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Energy Storage, Definition and Ownership Between Alberta and Texas

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Alberta has the least regulated electricity market in Canada (see generally Natural Resources Canada, "About Electricity"). The Alberta market is an energy-only market where electricity generators are paid solely based on the amount of electricity they produce. In 2020, wind and solar power accounted for 11% and 1% of the installed electricity generation capacity in Alberta, respectively (AESO 2020 Annual Market Statistics at 13).

At the same time, the Alberta Utilities Commission (AUC) acknowledges how energy storage could potentially disrupt the wholesale energy market (Distribution System Inquiry: Final Report, at para 225). Gird-scale energy storage may be able to mitigate the intermittency of wind and solar power. However, as Eeles et al note, it is uncertain where energy storage stands in Alberta's utilities legal framework (David Eeles et al, "Energy Storage: The Regulatory Landscape in Alberta" (2021) [unpublished, archived at Norton Rose Fulbright Canada LLP]). This blog post summarizes the four main types of energy storage and discuss uncertainties around the definition and ownership rules of energy storage in Alberta and Texas. Both the Alberta and Texas electricity markets are energy-only markets as opposed to capacity markets. Electricity producers are solely paid base on how much electricity they generate. In capacity market jurisdictions, electricity producers have a second revenue stream based on how much of their production capacity is made available to the grid, regardless of whether the whole capacity is utilized or not.

Energy Storage Technologies

The Alberta Electric System Operator (AESO) is Alberta's independent system operator (ISO) responsible for the management and operation of the power grid. AESO's 2019 Energy Storage Roadmap (the Roadmap) defines energy storage in a technologically agnostic manner: "Energy Storage is any technology or process that is capable of using electricity as an input, storing the energy for a period of time and then discharging electricity as an output" (at 6).

Battery Energy Storage Systems (BES)

BES is flexible as to where it can be installed. Batteries can come in very small sizes making BES a suitable technology for retail and home-installed energy storage systems such as the TESLA "Powerwall". Among the different battery types, lithium-ion batteries dominate the electric vehicle market as well as the gird-scale market (see the National Renewable Energy Laboratory and the International Energy Agency for more details). Child labour among other human rights abuses threatens the future of lithium mining. With the growth of wind and solar electricity generation, BES will only grow in importance. Alberta, in particular, is perfectly positioned to be a global source of ethical lithium, notwithstanding the legal risks associated with local lithium extraction.

Compressed Air Energy Storage Systems (CAES)

Energy can be stored by compressing and refrigerating air, which is later heated and released to discharge the stored energy. This podcast explains how CAES works. The mechanical technology used in CAES is similar to technologies used in the production of oxygen for medical purposes. CAES also utilizes many skills and components that are readily available in the oil and gas industry. CAES has lower efficiency than BES, 50-70% compared to 80-90%, respectively. However, CAES does not degrade like batteries. CAES projects typically have a service life of 30-40 years, which is considerably longer than what is expected from BES. CAES pipes are mostly made of stainless steel, which can be recycled and sourced locally. There are no emissions, no water consumption, no recycling challenges, fire hazards or mining concerns, making CAES a cost-efficient solution for storage durations longer than 6 hours, perfectly suited for inter-day peak hour price arbitrage. To be commercially viable, the size of CAES projects needs to be at least 20MW. The attractiveness of CAES technologies lies in the easy scalability and availability of components. Unlike BES, CAES can store energy for longer periods without needing a larger footprint. Eeles et al note that Alberta's geology is favourable to CAES. CAES can use existing salt caverns to store the compressed air as well as utilize existing oil and gas equipment. For example, the ATCO Heartland Energy Centre in Strathcona County stores natural gas liquids and hydrocarbon products in salt caverns.

Pumped Hydro Storage Systems (PHS)

Electric energy can be stored by pumping water to a higher elevation, converting the electric energy to kinetic energy in the water. Energy can be discharged by releasing the water to power turbines. To be commercially viable, PHS requires the creation of water reservoirs and a minimum altitude difference between the two water levels of 300 meters (Eeles et al). PHS is more suited to long-term storage and is the most prevalent form of energy storage worldwide by capacity. PHS is especially attractive when it benefits from existing hydro infrastructure, such as dams in Quebec. PHS requires a large geographic footprint, restricting where it can be installed. Alberta's mountainous geography is ideal for PHS, but development of new large hydroelectric projects faces environmental and social risks and would invariably require consultation with Indigenous groups. Alberta could stand to benefit from British Columbia's existing hydro infrastructure if interties are developed between the two electric grids (Eeles et al).

Hydrogen as Energy Storage

Natural Resources Canada (NRCan) views hydrogen as the best energy storage option for grids with a high dependency on wind and solar generation. When wind and solar generation produces energy during undesirable times, the excess energy can be used to electrolyze water and produce green hydrogen. Hydrogen can then be used as a versatile fuel source for electricity generation, transportation as well as heating. Hydrogen can be transported to heat buildings using existing natural gas pipeline infrastructure by blending hydrogen with natural gas. However, this method creates its own technical and legal challenges. Hydrogen can be stored for long periods to take advantage of price arbitrage. There are multiple hydrogen storage methods, including long-term storage in existing salt caverns which can be repurposed for hydrogen storage. NRCan uses Prince Edward Island as a Canadian example. Wind accounts for 98% of power generation in PEI. Hydrogen can potentially replace importing dispatchable power from neighbouring New Brunswick, thus helping PEI's grid be more independent. Using green hydrogen as a form of energy storage produces no greenhouse gas emissions and provides a versatile fuel that can be used for multiple purposes.

Energy Storage Future in Alberta

AESO Energy Storage Roadmap

The Roadmap sets out AESO's plan to integrate energy storage technologies into the electricity grid and market. Three main points in the Roadmap stand out. First, AESO acknowledges that energy storage is *sui generis*. It is neither a load nor a generator. The Roadmap envisions a future where standalone energy storage facilities are connected to the grid, and hybrid energy storage technologies are attached to wind, sold, natural gas and industrial generators. Energy storage will also be attached to transmission and distribution networks as well as solar generation in industrial, commercial and residential load. The Roadmap also includes grid-connected energy storage technologies attached to electric vehicle charging stations.

Second, AESO's approach towards energy storage is technologically agnostic. The market will decide which energy storage technologies are developed. We can therefore expect to see a mix of storage technologies, batteries for short-term storage and pumped air and pumped hydro for longer duration storage.

Third, AESO will be impartial to configuration and point of connection. This means that AESO may accept energy storage technologies installed behind and in front of the meter.

AESO 2021 Long-Term Outlook (LTO)

Should we expect an increase in energy storage installed capacity in Alberta? In short, yes. In June 2021, AESO released the 2021 Long-term Outlook (LTO). The LTO is a twenty-year forecast of Alberta's load and generation requirements. AESO expects load growth over the next 20 years to be moderate, and on average slower than the previous 20 years. The exception is a period of faster load growth as Alberta's economy recovers from COVID-19.

The Alberta government announced in 2015 its plan to phase out coal-fired power plants by 2030, and Alberta is already on track to reach this goal earlier than the deadline (see Global News). The LTO expects that most of the coal generation capacity will be replaced by natural gas and provides 4 different scenarios. The Reference Case reflects current technology, policy and regulatory environments and acts as "the main corporate forecast" (at 3). It only considers the currently legislated carbon price of $50/ton by 2022. On the other hand, the Clean-Tech scenario assumes faster cost reductions in renewables, faster decarbonization of the economy and wider adoption of corporate PPAs. It also assumes a $170/ton carbon price as announced by the federal government, despite it not being legislated yet. The last two scenarios describe aggressive and stagnant growth of Alberta's energy sector.

Energy storage plays an important role in both the Reference Case and Clean-Tech scenarios. The Clean-Tech scenario forecasts larger installed capacity for wind and solar generation with more energy storage to remedy the intermittent nature of wind and solar generation. By 2041, energy storage capacity is forecasted to be 150 MW in the Reference Case. The Clean-Tech scenario forecasts more than 10x the Reference Case at 1,520 MW by 204,1 including 75 MW of PHS. The forecasted capacity in both scenarios are lump sums that include all types of energy storage technologies and purposes. Despite the Roadmap pointing out that energy storage is *sui generis*, the LTO does not treat energy storage as a unique class of asset. Energy storage capacity is calculated as part of generation capacity. In short, AESO expects an increase in energy storage installed capacity over the next 10 years. This growth is closely tied to how fast wind and solar electricity generation expands.

ERCOT

The contiguous United States is covered by three power networks; the Western Interconnect, the Eastern Interconnect and the Texas Interconnect (see the EPA here). The Electric Reliability Council of Texas (ERCOT) covers most of Texas. ERCOT is also the name of the grid's ISO. Wholesale electricity markets in Texas and Alberta are both deregulated energy-only markets. However, Texas has a Day-Ahead futures market where market participants can enter bids for the next day's ancillary services and energy markets. The Public Utilities Commission of Texas (PUCT) is governed by the Texas Utilities Code, UTIL tit 2 (1997) (the *Code*). Under Title 2, § 14.001 of the *Code*, developers of power generation and energy storage facilities must first seek administrative approval from the PUCT, similar to the Alberta Utilities Commission (AUC). ERCOT's procedures and processes are compiled in ERCOT's Nodal Protocols. ERCOT created a Battery Energy Storage Task Force (BESTF) to advise its Technical Advisory Committee (TAC) on the future of battery energy storage. BESTF submits recommendations that are subject to TAC's approval. There are no similar task forces for other types of energy storage such as compressed air or pumped hydro.

Defining Energy Storage

AESO's above-mentioned working definition of energy storage is technologically agnostic. The Roadmap emphasizes the need for energy storage facilities to be a class of their own. However, so far, they have received AUC approvals as power plants and distribution systems. The AUC relies on its public interest mandate to approve energy storage projects in Alberta because energy storage does not fit in either the power plant or the load boxes (Eeles et al at 28). For example, the AUC was satisfied that eReserve1 met the definition of a power plant under the Hydro and Electric Energy Act, RSA 2000, c H-16 despite the fact that energy storage does not *produce* energy; it merely stores it (Eeles et al at 29 citing *TERIC Power Ltd.*, 25205-D01-2020, AUC).

In Texas, section 35.152(a) of the *Code* states that "Electric energy storage equipment or facilities that are intended to be used to sell energy or ancillary services at wholesale are generation assets." Owners of electric energy storage equipment must register with the PUCT *as a power generation* *company* under section 39.351(a) of the *Code*. The PUCT, therefore, does not have AUC's public interest discretion in approving energy storage projects as power plants or as distribution assets. ERCOT, however, has more detailed definitions than the *Code*.

ERCOT defines an Energy Storage System (ESS) as "a facility, process, or device(s) that receives electric energy and stores it, in any form, for the purpose of later releasing electrical energy" (at 29). This catch-all definition is similar to AESO's working definition of energy storage. It defines an energy storage system based on its ability to consume, store and discharge electricity while being technologically agnostic to the mode of storage. Under ERCOT's protocols, a resource could be an Energy Storage Resource (ESR), a Generation Resource or a Load Resource. This is where ERCOT's definitions go one step further than AESO's. An ESR is "an Energy Storage System (ESS) registered with ERCOT for the purpose of providing energy and/or Ancillary Service to the ERCOT System" (at 76). ERCOT's protocol goes further to define two special categories of ESRs to distinguish between stand-alone energy storage and hybrid facilities where energy storage is combined with wind or solar generation. A DC-Coupled Resource is attached to wind or solar generation and is "interconnected at the same point of interconnection" (at 76). A DC-Coupled Resource and its wind or solar generation resource are connected to the grid as one resource.

A Distribution Energy Storage Resource (DESR) is "an Energy Storage Resource (ESR) connected to the Distribution System that is either: (1) Greater than ten MW and not registered with the Public Utility Commission of Texas (PUCT) as a self-generator; or (2) Greater than one MW that chooses to register as a Resource with ERCOT to participate in the ERCOT markets" (at 77). DESRs include stand-alone storage systems that are not part and parcel of a generation resource.

ERCOT's definitions of generation, load and energy resources are based on how ERCOT registers the resource. A Generation Resource is "a generator capable of providing energy or Ancillary Service to the ERCOT System and is registered with ERCOT as a Generation Resource" (at 77). A Load Resource is "a Load capable of providing Ancillary Service to the ERCOT System and/or energy in the form of Demand response and registered with ERCOT as a Load Resource" (at 78). This approach creates three mutually exclusive buckets since resources can only be registered as one of three types.

Ownership of Energy Storage

Eeles et al note that "electric distribution system" and "transmission facility" are defined in the Electric Utilities Act, SA 2003, c E-5.1 by excluding a generating unit (Eeles et al at 35). Distribution and transmission utilities are not allowed to own a power plant. If energy storage is classified as a generation unit, then distribution and transmission utilities are not allowed to own energy storage facilities. The uncertainty comes from AUCs approval of energy storage facilities as both generation and distribution assets.

In Texas, on the other hand, § 35.152(a) and (b) of the *Code* define energy storage equipment as generation assets and requires the owner of such equipment to be registered as a power generation. A power generation company must not own a transmission and distribution facility (§ 31.002(10)). A transmission and distribution utility is also banned from participating in the wholesale market except to buy electricity for its own needs (§ 39.105). These requirements prohibit transmission and distribution utilities from owning energy storage equipment as they would be required to register as a power generation company, which they are not. One exception was created in 2019. Under § 35.152(d), municipally-owned utilities and electric cooperatives can own and operate energy storage equipment or facilities without the need to register as a power generation company. This amendment opens the door for energy storage facilities to provide grid reliability services. Soon after this amendment, the first cooperative-owned battery storage project was launched.

Texas Senate Bill 415 came into effect September 1, 2021 amending § 35 of the *Code*. Section 35 now also applies to electric energy storage equipment or facilities that provide reliability services to distribution customers. Transmission and distribution utilities are still be prohibited from owning energy storage facilities, but they can contract with a power generation company to provide reliability services via an energy storage facility. If a transmission utility, for example, finds that energy storage is a cheaper alternative to building a new transmission line in a situation similar to Waterton, AB, it may contract with a power generation company to build such energy storage facility on its behalf. Section 35.153(d) of the *Code* stipulates a condition that energy storage must be "more cost-effective than construction or modification of traditional distribution facilities."

Recommendations

The Alberta legal framework of energy storage needs more clarity. The working definition of energy storage is not sufficient. Energy storage needs to be defined as a unique class of assets that is neither load nor a power plant. Any modifications to the definition of energy storage in Alberta need to remain technologically agnostic and let the market decide what technologies are efficient, financeable and profit-maximizing.

Alberta needs some clarity on who is allowed to own energy storage projects. Texas is an example of a working solution. Legislative clarity and certainty are essential to growing the energy storage industry. The future Alberta laws need not follow the exact same footsteps as Texas. But the common thread is that this is a job best suited for the state or provincial legislative body and not the respective utilities commissions. Eeles et al note that AESO prefers the Texas approach where distribution and transmission utilities procure reliability services from de-regulated market generators.

Energy storage is not only here to stay but will expand in Alberta in the next 10 years as forecasted by AESO's LTO. To make sure Alberta reaps the benefits of this new industry, the above legal issues, among others, must be addressed. There are lessons to be learned from Texas. Coordination between the legislator and industry is crucial to the development of the energy storage industry.

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