Integrated Planning to Tackle Energy Transition

A Holistic Approach

By Guidehouse's Hector Artze

Traditionally, resource and investment planning have followed a linear process. Utilities forecasted future supply needs taking into account the expected load reduction of demand-side management programs, and then scaled their generation, transmission, and distribution capacity to meet demand by deploying investments in new utility-scale generation.

Since the 1980s, increased energy efficiency kept the need for explosive generation development in check by decoupling energy consumption from economic growth and doubling energy productivity.

Now, the investment and resource planning landscape are much more complex. Multiple policies and regulations with varying compliance demands make a single formula unfeasible. Corporate and individual customers, regulators, and investors are increasingly demanding utilities set decarbonization targets for transitioning to low- and no-carbon energy generation.

Meanwhile, distributed energy resources are projected to grow significantly. Global spending on DER in commercial buildings alone is likely to reach $38.6 billion by 2030, with an annual compound growth rate of 9.1 percent.

But even with expected increases in DER, energy efficiency, and energy-smart technologies, energy demand is expected to rise significantly as the energy transition drives mass commercial and residential adoption of electric vehicles, as well as building and industry electrification initiatives.

Climate change weather effects will also boost demand, with a 2019 study predicting energy consumption increases of eleven percent to twenty-seven percent with modest warming and twenty-five percent to fifty-eight percent with vigorous warming by 2050.

To meet the challenges of this complex energy future, it's clear to all that utility investment and resource planning can no longer be considered from a linear perspective. But they can also no longer be siloed. Gone are the days when separate departments for generation planning, distribution planning, transmission planning, and customer programs planning made sense.

The utilities of the future must take a holistic and optimized approach to navigate the complexity of the changing energy landscape and to better manage considerable risks around cost, reputation, and reliability. Those that are able to integrate their planning will have a competitive advantage and be better positioned for future growth and success.

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Risks and Opportunities

The bulk of utility investment has traditionally focused on the development of generation capacity. With the increased future demand for clean energy, new utility-scale generation investments in renewables will be required. But investments in transmission, distribution, and customer programs will also be key.

An integrated approach to prioritizing investment dollars is critical. Many utilities are currently underestimating future growth in DERs, and thus not properly anticipating their effect on current distribution, transmission, and generation plans.

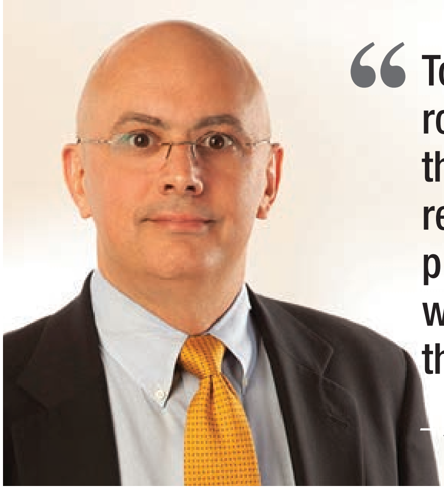
With a fifth of the world's companies already making net-zero commitments, much of the explosive growth in DER will come from corporations. Some organizations that have set decarbonization targets will decide to generate their own renewable energy since utilities aren't transitioning fast enough.

Cost savings and greater control over electricity management and resilience will also drive corporate adoption of DER. Expect more state and federal government regulations like FERC Order 2222 to support this trend – and even provide economic resources to further sustainability.

Utilities will be expected by individual and corporate customers, investors, and state and federal governments to be prepared to manage a grid with extensive DERs. But to do so well will require significant investments in distribution system upgrades and grid modernization.

Such investments are costly, according to a study from Princeton University, which found a cumulative incremental distribution system capital investment need of two hundred and fifteen billion dollars by 2050 to meet increases in peak demand and cope with the added operational complexities.

A robust grid will be especially important as extreme weather events and sustained climate shifts become more common. The resulting increases in electricity demand may create dangerous load peaks that could make grid failures, like the one that happened in Texas, not unusual.



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> – *Hector Artze*

While many utilities believe the latter can be solved by weatherization, grid-responsive smart devices, distributed energy storage, and load flexibility, those interventions can only go so far. Investing in systems upgrades is critical to utility business models.

With DERs poised to add significant capacity, utilities should focus on generation investments that account for DERs. During this transition period, if utilities don't plan with net-zero generation and DERs in mind, they risk investing in the wrong type of generation, creating stranded assets that could increase the cost of electricity, and impact customer satisfaction, utilities' reputations, and their balance sheets.

Restructuring Planning and Investment is Critical

One key reason utilities aren't able to properly plan for the dynamic energy future is that planning within utilities remains siloed. They might collaborate, but they aren't fully integrated.

For utilities to create an effective roadmap to navigate the energy transition, resource investment and planning have to happen with experts in generation, transmission, distribution, and customer programs all sitting around the same table, using common data, integrated planning tools, and an optimized investment decision process.

Together, these groups can better understand and tackle the impact of challenges, such as the increase in DERs, customers' rising demand for renewables, effects of climate change, and the utility's investment needs and operational challenges.

That will allow them to make more strategic investment choices. For example, they might decide to shift some of their planned investments in utility-scale generation to customer programs that support DER development, help clients electrify buildings, and assist in the electric vehicle transition, unlocking new revenue streams.

In these ways, utilities can unlock the value of DERs as a resource, positioning themselves as more relevant to customers. Integrating the silos won't be easy. It will require new governance, substantial process redesign, and integrated tools for planning.

But utilities that succeed at combining these functions will make superior investment decisions, increase capital efficiency, optimize their assets, better educate regulators and customers, and provide more relevant and affordable service to their customers in the future.

Systems-level Planning Sets Up Financial Success

With the lead up to 2030 being called the Climate Decade, utilities carry much of the weight of reducing emissions to keep pace with national, corporate, and their own internal net-zero targets.

Dynamic systems-level planning is required to respond to the complex energy future, meet the goalposts of the energy transition, and ensure utilities are positioned for growth and success. That will take integrated, agile leadership from teams that understand the complex interconnections of generation, distribution, transmission, and customer programs.

Using a comprehensive approach, utilities can chart a future that is responsive to the shifting energy environment, thereby managing risk effectively and giving their companies a competitive edge. PUF

PUF Five Years Ago: EPRI's Dan Bowermaster

46 – that's the number of electric vehicle models either on the market or in development to roll into dealers' lots by 2020. It's a number and landscape that is changing almost daily, according to Electric Power Research Institute's electric transportation program manager Dan Bowermaster. "What is very exciting in the industry is we are starting to see the rise of the mass market of 200-240 mile range cars. In fact, GM is building their Bolt EV as we speak in Detroit," said Bowermaster. "That's a 230 mile range car that stickers at about $37,000." – Excerpted from January 2017 PUF, page 21, from "EPRI Unplugged" podcasts.

Energy Assurance Challenge

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amount of on-site back-up fuel plus replenishment capability; and Coal resources limited by transportation needs, as well as cold and moisture impacts on reserve piles.

All resources are limited by forced outages (and partial outages) due to thermal stresses, equipment failure, and, in some cases, emission allowances and discharge water temperature values.

For example, fossil-fueled resources may experience energy limitations due to emission limitations, which are expected to increase over time. In addition, limitations can also be caused by transmission maintenance that inhibits energy deliverability. To further complicate analyses, market rules are in place to reserve limited-energy resources for a later time, optimizing the overall solution.

Identify the Tools and Methods Needed: For the mid- to long-term planning, operational planning, and operations time horizons, tools and methods are needed to identify the right mix of resources to ensure sufficient amounts of energy are available to serve demand at all times adequate ramping capabilities exist, and essential reliability services are available.

In addition, in organized markets, market-based incentives or rules, tariff changes, and other market tools need to be investigated. For example, some jurisdictions have evolved to performing eight thousand seven hundred sixty stochastic simulations to assess hourly levels of risk.

Some jurisdictions also have established locational, flexible, capability, and performance requirements into their resource adequacy programs. Reviewing existing tools and methods already developed, identifying any gaps, and providing guidance to address the gaps will support creation of systems that will have sufficient amounts of energy for the reliable operation of the BPS.

Conduct Loss-of-Load Assessments: The system must be planned (in both the mid-to long-term and operations planning time horizons) to provide a set of options to the operator so sufficient amounts of energy are available for the reliable operation of the BPS throughout all seasons of the year.

Energy limitations need to be incorporated into the electric power resource adequacy models to more accurately estimate key adequacy metrics, such as loss-of-load expectation, loss-of-load hours, and expected unserved energy. As the applications of electricity grows in North America, the impact of lost load will further increase, and as a result, the value of energy assurance to serve load will grow in importance.

Furthermore, as microgrid developments increase, assessment of contributions to reliability and consequences of energy sufficiency needs to be more fully understood. An important feature of integrating these suggested analyses with existing tools is the ability to incorporate operational solutions into the planning models. For example, incorporation of demand response, voltage reduction, and public appeals would be valuable.

By including cross-energy sector study results from energy limitations, such as fuel or pipeline infrastructure limitations, into probability-based resource adequacy models, an accurate representation of risk can be quantified and then translated into risk-based planning solutions.

Replacing the existing generation fleet with energy-limited resources requires industry to consider both capacity requirements and energy sufficiency, and by extension, fuel availability.

Cross-energy sector studies should include agreed upon study criteria between the sectors on what it means to be reliable and what the implications are on system resilience. This is important, as one sector may have a view of reliability that does not translate into other dependent sectors.

For example, should sustaining the loss of a large natural gas storage field be considered a credible event impacting reliability of the BPS that should be addressed by both the natural gas and electric sectors?

Additionally, agreed upon contingencies impacting fuel transportation or severe weather event scenarios that impact multiple energy sectors are necessary. This analysis can be used for all time frames, incorporating more granular information as the system approaches the operations time frame.

Appropriate reliability metrics and criteria for the three time frames must be developed as the degree of uncertainty in assumptions varies across each time frame. Study is needed to determine if the same or different metrics are required when the three time frame assumptions have varying risk profiles.

Energy assurance is a difficult challenge, but the process of solving this complex problem will undoubtedly be exciting and transformative. By working together, we can meet these challenges and develop the solutions necessary to ensure the continued reliable operations of the bulk power system, while still maximizing the integration of resources that meet the goals of a decarbonized society. PUF

On January 26, 1895, 127 years ago, Charles Proteus Steinmetz, known as the Forger of Thunderbolts, patented a system of distribution by alternating current, one of his most impactful discoveries among the over two hundred patents he received.