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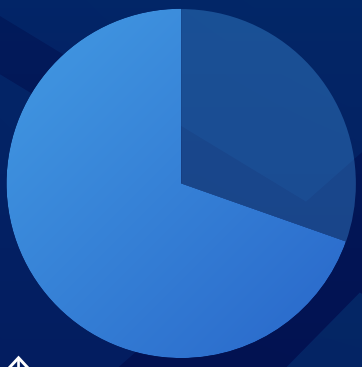
THE NEXT GEN GRID

How Utilities Can Provide Value as They Lose Control



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As wildfires continue to place pressure on grids in the Pacific Northwest, the East Coast hurricane season is exposing more cracks in America's energy distribution systems. In the wake of Hurricane Ida, more than 1 million people in New Orleans and the surrounding areas were left without power, and many remained in the dark long after the storm had passed.

The problem isn't endemic to these two opposite corners of the country. Rather, it is a product of the energy transmission model that the entire U.S. has relied on for decades – and it's one that must be solved soon.

The existing system of linear energy transmission grids powering American homes and offices has been a viable solution to a highly complicated challenge and is undoubtedly a feat of engineering brilliance. However, it's also massively inefficient: Roughly 67% of the power generated by utilities is lost prior to reaching customers.

Moreover, the current grid system is fragile, a reality that people in Louisiana, Oregon, California, Texas and other states have become all too familiar with in recent years. It facilitates the transmission of power from a central plant to customers through high-capacity transmission lines and creates a single point of failure in the process. That can lead to catastrophic consequences when disaster strikes.

It could also soon be obsolete.

The new node-to-node model

Thanks to a combination of factors, the hierarchical grid we have today is on the brink of being replaced by a system of distributed microgrids. These self-sufficient energy ecosystems take advantage of renewable energy sources, batteries and software to power communities, are already demonstrating improved resilience in the face of natural disasters and have the potential to deliver a number of other benefits as well.

By allowing for the autonomous import or export of energy through a system of independent nodes, local energy grids can help communities reduce costs and ensure energy transmission when the overall grid is compromised. For example, in parts of California that have been ravaged by wildfires, planned outages have occurred with growing frequency. Microgrids could allow affected households to be self-sufficient until transmission from the main grid resumes.

That promise is why microgrids are projected to grow at an annual compound rate exceeding 24% through 2026, according to a recent report from Global Market Insights. Though they aren't a new concept, the improved economics of renewable energy sources and battery storage are making them increasingly cost-efficient, environmentally friendly and critical to business continuity planning.

While this might all be great news for the 320-plus million Americans who view electricity as a staple of modern life, the development of the Next Gen grid will pose immense challenges for established energy companies. A couple of things can (and should) be done differently. First, investments in wind, solar and battery, including direct investment and incentives to

build out this new infrastructure. Second, there are still a lot of hurdles to connecting some of the newer distributed technology (such as batteries) to the grid. The system right now prices for a block of energy delivered over a period of time. This is great for the current means of generating electricity but does not work very well for batteries, which will sometimes consume power and sometimes produce power.

Battery storage is hugely valuable because the grid currently has no way to store energy for later use. We have to pay gas and coal plants to generate more energy than is being used at any given point, just in case there is a spike in electricity demand. This is terribly wasteful and inefficient. As such, batteries are providing more value than just the difference in energy price between when they are charging and discharging. However, it will be hard for the grid to take advantage of the added resiliency that batteries bring until there is a better way for the electricity market to pay for that value.

The third action would be to invest in next-generation distributed energy resource management systems (DERMS) in order to take advantage of the added resiliency of microgrids across the territory. Distributed resources need to be able to self-manage in the event that they are disconnected from each other. Technology is just now starting to surface to enable this, but once in place, it will really unlock the next level of resiliency against major events like Hurricane Ida.

From complicated to complex

Throughout the 20th century, utilities and their customers were participants in a linear value chain. Generators earned revenue based on the amount of electricity they generated and were thus incentivized to generate as much as possible.

Today, ongoing technological advancements in wind, solar and energy storage technology are giving industries, corporations and families more choices around energy consumption, disrupting the monopoly utilities once held.

In his book "It's Not Complicated: The Art and Science of Complexity in Business," author Rick Nason gets to the heart of the challenge these legacy companies now face. A formerly complicated process – the transmission of energy from generators to customers – is morphing into one that is highly complex. The same solutions that utilities have historically developed to keep the grid predictable will no longer serve them as microgrids and residential solar become more prevalent. Increasingly, utilities must figure out how to manage intermittent and erratic consumption, accounting for an array of factors, from weather patterns to consumer adoption of electric vehicles (EVs), which might be connected or disconnected at unpredictable intervals.

If they hope to achieve anywhere near the success that those companies have enjoyed, utilities will have to view the shifting energy landscape holistically

One approach that has gained traction is the virtualization of distributed assets. Virtual power plants consisting of solar and wind technology, various storage arrays and on-demand curtailment could theoretically function as larger generation sources that utilities could interact with in aggregate. While this idea represents a step in the right direction toward the large-scale deployment of renewable energy, it's not a panacea. For instance, a danger in using this approach is that utilities could fail to take advantage of improvements in resiliency, intermittency and transmission loss when the layer of abstraction introduces artificial chokepoints, such as first transmitting energy to a central node prior to redistribution.

Obviously, this new infrastructure would also have to be built to withstand hurricane-force winds to be useful in these extreme natural disasters, but that can be done with the proper planning and engineering specifications for the area where they will be built. Sunnova recently posted information about how well its systems held up to Maria and other storms. And with a high number of generation sources built around the region, the impact of any one area going offline would be less impactful.

The prevailing mindset among established energy companies – that loads should be managed in blocks of kilowatt-hours – is at odds with a truly adaptable grid. However, that fact also points to a solution to the larger problem at hand.

The mindset shift

Before any engineering solutions can be successful, energy companies must change the way they view their businesses. The energy transition will fundamentally alter the value chain for independent system operators and regional transmission organizations. In order to survive, legacy companies must adopt flexible business models as once-profitable service lines become obsolete.

Customers embracing rooftop solar, behind-the-meter energy storage and other solutions will inevitably require less energy from regional utilities. Rather than fighting against this shift, utilities should help facilitate it while looking for new ways to provide value. Fortunately, opportunities abound.

Retail energy companies could provide higher-margin services to customers who are increasingly thinking of their energy needs in a more holistic way. These could be solutions that help customers better manage energy usage or applications that provide an integrated view of energy consumption related to next-generation appliances.
Austin Energy, the publicly owned utility that has provided energy to the Texas capital city for more than a century, has partnered with residential solar installers in the area to actually facilitate the transition to renewable power generation. It even provides a renewable energy option for customers who rent their homes or live in locations that don't get enough sunlight for rooftop photovoltaic technology to be viable.

This tactic is generally the exception among utilities, which often seek tight controls over microgrids and other decentralized energy resources, but it's likely the optimal one. By approaching the system with a peer-to-peer,

market-based strategy that incorporates distributed trust, grid operators could unlock further value for businesses and consumers and enhance their own value in the process. This is exactly how companies like Uber or Airbnb disrupted the transportation and hospitality industries, respectively.

If they hope to achieve anywhere near the success that those companies have enjoyed, utilities will have to view the shifting energy landscape holistically. That means thinking ahead to potential regulatory outcomes, customer value propositions, Next Generation digital grid management systems and other technologies that will ultimately power the grid in the not-so-distant future.

The latter will be especially important.

The digital foundation of the Next Gen grid

Modern technologies such as the Internet of Things (IoT), machine learning (ML) and blockchain will play a vital role in the functioning of an energy ecosystem that is more flexible, efficient, sustainable and resilient than the current linear system. Here's how:

Using IoT to monitor grid health

IoT is an umbrella term for the growing number of internet-connected devices that collect and generate real-time data, enabling them to take instructions and run computations. The myriad smart appliances, EVs, and other connected devices that comprise the Next Gen grid will effectively communicate with one another to understand the state of the grid and automate appropriate action. In some cases, that will mean acting in their own self-interest to ensure optimal energy management at a granular (say, household) level. In others, it will mean acting in the interest of a larger network.

These distributed networks must be able to continue functioning as an autonomous microgrid when the overall grid is compromised, which will inevitably require more robust IoT technology with processing at each endpoint. That technology is within reach thanks to advances in edge computing, which moves data-intensive processing tasks closer to data sources. The latency of centrally managed systems won't be sufficient for a grid that must balance frequency in milliseconds, but as modern cloud platforms offer more capabilities at the edge, autonomous microgrids will become a reality.

Enabling intelligent action through machine learning

In order for each node in a network of distributed energy resources to effectively balance its own interests with those of the larger grid, these resources must be able to generate insights from vast amounts of data. Specifically, they must be equipped with the pattern matching and advanced processing capabilities enabled by artificial intelligence (AI) and machine learning.

Powered by AI/ML technologies, distributed resources will be able to navigate changing grid conditions autonomously while simultaneously feeding the inputs they are sensing to a central data lake.
The sophisticated models receiving that information will be updated in

real time, allowing all the other resources in the network to continue operating optimally. Again, these data-intensive processes won't be possible unless networks are underpinned by a modern, cloud-based architecture.

Creating peer-to-peer energy markets with blockchain

There is no existing market mechanism for facilitating energy exchange between individuals at present, but distributed ledger technology could change that. Microgrids built on digital architectures that incorporate proof-of-stake consensus algorithms, which power many newer blockchains (and dramatically reduce the energy consumption required by proof-of-work mechanisms like the one Bitcoin uses), could be revolutionary. The data generated by an IoT system tied to a blockchain could be immediately recorded and verified so that all network participants could trust it in the absence of a central management authority. Early experiments in using blockchain technology to help manage energy markets are underway in Australia and Brooklyn.

Distributed ledger technology could also be used to track carbon offsets associated with renewable generation and dramatically improve sustainability reporting. As retail and institutional investors alike place more and more value on ESG metrics when making investment decisions – and as regulators impose more stringent sustainability mandates – companies that can show indisputable evidence of their efforts stand to gain a distinct competitive advantage.

Learning to let go

The energy transition is well underway, and legacy energy companies must soon make a simple choice: adapt or become obsolete. While the transition will likely take decades to complete, the move away from hydrocarbons is occurring faster than many industry leaders thought possible. Similarly, individuals and organizations are increasingly calling for urgent changes to the way energy is generated and distributed, and many are taking matters into their own hands.

The job of utilities and grid operators has always been complicated and has recently been made even more so with the introduction of utility-scale intermittent renewables like wind and solar. However, we're now seeing a wave of customers looking to generate and store power independently while remaining connected to the grid, a phenomenon that is making the space truly complex.

In this new landscape, energy leaders must have a plan for the unexpected and be comfortable giving up some of the control they've long held – over how they generate and deliver power, with whom they do business and with whom they compete. The reality is that the environment will only grow more complex in the coming years and that control will continue to recede.

Rather than struggle against the shift to a more decentralized system, industry leaders should strive to learn from the decentralized systems that are all around us. Instead of delivering resources straight to customers, companies like Uber, Lyft and Airbnb have succeeded by unlocking the value of previously unused resources. A decentralized energy system will have room for many players and a variety of critical roles that legacy energy companies have the knowledge and resources to fill. The companies that begin carving out theirs now will be positioned to thrive as the transition gains even more momentum.

Pariveda is constantly monitoring the technological, cultural and economic shifts shaping the modern energy industry. As the pace of change accelerates, we help companies navigate new challenges and develop strategies that allow them to adapt faster and face the future with confidence.

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Derrick Bowen has more than 11 years of consulting experience leading user-centered software development, CRM, business intelligence, and strategy projects in industries including energy (traditional and renewable), healthcare and financial services.

ABOUT PARIVEDA

Pariveda is a consulting firm dedicated to solving complex technology and business problems by aligning our people-development focus with the mission of our clients. We desire to help our clients achieve lasting success now and into the future. As an employee-owned company, our naturally curious people have strong technical, business and strategic skills to help our clients identify, architect and develop custom solutions. We believe in challenging our clients' thinking, and we are comfortable solving problems without a clear solution. Our solutions create new opportunities for our clients, and we manage the change each solution brings to their company.

Visit our website to explore our perspective on the energy industry and read the stories on how we help organizations just like yours align to their full potential and achieve lasting success.

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