A PERSPECTIVE ON CANADA'S ELECTRICITY INDUSTRY IN 2030

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The costs of solar and wind power, as well as that of energy storage, have been coming down at double-digit rates per year for many years. Every year. Double-digit percentages. Again. It continues. Tirelessly. No end in sight. Capitalism and innovation at their best. No government regulation nor corporate ego will stop it. It will happen, driven by China's efforts if nothing else. And it'll reshape — no, it's reshaping — the electricity industry in Canada and around the world.

Before 2030, wind and solar power and energy storage will have become so inexpensive that they will have upended the traditional economics of the electricity industry. Some factors will also tint how stakeholders react to the energy transition, including climate change, increased dependence on reliable electricity, and physical and cybersecurity threats. Each of these factors helps define how utilities, customers, regulators, policy makers and product and service vendors react to or take advantage of the transition, sometimes to accelerate change, sometimes by attempting to slow it down.

Based on how the electricity industry is evolving elsewhere in the world and how other industries went through similar transformations, can we think through this transformation and apprehend its logical conclusions? We believe so. However, if broad conclusions can be drawn, we always need to be mindful that local specificities in resource availability, cost structure, stranded assets, and ownership will mean that the 2030 game will not exactly be the same in every province.

WHAT WILL THE GRID LOOK LIKE IN 2030?

Wind and solar power are not only becoming increasingly cost effective, but they are doing so at a much smaller size than traditional generation. By 2030, many customers will have solar panels on rooftops or small wind turbines in backyards, even in absence of incentives or net metering, taking all the "free electrons" they can and wasting what they won't use or sell. If wasting electricity seems heresy, think about the iPhone in your pocket: it has more computing power than a supercomputer of a generation ago, and yet it's idling most of the time, its vast computing power wasted. Still, the iPhone has transformed how we access information and communicate with others. Similarly, inexpensive renewables will transform our relationship to electricity – it'll become far more personal.

By adding storage, customers can arbitrage time-of-day rates or peak demand charges, shifting consumption at other times to reduce costs. Having local generation and storage also turns a customer site into a microgrid or a nanogrid able to maintain power during grid disturbances or outages, maintaining production for businesses and food stuff cold for consumers. Smart communities and campuses will also become microgrids regrouping multiple customers and utility-scale resources for better resiliency, efficiency and control.

Even with this abundance of distributed generation, grid defection will be the exception, as most customers will keep the utility connection as an insurance policy. However, while the low energy intensity of solar make it impractical to generate all the energy needed in urban areas, natural gas and fuel cells could become an alternative to the electricity grid if the costs come down sufficiently.

Given how low-cost renewables and storage are advancing, by 2030, but likely before, the traditional, centralized grid

will have been transformed into a transactional grid of microgrids, with customer-owned distributed energy resources controlled by an array of energy service vendors. This will have repercussions across the industry, transforming customer relationships, competition, energy markets, regulation, grid architecture, and utility operations.

TRANSFORMED CUSTOMER RELATIONSHIPS

First and foremost, reshaping the electricity industry will transform the relationships between customers and energy service providers. Customers will want choice, get together in communities, share energy assets and expect utilities to perform.

To succeed, utilities will need to learn from the lessons of other industries that went through deregulation and the introduction of competition, such as airlines and telephone companies. Twenty years ago, an Angus-Reid survey put Bell Canada #2 among most admired corporations in Canada. In 2017, Bell Canada ranked #291 in a University of Victoria's brand trust survey. People love their Apple or Samsung phones, are addicted to Facebook to stay in touch with friends, and turn to Microsoft Skype to see remote family members, but they now mostly hate their phone company.

This may be starting to happen with utilities: many real estate developers, commercial businesses and power producers are already complaining about the rigidity of utilities. In 2030, there will be even more potential friction points with utilities. To succeed, utilities will have to be seen as leading the change, not opposing it like phone companies did, while showing what they actually do for customers. Utilities will also have to reset their perceptions of customers' wants, as customers are redefining what quality is for electrical services. Finally, utilities will need to partner with local community leaders.

RETAIL UNBUNDLING AND COMPETITION

Well before 2030, customer-owned and developer-owned distributed energy resources will have pressured policy makers and regulators to unbundle energy retail from the wire business, as it's already the case in Alberta.

Unbundling and the ensuing retail competition will remove barriers for customers owning generation and controllable load, or their agents, to sell energy and services on open markets through the grid, along with pure-play distributed resource operators. Energy, in kWh or MWh, will get cheap.

Unbundling will expose the capacity-driven cost of the grid, which will have to be regulated separately in its own way. Power, in kW or MW, will be very valuable.

Unbundling will also allow utilities to concentrate on the regulated wire business. In some jurisdictions, utilities' unregulated subsidiaries may compete in retail as well. The latter is a clear growth opportunity for utilities, not limited to traditional territories. Another opportunity is for utilities and third parties to offer retail or wholesale recharge services for electrical vehicles, both battery electrical vehicles and fuel cell ones. Displacing gas stations with EV stations will be a welcome development to offset further reduction in electricity consumption in Canada.

Overall, this view is similar to long-distance telephone service unbundling in the 1990s. With competition forcing energy suppliers to keep price low, energy price regulation will be lightened, just like telephone regulations are much lighter now than they were 25 years ago. Deregulation also enabled new content providers like Google and Facebook to enter the market, often with free content services in exchange for information.

RENEWED ENERGY MARKETS

The emerging energy service providers will cater to customers, distributed generators and microgrid owners, removing complexity, providing financing and turning energy into commodity services for energy users and grid operators. In the end, customers will have gained more choices in what energy they sell, what they buy, and how they use it, but paying less than they would otherwise, with sophisticated demand response programs helping to balance the grid. This is already happening in Europe, where retail supply services are one of the most profitable segments of the industry – far more profitable than non-contracted generation.

Today's energy markets and their supporting technologies were not designed for a large number of players distributed across the grid with varying capabilities – in fact, retail

energy markets are currently non-existent in most provinces. Energy markets will evolve to improve the way electricity is priced, scheduled and procured in order to ensure balancing, reliability, transparency, and efficiency at the lowest cost. With funding from the new energy markets, distributed energy storage systems will accumulate electricity when the sun is shining or the wind blowing, releasing it at time of use. Demand management will shape the load curve to better match availability of inexpensive renewable resources. New flexible uses will take advantage of inexpensive electrons when low prices occur at odd hours – an example may be hydrogen generation, storing it for use in fuel cells or feeding it into natural gas networks. Charging electric vehicles will be controlled to take advantage of low prices, perhaps even giving power back to the grid when prices are high enough.

This may sound complicated, but not more so than what is happening today in the stock market or in telecom networks: market intermediaries will act automatically on behalf of distributed asset owners. New transactional technologies, perhaps blockchain, will help deal with the sheer volume of automated energy transactions.

PERFORMANCE-BASED POWER UTILITY REGULATIONS

In the traditional Canadian rate-of-return regulatory framework, electric utilities earn a return on investments based on past capital expenditures approved by the regulator. This model will no longer be suitable in 2030 to regulate the wire business of utilities because of it is biased toward capital, devalues collaboration with third parties, is insensitive to reliability, and inhibits innovation.

By 2030, the provincial regulatory regimes will have evolved toward a performance-based model. This new model will incentivize lower costs and better reliability. Both operating expenses and capital expenditures will be counted in order to not discriminate against third-party non-wire alternatives, such as energy storage and virtual power plants, while avoiding service interruptions that trip distributed generators offline. In a performance-based regulatory model, utilities are freed to implement innovative solutions without regulators and interveners second-guessing every investment in technology. Multi-year incentive plans will allow utilities to plan ahead better. Similar regimes already exist elsewhere, as in Great Britain, where the regulator developed its RIIO (Revenue = Incentives + Innovation + Outputs) 8-year framework.

HIGH-AVAILABILITY DISTRIBUTION GRID

By 2030, we'll obviously not have replaced all poles, conduits and wires that make up the legacy grid – nor should we have to. Utilities, however, will have adapted this critical infrastructure with smart devices and analytics to make it more resilient (especially against the impacts of climate change) and more reliable (essential to keep distributed energy resources online).

Leading utilities are already showing how this can be done. For example, according to surveys and government reports, Florida Power & Light has the most efficient operations in the USA, the best electric reliability in the USA, and the highest rating in customer satisfaction among large utilities – all at once. This is accomplished by rigorous storm-proofing of critical feeder sections, including undergrounding of mainlines, with intelligent protection devices on laterals to minimize disturbance while faults are being cleared on overhead lines. Grid sensors help locate grid problems before they cause outages. Protection devices, switches and sensors are automated to the best extent possible and remotely operated, from a control room or from a vehicle. Ultimately, a more resilient and reliable grid saves on operating expenses by eliminating truck rolls and through more efficient and safer operations.

NEW OPERATING MODEL IN DISTRIBUTION

Distribution utilities unshackled by regulations are free to innovate, lowering costs and improving reliability at the same time. Utilities will develop new skills. They will become better technology integrators and project managers. Utilities will partner much more with technology vendors who have the global scale and expertise to provide better products and professional services at a lower cost. This is very different than the physical work and manual switching that now dominates local distribution grid operations.

This is a known model, as utilities would follow the path already taken by telecom network operators, who now have a very different supply chain and vendors than they

had some years ago. For example, Cisco System, a start-up in the 1980s, is now the largest networking company in the world, while many legacy telecom vendors, such as Nortel, went bankrupt in the 1990s or 2000s, unable to keep up with innovation in the industry at the same time when the price of commodity products plunged with manufacturing in Asia.

By 2030, the same will have happened to some electric hardware or software vendors that are well known today, as well as some new entrants to the industry. For many electric hardware vendors whose skills reside with manufacturing traditional devices, the advent of a distributed, transactional and digital-enabled electrical grid will be challenging. Many of the current electrical hardware vendors will be unable to develop cybersecured control systems than can be integrated into the new systems used by utilities, or entirely new systems, such as microgrid controllers, storage systems and distributed resource management systems. Those vendors will face uncertain futures, either pushed out because they cannot keep up with innovation or priced out by Asian manufacturers. New vendors are also not immune to failures, as shown by the many storage and solar developers who failed in the last few years.

This puts energy service providers and utilities in a difficult position, as they need to rely on vendors to build the new grid. This is another reason why better integration skills and a more flexible technology architecture are so critical. Utilities should also lead better standardization and interoperability efforts in the industry. If iPhones can connect to Ericsson cellular base stations, shouldn't smart meters and reclosers be plug-and-play like that too; ?

CONCLUSION

This new, distributed, transactional and digital-enabled electrical grid will be more resilient and sustainable. Its resiliency is based on multiple and alternate energy local sources and paths, with reduced reliance on large infrastructure. This new resilience is welcomed given the growing importance of electricity in energy use, as residential and industrial customers are dependent on electricity to power our modern life in smart communities and with the advent of electrical transportation. The new grid will also be more sustainable, reducing the environmental impact of communities and improving quality of life – while being financially affordable.

Preparing for the future is essential for Canadian electric utilities and new players. In an industry traditionally defined by centralized generation and rigid geographic boundaries between utilities, new linkages need to occur: utilities and customers, vendors and entrepreneurs, cities and businesses, ensuring that all see the opportunities that didn't exist before and have the support they need to get their ideas to market quickly. The structure of the industry will emerge transformed, with Canadian-owned service providers developing new skills and offering novel energy solutions in Canada, backed by a web of hardware, software, and professional service vendors. Realizing this vision will increase competitiveness and opportunities for Canadians to export their energy, their expertise, and the fruit of their labor.

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