U.S. POWER INDUSTRY OUTLOOK 2020

YEAR THREE OF PRESIDENT TRUMP'S DRIVE FOR ENERGY DOMINANCE BY BRITT BURT AND BROCK RAMEY

resident Donald Trump's goal of achieving energy dominance took several steps forward in 2019. In the power business, the most significant move was the finalization of the Affordable Clean Energy (ACE) rule in June.

EPA Administrator Andrew Wheeler said he thought the rule could lead to the construction of new coal-fired power plants. Shortly after the rule was published in The Federal Register, a coalition of 29 states, cities and the District of Columbia sued to block ACE's implementation.

It is likely that litigation over this clean air rule, like litigation over the Obama administration's Clean Power Plan rule, could go all the way to the U.S. Supreme Court.

Deregulatory steps taken by the White House, Department of Energy, Department of Interior and Environmental Protection Agency have loosened regulation of the oil & gas industry. This has helped spur dramatic gains in domestic oil and gas production. As yet, nothing similar has been achieved in power.

Indeed, coal use to generate electricity (by utilities, independent power producers, and commercial and industrial customers) is projected to fall to 538,000 short tons in 2019 and 526,000 short tons in 2020, a decline of about 50% over the last 15 years (Figure 1).

```
Continues on page 20
```



While the fate of ACE may not be known for a year or more, no one has announced plans to build a new coal-fired generator since the draft ACE rule was issued more than a year ago.

However, President Trump's efforts to overturn President Obama's environmental rule limiting carbon dioxide (CO_2) emissions from power plants were welcomed by the National Mining Assn. as well as three major electricity trade groups.

Despite the actions of the president and his EPA administrator, energy markets have spoken longer and louder. Nothing in the foreseeable future is expected to change that.

Based on the tracking of planned spending in the power industry, we see an even more pronounced version of what has been observed for years: coal being eclipsed by natural gas and renewables as the leading source of new-build electric generation.

One piece of good news: developers' top-line plans to build new electric generation have trended upward in recent years, hovering around 212,000 megawatts (MW) for the three most recent five-year periods, well above the trough of roughly 160,000 MW from the three earlier five-year periods (Figure 2).

Not all of this generation capacity will get built. Historically, roughly 25% are either cancelled or delayed in any given year. That average obscures differences between differently fueled power plants: natural gas-fired power plants have lower rates of cancellation or delay than renewable energy plants.

Renewable energy generation, mainly solar and wind, is expected to account for 72% of all new-build generation projects scheduled to begin construction between 2020 and 2024.

By contrast, renewables were expected to account for about 57% of all new-build generation between 2019 and 2023 in last year's forecast.

Natural gas is expected to be the fuel for approximately 26% of new generation over the 2020–2024 period. Last year, gas was projected to fuel about 41% of all new-build generation constructed between 2019 and 2023.

The outlook is clear: U.S. new-build generation over the next five years is expected to be even greener, but less gassy, than in prior five-year assessments.

As always, technology, economics and the sentiments of utility regulators play important roles in shaping the long-term outlook for U.S. power generation. Notable this year is the small-but-growing trend among state utility regulators to oppose new gas-fired generation in favor of renewables, distributed generation, battery energy storage projects and customer



Figure 1: Consumption of Coal by U.S. Power Industry

Source: Electric Power Monthly and Short-Term Energy Outlook reports, U.S. Energy Information Administration



Figure 2: Top-line plans to build new generation Source: Industrial Info Resources

programs to reduce energy use or shift peak demand periods.

Developers even plan to build more new fuel oil-fired generation than coalfired generation over the next five years.

Coal outlook

The Federal Reserve Bank of St. Louis uses Bureau of Labor Statistics data to track employment across a range of industries including coal mining. Its most recent depiction of coal-mining employment (Figure 3) documents the decline of coal-fired generation in the U.S.

Three decades ago, nearly 180,000 people were working in the coal-mining industry. That dropped to about 53,000 in mid-2019.

Coal-mining interests point to the last three years, where employment increased by around 4,000, as evidence that the Trump administration's commitment to end the "war on coal" has succeeded in staunching the bleeding. Before you can rebuild, mining interests would say, you have to stop the bleeding.

U.S. asset owners have closed over 546 coal-fired units representing aggregate generating capacity of about 102,000 MW in the last decade, according to the Energy Information Administration (EIA) (Figure 4). Operators intend to close another 17,000 MW or so by 2025, the EIA said.

Federal environmental regulations like the Cross-State Air Pollution Rule (CSAPR) and the Mercury and Air Toxics Standards (MATS) have played a role in dimming the future of U.S. coal mining and coal-fired generation.

But the shale revolution that has unlocked trillions of cubic feet of low-priced natural gas, and continuing improvements in the technologies and economics of renewable generation, also played important roles.



In recent years, different partisan organizations have waged a war of words over "who killed coal?" Some overlook the role that automation played in thinning the employee ranks at coal-mining companies.

All of that notwithstanding, there is only one new-build coal-fired project scheduled to kick off over the next five years: a 75 MW power plant at a magnesium processing plant in Nevada scheduled to begin construction in 2023. That construction kickoff has a low probability of keeping its schedule. Most of the capital invested in the U.S. coal fleet over the next five years will go to in-plant maintenance, environmental compliance, turbine upgrades and the like.

Over the next five years, about \$7 billion is expected to be spent on these in-plant capital projects. We expect to see heavy investments by utilities such as Dominion Energy, Northern Indiana Public Service Company (NIPSCO), Santee Cooper, the Tennessee Valley Authority and Vistra Energy as well as operating units of American Electric Power, Berkshire Hathaway Energy, Duke Energy, Entergy, NRG and the Southern Company.

Natural gas outlook

Natural gas is expected to secure a smaller share of the new-build market over the next five years. It will account for about 26% of new-build construction, down sharply from recent years.

State utility regulators' concerns about the potential over-reliance on gasfired generation is one reason for the



Figure 4: Total net summer capacity of retired and retiring coal plants, 2010–2025

Source: U.S. Energy Information Administration

expected drop. In 2019, utility panels in California, Arizona and Indiana rejected utility plans to build gas-fired generation.

Regulators in states that toughened their renewable portfolio standard (RPS) or ramped up their greenhouse gas emission-reduction program were called upon to issue decisions that would limit new gas generation.

Figure 5 shows the deceleration over the past year of plans to build new gas-fired generation in the Southeast, Great Lakes, Southwest and Northeast regions. The fiveyear outlook to build new gas-fired generation slipped slightly in the West Coast, New England and the Mid-Atlantic regions and rose a tad in the Rocky Mountains area.

A number of utilities in the Southeast, including Florida Power & Light (FPL), Gulf Power and Tampa Electric have cancelled or pushed back the start of construction for new-build gas-fired generation.

FPL has been shuttering older, less efficient fossil plants for years, replacing them with high-efficiency natural gas combined-cycle generation. But it made a turn toward the sun and energy storage during 2019.

Renewables outlook

Plans to build new renewable energy generation — defined as solar, wind, hydro and other — soared over the last 12 months. There are plans to begin construction on about 131,000 MW of renewable generation over the next five years. That is roughly 72% of all new-build generation.

Historically, nearly 33% of renewable generation projects are either cancelled or delayed. Still, the dominance of renewable energy is an inescapable fact, contained in integrated resource plans (IRPs) from utilities around the country.

Within the renewable energy category, developer plans by fuel are shown in Figure 6. New-build solar is expected to account for just over half of the renewable generation built between 2020 and 2024.

The economics of renewable energy continue to improve. On a cost per kilowatt of installed of capacity, wind generation costs have fallen 69% over the last decade, and further reductions are possible, according to a mid-2019 research report from Lawrence Berkeley National Laboratory and the National Renewable Energy Laboratory. Photovoltaic (PV) solar generation costs also have dropped more than 70% over the last decade, according to research from the Solar Energy Industries Association (SEIA) and Wood Mackenzie Power & Renewables. That cost decline has helped fuel dramatic gains and projected gains of PV deployment (Figure 7).

In addition to aligning well with environmentally conscious regulators, renewable energy is popular with customers, particularly commercial and industrial (C&I) customers who may be operating under a green supply chain mandate from headquarters.

In years past, those directives led to increased purchases of green energy from local utilities, but more recently the drive to go green has meant installation of distributed renewable generation at a C&I customer's site.

Deloitte's Resources 2019 Study, released in mid-2019, noted that many U.S. businesses have targets for renewable energy procurement. Customers are driving this trend. The study said a portion of business support for renewable energy procurement is due to consumer demand, with 67% of consumers voicing concerns about climate change and the environment.



Figure 5: What a difference a year makes: New-build gas generation plans, 2019–2023 vs. 2020–2024 Source: IIR

3% Other 20% Hydro 51% Solar 26% Wind

Figure 6: Breakdown of renewable generation, by fuel Source: IIR





Businesses, Deloitte wrote, "see a connection between green (resource management programs) and green (financial gain). And more than ever, they see energy procurement as a way to create value, not as a cost."

Plans to construct new renewable energy generation account for nearly all of the planned generation additions in the Midwest over the next five years. Several areas — the Rocky Mountains, Southwest, West Coast and New England regions — expect to have renewable generation account for roughly three-quarters of generation that will be built over the next five years.

The Northeast, too, is poised to increase its reliance on renewable generation. During 2019, New York and New Jersey announced plans to ramp up clean energy plans, that include a healthy dose of offshore wind generation.

New York wants to have 9,000 MW of offshore wind generation by 2035; over the summer, it began negotiations with developers of two offshore wind farms totaling 1,696 MW. Under the recently enacted Climate Leadership and Community Protection Act (CLCPA), the state has committed to getting 70% of its electricity from renewable resources by 2030.

In mid-2019, New Jersey signed a contract with Danish developer Orsted for 1,100 MW of wind generation located about 15 miles off the coast of Atlantic City. Other states on the East Coast have moved forward with planned offshore wind projects.

But it is important to separate grandiose plans from stubborn reality. Despite its widespread popularity in Europe, where thousands of offshore wind turbines operate, only one offshore wind farm is operating in the U.S.: the 30 MW Block Island project off the coast of Rhode Island, which Orsted spent about \$290 million to build. That five-turbine windfarm began operating in late 2016.

Plans to build U.S. offshore wind gen-

eration typically have been met by prolonged and vociferous local opposition, which a few years ago doomed the planned \$2.5 billion Cape Wind project off the coast of Massachusetts.

Some 24 proposed U.S. offshore wind farms with a total generating capacity of more than 12,000 MW and a total investment value of about \$44.4 billion have been cancelled over the last decade.

Only days before New York Governor Andrew Cuomo announced that negotiations had begun with two developer teams for 1,696 MW of offshore wind, a different developer abandoned plans to build offshore windfarms off the coast of Long Island.

Will states invoke force majeure to override local opposition to offshore wind as well as land-based utility-scale solar farms? It is hard to see how many of those projects will get built otherwise over the next five years.

Nuclear Outlook

Only one new nuclear power plant (Blue Castle, Utah) is scheduled to begin construction over the 2020–2024 period. But that two-unit plant, which has a price tag of around \$20 billion, has experienced more than a decade of delays, and there are serious doubts that it will ever be built.

Construction of two new units at the Alvin W. Vogtle Nuclear Plant in Georgia continues to chug along, with projected in-service dates of November 2021 (Unit 3) and November 2022 (Unit 4).

The addition of two units at Vogtle is about 77% complete, but the costs — an estimated \$25 billion to add 2,234 MW of new nuclear capacity — casts a long shadow over other new-build nuclear projects.

At least Southern Company and its Vogtle co-owners can reasonably expect to receive electricity for their investments in that project. No such luck for utilities that tried to add two new nuclear units at the Virgil C. Summer Nuclear Power Station.

After spending a reported \$9 billion in

the project, South Carolina Electric & Gas and Santee Cooper abandoned it a few years back. The only thing it has generated is controversy, as investigations have dogged the two utilities since construction was cancelled in 2017.

Aside from the Blue Castle nuclear project, there are plans to invest about \$3.3 billion in small modular reactors (SMR) by the Utah Associated Municipal Power Systems (UAMPS). These are the only new-build nuclear generation projects on the horizon.

However, about \$9 billion of work at nuclear plants is likely to be spent over the next five years. Most of that is earmarked for decommissioning and demolition (D&D) of shuttered nuclear plants in New Jersey, Vermont, Michigan, Pennsylvania, Massachusetts and Iowa. That book of business may grow once owners of shuttered nuclear plants in California, Nebraska and Florida finalize their D&D plans.

Roughly \$1 billion in planned D&D spending for two nuclear plants in Ohio — Perry and Davis-Besse — looks like it will be pushed back. During the summer of 2019, the Ohio legislature passed, and the state's governor signed, legislation that provided about \$1 billion in subsidies over seven years to the plants, owned by a unit of FirstEnergy Corporation. The owner said the plants would be closed if the subsidies did not come through.

In addition to nuclear D&D work, other in-plant capital projects in nuclear plants are scheduled to begin between 2020 and 2024. These projects include nuclear refueling, construction of dry cask storage units, steam generator replacements, water system upgrades and controls upgrades.

Battery Energy Storage Systems

Battery energy storage systems (BESS) have grown rapidly in recent years, and are expected to grow even faster in the next few years. One reason is the technology's flexibility.

Some call BESS the "Swiss army knife of the energy industry." These systems can provide voltage support to the transmission and distribution grid, store renewable energy, relieve overloaded distribution transformers, provide uninterrupted or backup power and operate as part of a microgrid. This asset class is here to stay.

More than 700 MW of BESS have been installed in the U.S. to date, and an additional 4,000 to 7,000 MW should come online by the end of 2022. Roughly 4,000 MW are either under construction now or are expected to begin construction by the end of 2020. The areas with the most active pursuit of BESS include the West Coast, Southwest, Southeast and the Rocky Mountains.

Another factor behind BESS' dramatic growth trajectory: Order 842 from the Federal Energy Regulatory Commission (FERC), which required battery storage technologies to be used and compensated as a stand-alone resource or in conjunction with other generation resources.

FERC has asked all regional transmission groups to complete a comprehensive review of potential deployments of BESS technologies by the end of 2020, but some groups have asked for an additional year to complete the analytic work.

Microgrids

The U.S. has over 650 MW of microgrids up and running, and another 200 MW are scheduled to go live by the end of 2019. Roughly \$1 billion of microgrid construction projects are scheduled to begin construction this year.

That \$1 billion is a down payment on about \$2.85 billion of microgrid projects that are in an early stage of development or plan to begin construction by 2026.

C&I customers, as well as government agencies, are drawn to microgrids for the same reasons they are considering BESS: power reliability and power quality.

Manufacturing and service businesses, such as finance, are relying to an ever-greater degree on reliable power. Many define their needs as five nines (99.999% availability). Driven by burgeoning demand from C&I customers, educational institutions and units of government, the microgrid business could balloon into a \$20 billion market by 2026.

In recent years, these customers have taken steps to insulate themselves from electric disruptions caused by natural disasters such as wildfires and earthquakes as well as severe weather like Hurricane Harvey and Superstorm Sandy. For certain types of customer, cost is less important than staying online 24/7/365.

In addition to the autonomy from the grid that microgrids offer, cybersecurity makes them attractive to the military as well as units of federal, state and city governments.

There is a cost, sometimes a hefty one, to these benefits. Depending on which bells and whistles a customer wants, building a microgrid costs between \$1.5 million and \$3.8 million per installed MW of capacity.

Depending on the complexity and scale of a microgrid, costs for controls, software and switching systems have a mean cost of about \$155,000 per installed MW of capacity, with a range of \$6,200 to \$470,000 per installed MW of capacity.

The regions most interested in microgrids are the same regions that have been hard-hit by severe weather in recent years: The Southwest (especially the Gulf Coast), Southeast and East Coast.

Microgrids, like BESS, remain in a relatively early stage of development, subject to the same kinds of risks and uncertainties as any emerging technology.

Distributed Energy Resources

Distributed energy resources (DER) have grown, though they are still a nascent part of the electricity business. IIR expects *Continues on page 26*

KOP-FLEX



USING LESS AND USING IT SMARTER

At Regal, we can recertify your Kop-Flex[®] API-671 specified coupling and bring it back to like-new condition, with a typical savings of 50% compared to new. With facilities worldwide, Regal can offer this valuable service virtually anywhere, at any time. In every Regal location around the world, we set targets to reduce our footprint. It's a journey with a continuous improvement mindset.

For more information about how we can help with your coupling needs, call Application Engineering at 800-626-2120.

www.regalbeloit.com/turbomachinery Creating a better tomorrow™...

Regal, Creating a better tomorrow and Kop-Flex are trademarks of Regal Beloit Corporation or one of its affiliated companies. ©2016, 2019 Regal Beloit Corporation, All Rights Reserved. MCAD18069E • Form# 10042E



this sector to continue growing over the next five years.

As a category, DER includes a broad range of resources: rooftop solar, community wind or solar, BESS, electric vehicles (EVs) — basically anything that is not utility-scale and that does not burn fossil fuels.

Public policy, including supportive FERC and state utility commission decisions, have helped DER grow. For larger-scale DER, FERC Orders 828 and 842 provide for compensation if the resources provide generation or frequency support.

Utility generation owners have had some concerns about implementing Order 842, but DER can also rely on FERC Order 828 for support in the market.

Spending on DER looks likely to accelerate sharply in the coming years. Between 2016 and 2018, roughly 450 MW of DER came online, according to data tracked by IIR. Over the 2019–2020 period, we see as much as 3,000 MW of DER beginning to operate.

The regions with the greatest level of DER project activity are the Southwest, West Coast and the Great Lakes.

Looking ahead

Industry veterans accustomed to building baseload coal and nuclear generators may

scoff at the industry's plan to invest so heavily in building renewable generation over the next five years. They may question the rush to build BESS, microgrids and DER.

We do not expect all of these planned projects to be built. But neither do we expect to see a resurgence of the traditional baseload coal and nuclear generation projects over the next five years.

Those days are gone, at least for the foreseeable future, barring some dramatic "black swan" event like a reliability crisis or a dramatic run-up in the price of natural gas.

The U.S. power generation business still is in an early "discovery" mode about integrating renewable generation and BESS into the grid. And the proliferation of microgrids, though tiny by comparison to the U.S. generating fleet, remains in an early stage of exploration. All of these are disruptive trends that bear watching.

At the end of the day, most generation plans must still pass muster, to one degree or another, with each state's utility regulatory commission. Right now, those regulators are increasingly operating under a "greener is better" mandate from their governors, legislatures and citizens.

The novelist F. Scott Fitzgerald, author of *The Great Gatsby*, remains a widely read author in part because he was an eternal optimist.

He often wrote with a sense of wonder about the dramatic changes — technological, social, economic — he witnessed in the early years of the 20th century. At one point, this is how he explained his optimism about the future: "I saw the improbable, the implausible, often the 'impossible,' come true."



Britt Burt is vice president of Global Power Industry Research for Industrial Info Resources (IIR), which is headquartered in Sugar Land, Texas, and has six offices

in North America and 12 international offices.



Brock Ramey is North American Power Specialist for IIR, which provides global market intelligence for companies in the power, heavy manufacturing and industrial

process businesses. For more information see www.industrialinfo.com or email powergroup@industrialinfo.com.