BC Hydro
Power smart

2021 Integrated Resource Plan Application

Sections 1 to 4
Appendix J: Resource Options Database

Filed with the B.C. Utilities Commission on December 21, 2021

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1 Summary of the Resource Options Database

Resource Options Database (**RODAT**) is BC Hydro's inventory of potential resource options from which portfolios of resource options are built. In RODAT, each resource option is described at a high-level regarding technical, financial, environmental, and economic development attributes. RODAT is an input into portfolio modelling and other resource planning processes. An abbreviated RODAT containing a representative sample of each resource type is found in Appendix J-1.

In updating RODAT for the 2021 Integrated Resource Plan (**2021 IRP**) (as found in Appendix B), BC Hydro staff engaged with internal and external technical specialists and other external stakeholders. The update is broad in scope and we have sought to identify a wide range of potential resource options that could be built or acquired to serve our load during the 2021 IRP timeframe. The update includes:

- Supply-side resources;
- Demand-side measures;
- Upgrades to existing BC Hydro generation resources;
- Renewals of existing electricity purchase agreements; and
- Infrastructure that increases transfer capacity on the bulk transmission system that connects different regions of the province.

2 Attributes in the RODAT

RODAT characterizes each resource option in terms of its technical, financial, environmental, and economic development attributes. Table J-1 depicts a selection of relevant attributes and their units.

Table Error! No text of specified style in document.**J-1**
Selection of Attributes in RODAT

Area	Attribute (units)
Technical	• Installed/nameplate capacity (MW) • Average annual energy (GWh/yr) • Annual firm energy (GWh/yr) • Dependable generation capacity (MW) • Effective load carrying capability (MW) • Project life (years) • Project lead time (years)
Financial	• Capital cost (total $) • Fixed operations and maintenance costs ($/yr) • Variable operations and maintenance costs ($/MWh) • Unit energy cost ($/MWh) or unit capacity cost ($/kW-yr) • Total resource costs and utility costs for demand-side measures resources ($) • Technology learning curve (% change in costs)
Environmental	• Location (region and latitude / longitude) • Direct greenhouse gas (**GHG**) emissions (tonnes GHG/yr) • Footprint (hectares)
Economic development	• Direct employment (total person-years)

2.1 Understanding Unit Costs

For resources that provide primarily energy (e.g., wind resources or energy efficiency programs) the financial measure of interest is the unit energy cost (**UEC**). The unit energy cost represents the costs to deliver a unit of energy to the grid over the life of a resource taking into account the upfront capital and ongoing maintenance, operations, and fuel costs. The annualized costs in the numerator and the annual energy generated in the denominator are discounted by the real weighted average cost of capital. UEC is measured in $/MWh in 2020$.

For resources that provide primarily capacity during peak periods (e.g., time-varying rates or energy storage) the financial measure of interest is the unit capacity cost (**UCC**). Like unit energy cost, the unit capacity cost represents the unit cost of capacity, taking into account the upfront capital and fixed operations and maintenance costs, The annualized costs in the numerator and the annual dependable capacity in the denominator are discounted by the real weighted average cost of capital. UCC is measured in $/kW-year in $2020. [1,2]

In general, the UEC or UCC is a measure of cost from the point of view of the resource developer. Appendix L, section 2.1.3.3 to the Application describes a number of adjustments that can be applied to the simple UEC in RODAT to estimate the cost from the point of view of the utility. Appendix L, section 2.2.3.2 describes a similar adjustment than can be applied to the simple UCC in RODAT.

2.1.1 Total Resource Costs and Utility Costs of Demand-Side Measures

The cost of demand-side measures can be borne by participating customers, the utility, or in most cases by both. As a result, the unit costs of demand-side measures can be calculated in different ways, which consider different perspectives on whose costs and benefits are included in the calculation. These different approaches to calculating unit costs for demand-side measures resources are as follows:

- Total resource cost: an accounting of costs that includes costs to the utility as well as costs incurred by participating customers;
- Utility cost: an accounting of costs that includes only costs to the utility;
- Net total resource cost: an accounting of costs and offsetting benefits that are borne by and accrue to both the utility and participating customers; and
- Net utility cost: An accounting of costs and offsetting benefits that are borne by and accrue to the utility.

[1] For capacity resources that do not provide dependable capacity, the installed capacity is used in the denominator.

[2] Variable costs, such as fuel costs or water rental costs, are not included in simple unit capacity cost calculations.

Unless otherwise stated, the unit cost measures for demand-side resources reported in this 2021 IRP are based on the utility cost approach.

2.2 Understanding Capacity Contributions to the Grid

Installed capacity refers to the highest potential output of a resource. However, only a few types of resources have their total installed capacity available to the grid for every hour of the year. In practice, there are limitations of fuel or required maintenance for most resources that make less than 100% of the installed capacity available throughout the year. The important factor in understanding a resource's capacity contribution to the grid is the capacity that is reliably available during BC Hydro's winter peak periods.

Some resources operate steadily throughout the year or are reliably dispatchable during winter peak periods, such as hydro resources with ample storage or gas turbines. These resources provide Dependable Generation Capacity, and in general, their Dependable Generation Capacity contribution is close to their installed capacity with adjustments for observed daily winter generation.

2.2.1 Effective Load Carrying Capability

Some resources are intermittent by nature, such as wind or solar. Their generation during a given winter peak event is uncertain. These resources do not provide dependable capacity, but they can increase the system's effective load carrying capability (**ELCC**) to the degree that their generation, on average, coincides with our winter system peaks. Effective load carrying capability is defined as a probabilistic assessment of a resource's or a power system's ability to reliably supply system load, and is measured in MW.[3] When considering a single resource option's contribution to the system effective load carrying capability we may use the resource

[3] Please refer to Appendix Q-2 to the Application for further details on effective load carrying capability.

option's own effective load carrying capability factor, which is the percentage of its capacity that can reliably serve system load.

The contribution to system effective load carrying capability from intermittent supply resources are estimated based on an analysis of historical generation records from existing British Columbia intermittent resources and the correlation with B.C. winter system peaks.

Some resources, such as demand response or batteries, are limited in either the duration for which they are available, the frequency or number of times they can be called upon, or the energy they have stored that can be used during times of peak demand. These resources do not provide year-round dependable capacity, but they too can increase effective load carrying capability to the degree that their output coincides with our winter system peak, and their charging or snapback effects do not impact system reliability outside of peak hours.[4] The contribution to system effective load carrying capability from these resources is estimated based on an hour-by-hour analysis of the reliability impact of these resources on a typical winter season load profile of the BC Hydro system.

2.3 Understanding Environmental Attributes

RODAT includes a high-level characterization of air and terrestrial impacts from resource options. It characterizes air impacts by the estimated direct annual greenhouse emissions from the combustion of fossil fuels. Among all resource options, only fossil natural gas-fueled gas turbines have direct greenhouse gas emissions.[5] Terrestrial impacts are characterized by the simple footprint on the land from the infrastructure to produce and transmit energy to the existing BC Hydro system. For supply-side resources, the footprint includes the land area for

[4] Snapback effects refer to the increase in load immediately following the end of a peak price signal or demand response event as customers take advantage of off-peak price signals and equipment is allowed to return to a normal operating set point.

[5] Biomass and renewable natural gas resources are assumed to be greenhouse gas neutral.

generation infrastructure and associated works, and land for new rights-of-way to interconnect the generator to the closest existing BC Hydro substation. For transmission resources, the footprint includes only that from new rights-of-way. For demand-side resources or renewals of existing electricity purchase agreements with independent power producers, RODAT assumes the terrestrial impacts are negligible.

While RODAT provides a high-level assessment of environmental impacts for individual resource options, a more detailed evaluation is performed to assess the aggregate environmental impact of portfolios of resources. This evaluation, which is part of the portfolio analysis process, is described in Appendix O-3 to the Application.

2.4 Understanding Economic Development Attributes

RODAT characterizes the direct labour associated with individual resource options' construction, operation, and maintenance. The estimates of direct labour for each resource option is based on a literature review to create a simple labour calculator for each resource type, considering differences in resource option sizes. The measure for this attribute is total person-years, which is the simple product of the number of people employed and the number of years employed. For example, a resource option may have a total direct labour of 500-person-years, composed of 100 people for four years during construction and five people employed for the 20-year project life. This high-level approach to calculating direct labour was not applied to demand-side resources or electricity purchase agreement renewals. Please refer to Appendix O-2 to the Application for further details on the simple assessment of labour impacts for supply side resources.

While RODAT provides a high-level assessment of direct labour impacts for individual resource options, a more detailed evaluation is performed to assess the aggregate economic development impact of portfolios of resources. This more detailed evaluation of portfolios of resources, which includes impacts from demand-side resources, is further described in Appendix O-1 to the Application.

2.5 Project Lead Time

In general, the project lead times in RODAT are based on estimates of the durations for the planning and construction phases for a generic resource option of each resource type in the B.C. context. For some specific resource options, shorter lead times than normal were provided where BC Hydro has knowledge of early investments and preparation having already taken place.

In portfolio analysis, project lead times may not be sufficient to fully account for the time required to materialize a resource option. For example, constructing a supply-side resource option led by an independent power producer may require preceding steps to secure a long-term energy purchase agreement from BC Hydro. This would generally involve a separate BC Hydro-led acquisition and contracting stage that typically lasts two to four years before culminating in energy purchase agreements, only some of which may be concurrent with the planning stages of the resource option itself. As a result of this additional lead time, the portfolio analysis assumes an additional two years for new supply-side resources on top of the project lead times described in RODAT.

2.6 Project Lifetime

Project lifetime is the number of years a resource option is expected to be in service.

2.7 The Technology Learning Curve and Future Resource Costs

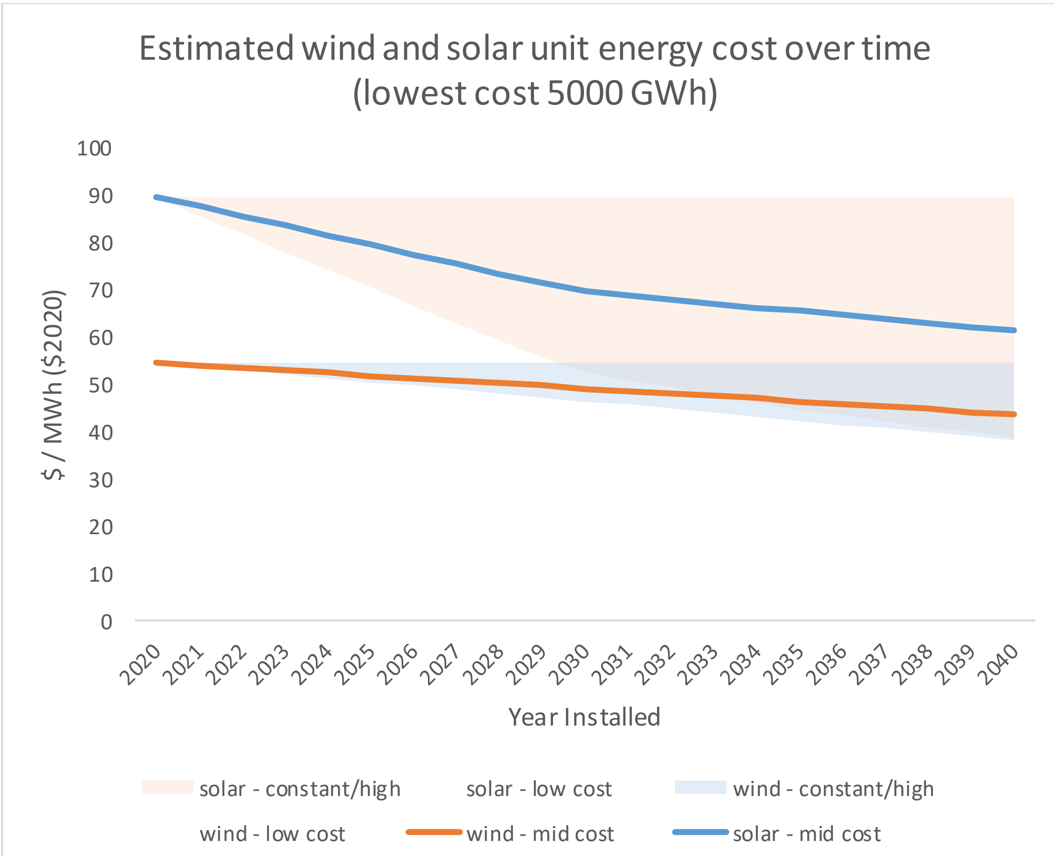
The financial attributes presented in RODAT represent the costs for systems brought into service in 2020. To account for future technological development, BC Hydro has developed a forecast of the changing costs over time for each resource type based on the 2019 National Renewable Energy Laboratory Annual Technology Baseline

(**ATB**).[6] The ATB generates a high, mid, and low future forecast for most supply technologies using a consistent methodology updated annually. The ATB mid-forecast for each technology is used to project a percent change of unit costs of resources brought into service in the future, relative to the 2020 cost baseline in RODAT.

Most of the supply resources will have negligible changes in the real unit costs over a 20-year timeframe. Three technologies are projected to see notable improvements in costs and performance – wind, solar, and batteries. Figure Error! **No text of specified style in document.**-1 illustrates the projected high, low, and mid-cost declines applied to the average 2020 cost of onshore wind and utility-scale solar resources in B.C., respectively. Figure J-13 illustrates the forecasted change in costs for batteries versus conventional pumped hydro storage resources, based on the ATB mid-cost forecast applied to the 2020 estimated costs of these resources as described in RODAT.

6 https://www.nrel.gov/docs/fy19osti/74273.pdf

Figure Error! No text of specified style in document.**-1**
Estimated Wind and Solar Unit Energy Cost for Representative Resource Options



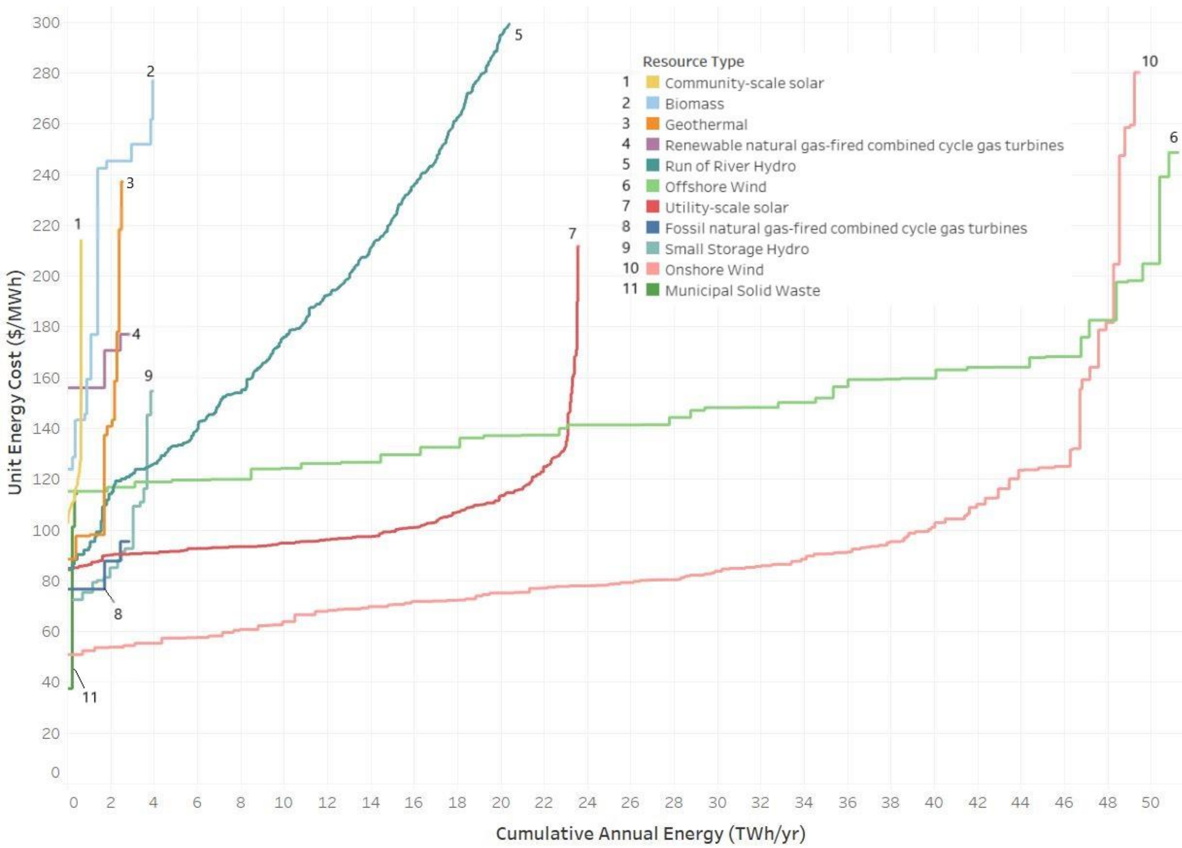
3 Supply-Side Energy Resources

Supply-side energy resources refer to new greenfield generation resources whose primary product is energy.[7]

Figure J-2 shows the supply curve of all supply-side energy resources, illustrating how the UEC changes from the lowest cost to the highest cost resource options for each resource type.

[7] Greenfield generation resources whose primary product is capacity are described in section 4.

Figure J-2 Supply Curve for all Supply-Side Energy Resources



By way of example, Figure J-2 shows that the single lowest-cost onshore wind resource option can provide energy at a UEC of ~$50/MWh. Many other onshore wind resource options also provide energy at a similar cost. Approximately 10,000 GWh of onshore wind energy is available at a UEC less than $60/MWh, and 40,000 GWh of onshore wind energy is available at a UEC less than $100/MWh.

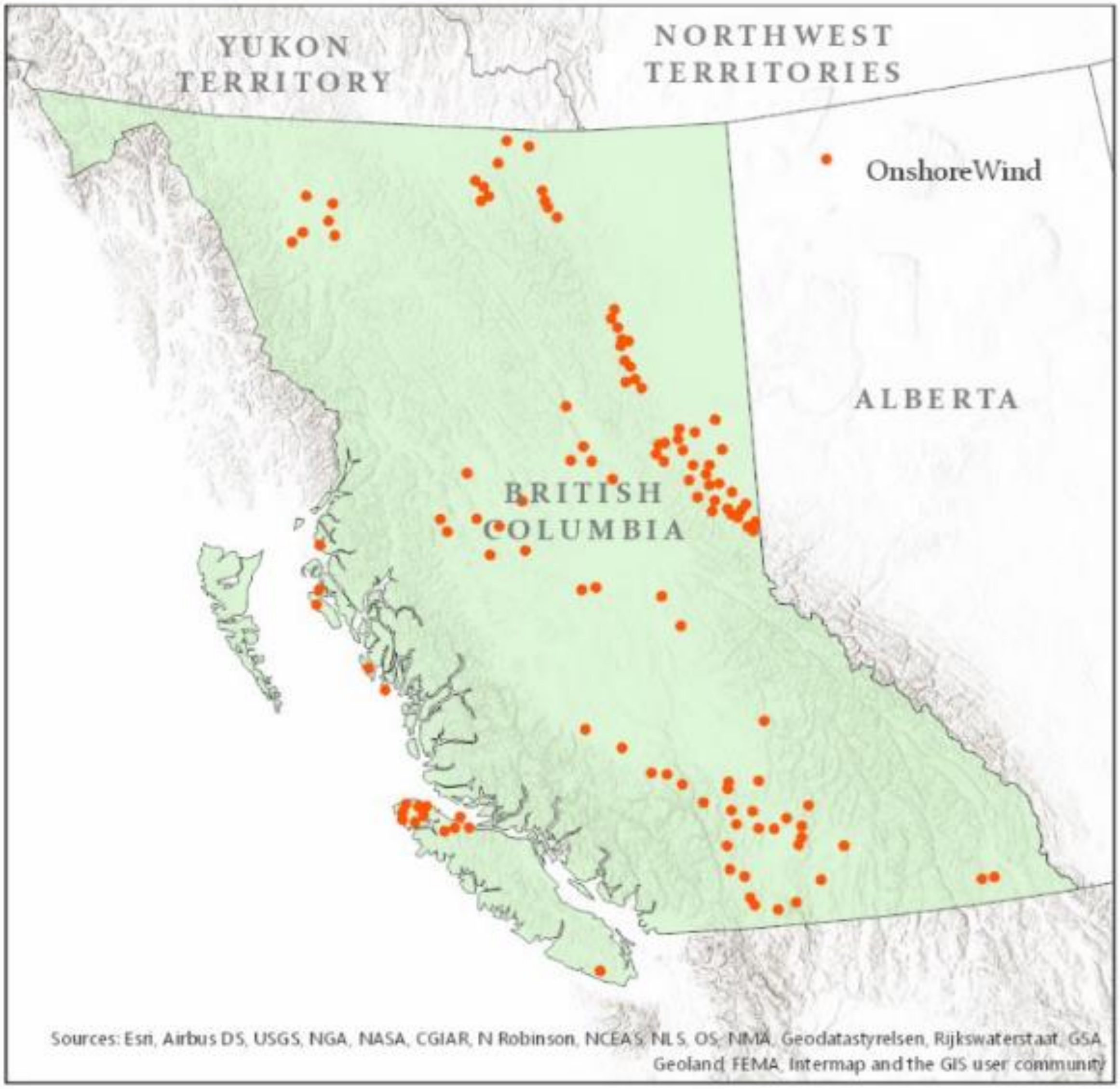
3.1 Onshore Wind Resources

Wind power refers to the conversion of kinetic energy from moving air into electricity. Modern utility-scale wind turbines are horizontal-axis machines with three rotor blades. The blades convert the linear motion of the wind into rotational energy that is then used to drive a generator. Onshore wind resources refer to wind turbines located on land, as opposed to offshore wind resources located at sea.

High-quality onshore wind resources are located throughout the province; however, many of the resource options that combine a high-quality wind resource, proximity to existing transmission infrastructure, and relatively simple terrain are in the Peace region of the province. These features lower capital costs and increase annual generation. Wind resource options in the Peace region are likely to be the lowest cost wind resources in the province.

New wind resource options are assumed to have a five-year lead time. However, a small number of wind resource options are assumed to have lead times as short as three years because they have already begun or completed preliminary wind resource evaluation and site acquisition processes.

Figure J-2 Location of On-Shore Wind Resources in B.C.

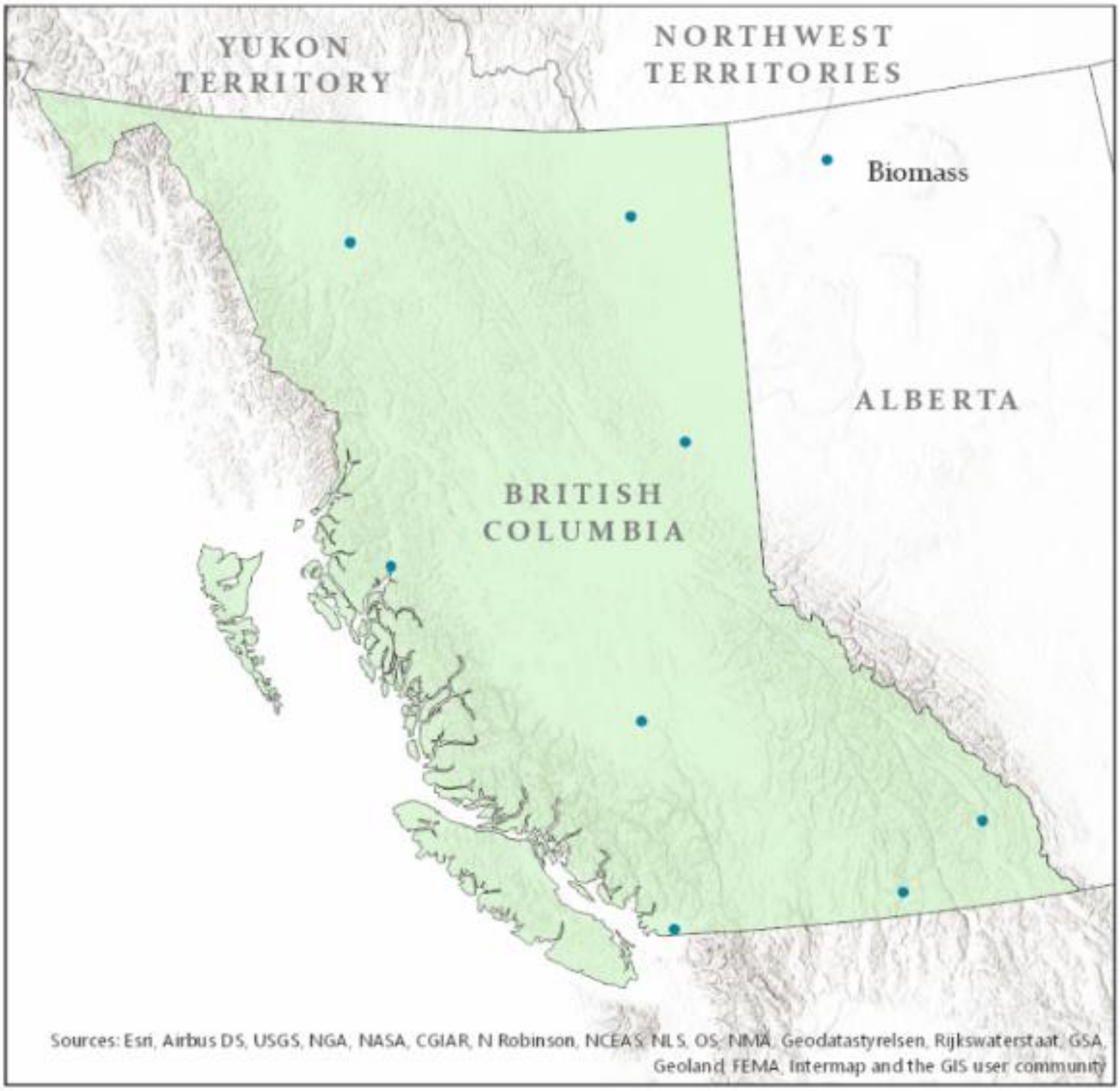


3.2 Wood-Based Biomass Resources

Wood-based biomass (**biomass**) electricity is generated from the combustion or gasification of woody organic materials – standing timber, pulp logs, roadside debris, or sawmill wood waste with the heat being used to drive a steam turbine and in turn a generator. B.C. has significant biomass resources. However, there are many competing uses for biomass from the forest industry. Our estimate of the biomass supplies that are surplus to the demands of the forest industry could support approximately 460 MW of new generation capacity over the next 20 years.[8] Within this volume of available biomass, the portion of low-cost sawmill wood waste is relatively minor and concentrated in the coastal and West Kootenay regions (sufficient to supply 32 MW of new generation capacity). The majority of the biomass resource is comprised of high-cost standing timber located in the coastal mountainous areas of the province.

[8] https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/integrated-resource-plans/current-plan/wood-based-biomass-report-201803-industrial-forestry-service.pdf

Figure J-3 Location of Wood-Based Biomass Resources in B.C.



3.3 Municipal Solid Waste Resources

Often referred to as waste-to-energy, municipal sold waste (**MSW**) resources burn energy-rich garbage, such as plastics or products made from wood, to produce electricity. Conventional incineration facilities burn the garbage to produce steam in a boiler that drive turbines. However, more advanced gasification or pyrolysis technologies are in development or early commercial stages, reducing air pollutants compared to conventional incineration technologies, or producing synthetic natural gas or liquid fuels instead of steam in a boiler.

MSW facilities depend on large local populations to reliably produce the fuel. BC Hydro identified three regions that could support a new MSW facility – Vancouver Island, Lower Mainland, and the Okanagan. Availability of fuel will depend on the waste production and waste diversion programs within the local communities.

The decision to develop new MSW facilities is not driven solely by the economics of electricity production. There are other economic factors (e.g., additional revenue streams from MSW facility operators from tipping fees or heat sales) and non-economic factors that may drive decision-making far more than the value of the electricity.

Figure J-4 Location of Municipal Solid Waste Resources in B.C.

3.4 Offshore Wind Resources

Similar to onshore wind, offshore wind resources typically use large three-bladed wind turbines to convert kinetic energy into electricity. Off-shore wind turbines tend to be taller and larger than their onshore counterparts, taking advantage of even stronger wind resources and larger swept areas. Offshore wind turbines in relatively shallow waters (less than 40 metres) are a mature technology globally, although there have been no utility-scale deployments in Canada to date. Off-shore wind turbines at even deeper water depths that use floating platform technology are at the early commercial deployment stage.

The Pacific coastal waters of B.C. have significant wind resources. Still, the lack of existing transmission infrastructure along most of the B.C. coast limits the number of economically viable sites. Further, the economies of scale in offshore wind turbine deployment and new marine transmission infrastructure demand that projects must be significantly larger than 100 MW to achieve competitive economics.

Figure J-5 Location of Offshore Wind Resources in B.C.

3.5 Geothermal Resources

Geothermal resources convert thermal energy in the steam or hot water from deep underground reservoirs into electricity in above ground turbines. The development of these resources depends on identifying hot fluids in permeable subsurface structures, drilling wells into these reservoirs, collecting the hot fluids at the surface, utilizing the heat energy in these fluids to drive a turbine, and returning the cooled fluids to the reservoir.

Conventional hydrothermal geothermal resources are a mature technology, with continuing advances in drilling and exploration techniques. Exploration for geothermal resources in B.C. began in the 1970s and focused on the Mt. Meager thermal complex. Several other sites in the province have been identified as having promise, with some undergoing recent or active resource evaluation. The other resources are smaller in size compared to the Mt. Meager resources, and some are far from existing transmission infrastructure. Resources in the sedimentary basin in the Northeast of B.C. have not been thoroughly inventoried but hold promise by virtue of their proximity to electricity consumers among the natural gas producers and processors in the region, availability of geological data from the oil and gas industry, and the potential for co-development of geothermal and natural gas resources.

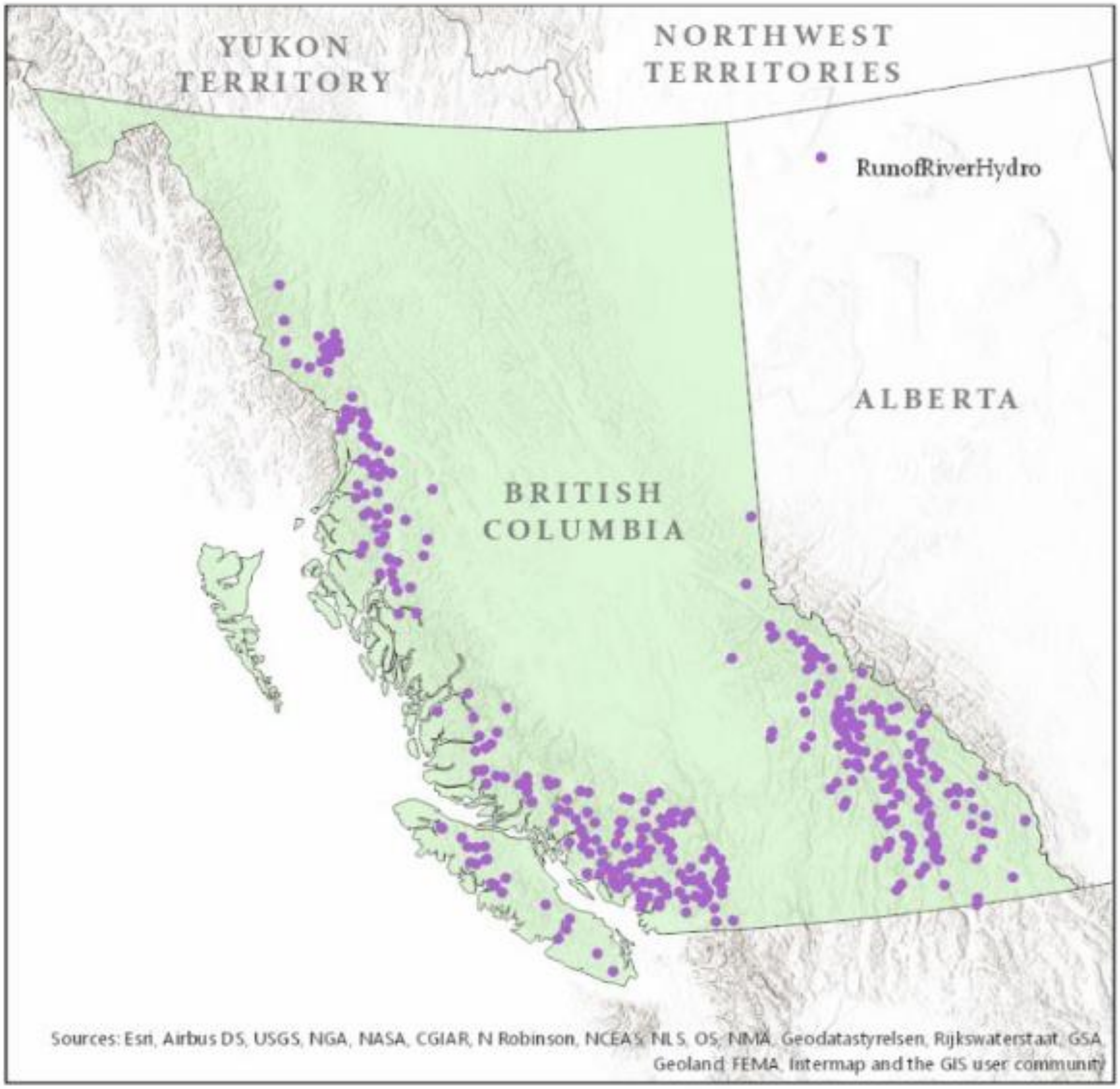
Figure Error! No text of specified style in document.**J-6 Location of Geothermal Resources in B.C.**

3.6 Run-of-River Hydro Resources

A run-of-river hydro facility diverts a portion of natural stream flows and uses the natural drop in elevation of a river to generate electricity. Run-of-river hydro projects divert only some of a river's flow for power generation and return the water to the river downstream of the powerhouse. Without any significant impoundment of water, the monthly generation profile of these facilities is directly related to the precipitation or snowmelt in the regional basin and the operation of any upstream storage hydro resources.

B.C. has a large run-of-river resource potential, with more than 7,000 individual run-of-river resource options identified in RODAT. Of the 7,000 potential sites, only 448 have a unit energy cost of less than $300/MWh, and only 11 have a unit energy cost between $85 and 100/MWh. Most of the run-of-river resource options are located in the North and South Coast regions, East Kootenay, and the areas around Revelstoke and Mica as shown in Figure J-7 below.

Figure J-7 Location of Run-of-River Hydro Resources in B.C.



3.7 Combined-Cycle Gas Turbine Resources

Combined-cycle gas turbines generate electricity in two stages. Fuel is first combusted in a turbine that generates electricity. The heat exhaust from the turbine produces steam in a boiler, which is then used to drive a steam turbine that also generates electricity. The fuel could be fossil natural gas that would contribute to green house gas emissions, or alternatively renewable natural gas that is considered a carbon-neutral fuel.

The candidate location of a combined-cycle gas turbine facility has been notionally identified in the regions near to existing transmission infrastructure at Kelly Lake. However, combined-cycle gas turbines could also be built in a number of other locations in the province at a similar overall cost.

For the purposes of RODAT, we have examined the costs of a combined-cycle gas turbine using two types of fuel:

- Using fossil natural gas, including the cost of fuel delivered to the facility and associated $50 / tonne greenhouse gas tax; and
- Using a greenhouse gas-neutral renewable natural gas (**RNG**) fuel without the greenhouse gas tax. We have assumed the renewable natural gas is contracted from a remote biogas production facility via Fortis or other renewable natural gas supplier, which is responsible for replacing the full volume of natural gas used at the combined-cycle gas turbine facility with renewable natural gas delivered to the integrated gas system. The near- and medium-term viability of a renewable natural gas-fuelled baseload resource at utility scale is low due to the large volumes of renewable natural gas that must be secured from a from a still emerging renewable natural gas supply market. The viability of this renewable natural gas-fuelled resource in the 2030 plus timeframe is uncertain and will depend on many factors, including the maturity and scale of the B.C. renewable natural gas supply market.

Figure Error! No text of specified style in document.**J-8**
Location of Combined-Cycle Gas Turbine Resources in B.C.

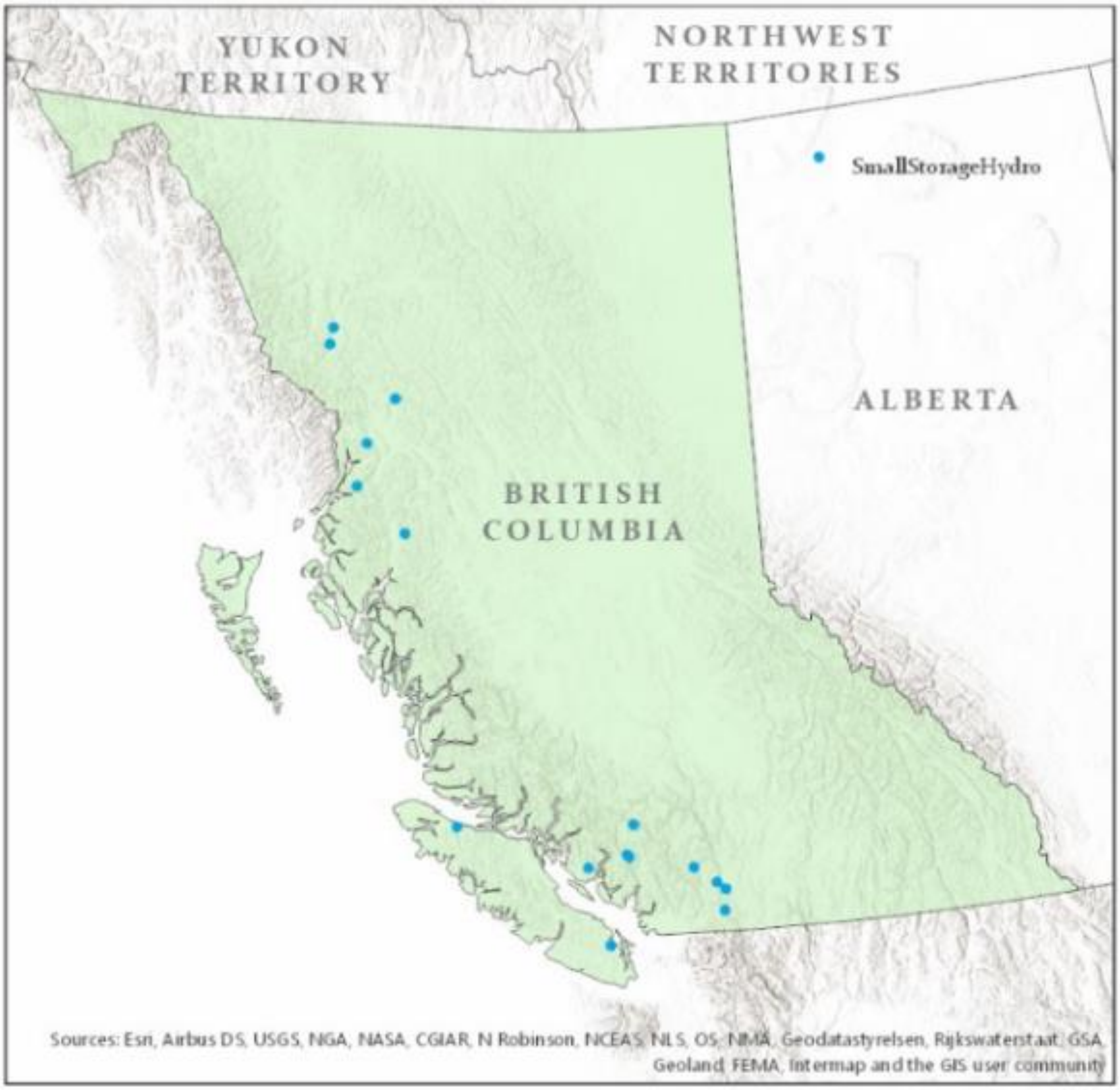
3.8 Small Storage Hydro Resources

Small Storage Hydro resources refer to hydroelectric facilities that include a dam to impound water in a reservoir. Water released from the reservoir flows through a turbine to generate electricity. The water may be stored and released to meet peak power demands or to maintain reservoir levels.

The small storage hydro inventory is based on a 2018 consultant report to identify potential small storage facilities in the 20 MW to 100 MW range in the North and South Coast regions that meet minimum size, minimum dependable winter storage capacity, and maximum capital cost.[9]

9 https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/integrated-resource-plans/current-plan/small-storage-hydro-report-20180712-knight-piesold.pdf

Figure Error! No text of specified style in document.**J-9**
Location of Small Storage Hydro Resources in B.C.



3.9 Utility-Scale Solar Resources

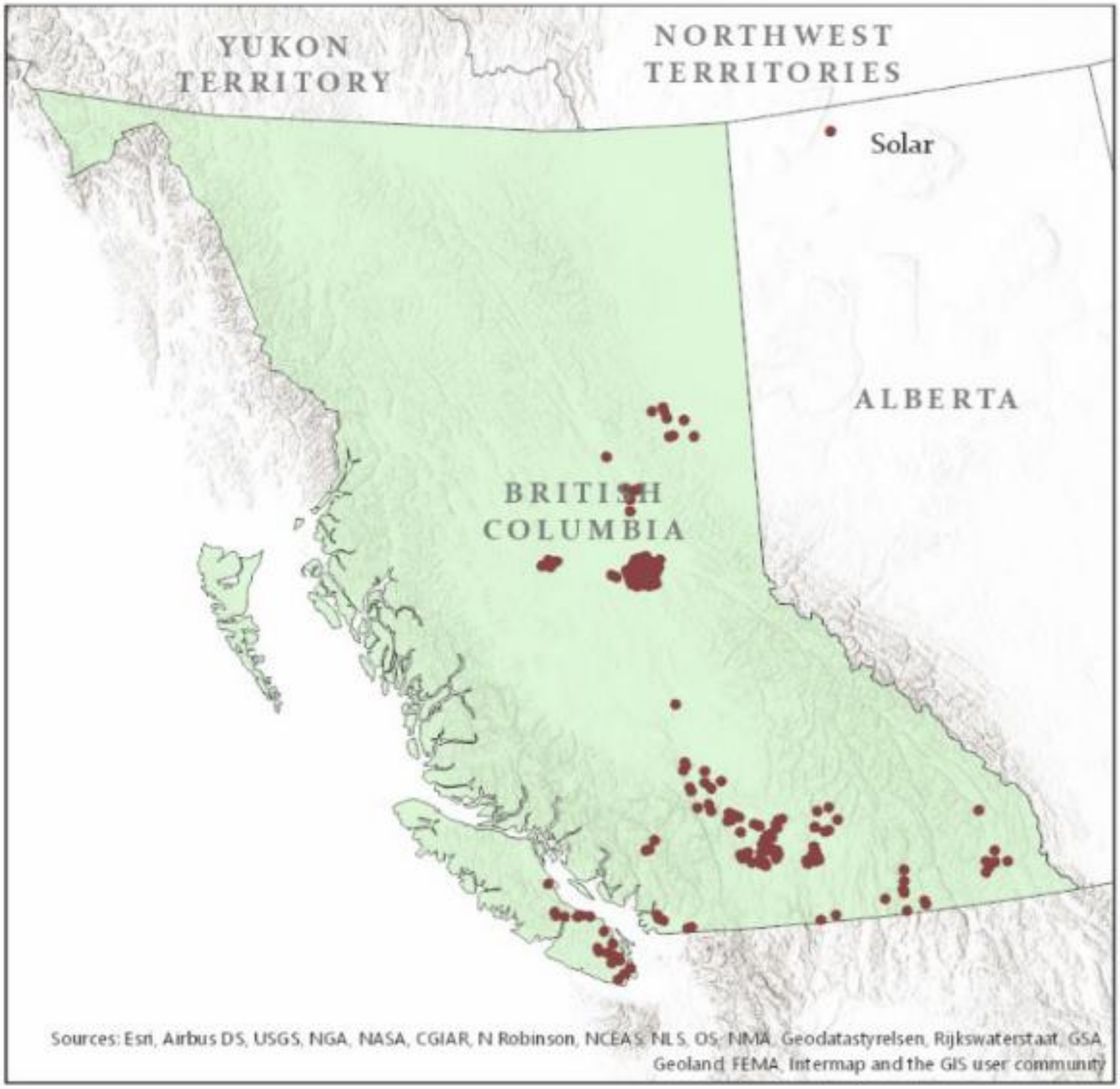
Conventional solar resources convert solar energy into electricity using photovoltaic cells. Utility-Scale solar resources refer to solar farms of at least 15 MW in AC output (but can be even more than 1,000 MW) that is connected at transmission voltage to the BC Hydro system.

Although B.C. is not nearly as famous for its sunshine as it is for its precipitation, the solar resource in B.C. is comparable to regions like Germany or Japan that have been world leaders in solar deployments. Areas in southeast B.C. have the best solar resources in the province.

The quality of solar resources is one of several important factors in developing an inventory of solar resource options. Solar power systems require a significant land area that is reasonably flat and close to existing transmission infrastructure. BC Hydro has used a Geographic Information Systems (**GIS**) approach to identify suitable sites for solar development, creating an inventory of 191 discrete resource options.

The UEC from these resources depends primarily on three factors – the quality of the solar resource, the distance from existing transmission infrastructure, and the capital cost per MW, which is itself dependent on the size of the solar farm. Although the southeast of B.C. has the best solar resources, the Central Interior and Kelly-Nicola region have the lowest cost solar resource options because of the larger project sizes and proximity to transmission. The UEC from even the best sites identified in B.C. is higher that the publicly cited costs of solar facilities in places like California due to the differences in solar resource, the impact of capital or operating subsidies available in some jurisdictions, and the relatively long distances to transmission infrastructure for many of the sites so far identified in B.C.

Figure J-10 Location of Utility Scale Solar Resources in B.C.



3.10 Community-Scale Solar Resources

Community-scale solar resources consist of a small number of solar arrays producing between 1 MW to 15 MW of power, located within urban areas and connected to local distribution systems.

A GIS-based approach similar to the one described in section 3.9 identified 127 potential sites for community-scale solar development. Because these small resources are assumed to connect to existing distribution systems, an additional screen of carrying capacity on the local distribution system was applied, resulting in 58 viable options. These options are found in communities around the province.

Figure J-11 Location of Community-Scale Solar Resources in B.C.

4 Supply-Side Resources – Capacity

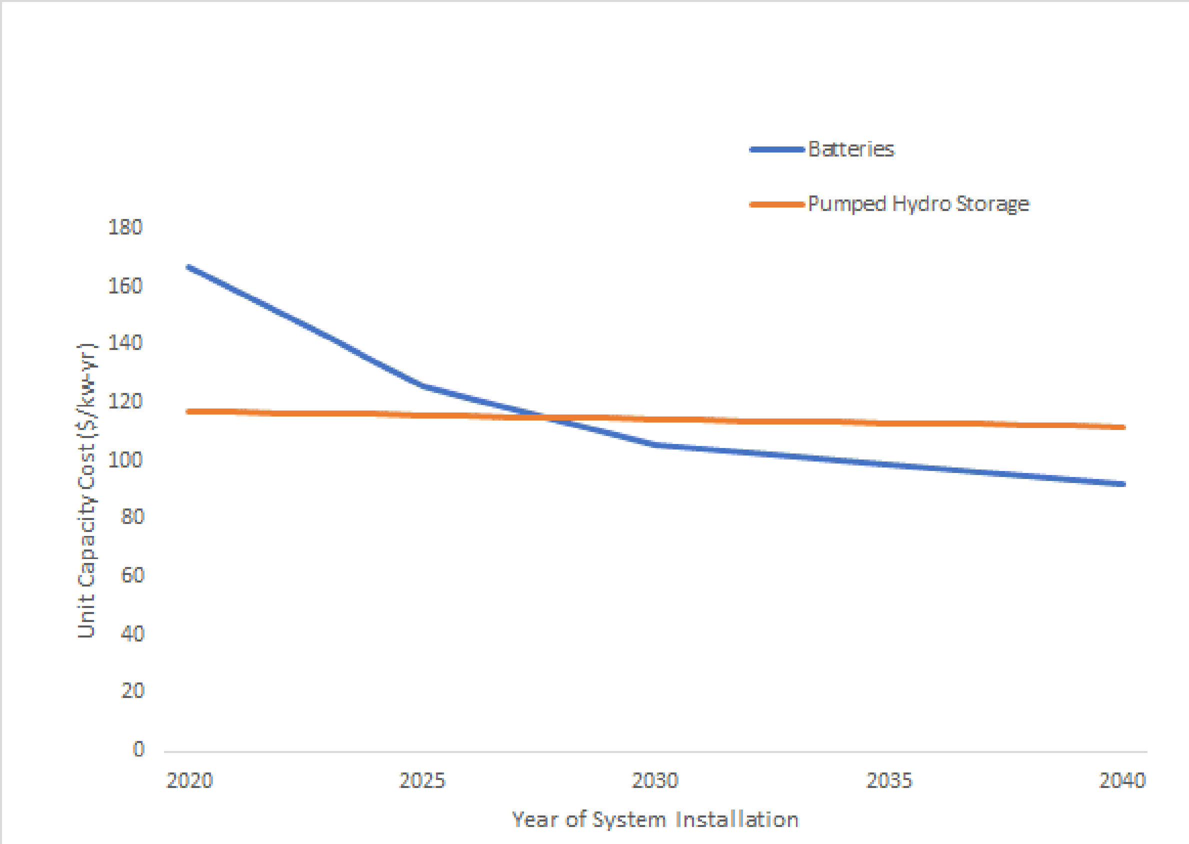
Supply-side capacity resources refer to new greenfield generation resources that can be relied upon to provide power during winter peak periods. These resources can offer either dependable generation capacity or support the grid through their effective load carrying capability. These resources do not generate substantial energy outside the winter system peak periods and are available for dispatch in response to system peak events.

There is a more than 150 GW of potential pumped hydro storage capacity, with the lowest cost pumped hydro storage resources providing capacity at approximately $80 / kW-yr.[10] Single-cycle gas turbines have a low cost of capacity, but they are not considered clean resources when fuelled with fossil natural gas.

Over a 10-year timeframe, battery storage costs are projected to have declined such that they are competitive with the lowest cost pumped hydro storage facilities, as shown in Figure J-12. Battery storage also has a number of technical advantages over pumped hydro storage as a resource: shorter lead times, smaller modular size, and higher energy efficiency. However, both batteries and pumped hydro storage have limitations as capacity resources due to their maximum of four- to six-hours of peak generation output respectively before they must recharge. Their value as a capacity resource declines as the system peak period extends longer than four- to six-hours. Still, in general, batteries present a less costly and more flexible clean capacity resource in the medium- and long-term.

[10] The approximately $80/kW-yr cost is from the lowest cost pumped hydro storage facility, which is a 1,000 MW facility near Stave Falls. The lowest cost pumped hydro storage facility at the 500 MW scale is $120/kW-yr.

Figure J-12 Batteries Versus Pumped Hydro Storage Costs Over Time

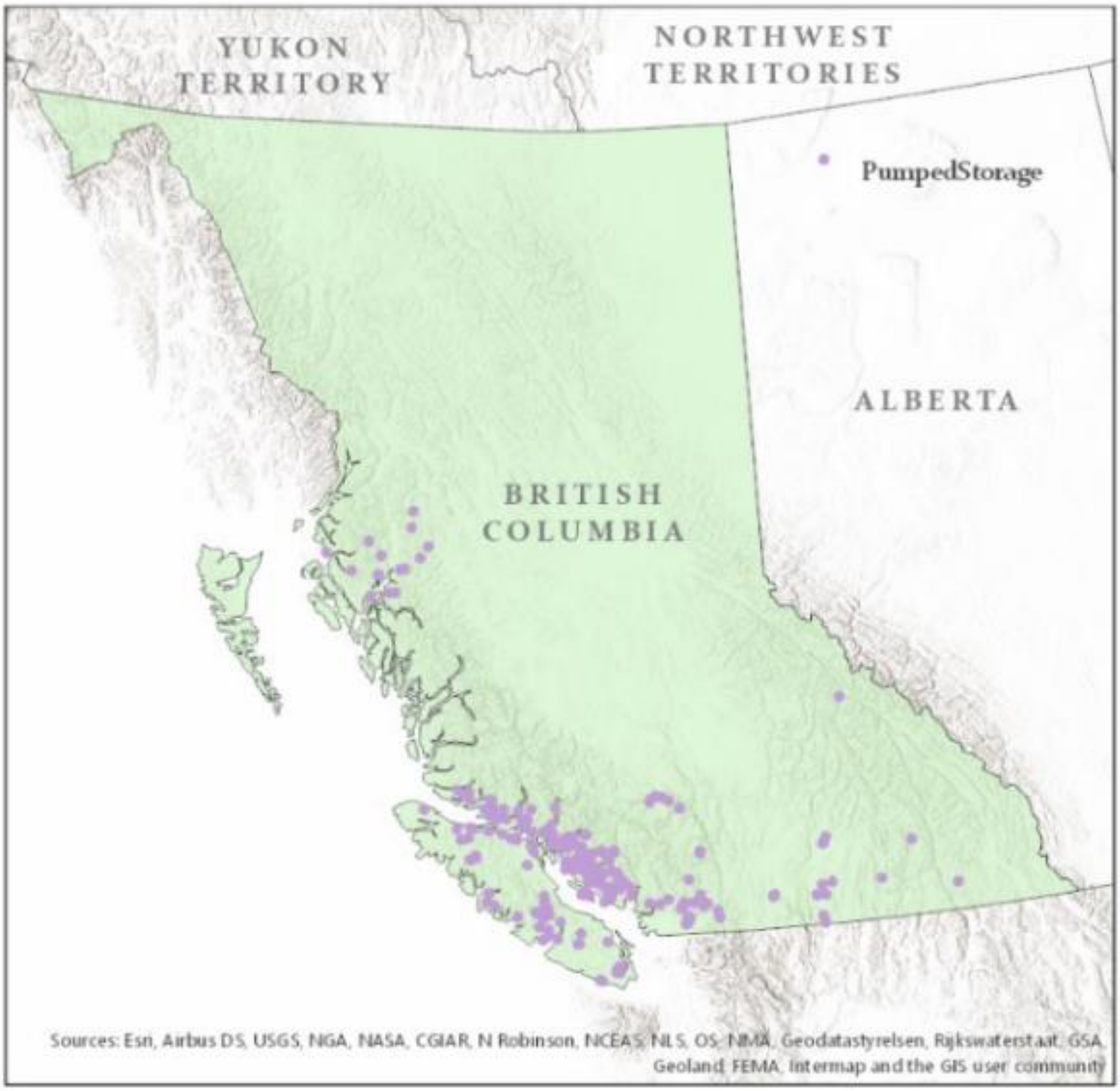


4.1 Pumped Hydro Storage Resources

The concept of pumped hydro storage is similar to conventional large storage hydro, where water stored in an upper reservoir can flow through a turbine to generate power. However, a unique aspect of pumped hydro storage is that operators can reverse the flow of water through the turbine, pumping water from a lower reservoir back to the upper reservoir. Though the cycle is a net-consumer of energy with a ~75 per cent round trip efficiency, the pumping process typically occurs during off-peak periods to make generation available during daily winter peak periods. Pumped hydro storage can take advantage of existing lakes or river systems in an “open loop” configuration, or both reservoirs can be artificial in a “closed loop” configuration. Pumped hydro storage most commonly uses freshwater, although use of the ocean or abandoned mines for the lower reservoir are at the concept or demonstration stage around the world.

In general, there is an abundance of technically viable sites in the South Coast region due to the many small lakes and existing reservoirs with a steep surrounding topography. However, two issues with pumped hydro storage are the long lead times (six to nine years) and the economies of scale in construction such that facilities less than 500 MW is size are very expensive, which means pumped hydro storage resources must be developed in large blocks of capacity.

Figure J-13 Location of Pumped Hydro Storage Resources in B.C.



4.2 Single-Cycle Gas Turbine Resources

Single-cycle gas turbine resources, similar to combined-cycle gas turbine resources described in section 3.7, use either fossil natural gas or renewable natural gas to drive a turbine.

The candidate location of a single-cycle gas turbine facility has been notionally identified in the regions near to existing transmission infrastructure at Kelly Lake. However, single-cycle gas turbines could also be built in a number of other locations in the province at a similar overall cost.

Single-cycle gas turbine facilities have lower capital costs than combined-cycle gas turbines but are far less efficient and are typically used only as-needed to provide dependable capacity during times of peak demand. Even though a potential renewable natural gas-fuelled single-cycle gas turbine facility would consume much less fuel than a combined-cycle gas turbine facility operating as a baseload resource, the near- and medium-term viability of a renewable natural gas-fuelled single-cycle gas turbine at utility scale is low due to the large volumes of renewable natural gas that must be secured from a from a still emerging renewable natural gas supply market. The viability of this renewable natural gas-fuelled resource in the 2030 plus timeframe is uncertain and will depend on many factors, including the maturity and scale of the B.C. renewable natural gas supply market.

Figure J-14 Location of Single-Cycle Gas Turbine Resources in B.C.

4.3 Utility-Scale Battery Resources

Utility-scale battery resources refer to large battery energy storage systems connected at transmission voltage to provide peak capacity. Batteries are a form of rechargeable chemical energy storage that can store off-peak electricity for use during peak periods. A number of different battery chemistries exist, however, lithium-ion batteries are currently the dominant chemistry for utility-scale battery resources. As such, only the lithium-ion chemistry of batteries are included in RODAT.

Lithium-ion battery energy storage systems are modular and can be located within the fence or proximal to existing transmission substations. Battery resources can also be developed in concert with intermittent renewable resources such as large wind or solar projects, where they can share some common infrastructure and find cost savings. A non-exhaustive list of potential sites in the South Coast and the Kelly-Nicola region has been identified.

Battery energy storage systems designed for system capacity commonly have a 4:1 ratio of stored energy to inverter capacity. For example, a battery system with a 100 MW inverter capacity will have a maximum of 400 MWh of energy storage capability and can discharge for up to four hours at peak capacity before requiring at least four hours to recharge. RODAT assumes all utility-scale battery resources have a four-hour duration.

Figure Error! No text of specified style in document.**J-15**
Location of Battery Resources in B.C.

4.4 Distributed-Scale Battery Resources

Due to the modular and scalable nature of lithium-ion battery systems, a relatively small number of battery modules that are otherwise identical to larger utility-scale systems can be deployed within the fence or proximal to existing distribution substations and connected at distribution voltage. Although these systems sacrifice some economies of scale, they can generate additional utility value if deployed to benefit the distribution system either by augmenting local reliability or deferring investments in distribution infrastructure.

Distributed battery resources are assumed to be located within the fence of the existing distribution infrastructure to minimize permitting and interconnection costs. A high-level review of BC Hydro distribution stations indicated a limited amount of available space in almost every planning region to accommodate up to five battery systems in each region of up to 10 MW. The total potential for distributed battery resources in B.C. is 250 MW if limited to sites within the fence of existing distribution infrastructure.