

U.S. POWER INDUSTRY OUTLOOK 2023

Can Anything Reverse the Rush to Renewables?

BY BRITT BURT AND BROCK RAMEY

Conventional wisdom held that President Biden's plan to decarbonize the U.S. Power industry was wounded critically, if not fatally, by the one-two punch of the U.S. Supreme Court's Clean Air Act ruling in *West Virginia v. EPA* and U.S. Senator Joe Manchin's (D-W.Va.) resistance to supporting Biden's plan to fight climate change.

But Manchin reversed course and agreed to support a slimmed-down piece of legislation, the Inflation Reduction Act of 2022, that would direct an estimated \$369 billion to renewable energy and climate-change measures. That law broadened and extended the federal government's intervention in the power industry that stemmed from the 2021 Infrastructure Investment and Jobs Act (IIJA), which directed tens of billions of dollars into various aspects of electric power generation and grid reliability and resilience. But the U.S. power business appears to be headed for cleaner and greener pastures, according to new-build power plant data tracked by Industrial Info Resources (IIR).

Whether the U.S. generating fleet is cleaning and greening fast enough to make a dent in global climate change is the question. The Paris Agreement of 2015 pledged to take action to limit global temperature gain to either 1.5°Celsius or 2°C above pre-industrial times. The globe is nearly there, with cumulative temperature gain of approximately 1.2°C through 2022.

As the U.S. emerged from COVID-19 restrictions in 2021 and the government distributed trillions of dollars of aid, consumers engaged in "vengeance spending," scooping up cars, taking vacations, and renovating homes.

The reckoning started in late 2021 and mounted in 2022 as prices rose for all goods and services — including energy. Gradually, the U.S. public became familiar with supply chain bottlenecks. Across the U.S. economy, inflation rose to a four-decade high, scrambling the energy sector. For the power generation industry, the wait list for new transformers stretched as long as three years.

As natural gas prices shot up, coal made some opportunistic market-share gains among operating power plants. But the sharp price increase of fossil fuels is expected to cause U.S. electric demand growth to revert to the mean of between 0% and 1% in 2022 and 2023, according to a global electricity report from International Energy Agency (IEA).

There is, however, no evidence that gas vs. coal jockeying for market share among operating power plants has had any bearing on the power industry's new-build rush to renewables.

ENERGY TRANSITION

In 2014, when then-President Barack Obama first proposed his Clean Power Plan to reduce carbon emissions from coal-fired power plants by an estimated 870 million metric tons by 2030 compared with a 2005 baseline. The rule was finalized in 2015, but was never implemented because the U.S. Supreme Court, in a highly unusual step, blocked it. Years of litigation followed. The Clean Power Plan was the most litigated rulemaking that never went into effect in U.S. history.

While litigants wrestled, the market moved. For more than a decade, electric utilities, perhaps seeing the writing on the wall but certainly driven by the Clean Air Mercury Rule of 2005 and the Mercury and Air Toxics Standards rule finalized by the EPA in 2012, began closing coal-fired generators or switching them to burn natural gas instead. Federal activity on carbon regulation was also backstopped by state public utility commissions, which compelled utilities to file integrated resource plans (IRPs) on their proposed long-term electric generation options. Increasingly, those IRPs focused on decarbonization as well as low-cost options. As renewable energy became more competitive with traditional fossil-fueled generation, regulators pressed utilities to switch to the cleaner generation.

Long before the Supreme Court handed down its decision in *West Virginia v. EPA*, the market accomplished what lawmakers and regulators could not: meaningfully reducing CO₂

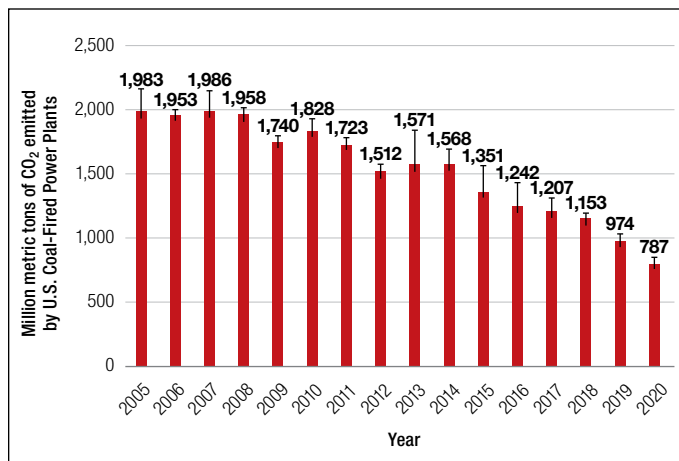


Figure 1: Annual carbon emissions from coal-fired power plants.

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North America	6,832	16,749	2,742	30,189	11,111	7,830
Middle America	409	449	178	2,047	281	127
South America	4,328	2,637	2,327	14,646	1,801	1,234
Europe	11,171	13,001	5,791	31,032	6,503	2,977
Africa	3,573	1,591	1,918	9,518	999	717
Asia	31,310	22,377	17,887	75,498	16,477	6,421
Oceania	1,133	670	530	3,577	382	322
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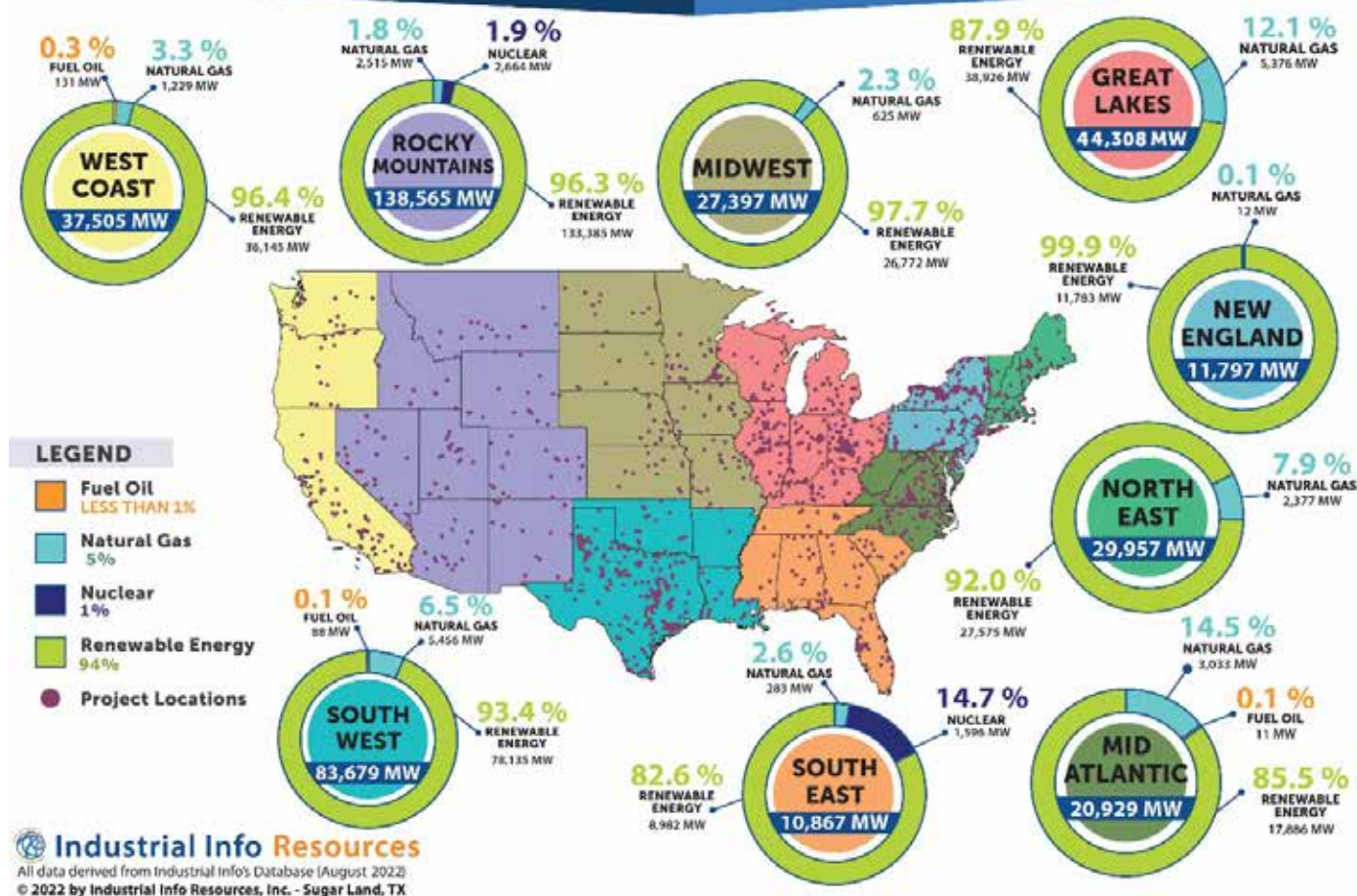


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U.S. POWER GENERATION CAPACITY

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emissions from coal-fired power plants. Between 2005 and 2020, according to the U.S. Energy Information Administration (EIA), CO₂ emissions from coal-fired power plants dropped by about 1.2 billion metric tons — far exceeding the aims of the Obama Clean Power Plan (Figure 1).

As a demonstration of how far and fast the market has moved, renewable energy is now expected to account for about 94% of all new-build power plant construction over the 2023-2027 period. That is up from 88% of all new-build project kick-offs only a year ago. Five years ago, renewable energy was expected to account for about 56% of all new-build power plant activity over the 2018-2022 period.

For the 2023-2027 period, the rush to renewables is generalized across the U.S., but is particularly pronounced in New England, where renewables are scheduled to account for 100% of planned power plant construction, the Midwest (98%), the West Coast and Rocky Mountains (both 96%), and the Northeast (92%) (see map).

Overall, developers have scheduled the construction of about 405 GW of new generation over the next five years. That is up about 28% from a year ago, and nearly double the planned capacity additions from two years ago (Figure 2).

Not all of that new generating capacity will be built as scheduled over the next five years. Depending on the technologies involved and developers' ability to secure financing, lock down offtake arrangements, and achieve regulatory support, we typically see between one-quarter and one-half of all announced projects delayed or cancelled. Higher interest rates mean that fewer projects will pencil out. But then again, as we have seen over the last 30 years, new power projects are announced on a near-daily basis.

Bottom line: Renewable power developers are in the green, and carbon-based developers are singing the blues.

COAL OUTLOOK

IIR is not aware of any new-build coal-fired power project that is scheduled to begin construction between 2023 and 2027. This continues a long downward trend for new-build coal as well as in the number of coal miners and overall coal use by the power sector. Coal burned by U.S. electricity generators is expected to fall slightly in 2022, to about 482 million metric tons, and a further decline for 2023 is forecast by EIA (Fig. 3). Employment in coal mines held steady at about 38,000, as

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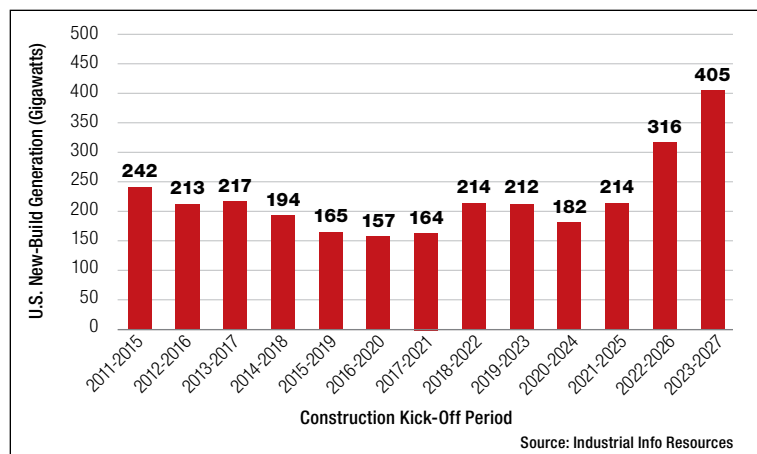


Figure 2: Planned new-build capacity additions increase sharply.

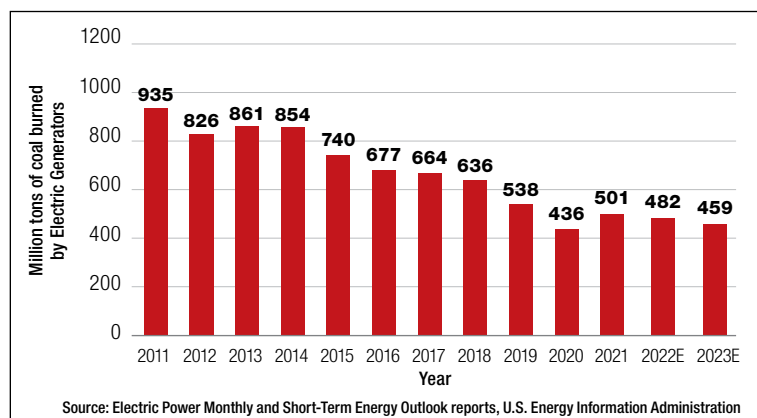


Figure 3: Coal burn by U.S. electric generators.

mines and their customers rationalized the demand for and supply of thermal coal (Fig. 4).

The IRA and IJA laws provide some federal dollars for carbon capture and sequestration (CCS), which could help existing coal-fired power plants stay open. But we think those credits, on their own, will not be enough to help make any proposed new-build coal plants move forward. Over the next five years, most of the project spending that will take place among coal-fired power generators is expected to be for: dismantlement & demolition (D&D); environmental remediation, such as closure and clean-up of coal ash ponds; and in-plant capital spending on maintenance and upgrades.

We estimate that about \$2.85 billion will be spent on D&D activities at U.S. coal plants over the 2023-2027 period. An additional \$4.4 billion is scheduled to be spent on environmental remediation over that time. A third category of coal plant project spending, in-plant capital spending, covering boiler revamps, fuel switching, generator rewinds and turbine refurbishments, will reach about \$820 million over the next five years. And \$600 million is expected to be invested in planned maintenance at coal-fired generators over the next 2023-2027 period.

Although Coal Country welcomed the Supreme Court decision in *West Virginia v. EPA*, and cheered Joe Manchin's months-long resistance to the president's climate legislation, there was scant possibility that either would reinvigorate coal-fired generation or lead to the construction of new coal-fired generation. Mid-summer analyses from Morgan Stanley and Glenrock Associated were even bleaker: the Supreme Court decision in *West Virginia* would not create an opportunity to extend the

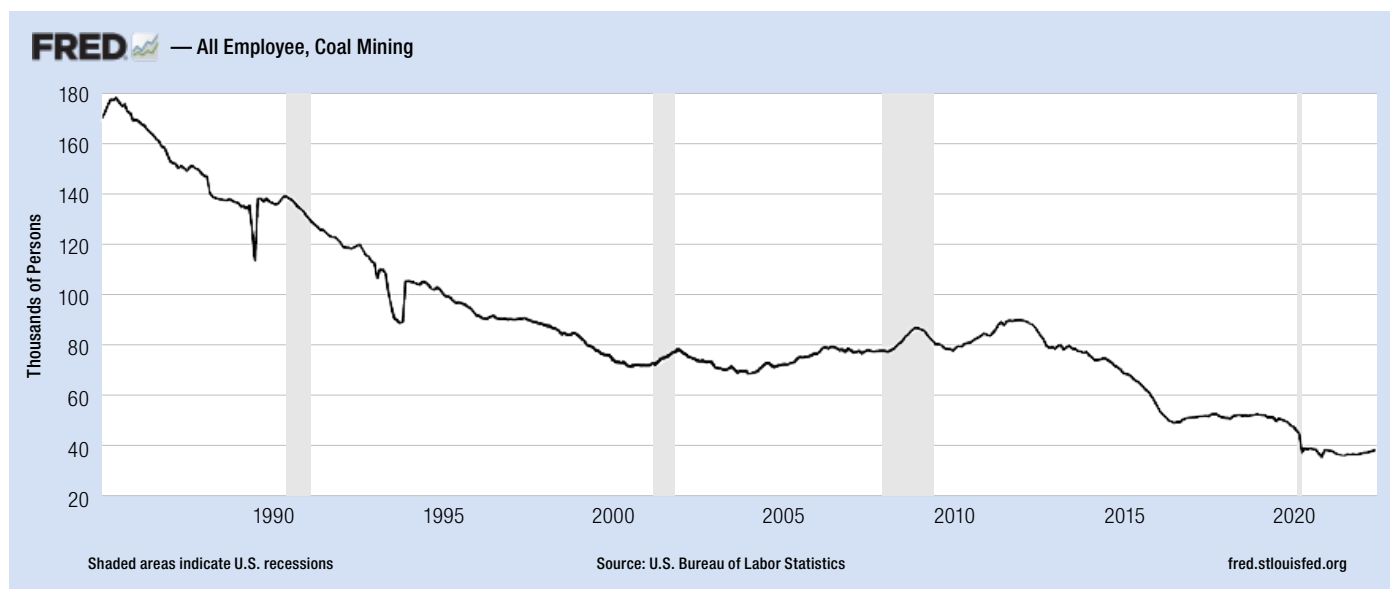


Figure 4: Coal mining employment continues to drop.

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lives of existing coal-fired generators, much less build new plants, analysts said. The court decision may be a setback for the Biden administration, “but utilities aren’t changing their plans,” according to Paul Patterson, an equity analyst with Glenrock Associates. He added that most of the action on reducing greenhouse gas emissions (GHGs) from the power sector has been driven by state policies, federal tax incentives, and corporate green power purchasing decisions. In the absence of federal action, there were plenty of other drivers pushing coal to the margins.

Once a coal plant is deactivated and mothballed, it’s not economic to reverse course and bring it back online. Approximately 115 GW of U.S. coal-fired generation was closed between 2011 and 2021. Going forward, we expect another 44 GW of coal-fired generation to be closed by 2025 (Fig. 5).

Numerous asset owners announced the closure of coal-fired power plants in 2022 or moved up the closure dates. During the year, the PJM Interconnection deactivated about 3.2 GW of coal-fired generation, most of which was owned by Energy Harbor. AES announced plans to exit coal by 2025. Duke told investors it would be coal-free by 2035. Xcel Energy plans to stop using coal by 2032. Public Service Company of New Mexico announced plans to close two units of its San Juan complex in September. There were many other announcements along these lines.

Another driver working against new-build coal generation is the rise of Environmental, Social and Governance (ESG) investing. More than 3,400 institutional investors have signed the U.N. Principles for Responsible Investing (PRI), and their assets under management (AUM) exceeded \$121 trillion as of March 30, 2021 (Fig. 6). That means developers seeking to build new coal-fired generation have fewer places to source their capital.

In a cruel irony, it may be that the most valuable assets owned by retired or retiring coal-fired power plants are their transmission lines and their land. Numerous coal-fired plant sites — including those in Illinois, Colorado, Nevada, New Mexico, North Dakota, Nebraska, Minnesota and Maryland — are slated to be transformed into renewable energy and/or battery energy storage projects in the next few years, according to an investigation by *The New York Times*. In addition, two retired coal-fired power plants in Massachusetts and New Jersey are scheduled to be converted to receive power generated by offshore wind farms. Further out, Bill Gates-backed TerraPower has plans to build a small nuclear power plant on the grounds of a Wyoming coal-fired power plant that is scheduled to be closed in the late 2020s.

NATURAL GAS OUTLOOK

The outlook for new-build natural gas generation in the U.S. has dimmed considerably in recent years. Looking forward to the 2023-2027 period, that erosion is expected to continue. Over the next five years, new-build natural gas generators are scheduled to account for only 5% of all new power

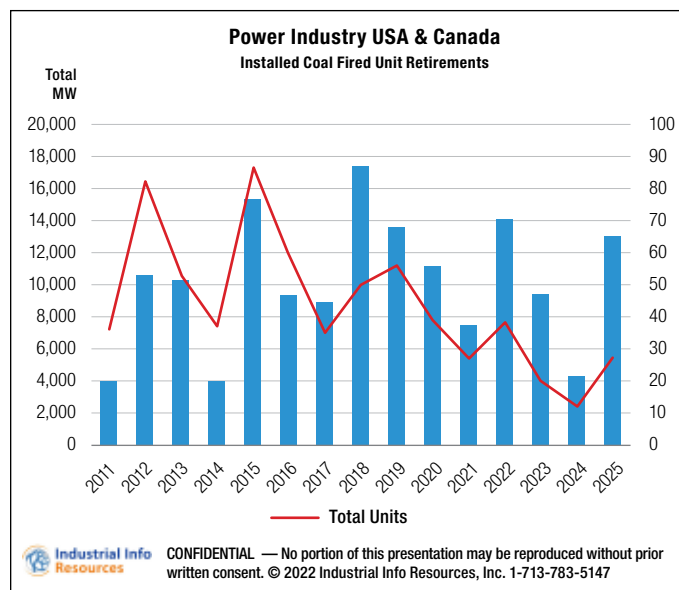


Figure 5: Coal capacity retirements.

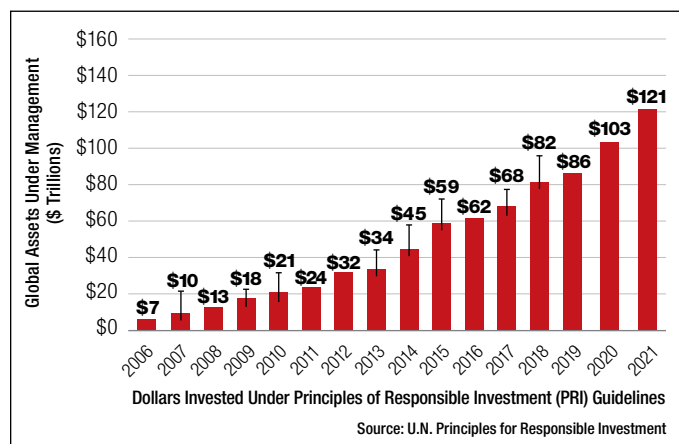


Figure 6: ESG investing continues to grow.

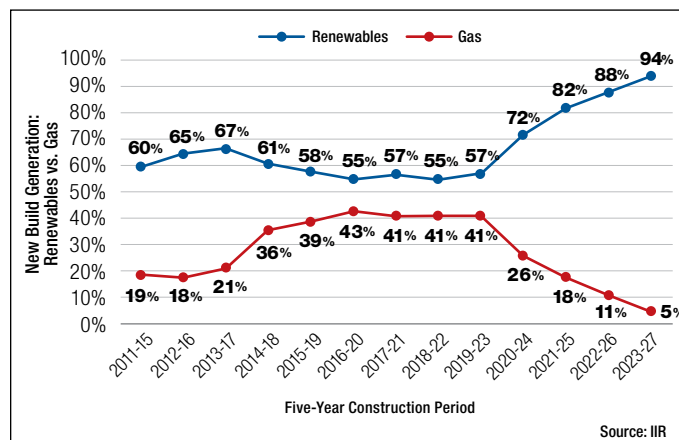


Figure 7: Proposed new-build generation, renewables vs. gas.

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plants scheduled to be built. Last year, that percentage was about 11%, and five years ago it stood at about 41% (Fig. 7).

What happened? One view is that gas became a victim of the “Carbon is Public Enemy #1” campaign undertaken by environmental organizations. A more nuanced perspective is that the hands of regulators have been tied by state laws and goals on renewable portfolio standards (RPS) and GHG reduction. Gas has a bleak future in states that are driving down their GHGs while increasing their RPSs.

On a percentage basis, the Mid-Atlantic region has the highest share of proposed new-build gas generators in the U.S., accounting for about 14% of all new power plants scheduled to be built over the 2023-2027 period. Following the Mid-Atlantic are the Great Lakes (12%), the Northeast (8%) and Southwest (7%). In terms of raw numbers, the Southwest has scheduled construction of the greatest amount of new-build gas-fired generation, at 5,456 MW, followed by the Great Lakes (5,376 MW) and the Mid-Atlantic (3,033 MW) regions.

Over two dozen proposed gas-fired generators that were scheduled to be built over the next five years have been cancelled. The aggregate value of those proposed projects exceeds \$13 billion. The states with the largest number of project cancellations on a project-dollar basis are: Virginia (\$1.8 billion); Texas, Pennsylvania and New Jersey (\$1 billion each); and Florida, California and West Virginia (all slightly less than \$1 billion each).

An additional 41 new-build gas-fired generation projects with aggregate value of \$15.8 billion were scheduled to begin construction over the next five years but have been delayed. Texas is far and away the state with the largest dollar-value of project delays, at more than \$8 billion, followed by Michigan (\$2 billion) and Ohio (\$1 billion). COVID-19 has been the cause of some of those project delays. The pandemic caused labor and materials shortfalls that have affected the entire power industry. Some of these delayed gas power projects could become reactivated over the next five years.

Organized wholesale regions like ERCOT (Electric Reliability Council of Texas) and MISO (Mid-Continent Independent System Operator) have sounded alarms of a potential generation shortfall in recent years, and the heat dome of Summer 2022 stretched those regions to the limit. Electric emergencies or rolling blackouts could focus the minds of regulators on the need for more dispatchable capacity. This bears watching, as events could cause regulators to relent and permit some new gas power development.

It is too soon to declare new-build gas plants a dead artifact of the 20th century. The thousands of MW of renewable energy that are operating, under construction or scheduled to be built will need to be backed up. That challenge outstrips the current capabilities of battery energy storage systems, even leaving aside the technological challenges of lithium-ion battery systems, as well as concerns over the available supply of lithium. Pumped storage hydro facilities could be paired with intermittent generation, but the cost and timeline for building new pumped-storage facilities is daunting. In short, as much as policymakers and developers want to quickly move toward higher reliance on non-emitting generation, we see a continued need for new-build gas-fired generation.

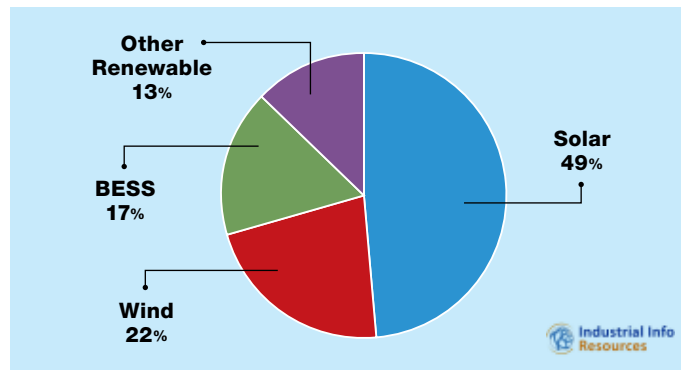


Figure 8: A more granular view of renewables.

In addition to new-build generation, IIR is tracking more than \$13 billion in planned in-plant capital spending at U.S. gas plants over the next five years. Also, developers, engineers, and analysts are investigating the potential to co-fire gas plants with hydrogen.

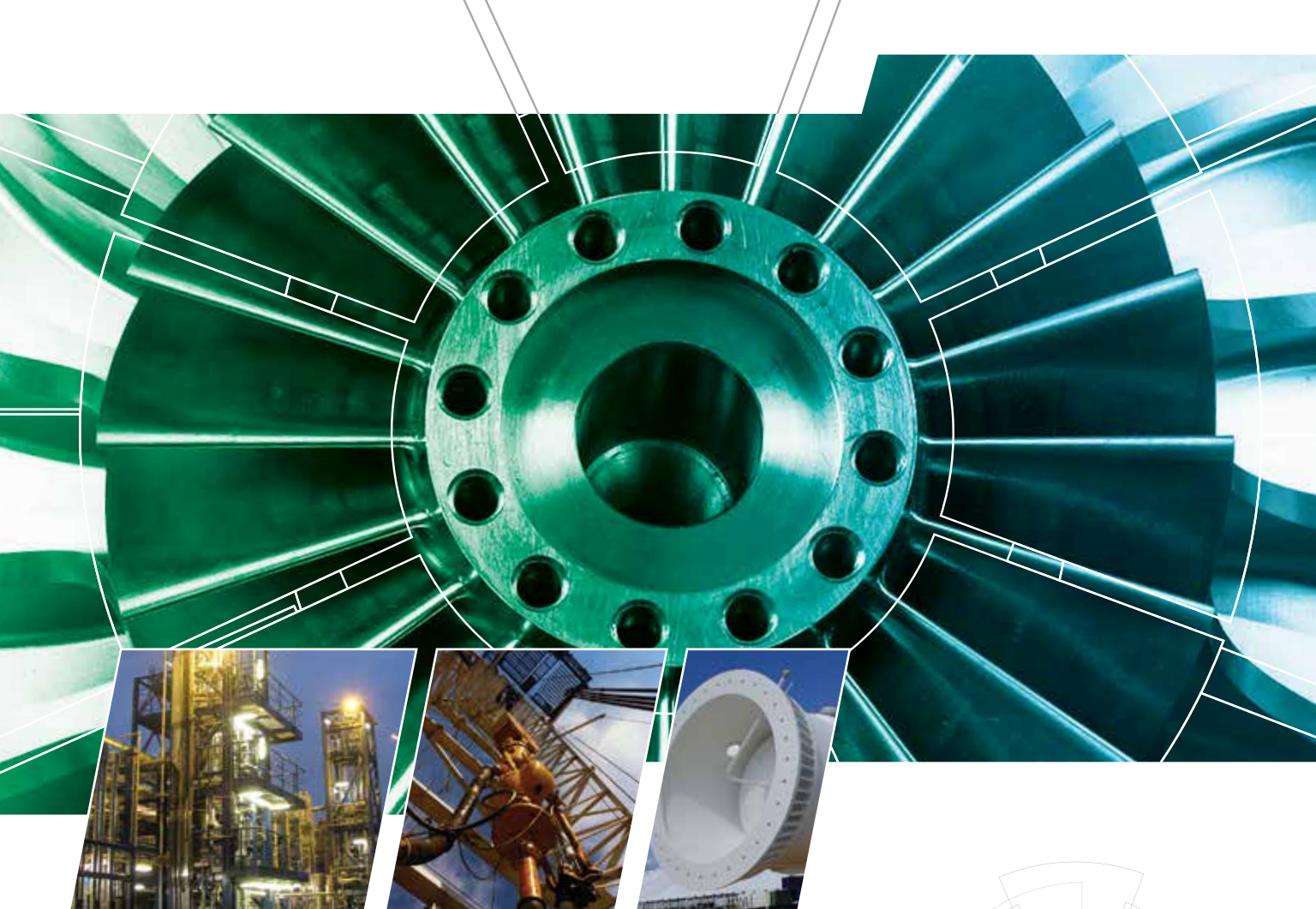
RENEWABLES OUTLOOK

Even before Senator Manchin reversed course over the summer and supported the president’s slimmed down climate-change bill, plans to build renewable energy generating capacity over the next five years were exploding. They have risen to about 379 GW or 94% of all planned new-build capacity over the next five years. Last year, renewables were scheduled to account for 88% of all new-build construction over the 2022-2026 period. Five years ago, for the 2018-2022 period, that percentage was 55%.

In assessing the new-build generation market, we did not include renewable energy plants that could get built due to the Inflation Reduction Act of 2022, as the thinner version of “Build Back Better” was tabbed. That proposal, with an estimated \$369 billion in clean electricity funding, includes Production Tax Credits (PTCs) for wind, solar and battery energy storage, among other things. The PTC for solar power would be new, as that industry has depended on Investment Tax Credits (ITCs) for years. If anything, our estimate for the new-build renewable generation market for the next five years could be conservative.

On a percentage basis, the U.S. regions with the greenest hues are: New England (where 100% of new-build generation is expected to be renewable); Rocky Mountains and West Coast (each 96%). On a MW-basis, the regions leading the green power parade are: Rocky Mountains (133 GW), Southwest (78 GW), Great Lakes (39 GW), and West Coast (36 GW). Again, we don’t expect all this planned renewable generation to be built as proposed. But the 2023-2027 period is starting off with an enormous number of renewable energy projects.

“Other” renewable energy projects, such as hydropower and geothermal, are expected to account for as much as 49 GW, or about 12% of all renewable capacity scheduled to be built over the next five years. Hydropower, in particular, is expected to benefit from some \$754 million in incentives contained in the Infrastructure Investment and Jobs Act, signed



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into law in late 2021 by President Biden. New-build hydro could also benefit from the Inflation Reduction Act of 2022, depending on how the enabling legislation is written: Will hydro be defined as a “renewable” source of energy? Given that people define “renewable energy” differently, we thought it would be helpful to provide a more granular look at how plans to build renewable energy break down.

Solar

The “run to the sun” has accelerated in recent years. In a category once dominated by wind power, plans to build solar generation have taken a decisive lead, with 49% of planned renewable new-build capacity, or about 184 GW, set to begin construction over the next five years (Fig. 8). Areas with the greatest amount of planned solar generation construction include the Rocky Mountains (55 GW), Southwest (52 GW), Great Lakes (26 GW) and West Coast (13 GW). A huge countervailing factor that could limit the growth in new-build solar is the rise in prices that started to become evident in 2021. The supply-chain bottlenecks and soaring costs for materials have derailed or delayed some of these planned solar projects.

Wind

Among renewable projects, wind power has long been the hare to the solar industry’s tortoise. But for the next five years, wind power will fall into second place with about 22% of all new-build generation, or about 82 GW. The U.S. regions with the greatest amount of wind power project activity over the 2023-2027 period, measured on a GW basis, include the Rocky Mountains (about 23 GW), Midwest (17 GW), Southwest (10 GW), and New England and Great Lakes (9 GW each).

Energy storage

Plans to build battery energy storage systems (BESS) have skyrocketed in recent years. Developers have announced plans to build as much as 64 GW of BESS over the next five years. Data from the EIA shows that developers proposed to sharply increase large-scale BESS projects between 2022 and 2024. Operational BESS capacity more than tripled in 2021, to 4.6 GW from 1.4 GW in 2020, according to the EIA (Fig 9). Most of that capacity was being deployed by regional transmission organizations (RTOs). Going forward, construction of new BESS capacity is expected to surge. The EIA projects BESS capacity will shoot up from an estimated 4.6 GW in 2021 to about 22 GW by 2025 (Fig. 10). About 382 BESS projects are scheduled to be built over the next five years, valued collectively at about \$81.1 billion. The regions with the greatest amount of BESS construction activity are the: Rocky Mountains, with 76 projects valued at \$33.3 billion; Southwest, with 109 projects valued at \$23 billion; and West Coast, with 76 projects valued at \$12 billion.

NUCLEAR OUTLOOK

The first iteration of the nuclear renaissance looks like it will be ending with a whimper, not a bang: the last new-build nuclear power project, the two-unit addition to the Alvin W. Vogtle

Nuclear Power Station, is scheduled to finish construction in 2023. Years late and billions of dollars over budget, the Vogtle unit additions, totaling 2,234 MW, were expected to be the showcase of a revived nuclear industry when they were announced in 2008.

The two new units now have an estimated \$32 billion price tag, nearly three times the original cost of \$12 billion. If the units are brought online in 2023, it will be roughly seven years after the first unit was scheduled to begin commercial operations. The owners, led by project manager Georgia Power Company, are embroiled in litigation over who pays what for the project. And GPC can expect some tough questioning from the Georgia Public Service Commission when prudence hearings begin.

As difficult as the Vogtle experience has been, and for the Virgil C. Summer Nuclear Power Station before it, at least those plants succeeded in getting steel in the ground. Another

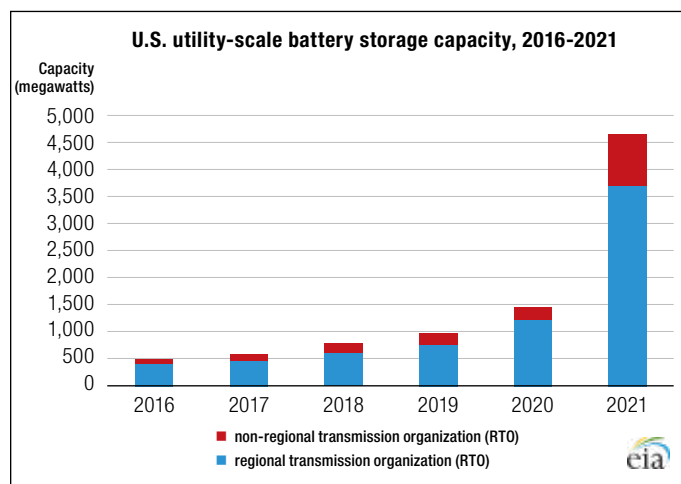


Figure 9: BESS operating capacity shoots up.

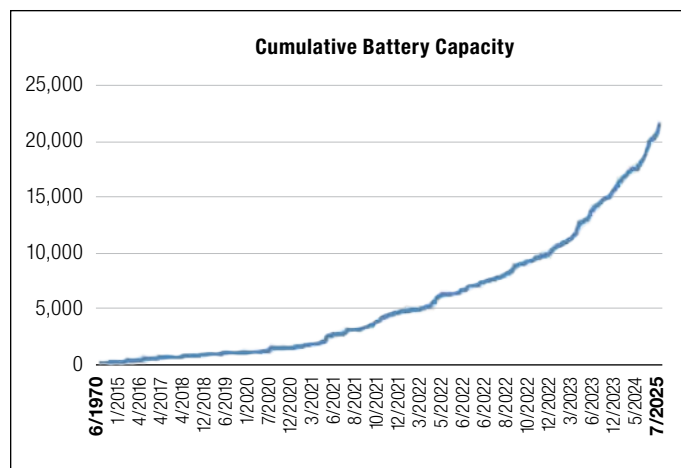


Figure 10: Actual and planned BESS capacity.

nuclear plant announced at the same time as Vogtle, the Green River Blue Castle Nuclear Power Station in Utah, hasn't made it out of the starting gate, and may never. That two-unit project, with total generating capacity of 2,000 MW, has been under development since 2008. It was designed to use two Westinghouse AP1000 reactors before Westinghouse exited the nuclear business with a 2017 Chapter 11 bankruptcy. Currently, the developer plans to begin construction in 2025. There are more questions than answers for that Utah project.

For a lot of reasons, utility leaders have been looking elsewhere for carbon-free generation that can be dispatched. The thinking now is the future is smaller — specifically, small modular reactors (SMR). One SMR design, from NuScale Power, received an approval from the U.S. Nuclear Regulatory Commission in August 2020. The Utah Associated Municipal Power Systems is trying to develop SMRs at Idaho Falls, Idaho. And Terra Power is eyeing construction of a different type of nuclear reactor, a sodium-cooled plant to be built at a soon-to-be retired coal-fired power plant in Wyoming. Both of those projects are scheduled to begin construction toward the end of the 2023-2027 timeframe. Also near the end of 2023-2027, the Tennessee Valley Authority and OPG (Ontario Power Generation) plan to begin construction of SMRs in Oak Ridge, Tennessee.

The Inflation Reduction Act law contained production tax credits for nuclear, recognizing its role in decarbonizing the electricity industry. IIR doesn't think those tax credits will be enough, on their own, to lead to new-build nuclear power plants over the next five years, but they would help keep existing plants open. On that front, license-renewal applications for several plants are likely over the next few years, including Comanche Peak (Units 1 & 2) in late 2022, Perry in 2023 and Clinton in 2024. IIR also is tracking almost \$1.5 billion in scheduled maintenance activity and more than \$33 billion of in-plant nuclear capital spending over the next five years. These figures don't include new-build nuclear construction projects.

In another sign of a nuclear resurgence, some in California are advocating that Diablo Canyon remain open after its scheduled closure dates of 2024-25, to provide generation and grid support for the energy-hungry Golden State.

INDEPENDENT ENERGY OUTLOOK

Project spending by commercial, industrial, and institutional (CI&I) customers to construct non-utility generation in the U.S. has increased in recent years, and

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IIR expects that trend will continue over the 2023-2027 period. There are various drivers:

- Renewable onsite generation is being constructed by CI&I customers for decarbonization or GHG-reduction goals.
- Some large customers have been investing in onsite generation to ensure always-on power.
- Some are building onsite generation to offset the rising cost of electricity from utilities.
- Large energy-hungry operations like data centers and bitcoin-mining operations have built industrial energy producers (IEPs) to ensure predictably priced power.
- Local environmental regulations are causing some to replace diesel-powered generators with natural gas or even renewable natural gas.
- Some power-sensitive manufacturers have resorted to building generation when local power quality is low.
- CI&I customers that are remotely sited are installing independent power generation to ensure 24/7 operations.

Sometimes this non-utility generation powers a microgrid. Other times it is for standby or emergency uses. As more companies in the CI&I sector tabulate the true cost of power outages or low power quality, we expect a growing number will choose to install their own generation.

New opportunities for this generation are presenting themselves. Although the idea behind distributed generation is that it will be used to power a particular site, ISOs and RTOs increasingly are seeking to interconnect the non-utility generation with the grid in order to provide reserve power or voltage support when grid-connected generation is stressed or stretched. Several independent system operators (ISOs) and RTOs across the country count on these resources to be ready to operate when the grid needs them. ERCOT, the system operator that supports most of Texas, is counting on these generators. Several times during 2022, ERCOT has called upon these resources to help meet the state's peak electric demand.

Other states, such as New York and California, are pushing to connect these independent energy generators to their respective grids. Some studies have shown that use of onsite generation assets can cut overall power generation spending by 20% or more. As the rising price of natural gas pushes up the price of power purchase agreements, the installation of onsite power assets is becoming more appealing. IIR is tracking plans to spend more than \$10 billion on non-utility generation over the 2023-2027 period. That number does not include smaller generation assets, such as rooftop solar or generators that have less than 300 KW of capacity.

Non-utility generation, like all other segments of the power business, is working to repair its damaged supply chain. The current three-year wait for transformers, plus bottlenecks and rising costs for solar photovoltaic and battery energy-storage materials, are evidence that broken supply chains are nowhere near repaired.

MICROGRIDS OUTLOOK

Microgrids are becoming more popular among CI&I customers for the same reasons as independent energy production. When powered by renewable generation, microgrids sometimes are part of an organization's decarbonization push. When powered by fossil fuels, microgrids may backstop utility-supplied power. Microgrids can be part of grid strengthening and hardening, as we see after each bout of extreme weather.

Spending on microgrids could reach several billion dollars annually during 2023-2027. CI&I customers and utilities are finding that microgrids can fill an important need. Some utilities deploy them as part of a multifaceted effort to prevent wildfires, or to support remote communities at risk of outages.

The industrial sector looks to microgrids for onsite power during times of need and for protection against cybercriminals. Microgrids also provide power to the grid during peak demand. Industrial Info is tracking plans to invest more than \$2.4 billion in microgrids over the next five years, (not counting potential commercial or residential). Microgrid projects are experiencing supply chain shortages, and competition for required skilled workers and equipment.

In the same way that transmission organizations and local utilities sometimes call on independent energy generators to fire up and provide generation or capacity to the grid during times of high demand or resilience events, microgrid operators are receiving similar emergency requests for grid support.

LOOKING AHEAD

Over the 2023-2027 period, we expect new-build power to be characterized by market disruptions including: Technologies that generate electricity or support transmission and distribution; economic assessments of options; environmental regulations and exigencies surrounding generation; the regulatory framework; inflow of federal funds to support generation technologies; and consumer expectations.

The predicted rise of electric transport will likely add new strain to electric distribution networks and generation. But now, the power industry faces another disruption from employee expectations. A growing number want greater work flexibility. If employers want to win the war for talent, they need to learn to be flexible and responsive to this aspect of industry disruption. ■



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