Q. **Reference: Economic and Technical Assessment, page 20 (p. 54 pdf)**

Citation:

> Energy storage technologies have not yet matured to the point that they are a viable alternative for firm, reliable, least-cost provision of power when compared to diesel generation. This is supported by a National Renewable Energy Laboratory ("NREL") report "2018 U.S. Utility-Scale Photovoltaics-Plus-Energy Storage System Costs Benchmark."[26] This report includes a comparison of average energy storage durations for such systems and indicates that most storage technology is limited to 10 hours in duration, where none of which exceed an average of 100 hours.
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> For Hydro to rely on wind, solar, or run-of-river hydro generation, energy storage technologies would need to bridge the prolonged time in which there is little exposure to these energy sources. These periods may extend for several days; therefore, energy storage solutions are not a viable option. As such, Hydro cannot consider wind and solar generation as a firm energy solution for southern Labrador.

a. Please confirm that other technologies are under development which may well allow longer storage durations in the coming years.

b. Has Hydro explored the extent to which energy storage technologies are expected to become a viable alternative for firm, reliable, least-cost provision of power when compared to diesel generation, during the expected lifetime of these investments?

c. More specifically, if cost-effective energy storage over multi-day periods were to become available later in this decade, how would this affect Hydro's analysis of the optimal solution for meeting southern Labrador needs?

d. Should cost-effective longer-term storage become available during the life of the proposed project, would it allow wind and solar power to be treated as firm supply solutions to a certain extent?

e. Please elaborate on how the proposed project would be modified if it were assumed that a substantial quantity of firmed renewable energy would become available by 2035.

A. a. It is confirmed that other technologies are under development which may allow longer storage duration in coming years. These are outlined in "2018 U.S. Utility-Scale Photovoltaics-Plus-Energy Storage System Costs Benchmark."[1] While Newfoundland and Labrador Hydro ("Hydro") does not plan to meet peak system demand on a firm basis using these relatively new and unproven technologies, Hydro understand that they may allow significant increased opportunity for energy penetration and fuel displacement using renewable resources. Even if there is significant renewable energy penetration and it is available at half the price of diesel fuel, the outcome of Hydro's cost-benefit analysis, which demonstrates that the proposed alternative is the least-cost solution for providing reliable electrical service to the southern Labrador area. Appendix B of the "Long-Term Supply Study for Southern Labrador: Economic & Technical Assessment"[2] further outlines how the southern Labrador interconnection will create a system which is capable of integrating more renewable energy than multiple isolated diesel systems. For additional information, please refer to Hydro's response to PUB-NLH-001.

b. As per Hydro's response to PUB-NLH-001, Hydro does not expect energy storage technologies to become a viable alternative for firm, reliable, least-cost provision of power when compared to diesel generation within the next 15 years. The capabilities of this technology beyond this timeframe during the expected lifetime of these investments is speculative.

As indicated in Table 1-2,[3] the total cost of ownership cost of even 50% renewable energy across all of Hydro's isolated systems (listed as Option 6 in the referenced table), is estimated to be $423 million compared to continued operation of individual diesel generating stations without renewables, estimated to be $284 million. As identified in Table 10-5,[4] even if the renewable energy costs (listed in Generation CAPEX in the referenced table) was decreased by 50% it would still be more expensive than the continued operation of individual diesel generating stations without renewables ($330 million compared to $284

[1] Ran Fu, Timothy Remo, and Robert Margolis, "2018 U.S Utility Scale Photovoltaics-Plus-Energy Storage System Costs Benchmark," National Renewable Energy Laboratory, November 2018, <https://www.nrel.gov/docs/fy19osti/71714.pdf>.
[2] "Long-Term Supply for Southern Labrador – Phase 1," Newfoundland and Labrador Hydro, July 16, 2021, sch. 1, att. 1.
[3] Please refer to LAB-NLH-015, Attachment 3, p. 8.
[4] Please refer to LAB-NLH-015, Attachment 3, p. 106.

million). Also, as noted in Figure 3-1,[5] as renewable energy penetration starts to exceed 50% the amount of renewable generation and battery storage required for additional renewable energy penetration increase exponentially. For example, to achieve 50% penetration as per the situation discussed in the referenced figure, four renewable energy systems each consisting of an 800 kW wind turbine with an 800 kW battery energy storage system would be required, totaling 3,200 kW of wind turbines and battery energy storage systems. To increase the renewable energy penetration to 80%, 18 of these systems would be required, totaling 14,400 kW of wind turbines and 14,400 kW of battery energy storage systems. This is a 350% increase in renewable energy capacity that only allows a 60% increase in renewable energy penetration.

In general, Hydro does not plan systems based on forecasted technology costs as they are speculative, uncertain, and vary greatly depending on the publisher of the forecast. The National Renewable Energy Laboratory ("NREL") report titled *Cost Projections for Utility-Scale Battery Storage* compared over 25 publications that considered Lithium ion utility-scale storage costs.[6] This report notes that projections of storage costs may drop to between 20% and 75% of 2018 values over time, demonstrating a high amount of uncertainty in storage cost predictions.

c. If energy storage prices do drop to levels that allow for renewable energy to be considered firm capacity, then Hydro can account for this when Phase 2 and Phase 3 of the proposed interconnection are required. Hydro would assess options for the provision of additional firm capacity in advance of future phases, including options consisting of renewable energy sources with storage, should these technologies mature to the point of viability at that time. As stated above, Hydro does not anticipate that such technologies will mature to the point that they become the sole source of firm capacity and energy on these systems in the timeframe considered; and therefore, Hydro's proposed interconnection supplied by a regional diesel generating stations is expected to remain the least-cost alternative for provision of reliable supply for the southern Labrador region.

[5] Please refer to LAB-NLH-015, Attachment 3, p. 33.
[6] Wesley Cole and A. Will Frazier, "Cost Projections for Utility-Scale Battery Storage," National Renewable Energy Laboratory, June 2019, <https://www.nrel.gov/docs/fy19osti/73222.pdf>.

d. Should cost-effective longer-term storage become available during the life of the proposed project, it would allow wind and solar project to be treated as firm supply solution to the extent that the cost of the full solution including renewable generation, storage, operating and maintenance costs, interconnection costs, and sustaining capital costs becomes the least-cost alternative capable of reliably supporting the system load during peak.

e. If Hydro could be assured that cost-effective energy storage over multi-day periods would become available later in this decade (which it cannot currently do), Hydro could reduce the size of the proposed engine hall as additional capacity would not likely be required in the future. The diesel generating station will still require the same amount of generation as already proposed to support peak load in the meantime. However, if such measures were taken and the technological advancements were not to materialize (or if appreciable customer load were to materialize), Hydro would be faced with a circumstance where plant capacity could not be expanded. Customers would then have to incur increased lifecycle costs as the construction of new generating facility would be required. Given the low probability of the required technological advancements in the foreseeable future, the risks associated with such an approach are unacceptable.