The Great American Reset: Building a Resilient and Sustainable Grid

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Anthony Allard

In this Perspective, Anthony Allard, Executive Vice President and Head of Hitachi ABB Power Grids’ business in North America, makes the case for using the momentum generated by the Great American Reset to modernize and decarbonize the North American power network. Managing renewable energy variability using the latest technology, adding transmission capacity between states and provinces, as well as increasing infrastructure efficiency, will all help to create a more resilient grid. He also urges for more inter-regional planning to ensure coordinated investments are made quickly and efficiently across the continent.

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Placing electricity at the heart of the Reset

The impact of the global COVID-19 pandemic has presented North America with a golden opportunity to focus growth investments on modernizing its aging energy infrastructure. The North American electricity grid, whose origins are more than a century old, needs to become more resilient and flexible to enable a carbon-neutral future. The grid is under pressure to integrate growing amounts of variable renewable energy, adapt to shifting electricity demand patterns and more electrification (transportation, infrastructure and buildings sectors), and withstand changing environmental patterns (e.g. extreme weather conditions). These challenges need to be addressed in parallel to stimulating the American post-pandemic economy and the time to act is now.

In the US, President Biden is taking very encouraging steps with his proposal to spend $100 billion on grid resilience, underscoring the fact that electricity will be central to the economic reset and to meeting climate targets. I welcome this increased focus on electricity infrastructure spending and call on the wider energy industry to build on this momentum and make its investment commitments. The country requires additional transmission infrastructure to integrate new solar, wind, hydro, and other natural energy sources,
to better match production and demand centers by allowing regions to better exchange electricity when power systems are under stress. Economic and financial consultants, The Brattle Group, estimates that this modernization and expansion requires investments of up to $690 billion by 2050. The great news is that the technology to address these challenges is ready and available and the investments will create jobs.

Connecting renewables in bulk
The most pressing shift concerns the integration of renewables as electricity producers are adding gigawatts of green energy. North America, like other regions across the world, has ambitious targets to increase green electricity production. Canada plans to source 90 percent of its electricity from clean energy sources by 2030, and President Biden aims for the US power sector to be carbon-free by 2030, leading to a net-zero emissions economy by 2050.

This fast-paced growth in renewable energy needed to support the 2030 carbon-free goal poses several new challenges to the North American power system. Firstly, their variability brings stress to the transmission network, which was built on centralized, baseload electricity generation that was largely predictable. The influx of wind and solar resources, which cannot be produced on demand, also reduces the network’s inertia because, unlike traditional, thermal power plants, they are connected to the grid through power conversion systems based on power electronics and do not have the same kind of large, rotating turbines that produce grid inertia. Changes within the power generation mix which may lead to lower levels of grid inertia may result in a faster decrease in frequency when grid disruptions occur, which significantly reduces the resiliency of the grid. The answers to this threat to the network’s resilience can be found in utilizing digital capabilities combined with most modern power electronics. Hitachi ABB Power Grids has, for example, provided such a technological solution to a wind farm in Mexico, where a static compensator helps maintain high-quality electricity and stabilizes the network.

Secondly, high-quality renewable energy resources are often located far away from demand centers, such as mountain ridges in remote areas or offshore. A study by the American Council on Renewable Energy has shown that the 15 US states between the Rocky Mountains and the Mississippi River account for 88 percent of the country’s wind potential but are home to only 30 percent of expected electricity demand in 2050. This geographical mismatch between supply and demand creates a need for building both new intra-regional transmission lines as well as expanded connections between the grid interconnections, which are not synchronized and require high-voltage direct current (HVDC) to exchange power.

Deeper grid connections also addresses the third grid challenge posed by growing renewable energy: addressing the timing mismatch between production and demand. For example, peak solar production around the middle of the day does not coincide with the traditional peak of daily power demand in the early evening. Again, it is electrical engineering that is the answer here as HVDC transmission can help transport electricity over long distances with very few efficiency losses and its ability to control load flow, to places where it is needed at the time of production.

Another way of handling excess renewable electricity is to store it. Hydroelectric dams offer one way to do this. Managing reservoir levels, by pumping water into a reservoir and releasing it when electricity is needed, is a traditional method of bridging supply and demand gaps. Pumped hydro storage represents the bulk of electrical storage on the grid today. This method is working well on the north-eastern border between the US and Canada, but North America can apply it even more widely. As well as offering storage capability, the use of hydro and solar and wind power to operate pumps to fill storage reservoirs provides a carbon-neutral alternative that is in line with North America’s various strategies to cut greenhouse gas emissions.

Building resilience with more interconnection, microgrids, and energy storage
Strengthening the network by expanding the grid is not only important in the context of integrating renewable energy. The power outages in Texas earlier this year highlighted how crucial it can be for a grid to be well connected to other regions, particularly distant areas that may experience different weather patterns and that can provide support at times of system stress. Case studies of interconnected electricity networks across the world, for example in the European Union, have proven that grids become more resilient when regions can exchange electricity when dealing with unexpected events. Building more resilient networks does not only happen across large
HVDC transmission lines can be one of these solutions as minimal transmission losses allow for a more efficient way of sending electricity over long distances than AC lines. At Hitachi ABB Power Grids, we also deliver technology that detects equipment failure prior to a fault, allowing utilities and network operators to make their assets more reliable by better targeting maintenance work.

In line with anticipating factors that can threaten the resilience of a power grid, network operators and utilities need to constantly update assumptions around weatherization. If we return to the example of Texas, it has demonstrated that some of the weather-related assumptions applied were outdated given the increased level of severe energy storage and is expected to significantly reduce diesel consumption while meeting about 25% of the community’s electricity needs over an average year.

Combining storage solutions with a microgrid can also be an effective way to avoid the construction of new transmission or distribution lines, for example, in areas where space restrictions or local opposition complicate building new infrastructure. This option will become increasingly important as we move towards a future where electricity will be the backbone of the entire energy system.

Efficient and flexible infrastructure
Making the best use of our infrastructure and equipment in the name of sustainability is a request we are receiving from more and more of our customers. Where in the past investment costs were the top priority, energy infrastructure investors are increasingly opting for solutions that last longer, are more efficient, and help meet sustainability targets.

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A winter storm brought heavy snow in Texas causing the state’s power grid to also collapse.

(Image credit: NASA)

A map showing very cold weather in Texas and key parts of the country.

Events, including extreme cold, extreme heat, wildfires, floods, and hurricanes. Weatherization and grid hardening are not new issues, but utilities and network operators must apply the correct technology to work with the latest weather-related risks. Anticipating a threat from stronger and more frequent hurricanes, Puerto Rico, for example, commissioned us to build a weather-resilient energy system. This resulted in the deployment of a unique mobile solar system with foldable racking to protect equipment from weather-related dangers.

Coordination planning

Anticipation and planning are crucial in the electricity sector. To be able to build all the transmission lines that are required to address the above-mentioned challenges, an appropriate policy framework needs to be in place. Currently, this is not the case in the US, let alone in North America. Across the continent, each country, each state, each province has different capabilities which, if combined through a coordinated plan, can help build a more resilient overarching power network. This also includes designing a coordinated incentive mechanism for regions hosting long-distance transmission lines. A central approach is needed here to attract and efficiently invest the dollars in our future electricity system. Once the foundations are laid, the technology is ready to be deployed to render the grid as resilient as possible.

Now is the time!

As the need to expand and make North America’s grid more resilient has been recognized on the political agenda, the power industry must tap this momentum and speed up initiatives.

The Great American Reset is underway, and it is up to us as the industry to plan for the grid of the future today and to apply the latest technology to ensure funds are invested most efficiently. Given the long development cycle and criticality of electric infrastructure to national security, changes need to take place now.