Electricity Matters

Paul A. DeCotis

Assuring Energy Infrastructure Reliability and Resiliency

As the political environment in Washington DC changes on Monday, January 20, 2025, one of the previous administration's priorities will not change: the demand for electricity and the need for a safe, reliable electricity grid to meet growing demand.

Nationwide electricity demand is expected to grow 4.7 percent in the US over the next five years, outpacing previous consensus estimates that predicted an increase of 2.6 percent. The surge in demand comes from expansion in the country's industrial and manufacturing capacity and the continued electrification of the economy, including the need to power artificial intelligence (AI), AI-dedicated data centers, and crypto-mining operations. This growth is unprecedented—as over the last two decades growth has been close to zero.

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As published in numerous reports over the past few years and in this column, the existing electricity grid infrastructure is not prepared to meet this increased demand. Significantly more power generation and doubling or tripling of investment in grid infrastructure are needed to meet the near five-fold increase in energy demand.

While the mix of new power generation resources might change under the new administration in Washington due to changes in federal energy and tax policies in energy development and fossil power generation, the need for power generation and grid infrastructure investments will remain. Additionally, the significant growth in recent years in renewable and distributed energy resources (DERs) development, battery storage, and continued investment in energy efficiency and demand response are not going away any time soon. Whole industries and supply chains have been built and are functioning well in meeting market demand for these resources. Some slowing or redirection might be in store, but the prosperity of the US and its economic and military strength are dependent on a reliable and resilient energy ecosystem.

By far, the largest source of new power generation in the US has been renewable energy e.g., solar photovoltaics, wind, and battery storage. Contributions from improved energy efficiency and demand

response and a myriad of other DERs have also continued to grow. With the incoming administration signaling a desire to move away from clean energy resources, it is clear that some cleaner energy sources (like nuclear power, natural gas, and hydrogen) will play an increasingly larger role in meeting the US's energy needs.

RELIABILITY AND RESILIENCY

The World Resources Institute reports that 2023 was a record-breaking year for clean energy deployment in the US, including growing installations of solar resources and energy storage, and the increase in electrification of transportation and buildings using clean energy. A record 31 gigawatts (GW) of solar energy capacity was installed in the US in 2023, a roughly 55 percent increase from 2022 installations and substantially more than the previous record set in 2021. Even with significant project delays due to supply chain issues and other factors, solar was the fastest-growing power source in the US, representing half of all new utility-scale generating capacity through Q3 of 2023. According to the Solar Energy Industries Association (SEIA), installed solar capacity in the US now totals 161 GW, enough to provide approximately 5 percent of the nation's electricity.[1]

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As noted in the June 2023 *Electricity Matters* column in this journal, history shows that technological innovations and the businesses that bring them to market radically change economies, societies, and cultures.[2] New businesses and industries form around innovations to commercialize and scale innovations, making them commonplace. New businesses, business models, and supply chains supporting the commercialization of innovative technologies have revolutionized the way we live, work, and play. With technological breakthroughs new products and services are created, requiring new ecosystems to support them.

The progress made to date and the pipeline of projects, investment dollars, and research and development into innovations in renewable energy and strengthening its supply chain will not be easily reversed.

Products, supply chains, and supporting infrastructures are invested in and built simultaneously and in concert with one another. The process is not always smooth and can be rather lumpy and disjointed, leading to business failures, a lack of investment capital, and slowness in manufacturing or low market adoption. Investment capital needs to be available to support the entire value chain deemed critical and necessary for bringing new products and services to market. Take for example how state-level energy policies support new businesses and energy technologies through public–private partnerships.[3]

California has seen over 23 GW of new resources come online since 2020, and there are 19 GW of additional resources already under contract and expected to come online by the end of the decade. About 20 GW of the 23 GW of nameplate capacity are clean energy resources. The state also now has a centralized

[1] Bird, L., & Womble, J. (February 7, 2024). *State of the US clean energy transition: Recent progress, and what comes next.* World Resources Institute. https://bit.ly/49yDRRY.

[2] DeCotis, P.A. (2023). Scaling and sustaining innovations: No turning back. *Climate and Energy*, *39*(11), 24–28. https://doi.org/10.1002/gas.22350.

[3] Ibid.

procurement strategy under which the California Department of Water Resources will procure energy resources that have long lead times and need economies of scale to be cost-effective, with a goal of procuring the combined capacity of up to 10.6 GW from resources such as offshore wind, geothermal and various forms of energy storage.

The progress made to date and the pipeline of projects, investment dollars, and research and development into innovations in renewable energy and strengthening its supply chain will not be easily reversed. While it might pause momentarily or slow until political and market uncertainties resolve, it is difficult to put the genie back in the bottle once released. Nuclear power, natural gas, and hydrogen offer cleaner energy solutions that are compatible with the state of the business and economy and offer benefits for both consumers and investors.

There are some clear examples of the resilience and staying power of the clean and renewable energy industries with more private sector capital being deployed independent of any particular administration's priorities. Exxon Mobil Corporation recently announced plans to expand into the power generation business to meet the anticipated growth in electricity demand to serve data centers. A natural gas-fired plant is under consideration that will capture at least 90 percent of its carbon emissions to garner support and contribute to decarbonization goals. Exxon is also considering co-locating the power plant with the data center, thereby bypassing the local distribution grid completely. As written in this column before, this presents a potential existential threat to local utility franchise rights—one that regulators have yet to address.

Microsoft Corp. is proposing to invest in Acadia Infrastructure Capital LP's newly formed coalition, aiming to install 5 GW of renewable energy projects in the US over the next five years. Projects supported by the Climate and Communities Investment Coalition (CCIC) are expected to generate enough energy to power just under one million homes with Acadia planning a $9 billion pipeline of renewable energy projects across the US.

To reiterate, the demand for electricity and the need for a safe and reliable electricity grid to meet growing electricity demand remains.

NUCLEAR POWER

Nuclear power plants provide half of all low-carbon electricity in the US, supplying 18.2 percent of the nation's total electricity. This is not trivial. There are 92 nuclear power plants operating in the US, with 442 operating nuclear power plants across the globe. Developing advanced reactors, including small modular nuclear reactors (SMRs), will require significant and sustained effort, investment, and permitting.

Considering the critical need to meet accelerating electricity demand growth reliably, safely, and at reasonable costs all options must be considered. SMRs, as proposed by the vendors referenced above, cannot be easily dismissed.

A recent study by the National Academies of Science, Engineering, and Medicine (NASEM) reported that a variety of vendors are responding to the potential needs of an evolving energy system by pursuing innovative reactor designs in anticipation of a substantial future market in the US and abroad. The vendors offer a variety of deployment scenarios for these new technologies, including:

1. Deploying SMRs for electricity production. The smaller size enables manufacturing portions of the plant components in a factory setting, which could improve quality and reduce on-site construction activity and costs. SMRs

can be modulated to scale over time to meet growing electricity demand.

2. Repurposing existing or abandoned fossil generation sites with new nuclear generation would reduce costs by benefiting from the existing transmission and distribution infrastructure, cooling capability, and possibly portions of the existing plant.

3. Combining electricity production with thermal energy storage could provide flexible operation producing high-temperature heat for industry, such as chemical processing or hydrogen production.

4. Producing low-temperature heat for district heating, desalination, or agriculture by combining off-grid electricity and heat.

5. Providing dedicated electricity supply to an industrial customer rather than providing power to a bulk power grid using microreactors (1–10 MWe) for remote sites and electric vehicle charging, ancillary services at key grid nodes, or even as a primary source of electricity in a reconfigured grid.

6. Providing transportable small reactors or microreactors to meet emergency needs, like trailer-mounted generation or deploying reactors that are moored or located offshore from load centers, thereby enabling efficient shipyard construction and alleviating siting restrictions.

7. Using nuclear reactors for marine propulsion or providing reliable and resilient onsite power for military bases.[4]

Industry and government through public–private partnerships could speed up the manufacturing, siting, permitting, construction, and operation of SMRs for a myriad of uses. Considering the critical need to meet accelerating electricity demand growth reliably and safely, and at a reasonable cost, all options must be considered. SMRs, as proposed by the vendors referenced above, cannot be easily dismissed.

NATURAL GAS

As states across the country set ambitious clean energy targets, natural gas utilities are integrating cleaner molecules and decarbonization into their planning processes. Natural gas has contributed to greenhouse gas (GHG) emissions reductions by displacing more carbon-intensive energy sources, like coal and oil, as we have seen over the past two decades. As natural gas prices declined, more fossil generation has retired. This is less due to environmental compliance costs and more due to the abundant supply of less expensive natural gas.

In a recent webinar on natural gas pathways to a lower-carbon future, utility executives discussed how they are furthering emission reductions through innovative technologies, programs, and infrastructure improvements in power generation, industrial processes, and commercial and residential use.[5,6]

Energy efficiency; infrastructure modernization; and the integration of lower-carbon fuels, such as renewable natural gas (RNG) and hydrogen, are deemed crucial for aligning the natural gas utility industry to state clean energy and decarbonization policy objectives. Webinar panelists shared their experiences of how the country's natural gas infrastructure is providing safe, reliable, resilient, and affordable energy to millions of Americans. Panelists also discussed

[4] National Academies Press. (2023). *Laying the foundation for new and advanced nuclear reactors in the United States*. https://bit.ly/41p9Ul1.

[5] On September 16th, West Monroe hosted and moderated a webinar panel with leaders from natural gas utilities across the country, including Despina Niehaus (Director Strategy & Sustainability, SoCalGas), Jim Steffes (Senior Vice President Regulatory, Washington Gas), Fred Gomos (Senior Director Environmental Policy & Sustainability, NiSource), and Melissa Orsen (President, South Jersey Industries Utilities), to discuss the challenges of decarbonization and the pivotal role of natural gas utilities in the energy transition. Some highlights of the discussion are captured in this column.

[6] Oloriz, M., Biondi, A., & Mangeney, E. (2024, November). *The pivotal role of gas utilities in the energy transition.* Unpublished manuscript. West Monroe Partners, LLC.

how natural gas can support the electric grid in meeting the growth in electricity demand.

In all the panelists' service areas, energy adaptability is increasingly important, as industrial sectors like automotive and semiconductor manufacturing experience notable load growth, driving economic development and highlighting the need for dependable sources of energy. Panelists emphasized how energy efficiency will remain a cornerstone, benefiting customers by stabilizing costs while also mitigating some of the expected load growth. Energy efficiency, along with fuel switching, will reduce natural gas use, and under the traditional regulatory construct, also lower revenues for utilities.

RNG can leverage established pipeline delivery infrastructure while also advancing clean energy goals.

The panelists pointed out that decoupling mechanisms that separate throughput from revenue are an important part of managing costs for customers and utilities as the role of the natural gas system evolves. The benefits of RNG in bridging the gap to a lower-carbon future, especially as customers continue to demand natural gas, were highlighted often. RNG can leverage established pipeline delivery infrastructure while also advancing clean energy goals. Investments in technologies, such as carbon capture and management infrastructure, can further enhance the potential of natural gas to contribute to a sustainable energy future. Panelists concluded that by leveraging these innovations, natural gas utilities can play a pivotal role in achieving long-term sustainability goals while also meeting the national need for reliable and safe energy infrastructure.

As the world experiences more frequent and severe weather, the panelists argued that the largely underground and reliable natural gas system is easy to take for granted. Additionally, natural gas procurement practices should aim to minimize volatility by using natural gas storage facilities, liquefied natural gas, and market mechanisms to manage the natural gas ecosystem.

The panelists argued that a coordinated cross-sector approach and integrated energy planning can optimize the use of natural gas infrastructure. This isn't about choosing between natural gas or electricity—rather it's about leveraging the strengths of both to achieve a cleaner, more reliable, and resilient energy system. Viewing the energy transition as an either/or decision is shortsighted and misses opportunities to reap environmental benefits through innovative and cleaner natural gas technologies.

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The panelists concluded that an energy transition of this scale is unprecedented, with no silver bullet solution. Natural gas remains a critical part of the energy mix, bridging the gap between today's needs and tomorrow's goals. Panelists stressed that a coordinated approach that brings together the natural gas and electricity sectors, along with regulators and state and national policymakers, is essential to meet climate policy objectives. Through innovation and collaboration, natural gas utilities can continue to play a pivotal role in helping achieve decarbonization goals.

HYDROGEN

As a fuel source, hydrogen is considered the simplest and most abundant element in the universe. Hydrogen can be stored, delivered, and used in a variety of applications. It's energy-dense, and an engine that burns

pure hydrogen produces almost no pollution, making it a desirable power source. There are many ways to produce hydrogen, with various names assigned to them, including grey hydrogen, blue hydrogen, green hydrogen, and pink hydrogen.

Grey hydrogen is produced from natural gas through steam methane reforming. The production process emits significant amounts of carbon dioxide (CO_2), making it a less sustainable option than other production methods. Blue hydrogen is like grey hydrogen, but the CO_2 emissions from production are captured and stored or used in other applications, thereby reducing emissions. This makes it cleaner than grey hydrogen, but its production still relies on fossil fuels.

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Green hydrogen is produced through the electrolysis of water, using renewable or clean energy sources, such as wind and solar. The production process emits no CO_2, making green hydrogen the most sustainable hydrogen option. It's also the most expensive due to the high upfront costs of renewable energy and electrolysis equipment. Pink hydrogen, like green, is produced via electrolysis but uses electricity from nuclear power to split water into hydrogen and oxygen rather than wind or solar power. While there are no CO_2 emissions, the sustainability of pink hydrogen must address waste disposal concerns. A difference between green and pink hydrogen production is that pink hydrogen is capable of continuous production, unlike renewable energy sources, which produce green hydrogen intermittently.

As investment in hydrogen production methods and scale and innovations in production lead to cost reductions, hydrogen's role in our energy systems—including buildings, transportation, and manufacturing—is expected to grow.

CONCLUDING THOUGHTS

SMRs, natural gas, and hydrogen provide cleaner energy solutions than the current mix of fossil power generation and continue to support greater electrification and decarbonization of our buildings and transportation systems. Investors have many opportunities to consider the best investments, be they in clean energy technologies themselves or the factor inputs and supply chains needed to support them. Yet, expanding our perspective of what is needed to support sustainable energy technologies across the value chain of energy products and services provides insights into future investment opportunities. As the clean energy industry, electrification, and alternative and new sources of energy become available and scale, there is no turning back.

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Regardless of anyone's political persuasion, or beliefs around energy and environmental policy, the need to meet growing electricity demand in the US is critical to our way of life and national security. There are many ways to meet this demand and ensure continued economic and social well-being. Options need not be discarded due to politics. The challenge is too great. Our economic and national security should not be compromised.