpolicyperspectives.com/media/attachments/view/doc/commentary_bc_hydro_and_climate_change_24_october_2023/pdf/commentary_bc_hydro_and_climate_change_24_october_2023.pdf See also https://cleanenergybc.org/sector/wind/
[4] BCUC, BC Hydro June 2023 Update, Exhibit B-44, https://docs.bcuc.com/documents/proceedings/2023/doc_72895_b44bchintervenersir4signpostupdateresponsepublic.pdf pdf 648/941.
[5] Ibid., Exhibit B-39, Appendix B1, p. 48, pdf 155.

BC Hydro stated that the projected supply shortfall was an "energy" shortfall, not a capacity shortfall, meaning that it had sufficient storage capacity to provide the necessary baseline power to backup intermittent power supplied from wind turbines.[6]

Currently, BC Hydro has eight long-term wind farm contracts totaling 483 MW and 1,647 GWh. The two largest are in the northeast near Tumber Ridge, and have a combined capacity of 327 MW, and 1,018 GWh.[7] The Capital Power facility has 79 wind turbines rated at 1.8 MW, with a combined of 142 MW and 477 GWh capacity.[8] The Meikle wind farm employs 61 wind turbines rated at either 2.75 or 3.2 MW, and has a capacity of 185 MW and 541 GWh.[9]

2 A Capital Cost Estimate

Assuming that a land-based wind turbine costs approximately $2.5 million CAN per MW capacity, a 3 MW turbine would cost $7.5 million.[10] The turbines have a useful life of between 20 to 25 years.

Given the intermittent supply inherent with wind resources,[11] the rated (nameplate) capacity of the turbine is usually discounted by 50% to 60% to provide a more accurate estimate of available GWh energy. BC Hydro is assuming a 50% discount factor if the power is generated in the northeast, which is the most efficient wind region of the province.[12]

This suggests that in order to achieve the forecast new supply of clean electricity through wind turbines, the installed capacity would need to be twice the nameplate capacity. In other words, to achieve 3,000 GWh (Baseline), or 5,200 GWh (Accelerated) by 2029/30, proponents must be prepared to install 6,000 GWh to 10,400 GWh of wind power. This does not include the approximate 10% of power lost through long distance transmission.

The estimated number of 3 MW turbines operating at a 50% efficiency ratio is approximately 666 for the 2029/30 Baseline forecast, and 1,155 for the Accelerated forecast. The calculations are shown in Appendix A.

The total equipment cost for 666 turbines for the Baseline scenario would be approximately $5.0 billion. This does not include the cost of hundreds of acres of land,

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[6] Ibid., pdf 650/941.
[7] https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/independent-power-producers-calls-for-power/independent-power-producers/ipp-supply-list-in-operation.pdf
[8] https://www.capitalpower.com/operations/quality-wind/
[9] https://patterncanada.ca/projects/meikle-wind/
[10] https://weatherguardwind.com/how-much-does-wind-turbine-cost-worth-it/#:~:text=%241%2C300%2C000%20USD%20per%20megawatt.,on%20wind%20turbine%20operational%20cost.
[11] Turbines are not effective in low or very high wind conditions.
[12] Ibid., pdf 648/941. The capacity factor is the percentage of the time a system is supplying its installed capacity. The nameplate capacity times the capacity factor equals the actual output of the generating system.

"benefit sharing" with First Nation and local governments, and other site acquisition costs. Any transmission upgrades and transmission losses are also not included in the estimate.

If the 5,200 GWh target in the Accelerated 2029/30 scenario is required the estimated number of turbines climbs to 1,155, at an estimated cost of $8.7 billion. Again, this excludes the cost of the land, "benefit sharing" with First Nation and local governments, and other site acquisition costs, and transmission costs.

In a period of high borrowing costs, the actual financial outlay by the wind farm proponent would be even higher if most of the capital cost was financed through debt. In fact, with high interest rates and a high demand for wind turbines globally, the cost could be much higher. These costs would be included in the annual contract cost paid by BC Hydro. This enlarged cost base would, in turn, be included in the electricity rates paid by residents and businesses.

It can be expected that BC Hydro will not disclose the cost of the individual contracts it signs, citing commercial sensitivity.

3 The Horse Haven Hills Wind Farm Project

A major wind farm and solar/battery project in Washington State is an example of what the people of this province may face in the near future. The state government, like the BC government, has ambitious plans to reduce fossil fuel consumption through the use of renewable electricity.

The Washington State power regulator is currently reviewing a proposal for a massive 222 turbine wind farm in the northeast of the state. The three components of the project would cover approximately 5,450 acres, and cost approximately $2.3 billion CAN dollars.

There is significant local opposition centred on the displaced land and that only 30% of the rated capacity will be generated based on the average wind speed.[13] The proponent says the capacity is 1,000 MW, but at an estimated 35% capacity factor the operational average output is 350 MW, or approximately 1,000 GWh.

An article in the *Seattle Times* (4 November 2023) summarized the situation in Washington State.

> Regardless of the arguments for and against the Horse Heaven Hills Wind Farm, Washington needs more sources of renewable energy.
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> The Clean Energy Transformation Act requires Washington to replace coal generation by 2025. And the Climate Commitment Act requires the state to cut

[13] https://www.forbes.com/sites/jamesconca/2021/03/08/wind-turbines-on-washingtons-horse-heaven-hills--how-not-to-pursue-a-green-new-deal/?sh=22abb75d508d

> emissions 45% (from 1990 levels) by 2030, 70% by 2040 and 95% by 2050. Plus, the state must move to meet an ever-increasing demand for energy.
>
> Glenn Blackmon, manager of Washington's Energy Policy Office, estimated that by 2035 the state will need an additional 22 gigawatts of renewable energy, citing a recent study from the nonprofit Clean Energy Transition Institute.
>
> While it would be the largest renewable project in Washington, the Horse Heaven site represents less than 5% of that total need and is taking years longer than expected to build.
>
> "We actually need several more like it," Blackmon said.[14]

Many other states and countries are actively planning or building wind farms which often include some short-term battery storage. For example, there are a number of major projects underway in eastern Australia.[15] Alberta has over 70 wind farms in production or in various stages of development. Capital Power's Whitla Wind facility (350 MW) is one of the largest, with 98 turbines rated at 3.6 MW. The total construction cost was approximately $480 million.

3 Consultations

With the release of the revised load forecast in mid June 2023, Premier Eby announced that the process to select new private power producers will be designed by the Crown corporation and the province following discussions with Indigenous groups, industry representatives, and stakeholders. Also, a new BC Hydro task force "will provide strategic advice on program design, focusing on Indigenous ownership opportunities, speed of permitting and delivery, electricity rates, climate priorities, and economic opportunity acceleration. The task force will consult Indigenous and other external energy experts."[16]

The emphasis on Indigenous participation and ownership potential is a new twist on the IPP contract process. As BC Hydro notes: "We also heard a strong interest from Indigenous Nations in participating in new clean energy opportunities…. BC Hydro will be engaging Indigenous Nations and stakeholders on the design of a competitive energy acquisition process with a particular focus on how we can include a role for First Nations ownership in all projects."[17]

BC Hydro began a lengthy consultation process with respect to the new call for proposals to supply the new clean and renewable power. On 13 September 2023, it released a progress report on the information sessions, which were intended to garner

[14] https://www.seattletimes.com/seattle-news/environment/proposal-for-was-largest-wind-solar-project-shows-challenges-ahead/
[15] https://reneweconomy.com.au/squadron-unveils-major-wind-farm-plans-proposed-for-victoria/
[16] https://www.mccarthy.ca/en/insights/blogs/canadian-energy-perspectives/bc-government-announces-first-bc-hydro-power-call-15-years
[17] https://docs.bcuc.com/documents/proceedings/2023/doc_71932_b-39-bch-signposts-update.pdf p. 80, pdf 87/368.

"input from First Nations, IPPs and industry stakeholders to help us design the upcoming Call for Power."[18]

BC Hydro has been working closely with a number of indigenous governments to determine if there are opportunities for these first nations to receive economic benefits from the new power agreements, where their interests "align the needs of BC Hydro's business."[19] The potential power proponents and the Indigenous participants raised many questions about the planned call for proposals, which are summarized in the document.

As noted earlier, the northeast of the province seems best suited for the development of additional wind farms. However, permitting may be delayed by impact of the 2021 BC supreme court Blueberry River decision, where the court found that cumulative development permits constituted a breach of treaty rights. Following the court's decision, the Blueberry River First Nation and the provincial government signed an agreement to limit new development, and restore certain areas.[20]

However, it appears that not all the indigenous governments in the northeast are satisfied with the Blueberry River First Nation (BRFN) agreement. These governments claim that the agreement impinges on the rights of other Treaty 8 First Nations whose territories overlap with areas claimed by the BRFN.[21] Such disputes among the various First Nations increase uncertainty for oil and gas developers, as well as for potential wind farm investors. These disputes between Indigenous governments may delay the roll-out of the anticipated wind farms.

BC Hydro summarized key risks to achieving the required additional power, which are shown in Appendix B.

4 Summary

To meet its new Baseline load forecast for 2028/29, BC Hydro plans to issue a call for proposals to generate 3,000 GWh in the spring of 2024. It would appear that the bulk of the new power will be generated by wind farms located in the northeast of the province. To generate the requisite power from an intermittent wind source will require a doubling of the nameplate power rating. This suggests that the new gross supply would require 6,000 GWh, or 10,400 GWh to meet the Accelerated demand forecast.

This is a massive undertaking with an ambitious four-year target. The estimated capital cost conservatively equals approximately $5.0 billion for the Baseline demand forecast, and approximately $8.7 billion for the Accelerated target load.

[18] https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/independent-power-producers-calls-for-power/independent-power-producers/CFP-Ph1-Engagement-Summary-Report-Consolidated.pdf p. 1.
[19] Ibid., p. 2.
[20] https://vancouversun.com/news/local-news/blueberry-river-first-nation-restoration-development-agreement-bc
[21] https://biv.com/article/2023/11/treaty-8-nations-challenge-blueberry-river-agreement

In addition to the substantial cost the new intermittent source of power will require BC Hydro to devote more resources to balancing the power on the provincial grid with stored hydro power from its dam system. This increases the risk of shortages when demand and supply are not in balance.[22] BC Hydro may be forced to import more power to the province where there are shortages. It is highly likely that some of this imported power will be generated by fossil fuels.

The provincial and federal government's net zero ambitions require a much enlarged supply of clean electricity to satisfy the new demands. The cost of this new intermittent supply has not been disclosed, nor the impact on residential and commercial electricity rates.

Whether the move to wind power will allow BC Hydro to maintain an affordable and reliable power system remains an open question.

The writer is a retired senior BC government public servant whose paper describing the BC government's manipulation of the finances of BC Hydro from 2008 to 2014 was published by BC Studies in November 2016. BC Studies published his paper on the 40-year financial history of ICBC in 2013. He is an intervener in the BC Utilities Commission's reviews of ICBC's and BC Hydro's rate requests.

APPENDIX A

Assumptions to calculate the number of 3 MW turbines.

Baseline forecast of 3,000 GWh

The current IPP wind farms have a GWh/MW ratio of approximately 3/1,[23] therefore 3,000 GWh requires 1,000 MW of turbine capacity. Assuming average turbine capacity of 3 MW, this requires 333 turbines. However, as the efficiency factor is 50%, the total doubles to 666 turbines.

[22] https://wattsupwiththat.com/2023/11/09/the-intermittency-problem-with-wind-power-generation-in-great-britain/
[23] This ratio appears consistent with the BC Hydro IPP experience , see also https://cleanenergybc.org/sector/wind/#:~:text=Wind%20power%20provides%20a%20continuous,Columbia's%20reliance%20on%20fossil%20fuels.h

Assuming a cost of $2.5 million/MW the total cost is 666 x $7.5 million, or $5.0 billion.

Accelerated forecast of 5,200 GWh

The same methodology and assumptions. The 3/1 ratio produces 1,733 turbines. A 3 MW average capacity requires 578 turbines, and the 50% factor doubles the number to 1,155 turbines.

Assuming a cost of $2.5 million/MW the total cost is 1,155 x $7.5 million, or $8.7 billion.

APPENDIX B

From BCUC, IRP Review, Exhibit B-43, pdf 443/562 and 444/562; https://docs.bcuc.com/documents/proceedings/2023/doc_72893_b43bchbcucir4signpostupdateresponsepublic.pdf

The following project risks could increase the lead time required for future clean energy and renewable resources:

• Permitting risks (e.g., delays in carrying out studies for required permits);

• Financing risks (e.g., challenges in securing financing);

• Interconnection risks (e.g., volume of requests, authorizations or construction of interconnection facilities);

• Equipment procurement risks (e.g., delays in delivery of key equipment);

• Construction risks (e.g., geotechnical challenges resulting in longer construction periods);

• Commissioning risks (e.g., problems in ensuring safe operation and delivery of power);

• Engagement risks (e.g., requiring more time to obtain and consider feedback received, more time required for First Nations and IPPs to complete partnership agreements and to allow IPPs to obtain First Nations consent, as required); and

• Regulatory risks (e.g., time required for regulatory review of electricity purchase agreements, as required).