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How AI Enables Multigenerational Power Planning and Why You Need It

Aaron Larson

It's never been more important than it is today for power construction projects to progress smoothly. With the demand for power growing quickly due to the explosion in data center development, and the trend toward electrification of transportation and industry, power companies cannot afford delays and cost overruns when constructing power plants.

Yet, building a power facility is a complex undertaking, and history has shown that overschedule and overbudget projects are more common than the industry would like. The situation grows even more precarious when first-of-a-kind projects are on the table. Often, these new concepts introduce technical uncertainties, unproven construction methods, and unforeseen integration challenges that amplify both schedule and budget risks. Throw in supply chain constraints and you have a recipe for disaster. Thus, developing and implementing better project management techniques, advanced planning methodologies, and innovative construction approaches is essential to success.

A Multigenerational Approach Enhanced with AI

In a research report titled *Powered for Change 2025* issued by Accenture in August, the authors recommend a "multigenerational approach" to project development. "It's a shift from bespoke projects to repeatable systems; from singular firsts to continuous improvements; from cost escalation to compounded advantage," wrote Stephanie Jamison, lead author of the report, and global Resources practice chair and Sustainability Services lead with Accenture. "Rather than treating each infrastructure project as an isolated effort, a multigenerational approach connects them—technically, financially, and strategically—so that each project builds on the last," she added.

"I don't think the multigenerational approach as a concept is particularly new," Rob Hopkin, a contributing author of the report, and Accenture's Global Net Zero Infrastructure lead, told *POWER* in an exclusive interview. "When original fleets of nuclear and coal power plants were built back in the day, they were built as fleets, where you did it in a repeatable way. And we've seen the same things with solar and offshore wind, where the prices come down enormously because of more modularization, factory production, all that good stuff. But we think there's another level of gain from being very purposeful in that approach."

Meanwhile, as artificial intelligence (AI) data centers drive growth for the power industry, AI technology offers potentially great benefits for the industry. "AI is offering fundamentally different ways of working in the context of capital and project delivery, and firms are relatively nascent in exploring that potential," Hopkin said. "We've done work with a variety of clients, deploying point AI solutions—schedule optimization, writing of investment cases, reviewing of risk—but what we think is going to start being applied now is this end-to-end agentic approach, where you truly have human-machine orchestration of the full lifecycle of a capital project."

Accenture expects firms can achieve massive gains from that, because AI doesn't suffer from cognitive biases. "It doesn't have optimism bias. It doesn't fall for the sunk cost fallacy," Hopkin explained. "It can have access to all the information across domains, so you can have better coordination."

That means engineering, schedules, risk, cost, and many other dynamics that are part of a capital project can all be monitored and managed by AI. Furthermore, it can all be done across multiple generations. "It can see all the historical information relating to delivery from the last time you built something similar. What drove the cost? What drove the schedule? What were the challenges at the point of handover and commissioning?" Hopkin asked. "AI can ensure that those learnings are then embedded in full the next time you plan a similar project, which no human team can ever do alone."

Jim Mazurek, North American Utilities Strategy lead with Accenture, agreed that agentic AI could be a game changer. "Agentic AI could be applied to complex end-to-end processes," he said. "Agentic AI could maximize the roles—and the efficiency and effectiveness—we play as experts in the field. Meanwhile, the agents could pick up a lot of the more routinized tasks and activities along the way. There's a lot of air to squeeze out of that balloon."

Four Essential Levers

The report says four levers are critical for the success of the multigenerational approach. The levers target persistent challenges, such as cost volatility, supply chain fragility, and execution gaps. The levers are: scale efficient, resilient supply chains; foster community support and customer demand; reinvent talent, skilling, and workflows; and establish a strong digital core to power AI learnings.

Hopkin said all of the levers "need to be pulled," but to do so, other organizational changes may be necessary. "I think the crux of it is the willingness of organizations to think in a different way," he explained. "They must build investment cases and organize themselves in a way that thinks about a program, or a portfolio of projects, in its totality actually."

Hopkin noted that many organizations emphasize the project as the primary entity—the division of activity, thinking, and spending of money. "Stage-gated processes are for a project. A final investment decision is made for a project. And, therefore, the wiring of the organization is very much in favor of project-based thinking," Hopkin said. "You need to break through that to develop more of a programmatic portfolio, a multigenerational mindset. And, then, that will help you pull all of those four levers together."

In the end, the multigenerational approach doesn't necessarily resemble an assembly line. "It doesn't have to be a cookie cutter of exactly the same thing every time. It may, in some cases, be that the benefit is simply the repeatability of the methodologies that you're using, or the repeatability of some of the underlying balance-of-plant systems. or whatever it might be," Hopkin said. ■

—***Aaron Larson** is POWER's executive editor.*

Ready, Go, Set: How Disruptions Are Flipping EPC Contracting

What's driving a fundamental shift in engineering, procurement, and construction (EPC) contracting? Equipment lead times. Workforce shortages. Data center timelines. *POWER* examines how the traditional EPC model—plan, permit, procure, build—has been upended by new market realities.

Sonal Patel

For decades, engineering, procurement, and construction (EPC) firms have generally entered projects after utilities completed feasibility studies, secured permits, and negotiated power contracts. Typically, equipment procurement has followed design, and construction begins after approvals, in a sequence that has been deliberate, mostly linear, and allowed risk allocation to match project maturity. But, given a number of recent disruptions, that model appears to be on the brink of a fundamental inversion.

The first of three interconnected trends stems from geopolitical tension, which continues to send ripples through global supply chains and challenge project feasibility. According to executives participating in the EPC Show 2025, which took place in Houston last June, tariffs and trade realignments have made the cost and availability of key equipment increasingly uncertain, prompting developers and EPCs to reevaluate where and when to invest. A second, more structural tension lies in the industry's ongoing effort to balance traditional energy infrastructure with energy-transition work. Gas-fired, nuclear, and renewables now compete for limited capital and skilled labor (Figure 1) under volatile policy conditions, they noted. And the third—perhaps the fastest-moving disruption—is the extraordinary surge in electricity demand from artificial intelligence and data center growth, which is reshaping grid and generation planning in real time (see sidebar).

1. A skilled labor crunch is challenging power project development across nearly every region of the world. Courtesy: Burns & McDonnell

At the Experience POWER conference in Denver on Oct. 29, Michael Caravaggio, EPRI's vice president of fleet reliability, noted that these pressures come amid an already strained operational profile. "Six of the top 10 days for electricity use occurred this year," he said. "For essentially my entire career, the peak energy use has always been in the summer, but two of the highest peak days that occurred in 2025 were winter days." He added, "We actually have 20 GW less of coal and gas capacity today than we did about five years ago, but we had many more days this year where we needed more than 9 TWh from that energy. That's a big concern, especially if we're going into a period of growth, especially if we can't build fast enough to bridge that gap." Caravaggio suggested load growth once measured in decades is now arriving in quarters, driven by data center demand as utilities sign multi-gigawatt service agreements to support hyperscale projects. If flexible capacity isn't built adequately or fast enough, "it's a lot of load that makes the system get closer and closer to being put on the edge," he warned.

A Key Constraint: Infrastructure Timelines and Equipment Bottlenecks

As some experts told *POWER*, urgency—not necessarily cost—has now become the defining force reshaping EPC contracting. In its November 2025–released *2025 Electric Report*, Black and Veatch found data centers in 18 months from final investment decision to operation, while the grid and power infrastructure required to serve them can take three to six years. "The mismatch is straining utilities as they try to deliver city-scale power on exponentially squeezed timelines," the report notes.

"The urgency is real," the report says. "Data center developers need firm answers—how much dispatchable power is available, where and when. Utilities are working to meet that demand, even as they navigate complex permitting, aging infrastructure, uncertainty in planning and forecasting, material lead times, and workforce limitations. While there's not a one-size-fits-all answer to this challenge, there is real opportunity and progress when utilities and data center developers bridge the gap and work closely together and with their local Authorities Having Jurisdiction (AHJs)." However, "This isn't just about megawatts. It's also about speed, uncertainty about demand and funding, and the moving goalpost that requires business strategy updates on a continuous basis, not single projects that demand gigawatts," it adds.

Still, the biggest pinch point compounding project timelines remains equipment procurement, experts told *POWER*. One reason is that procurement is no longer a utility-EPC supply chain concern, it has become a multi-industry competition for constrained manufacturing capacity. Data centers, renewable developers, manufacturing facilities seeking electrification, and grid modernization programs are all competing for the same transformers, gas turbines, and circuit breakers simultaneously. Gas turbine and transformer manufacturers—once comfortably sequenced downstream of project approvals—are now first in line for capital commitments, given lead times of five years or more. In its third quarter (Q3) earnings call on Oct. 22, GE Vernova reported 12 GW of new gas turbine orders in Q3 2025, following 9 GW in Q2, pushing its total gas power backlog—including slot reservation agreements—to 62 GW.

"Customers are providing us enough financial capital on day one that one could argue we could be booking these things as orders," CEO Scott Strazik said. "They know they've got the equipment

The Utility Urgency for Procurement

Recent utility earnings reports suggest the materialization of demand is occurring at an unprecedented pace, and that rapid scaling has, in turn, prompted a rethinking of project timelines, procurement strategies, and contract structures.

At Entergy, data center demand in its Gulf Coast territory has expanded to a 7–12 GW pipeline—up from 5–10 GW just one quarter ago—prompting the company to move aggressively on long-lead equipment and EPC capacity. The company has secured more than 19 GW of generation components, including 4.5 GW of new power island equipment slated for 2031–2032, and 90% of the materials required for transmission projects through 2030. Executives said projects for customers such as Google and Meta are advancing under cost-protective service agreements, while new laws in Arkansas and Mississippi are expediting approvals for economic-development generation. Chief Financial Officer (CFO) Kimberly Fontan described the current environment as "very strong growth driven by our customer-centric capital plan," even as CEO Drew Marsh acknowledged tighter craft labor markets and higher EPC costs.

American Electric Power (AEP) is also leaning hard into the infrastructure supercycle as load growth accelerates across its 11-state footprint. The company projects system peak demand will reach 65 GW by 2030, fueled by data centers, reshoring industries, and large industrial projects. About 28 GW of new load—mostly from hyperscalers under take-or-pay contracts—is already committed, prompting AEP to lift its long-term growth outlook and expand its capital plan to $72 billion through 2030. More than two-thirds of that investment targets transmission and generation, supported by 8.7 GW of gas turbine capacity already secured and new high-voltage equipment agreements. CEO Bill Fehrman called this "a transformative moment for our industry," citing the company's unmatched 765-kV transmission backbone and legislative wins in Texas, Ohio, and Oklahoma that streamline cost recovery.

Dominion Energy, similarly, is tackling one of the largest simultaneous generation and transmission buildouts in its history as load from data centers surges across Virginia and the Carolinas. The company now has roughly 47 GW of data center demand in various contracting stages—up 17% since last year—including 10 GW under executed service agreements. CEO Bob Blue said the growth underscores why Dominion is "developing resources across distribution, transmission, and generation to meet this critical need on a timely basis." Major projects include the 2.6-GW Coastal Virginia Offshore Wind installation, nearing completion in 2026, and the 1-GW Chesterfield Energy Reliability Center natural gas plant. Dominion has also submitted $2.9 billion in new solar and storage filings, and its largest-ever PJM transmission proposals.

NextEra Energy, notably, appears to have more concretely moved beyond traditional EPC sequencing to a vertically integrated, speed-to-market model aimed at serving hyperscale and industrial load growth. The company's 30-GW renewables and storage backlog now includes 3 GW of quarterly additions, backed by a domestic supply chain that CEO John Ketchum called "a world-class development platform." Its recent partnership with Google to recommission the 615-MW Duane Arnold nuclear plant in Iowa, for example, illustrates how data center demand is driving bespoke generation agreements that blend nuclear, storage, and gas assets under long-term power purchase agreements. "We are unique in that we combine a national footprint, a strong balance sheet, supply chain capabilities, and experience in building all forms of generation and transmission, together with unmatched customer relationships and an industry-leading team on a development platform second to none," Ketchum said.

Likewise, Southern Co.'s load outlook has accelerated to levels not seen in decades, prompting a decisive shift toward contract-based generation and forward procurement. Executives said the utility has signed four large-load agreements across Georgia and Alabama in recent months totaling more than 2 GW, as part of a 50-GW pipeline of potential incremental demand through the mid-2030s. Georgia Power's updated forecast supports 10 GW of new capacity requests—including five combined cycle gas units and 11 battery energy storage sites—while Alabama Power is advancing 2.5 GW of new gas and storage builds, and recently acquired the 900-MW Lindsay Hill facility. CFO David Poroch emphasized that new data center contracts include minimum-bill provisions that "cover all of our costs, whether or not the meter spins," securing cost recovery as load ramps while, in parallel, they work those other solutions." GE Vernova's Electrification business backlog echoes the crunch: Orders "more than doubled year-over-year" to $26 billion, including $400 million in hyperscaler orders in Q3 alone. Prolec GE, a joint venture originally established between Xignux and General Electric in 1995—whose full acquisition GE Vernova announced on Oct. 21—reported that transformer sales to data centers have risen from 10% of total business in 2024 to 20% in 2025.

And while transformer shortages are cited as a particular crisis, an October 2025 analysis conducted with American Clean Power by Wood Mackenzie reported that demand for transmission and distribution (T&D) equipment has surged by 35% to 274% since 2019, driven by data center expansion, manufacturing investment, grid modernization needs, and extreme-weather resilience efforts. Power transformer lead times averaged 128 weeks—nearly two and a half years—down from a peak of 138 weeks but still twice pre-2022 levels, while switchgear averaged 44 weeks. The firm noted that tariffs, volatile electrical steel and copper prices, and ongoing order backlogs continue to strain domestic production capacity.

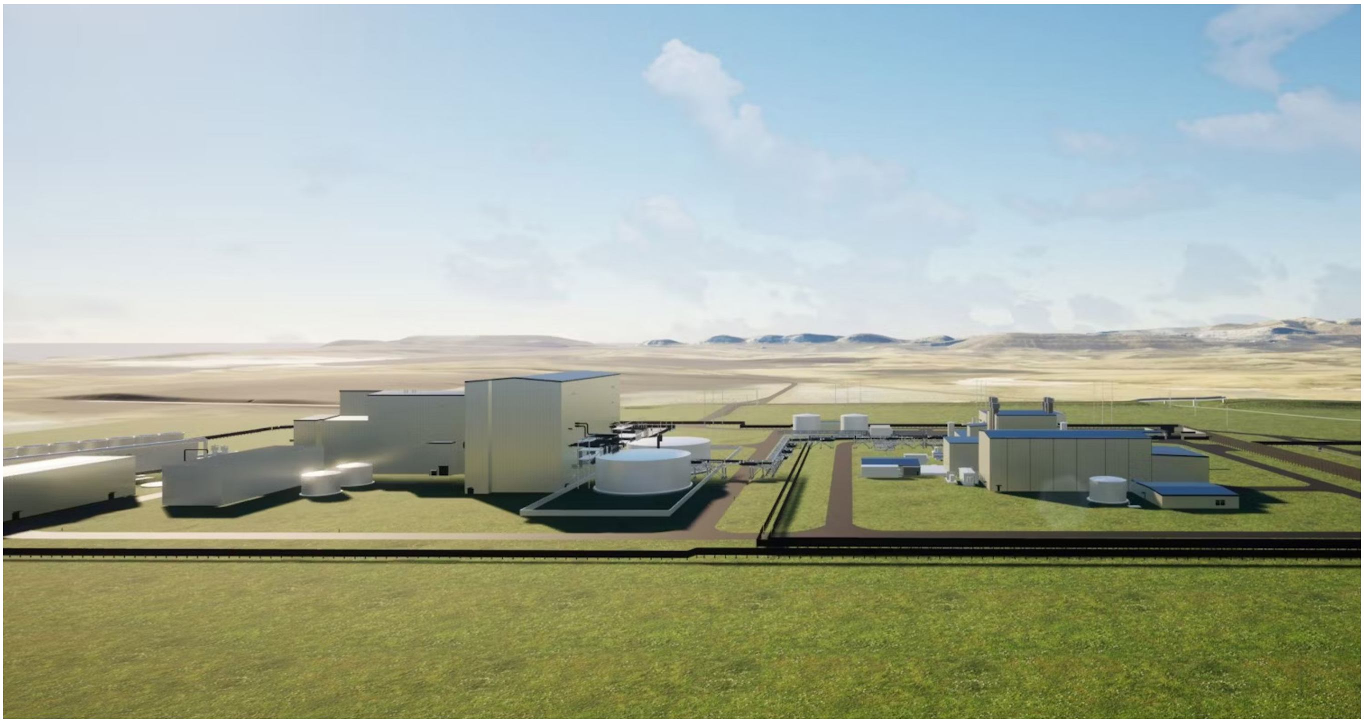
A separate U.S. Department of Energy report cited by Northfield Transformers in August indicated that some large power transformers now require more than 200 weeks—nearly four years—for delivery. Circuit breakers—another critical category of T&D infrastructure—are also emerging as component bottlenecks. At the October 2025 Experience POWER conference, industry panelists highlighted supply constraints for medium-voltage breakers as utilities race to build and upgrade substations to accommodate data center loads.

'Ready, Go, Set' as Industry Standard

EPCs told *POWER* they are responding to the myriad shifts in the broader energy industry with their own evolution. At Burns & McDonnell, a legacy design-build firm founded in 1898, that evolution has meant collapsing the traditional boundary between strategic planning and project execution. "The complexity of the energy transition requires smarter, more strategic planning from the start," Scott Strawn, senior vice president and general manager of the Power Group at Burns & McDonnell, told *POWER*. "The integration of 1898 & Co., our consulting arm, has been pivotal, combining their upfront business and utility consulting experience with our traditional engineering, procurement, and construction services. This allows us to partner with clients at the earliest stages, helping them navigate everything from decarbonization strategies to grid modernization before a single shovel hits the ground."

The approach addresses a fundamental mismatch. While utilities face 18-month data center interconnection timelines, they lack the internal capacity to complete feasibility studies, equipment selection, and procurement strategy simultaneously. "By pairing deep consulting knowledge with execution strength, we deliver holistic, end-to-end solutions that help clients manage existing assets and plan for a sustainable, reliable, and resilient energy future," Strawn said.

The consulting-plus-execution model addresses a fundamental sequencing problem that now qualifies project viability. "In today's gas market, the traditional 'Ready, Set, Go' development cycle has been flipped to 'Ready, Go, Set,' " Brendan O'Brien, senior business development manager in the Power Group at Burns & McDonnell, told *POWER*. "Owners are now required to make major capital commitments, such as placing deposits on long-lead equipment, at the earliest stages of a project, often before permits are secured, or the project is even fully defined."



2. TerraPower's Natrium Demonstration Project in Kemmerer, Wyoming—developed with Bechtel as its engineering, procurement, and construction (EPC) partner—features a 345-MWe sodium-cooled fast reactor coupled with molten salt energy storage to enable output to boost to 500 MW when needed. Courtesy: Bechtel

All of the Above Is Now the Norm

Another notable shift is a push for technology flexibility, given, as Black & Veatch's *2025 Electric Report* notes, load growth is now edging out emissions reduction as utilities' top priority, driven by data centers, industrial electrification, and manufacturing reshoring. Only two-thirds of surveyed utilities now report active clean-energy goals—down from 80% in 2024—while near-term investment plans for solar, wind, and electric vehicle fleet electrification have declined. In their place, utilities are pursuing more diversified "all-of-the-above" portfolios that balance renewables with natural gas, nuclear, and battery storage to maintain reliability and energy security. The firm calls it "a transition within the transition," where success may depend less on any single technology and more on optionality, pivotally, to support the ability to flex across fuels, policies, and timelines as load growth accelerates faster than infrastructure can catch up.

Bechtel, for example, simultaneously manages a $21 billion liquefied natural gas (LNG) portfolio (Rio Grande LNG Phase 1, Rio Grande Trains 4 & 5, Port Arthur LNG, and Corpus Christi expansion), as it is building advanced reactors (the Natrium Demonstration Project in Kemmerer, Wyoming, targeting 2029 operation). But, on the heels of success at Vogtle 3 and 4 in Georgia, it is also developing next-generation large reactors internationally (Poland's AP1000 facility, targeting 2033), while working on utility-scale solar (Mammoth Solar in Indiana, 1.3 GW across three phases by 2027), and providing front-end engineering and design (FEED) services for gas-fired generation.

The Natrium project (Figure 2) broke ground in June 2024. It's notable, in that, the first-of-its-kind facility exemplifies the expanding role EPCs are playing in advanced nuclear technology projects. Bechtel notes its "Digital Delivery" approach integrates building information modeling (BIM)—a comprehensive 3D virtual representation of the entire facility—with a central data environment to streamline design-to-construction workflows, enabling real-time coordination across design, procurement, and construction teams.

Likewise, Kiewit, through a joint venture with Black & Veatch and Aecon called Cascade Nuclear Partners, secured the progressive design-build contract for Energy Northwest's Cascade Advanced Energy Facility—four X-energy Xe-100 small modular reactors totaling 320 MW—while simultaneously partnering with NRG and GE Vernova on 5,000 MW of conventional gas generation across the Texas and PJM markets. The firm is also delivering Oklo's Aurora fast reactor at Idaho National Laboratory for operations later this decade.

Fluor continues to hold strategic optionality through its 39% equity stake in NuScale Power while continuing Phase 2 FEED work on Romania's six-reactor NuScale plant. Zachry Group spans the spectrum from conventional gas (Duke Energy's 1,360-MW Person County combined cycle facility, targeting 2028) to "clean combustion" technology, including for NET Power's first utility-scale near-zero-emissions gas plant in Texas, which is expected online in 2026. It also has a joint venture with Quanta Services to deliver NiSource's 2,600-MW combined cycle facility in Indiana by 2032.

However, not all EPCs are responding to equipment scarcity and timeline compression by taking on construction risk. KBR formally exited the lump-sum EPC market in 2022, following a decision first announced during the COVID-19 period. The company cited volatility in labor, materials, and logistics costs as incompatible with fixed-price contracting, where the EPC firm assumes full responsibility for delivering a project at a single agreed-upon cost.

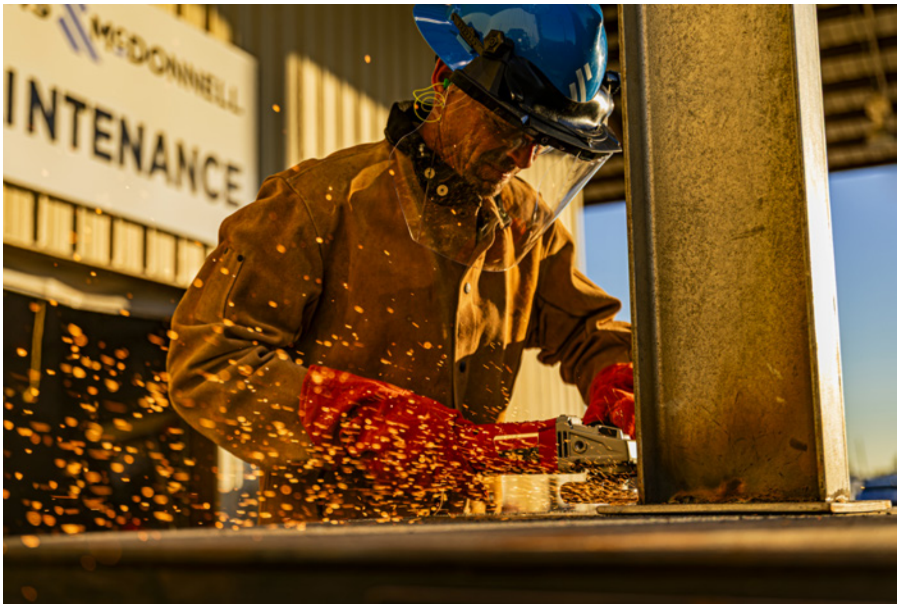
And, despite its deep nuclear and infrastructure history, AECOM recently deliberately shifted toward professional services models that emphasize advisory, program management, and owner's representation rather than lump-sum EPC delivery. In its August 2025 Q3 earnings call, AECOM CEO Troy Rudd emphasized the firm's advisory business grew at double-digit rates with plans to double the platform to $400 million in net service revenue within three years.

Likewise, at the May 2025 Bernstein Strategic Decisions Conference, Jacobs CEO Bob Pragada told investors that about 70% of the firm's work is now cost-reimbursable rather than fixed-price. He said Jacobs is increasingly focused on advisory and conceptual design engagements "because there is no scope" defined yet—allowing the company to shape projects at the decision-making stage before construction risk materializes. WSP's $1.78 billion acquisition of POWER Engineers in 2024 reflects a similar pivot. Both firms describe themselves as "consulting" organizations providing "program and construction management" and "high-level advisory" services rather than at-risk construction delivery, according to WSP's acquisition announcement and program management materials.

"We've seen across the industry companies pull back from lump sum," Andy Hemingway, Worley's executive group director of growth, reportedly said at the EPC Show in Houston this June, according to materials published by conference organizers. "I think there are a few reasons for that. One is that the premiums right now are high—people will take the risk, but they will charge for it. And the second one is probably each of us on this panel has had some painful experiences around lump-sum contracting due to misalignment on successful outcomes, so we're looking at more collaborative models."

Michael McKelvy, CEO of McDermott International, was more direct about the financial reality: "I think that we're all undergoing a transition where we cannot—for a variety of reasons—afford to bid EPC projects lump sum now. That is the reason so many companies have failed—they bit off more than they could chew, they took on risk that they couldn't mitigate." If contractors cannot bear the risk, it falls to customers and project owners. "We're all taking less risk," he said. "The financing side wants to see a little bit more cost certainty. The clients certainly didn't factor in the ultimate, realistic cost of the projects into their performance." McKelvy also suggested that strong customer relationships and early EPC integration could help avoid cost surprises for project owners.

Bechtel, which is still willing to accept fixed-price work, attributes success to early engagement with supply chains and equipment selection during pre-FEED and FEED stages. "You can't blur the lines of accountability. I think that's really, really critical," Paul Marsden, president of Bechtel's Energy global business unit, said at the EPC Show panel. "But there's so much you can actually do with a very modest level of investment to get in help and work to make each other successful."



3. Burns & McDonnell opened a 14,000-square-foot Construction Academy in Pearland, Texas, in 2025, offering knowledge assessments and hands-on training. A permanent skills facility simulating job site conditions will open in 2026. The academy qualifies craft workers through online knowledge assessment followed by hands-on evaluation—part of Burns & McDonnell's effort to address labor constraints and develop next-generation talent at scale. Courtesy: Burns & McDonnell

Workforce: Potentially the Most Critical Constraint

While equipment shortages and capital availability dominate headlines, workforce limitations have rapidly ascended as the most immediate and pressing bottleneck on project execution in 2025. At Experience POWER, panelists repeatedly called attention to the convergence of surging demand by multiple industries (including data centers), which is potentially creating more competition for a shrinking skilled trades pool.

"As much as all of us are probably pretty happy we're in this industry, I'm not sure if all our kids are thinking about being in this industry," said Carvaggio during the show's keynote speech. The workforce burden extends across operations and construction, he said. "You need an enormous amount of people to build these assets, and you need a dedicated, skilled workforce to run these assets," he said. "We're competing against the data center for labor. We're competing against the LNG terminals for labor. It's a huge challenge, and it's going to get worse."

While a definitive figure is difficult to pinpoint, estimated numbers are staggering. A Kearney study released in August 2025 in collaboration with the IEEE Power and Energy Society found that the global power engineering workforce must grow 100% to 200% by 2030—from roughly 450,000 to as many as 1.5 million engineers—to design, implement, and operate new power infrastructure. Today, "Up to 40% of global power executives find that an insufficiently skilled workforce and competition for talent are the two biggest challenges in filling engineering roles," Kearney noted.

The scale of the challenge could grow even more acute at the regional level. At the June 2025 EPC Show panel in Houston, Bechtel's Marsden projected a shortfall of 45,000 to 50,000 craft workers across the U.S. Gulf Coast alone—a region hosting roughly 1,200 miles of active construction sites for LNG facilities, refinery expansions, and power generation projects.

Proactive EPCs are responding with transformational workforce development initiatives. Burns & McDonnell, for example, launched a 14,000-square-foot Construction Academy in Pearland, Texas, earlier this year, designed as both a recruitment hub and skills development center. The firm is also deploying mobile training units that bring in-the-field knowledge assessments directly to project sites, reducing onboarding time and ensuring a supply of skilled artisans ready to work. Addressing the labor shortage requires new, scalable approaches, said Jeff Rashall, vice president of Burns & McDonnell's Construction Group. The company's initiatives aim to create a self-sustaining pipeline of talent, emphasizing safety, productivity, and rapid upskilling, he said (Figure 3).

Bechtel is pursuing complementary workforce strategies that combine global skills development with local training partnerships. Internationally, the company has launched initiatives such as its 2025 nuclear energy skills collaboration with the Gdansk University of Technology in Poland to help train the next generation of nuclear engineers. Domestically, Bechtel continues to work with high schools, colleges, unions, and veteran programs in Texas Gulf Coast communities—including Sabine Pass and Port Arthur—where large-scale LNG and pipeline projects are underway." Our industry's future depends on rebuilding America's construction workforce," Craig Albert, Bechtel's president and COO, recently wrote. "Without enough tradespeople, mission-critical projects could face lengthy delays or fail to get off the ground at all. Rebuilding America's construction workforce is no longer optional—it's a national imperative."

Kiewit is also investing heavily in workforce training through its Accelerated Journeyman Development Program and a growing network of mobile training facilities to build structured career paths for emerging craft professionals. A key facet entails bringing instruction directly to jobsites nationwide. "Companies will need to start hiring people who don't necessarily have experience," noted Andrew Pate, who manages Kiewit's Training Center in Colorado. "That's why training is going to become even more important, especially over the next five years."

Still, amid these challenges, firms see opportunity in reinvention. At Burns & McDonnell, leaders say the same ingenuity driving modularization, automation, and digital delivery must now be applied to developing the labor force itself. "We've strengthened and expanded our construction capabilities to drive deeper integration across every phase of project delivery," said Strawn. "That integration, paired with technology and training, gives our teams greater certainty and consistency in outcomes." Across the industry, a new generation of builders, technicians, and engineers is beginning to emerge—supported by data, digital tools, and deliberate investment in skill. ■

*—**Sonal Patel** is a POWER senior editor.*

Procuring Power: Experts Discuss Contract Complexities

Securing a reliable supply of electricity requires plenty of research to balance the risks and rewards of striking a deal.

Darrell Proctor

Securing a reliable supply of power is paramount for many businesses, particularly as more groups look to source their own energy rather than relying on the local electric utility. Negotiating favorable rates and terms for that power can involve many steps, with the process dependent on the buyer's energy needs, whether the electricity comes from thermal or renewable resources (or both), and market conditions, among other things.

Energy industry experts who spoke with *POWER* detailed several tasks businesses must execute in today's increasingly complex legal and regulatory landscape (Figure 1). An enterprise may need to negotiate a power purchase agreement (PPA), buying power from one or more sites for a contracted period. A group could be looking to build their own generation station, or buy existing assets or an operating (or even dormant) power plant. A contract also could involve the purchase of fuel, such as natural gas or hydrogen, or fuel cells, or battery energy storage.

The experts agreed that defining the objectives of securing energy is a first step. That could be deciding whether the group wants a fixed rate or a variable rate, and, of course, the length of a contract. It could include a decision about the use of thermal energy (coal, natural gas, or nuclear) or renewable energy (solar, wind, hydro, and energy storage). Does the business want to own the generation assets, or simply purchase the power?

"My view has always been that the most important factor when structuring a contract is to create good alignment between the parties involved," said Jim Summers, CEO of GPC Infrastructure LLC, a group that provides data centers with a long-term alternative to a utility grid interconnection. "Focusing on win-win solutions changes the approach and tone of the negotiations and positions both organizations to act collaboratively when challenges inevitably arise in the years—and in some cases decades—that lie ahead."

1. Complex contract negotiations require multiple steps. Seeking mutually beneficial solutions builds stronger, more sustainable partnerships. Source: Envato Elements

"The contract is your key tool for mitigating risk and minimizing the potential for disputes during the construction of a power project, and therefore the most important thing to keep in mind when negotiating contracts is the importance of clarity and specificity of language," said Laura Fraher, partner at law firm Barclay Damon. "Thus, it is generally preferable to address and resolve any potential ambiguities during the contract negotiation, including by discussing how the contract language would apply to concrete hypothetical scenarios that are likely to occur, rather than to accept potentially ambiguous language and rely on your ability to persuade a fact finder that your interpretation of that language is correct if a dispute arises later."

Rohit Ogra, co-founder and Chief Revenue Officer of Texas-headquartered Treaty Oak Clean Energy, said, "From our perspective as a generator, utilities prioritize reliability, cost-effectiveness, and confidence in execution. Delivering commercially sound terms and leveraging your financial strength to provide stability is key. Legally, the most important consideration is how risk is allocated. That includes risks related to permitting, procurement, and pricing. The ability to translate regulatory uncertainty into contract structures that fairly distribute risk is a key differentiator."

Developing Deals

Building and executing a contract, particularly a PPA, requires plenty of research. Those who spoke with *POWER* agreed that a business must assess its energy needs, which could involve a review of historical energy usage—a load profile—to help an energy supplier determine the best way to move forward at a specific site or sites. Market research also is important, and an end-user should understand pricing, current trends, and any possible regulatory and/or supply chain issues that could impact energy reliability (Figure 2).

Businesses must be ready to issue a request for proposals, or RFP, to enable a comparison of different costs based on supplier and fuel type. The power suppliers also should be evaluated to ensure their viability.

Negotiating the terms of a contract, and finalizing the agreement, is not the end of the process. Energy users should continually monitor their electricity consumption, and keep abreast of market trends, to determine whether the contract is effective, and whether adjustments are needed prior to any renewal.

Said Summers, "Key to this is being flexible and developing a deep understanding of what is most important to both sides. A good example of this is appreciating the need for a higher level of reliability when selling power directly to a data center versus a public utility. Generators need to understand the customer's expected load profile, backup systems, and response time requirements in order to create the right solution through a combination of technical, commercial, and contractual mechanisms. This might involve designing with redundancy, such as extra equipment, a redundant fuel supply, or using batteries. It could also be handled commercially, such as by procuring power from the grid to cover any shortfalls in generation.

"Another crucial factor in effectively managing project timelines and price uncertainty is the development of conditions precedent that must be met before work can begin. These can include securing the necessary permits, obtaining regulatory approvals, or expanding a gas pipeline for fuel supply," said Summers.

Hans Dyke, partner in the Washington, D.C., office of Bracewell and former in-house counsel for Sol Systems, told *POWER*: "PPAs generally take two forms, each enabling the financing and construction of the project. A traditional PPA is a contract used to structure the commercial agreement between buyer and seller for the physical delivery of electricity to a delivery point. A virtual PPA [or a contract for difference, known as a CfD, on the price of electricity] is effectively a financial instrument providing a hedge against electricity price volatility by locking in a long-term fixed price while delivering the environmental attributes of a renewable energy project to the buyer—most often a large corporation with publicly stated sustainability goals.

"Traditional physical power PPAs are pretty straightforward agreements [at least within the industry], providing for the delivery of physical power to a delivery point from seller to buyer," said Dyke. "The buyer may be a wholesaler, securing long-term, stable power for their retail customers. Alternatively, the buyer may be larger corporate/industrial users requiring power for their operations [such as steel plants, data centers, and other heavy load operations]. With physical PPAs, the buyer must be able to receive physical electricity delivered to a delivery point."

Dyke also noted virtual PPAs or CfDs "do not require a buyer to receive electrons. The virtual PPA is essentially a financial hedge that was created to enable the growth and financing of renewable energy projects. It has been critical to the renewable power industry. While the underlying power plant [such as a solar or wind project] is producing physical electricity and the electricity is delivered and sold into the grid, the transaction between buyer and seller is primarily structured to deliver the project's attendant environmental attributes [such as renewable energy credits, or RECs] to the buyer. Buyer and seller settle the difference between the agreed PPA price and the wholesale market price where the project sells its electricity. The virtual PPA serves as a hedge against electricity price volatility and as an environmental attribute procurement tool."

A Co-Op Perspective

Christian Nagel, director of Power Supply at Texas-based Rayburn Electric Cooperative, said his work includes overseeing "Rayburn's power supply strategy, generation planning, and load forecasting efforts. That includes negotiating contracts that support those functions, such as PPAs, asset acquisitions, and EPC [engineering, procurement, and construction] agreements that reflect our long-term risk posture and operational goals. I also work closely with our executive leadership and board of directors to ensure alignment with internal risk and planning policies."

Nagel said his group "has broad experience negotiating PPAs with varying structures. We've also executed large asset purchase agreements, equity purchase agreements, full-requirements contracts [where a single supplier provides all of a utility's power], and partial-requirements contracts [where a single supplier provides a significant portion of the overall load].

"There are several legal, regulatory, and commercial factors that must be carefully considered when negotiating contracts," said Nagel. "These contracts often span many years and involve complex operational, financial, and compliance risks, so thoughtful structuring is essential from the outset, and overall risk management is the key objective. On the legal and regulatory side, utilities must ensure that all contractual terms align with environmental regulations and broader ESG [environmental, social, and governance] commitments. Reliability and performance standards should be clearly defined, and force majeure protections must account for real-world disruptions that could impact delivery or construction timelines. Contracts should also address liquidated damages and include well-drafted indemnity clauses to clarify responsibility in the event of disputes or unforeseen costs.

"From a commercial standpoint, evaluating the creditworthiness of counterparties is critical, along with building financial structures that reflect market realities. Pricing mechanisms should be flexible enough to respond to market dynamics while still providing long-term certainty," said Nagel. "Contracts should also clearly outline product specifications and performance benchmarks, include appropriate termination provisions, and

2. Supply chain disruptions can cause unexpected project delays. Contract negotiations should establish clear responsibility for managing these risks. Source: Envato Elements

define rights related to assignment and subcontracting. Maintenance requirements and operational covenants should also be spelled out to ensure alignment over the life of the agreement.

"One recent example is our work on the EPC contract for RES II, a major expansion of the Rayburn Energy Station that will add 570 MW of natural gas–powered generation capacity to help meet accelerating demand across our service territory," said Nagel. "RES II will enhance local reliability and provide additional dispatchable resources to support long-term growth for our members. During the negotiation process, we incorporated strong performance protections and built in flexibility to account for market conditions and supply chain lead times. This approach allowed us to manage risk while maintaining both cost and schedule certainty. The experience reinforced the importance of close coordination across legal, commercial, and technical teams."

Construction Agreements and Contract Structures

Building a new power generation project has its own set of issues (Figure 3), which should be addressed in the contract between the utility and the builder. Fraher said these can involve different structures depending on factors such as the size of the project.

"As it relates to construction, the contract model most typically employed for large power projects is the EPC contract. This contract model essentially establishes a 'one-stop shop' for the owner entity, with a single EPC contractor fully responsible for the complete scope of engineering [design of the entire power plant], procurement [purchase, installation, and performance of all equipment], and construction of the entire project. Traditionally, most EPC contracts are lump sum contracts," said Fraher.

3. From small installations to major facilities, contracts establish the framework for on-time, on-budget delivery of quality work. Source: Envato Elements

"An alternative delivery model we are seeing more of lately, particularly in the context of very large, complex projects, is the engineering, procurement, and construction manager [EPCM] model," said Fraher. "In this scenario, the owner entity enters into an EPCM contract with a construction manager, who typically is fully responsible for the complete scope of engineering, but rather than performing the procurement and construction phases, instead acts as construction manager for those phases while the owner entity separately contracts with construction contractor[s] and/or supplier[s] for procurement and construction."

Fraher added, "An alternative pricing model we are seeing more of lately in the EPC context is the guaranteed maximum price [GMP] model in place of the lump sum EPC contract. This is a cost-reimbursable, not-to-exceed model and typically includes an open-book process with required supporting documentation. For the ongoing physical needs of the plant after construction is complete, operation and maintenance [O&M] or long-term services agreements [LTSAs] are typically used."

Tanya Bodell, a partner at StoneTurn Group LLP, noted five types or structures for contracts in the power generation space: PPAs, CfDs, tolling agreements, generation asset lease agreements, and shareholder agreements. "From the perspective of economics, business, and policy, I view contracts as allocating economic risks and rewards through contractual language of obligations and liabilities," said Bodell. "PPAs and other contracts extend well beyond the purchase and sale of electrical energy and power." Bodell said formalizing contractual obligations usually include descriptions of:

- *Purchase/Sale Commitments.* Obligations around quantity and price, along with technical specifications regarding delivery.
- *Property Rights.* Which party has priority rights to other property rights (such as excess power and environmental attributes).

> ***Protecting against liability starts with thoughtful risk allocation.***
>
> —Rohit Ogra, co-founder and Chief Revenue Officer of Treaty Oak Clean Energy

- *Performance Guarantees.* Obligations imposed on each party to ensure performance under the contract (such as performance validation, audit rights, credit requirements, parental guarantees, and escrow accounts).
- *Liability and Enforcement.* Avenues available to the parties in the event of failure of the other to meet the requirements in the contract, usually in the form of penalties, payments, liquidated damages, and mediation processes/legal venue rules.
- *Standard Contract Terms.* Other typical contract determinants such as start-date/end-date, term, extensions, and termination.

"For renewable [energy] projects, tax credits simply provided a separate revenue stream that could be financed through tax equity financing. In the absence of tax credits, the challenge is how to find a way to replace that revenue stream and the financing associated with that revenue stream," said Bodell. "In order to replace the lost financeable value in the absence of tax credits, renewable generators will either need to increase revenues through higher prices, decrease costs, or find other revenue sources (such as augmented state subsidies)."

Bodell added, "PPAs worked hand-in-hand with tax credits. Both are financeable and fund the upfront capital costs. Generators tend to prefer long-term PPAs as they generally are readily financeable through project financing and long-term payments mitigate the risks of recovering upfront capital investment and other fixed costs. However, they will not serve as a replacement for tax credits unless the market will cover those lost benefits. Creative financing, new ways of extracting value, and potentially new business models will be required to offset the lost tax credits."

Bodell also said, "Long-term PPAs are a blessing and a curse. The blessing is that they can allow for easy financing with higher leverage through project financing. The curse is that the industry is volatile, and long-term contracts can diverge dramatically from market conditions. For example, Quebec has a long-term power purchase agreement from the 1970s for which it is still paying only $1.50/MWh versus current market prices of $35 to $50/MWh over the past few years. When contract prices are that far apart, litigation happens."

Said Ogra, "Protecting against liability starts with thoughtful risk allocation. Generators face risks such as permitting delays, procurement challenges, and price volatility. Contracts need to provide flexibility and include off-ramps for circumstances beyond your control. Some risks can't be adequately hedged through traditional market instruments or strategies. In those cases, it's important to ensure risks are shared in a way that's rational and equitable."

Ogra added, "PPAs have always played a central role in project financing. Investors rely on them to secure predictable, high-quality cash flows, and buyers rely on them to secure a predictable price for energy and access to other attributes, like RECs. As the market evolves with growing demand, more renewable energy, and ongoing regulatory uncertainty, PPAs will become even more critical. In a post-tax credit environment, we expect power prices to adjust, which will likely lead to higher PPA pricing to make up for the lost value of incentives." ■

*—**Darrell Proctor** is a senior editor for POWER.*

Successfully Closing a Power Plant? It's All in the Details

Companies tasked with tearing down, cleaning up, or repurposing a project site know the importance of strategic planning.

Darrell Proctor

The retirement of older thermal power generation facilities, driven by a transition to cleaner forms of energy, has increased in recent years as utilities and other power generators mothball plants that are uneconomic or simply no longer needed. Renewable energy resources are not immune. A report from UK-based global insurance broker Gallagher Specialty last year noted, "A growing number of wind arrays are reaching their third decade of operation and starting to approach the end of their proposed lifecycle." Meanwhile, some state and local governments are now requiring a decommissioning plan be part of the initial permitting process for solar farms.

1. The Bruce Mansfield power plant in Pennsylvania was a 2.5-GW coal-fired facility. The plant came online in 1976, and was shut down in late 2019. Officials recently announced the facility will reopen as a natural gas–fired power plant as part of a $3.2 billion investment. Source: Bruce Mansfield Power Plant by Drums600, CC BY-SA 4.0 <https://creativecommons.org/licenses/by-sa/4.0>, via Wikimedia Commons

Decommissioning a power plant—whether it's a coal- or natural gas-fired station, nuclear plant, or a renewable energy site—is a complex, multi-year process. Companies involved in closures and teardowns must demolish or repurpose structures, and ensure the safety of workers. Closing a power generation site also may call for remediation of the area for its future use. And contractors must pay attention to local and state (and sometimes federal) environmental regulations. Nuclear plants, with radioactive materials, are particularly complex, with strict regulatory oversight.

"Power plants are decommissioned for a variety of reasons, often driven by a combination of economic, operational, regulatory, and strategic business factors," said Mark Dittus, associate vice president and the Global Asset Engineering Manager within Black & Veatch's Infrastructure Advisory group. "Decommissioning power plants, whether nuclear, coal, gas, renewables, or industrial, presents a range of complex challenges that require strategic planning, technical expertise, and stakeholder alignment."

"All power plants have a finite design life," said Dietrich Hoefer, partner at Womble Bond Dickinson. "Aging infrastructure may face reliability issues or safety risks if operated beyond its intended lifespan. Often, the primary reason [for closure] is that a plant is no longer economically viable. This can happen when operational and maintenance costs rise with the plant's age. For example, in the U.S., many coal-fired units have closed in the last decade [Figure 1] largely because natural gas and renewables became more cost-competitive, causing coal's share of generation capacity to substantially decrease. The economics of these units are often closely tied to environmental regulations that increase capital and operational costs."

Dittus concurred. "One of the most common reasons for decommissioning is changing operational demands leading to lower capacity factors and therefore reduced economic viability for the facility," he said. "Units designed for baseload operation are competing with newer generation and see limited operation, and this operation is often cyclical operation, which they weren't designed for. Both of these factors lead to increased maintenance costs and equipment failures, making continued operation financially unsustainable."

Dittus added, "Compliance with evolving environmental regulations and policy shifts can be cost-prohibitive for plants experiencing limited operation, prompting owners to shut them down. In some cases, the land itself becomes more valuable for other uses. Owners may opt to demolish a facility to repurpose the site, either for new energy projects or for sale. This is particularly common in urban or industrial areas where space is at a premium."

Risks and Challenges

Matt DeCourcey, a vice president in Charles River Associates' Energy Practice with two decades of experience in the regulated energy space, said his group's focus on decommissioning is on regulatory oversight, utility decision-making, and financial considerations. "An important trend in recent years has been the decommissioning of certain types of thermal plants, particularly coal, before their planned retirement date. Doing so creates risks and challenges," said DeCourcey.

"Plants are often retired ahead of schedule because changes in market conditions have rendered them obsolete. When it happens, a utility-owner may not have recovered all of the investments made in the asset [more formally, the asset would have an undepreciated balance]," said DeCourcey. "Utilities retir-

2. This image shows the demolition of a reactor containment building at a nuclear power plant under the DECON (immediate dismantling) protocol. A facility is said to be in DECON when active decommissioning work is underway. Source: Nuclear Regulatory Commission

ing plants ahead of the planned timeline must ask their regulators to authorize recovery of undepreciated balances in rates. Those requests tend to be controversial. To secure an approval, the utility must demonstrate that customers' paying for a plant that is no longer producing energy is in their best interest because the economics of the facility had become so poor. Examples from among our recent consulting assignments in which this has been an issue include SWEPCO's [Southwestern Electric Power Co.'s] decision to retire the Pirkey plant in Texas, [and] Empire District's decision to retire Asbury, a plant in Missouri. Both were older, coal-fired plants that had become uneconomical as coal became less competitive in energy markets, giving rise to the retirement decision."

Decommissioning a nuclear power plant (Figure 2) can involve either immediate dismantling—what's known as DECON—or placing the facility in monitored storage, or SAFSTOR, for many years (see sidebar "New Trend: Restarting Closed Nuclear Plants"), allowing radioactivity to decay. Decommissioning a fossil fuel-burning plant may require managing materials such as coal ash and asbestos.

"For fossil and nuclear units, all residual fuels and process chemicals must be safely removed or secured," said Hoefer. "Hazardous substances common in power plants are disposed of according to environmental regulations. Asbestos and PCBs [polychlorinated biphenyls, which are toxic chemicals], often present in older facilities, must be handled under strict rules."

Hoefer noted that demolition work, including dismantling of boilers, turbines, cooling towers, and support buildings, "must comply with safety laws and environmental controls. Foundations and underground structures are typically removed to a specified depth [often 3 feet to 5 feet below grade] unless closed in place.

New Trend: Restarting Closed Nuclear Plants

A trend has emerged with regard to closed nuclear power plants. Some U.S. nuclear facilities, such as the Palisades Nuclear Power Plant in Covert Township, Michigan, that were set for decommissioning now have plans to restart as operators seek ways to increase the supply of electricity at a time of growing power demand. NextEra Energy wants to restart the Duane Arnold nuclear power plant in Iowa, while Constellation Energy has plans to restart the Unit 1 reactor at the Three Mile Island site in Pennsylvania.

Outside the U.S., Italy and Belgium are both reversing previous decisions to phase out nuclear energy. Germany, which shut down its last reactors in 2023, is seeing support for bringing some units back online.

3. The Palisades nuclear power plant in Michigan was closed in 2022 and set for decommissioning. Holtec International, which bought the plant with a plan to handle the decommissioning, instead is restarting the facility. Courtesy: Entergy

Holtec International, a company with a history of decommissioning nuclear power plants, on October 20 of this year said the Palisades facility (Figure 3) has received new nuclear fuel—68 assemblies in total—as it prepares to restart. The 800-MW facility was shut down in May 2022.

"The *esprit de corps* of our tirelessly toiling worker force, over 1,800 strong boosted by the stout support of federal, state, and local government as well as our industry partners, labor, and the Southwest Michigan community, is a testament to the national consensus and our collective will to harness nuclear energy to meet the galloping demand for power in our country," said Dr. Kris Singh, Holtec's CEO, in an October 20 news release. The U.S. Nuclear Regulatory Commission gave its authorization for a restart in late August of this year, enabling the plant to receive new fuel at the site.

"All wastes generated are managed according to type," said Hoefer. "Hazardous wastes must be transported by licensed haulers to authorized facilities, under RCRA [Resource Conservation and Recovery Act] requirements. Nonhazardous industrial wastes [concrete, scrap metal, etc.] are recycled or landfilled as appropriate. For example, metal equipment and piping are often recycled, while construction rubble might be used as fill. Special wastes like coal ash or solar panels require particular attention. Documentation of waste disposition is important to demonstrate regulatory compliance."

Hoefer told *POWER*: "One of the biggest challenges [to decommissioning] is navigating the regulatory landscape, which can sometimes shift unexpectedly. For example, power plant owners might plan a [facility's] retirement date years in advance, only to have regulators or government authorities intervene to alter those plans."

Designing a Strategy

"Decommissioning a power generation facility is a complex, multi-phase process affected by several factors," said Dittus. "No matter the complexity of the site, Black & Veatch follows a framework grounded in safety, regulatory compliance, and long-term site strategy. We approach decommissioning not just as demolition, but as a strategic transformation of energy infrastructure. At Black & Veatch, our goal is zero change orders, which we achieve through clear specs and thorough planning. Our first step is to determine the final use of the site, whether it will be mothballed, demolished, or repurposed; this decision drives all subsequent planning and engineering."

Dittus told *POWER*, "Engineering teams assess structural, environmental, and regulatory factors to develop a site-specific roadmap. Demolition is executed by prequalified contractors to ensure safety and compliance. For nuclear and coal plants, fuel removal and hazardous material abatement are critical early steps. We also plan for how to manage debris and scrap responsibly. Selecting the right demolition contractor is critical. Companies must implement a rigorous pre-qualification process to avoid safety violations, delays, and legal liabilities. The wrong contractor can derail a project before it begins."

Case Study: A Natural Gas-Fired Power Plant in Nevada

The decommissioning and redevelopment of the Tri Center Naniwa Energy Gas Plant provides an example of environmental remediation and adaptive reuse of a power generation site.

The Tri Center station, a 380-MW natural gas-fired facility in Storey County, Nevada, near Reno, was decommissioned and remediated under the direction of Consolidated Asset Management Services (CAMS), after the plant's retirement from service. Previously owned by Morgan Stanley, the station had reached the end of its operational life and was identified for full demolition and environmental rehabilitation.

CAMS was contracted to manage the dismantling of the facility, execute asbestos abatement in compliance with federal and state regulations, and prepare the site for future industrial redevelopment. The scope of work encompassed the complete demolition of all above-ground infrastructure, including turbine halls, control rooms, and auxiliary buildings. A comprehensive hazardous materials survey was conducted prior to demolition, enabling precise planning and risk mitigation. Licensed teams carried out asbestos remediation using specialized containment and disposal protocols, ensuring minimal environmental impact and maximum worker safety. Site restoration efforts included grading and stabilization to meet industrial reuse standards, while stakeholder coordination ensured alignment with regulatory bodies and the future site owner.

CAMS employed an integrated project management system to oversee demolition, remediation, and regulatory reporting, promoting transparency and operational efficiency. Community engagement was prioritized through regular updates to local stakeholders, fostering trust and public support. The project was completed ahead of schedule and under budget, with zero safety incidents and full regulatory compliance. The property was ultimately sold to a telecommunications company, which is now developing the site into a state-of-the-art data center—demonstrating the value of strategic brownfield redevelopment.

A unique challenge during the project was the proximity of the 2020 Caldor Wildfire in the Sierra Nevada mountain range, which burned less than 30 miles from the site. This introduced significant safety concerns, particularly regarding air quality, visibility, and the use of open-flame cutting torches in outdoor environments. CAMS responded with a suite of enhanced safety protocols. Real-time air quality monitoring was conducted using portable sensors and regional alerts, and work schedules were adjusted based on air quality index readings. Respirators were issued during periods of elevated smoke levels, and N95 masks were provided to mitigate inhalation risks. Fire risk mitigation strategies included strict fire watch procedures, deployment of fire safety personnel, and immediate access to extinguishing equipment. Emergency preparedness plans were developed in coordination with local authorities, and daily safety briefings incorporated wildfire updates and evacuation protocols. Additional personal protective equipment was issued for asbestos abatement under compromised air conditions, and shaded rest areas with hydration stations were established to reduce heat and smoke-related stress.

Despite the environmental hazards posed by the wildfire, CAMS successfully completed the project without incident, underscoring its commitment to safety, adaptability, and operational excellence. Key lessons learned included the importance of early hazardous materials identification, close coordination with future site owners to streamline redevelopment, and transparent communication with regulators and the community to reduce project friction. This case exemplifies how strategic planning, environmental stewardship, and stakeholder collaboration can transform a retired energy asset into a platform for what is now a data center for a large telecommunications company.

*—**Nick Kemper** leads Business Development and Decommissioning and Brownfield Redevelopment at Consolidated Asset Management Services (CAMS).*

Dittus also noted that some project sites involve partial demolition, where one or more units are removed while others must be preserved. "This requires precise engineering, accurate drawings, and planning to safely isolate systems. The complexity increases significantly on multi-unit or industrial sites," he said.

Nick Kemper, general manager of Deconstruction and Brownfield Redevelopment Director of Corporate at Consolidated Asset Management Services (CAMS), has more than 12 years of experience in leading and supporting the decommissioning of industrial facilities, including thermal power generation plants powered by natural gas, coal, and fuel oil, across diverse U.S. markets. His expertise spans the full lifecycle of decommissioning—from environmental remediation and demolition to equipment disposition and site redevelopment. Some of Kemper's notable projects include:

- *Tanner Generation Station (Lowell, Massachusetts).* Decommissioning of an 84-MW natural gas plant near Boston, including environmental remediation and sale of used equipment and real estate.
- *Tri Center Naniwa (Reno, Nevada).* Led the complete deconstruction and remediation of a 380-MW gas-fired facility (see sidebar "Case Study: A Natural Gas-Fired Power Plant in Nevada").
- *Stateline Energy (Hammond, Indiana).* Oversaw the dismantling, environmental remediation, and land sale of a 515-MW coal-fired plant on a 64-acre site near Chicago, Illinois.
- *Werner Power Station (South Amboy, New Jersey).* Managed the complete deconstruction, environmental remediation, and hazardous materials disposal of a 212-MW dual-fuel plant.
- *Texas Portfolio.* Directed redevelopment efforts for multiple gas-fired plants in Texas, including Lon C Hill (295 MW), JL Bates (292 MW), and Victoria Power Station, as well as the Cedar Bayou Transformer Project in Houston.

"The principal drivers behind plant decommissioning are our clients, most of whom represent private equity (PE) and major financial institutions," said Kemper. "PE firms generally seek to maximize returns over a three-to-seven-year period. After generating value through strategies such as cost reduction, refinancing, or asset management, they may choose to close or divest facilities rather than invest in long-term improvements. Frequently, private equity acquires aging plants near the conclusion of a power purchase agreement and opts not to continue power generation."

Kemper told *POWER* that to boost short-term profitability, "owners often reduce maintenance spending and staff. This accelerates equipment degradation, making continued operation unsafe or uneconomical. When new environmental regulations require expensive retrofits (such as emissions controls), PE firms often choose closure instead of reinvestment because it doesn't align with their short-term ROI [return on investment] goals. PE-owned plants, especially fossil-fuel-based, are vulnerable to low wholesale electricity prices and competition from renewables. If margins shrink, PE firms may exit quickly."

Kemper outlined several steps in the decommissioning process. The items are explained below.

Planning and Regulatory Compliance. The process begins with a robust decommissioning plan, which includes environmental assessments, hazard identification, and stakeholder engagement. Operators must secure permits for demolition, waste handling, and site remediation, while also notifying regulatory bodies and local communities.

Shutdown and Hazard Mitigation. Once planning is complete, the facility undergoes fuel removal and hazard mitigation. This includes draining chemicals, neutralizing hazardous substances, and safely handling materials like lead, asbestos, PCBs, and mercury.

Equipment Dismantling and Asset Recovery. The next phase involves disassembling major components such as boilers, turbines, and generators. Valuable metals and equipment are salvaged for resale or recycling first.

Demolition and Structural Removal. Controlled demolition of stacks, cooling towers, and buildings follows. Dust suppression and vibration control measures are essential to protect nearby communities.

Environmental Remediation. This phase addresses soil and groundwater contamination, often from coal ash ponds, fuel storage, and chemical leaks. Cleanup may involve removing or capping contaminated soil and ensuring compliance with Environmental Protection Agency (EPA) or state standards.

Waste Management. Proper waste management includes segregating hazardous and non-hazardous materials, recycling metals and concrete, and disposing of hazardous waste in compliance with regulations.

Site Release and Redevelopment. The final step is obtaining regulatory clearance and planning for site reuse. Brownfield sites can be repurposed for solar farms (Figure 4), battery storage, data centers, or industrial parks. Federal programs like the Department of Energy's Energy Infrastructure Reinvestment loans and Inflation Reduction Act tax credits can support these transitions.

Decommissioning and Demolition

Keith Kotimko, U.S. Decommissioning and Demolition Leader for WSP, which provides services for decommissioning, made a point that decommissioning is a separate activity from demolition. "Decommissioning is the specific activity that serves as the necessary precursor to demolition. It encompasses all steps required to prepare the plant for subsequent abatement and physical tearing down. This process includes fundamental actions such as cessation of generation, thorough emptying and cleaning of major systems [like ash and coal handling], draining all oils and fuels, purging gas systems, and complete removal of all stored hazardous and non-hazardous waste. It culminates in de-energizing the assets and separating them from transmission and distribution systems. Utilities often manage these preparatory activities internally as a 'last outage event' before vacating the site," he explained.

Kotimko said that over the past 11 years he has been directly involved in planning and executing decommissioning of seven coal-fired power plants. His demolition experience is even broader, encompassing 24 plants of various types, including coal, oil, natural gas, hydro, and nuclear facilities.

"Successful decommissioning hinges on detailed preparation that goes beyond standard operating procedures," Kotimko said, noting his group focuses on "critical topics upfront, which, if handled correctly, can reduce added contingency costs in contractor bids, prevent environmental releases, and minimize expensive change orders later." Kotimko said there must be a recognition that decommissioning is not a standard plant outage.

"Although decommissioning shares activities with plant outages [like cleaning and draining], the required level of effort is fundamentally different. In decommissioning, it is unacceptable to leave hardened ash or unclean ductwork, even if that might be permissible during a temporary outage. When an owner performs only an 'outage level' of cleaning, the demolition contractor will inevitably find large, residual quantities of materials, triggering change orders and often leading to environmental releases onto the ground or into water systems."

Kotimko told *POWER*: "Success in these projects must include safety being paramount alongside the prevention of change orders. Change orders are not an expected part of the project; they are typically the result of insufficient planning and scoping." He said the most common change orders stem from four oversights.

Poorly Defined Cleaning Scope. Generalized requirements for material remov-

4. This solar farm in Tennessee is an example of a brownfield project. The array was built at the site of the abandoned Phipps Bend nuclear power plant project, and serves the Tennessee Valley Authority. Courtesy: United Renewable Energy

al often fail to achieve the necessary level of cleanliness needed for demolition.

Inadequate Asbestos Surveys. Surveys must be intrusive enough to find hidden materials that will undoubtedly be discovered during demolition.

Insufficiently Detailed Site/Owner Requirements. These relate to differing expectations regarding operational standards, such as requirements for dust control and monitoring, or the acceptance process for required submittals.

Poorly Defined Below-Grade Removal Work. "Since contractors assess above-grade demolition visually, below-grade work must be explicitly defined using drawings that specify the horizontal extent and vertical depth of all utilities, foundations, and buried features to be removed," said Kotimko. "This often-overlooked step requires combing through existing documents and potentially performing utility locating services."

DeCourcey said there are lessons to be learned from his group's recent work in the decommissioning space. "Utility decisions to retire thermal assets ahead of planned retirement dates can be risky and controversial. Demonstrating the benefits to customers is critical," he noted.

"Growing [power] demand, rising [electricity] prices, and the potential for an erosion of environmental standards under the Trump administration's EPA have led to the postponement of retirement decisions and the repowering of retired assets," DeCourcey said. "Site repowering can generate significant economic value, depending on the configuration of assets at the site and its location. Repowering has the potential to reduce the cost of installing emerging technologies, such as hydrogen-powered generation or SMRs [small modular reactors]." ■

—***Darrell Proctor*** *is a senior editor for POWER.*

Engineering the Future: How EnergyLink Is Rewriting the EPC Playbook

A surge in energy infrastructure demand—and the parallel squeeze on labor, supply chains, and environmental pressures—may be rewriting the EPC rulebook. EnergyLink International, a Calgary-based engineering, fabrication, and construction firm known for its clean technology and building systems, is taking that shift head-on.

POWER

The engineering, procurement, and construction (EPC) sector may be undergoing its most profound transformation in decades. While backlogs for tier-one contractors now stretch beyond 2030, looming workforce shortages across North America threaten execution timelines. At the same time, project owners are demanding tighter environmental controls, faster delivery, and new financing models that share risk rather than simply shift it.

As *POWER's* reporting has shown, several trends are taking shape. Modularization, early-stage environmental integration, and artificial intelligence (AI)-driven project tools and controls have moved from experimental to essential. Fixed-price EPC contracts are giving way to collaborative frameworks that reward predictability and innovation over the lowest bid. And as the energy transition accelerates, developers increasingly seek partners who can deliver not only steel and concrete, but also a deep understanding of decarbonization economics and regulatory compliance (Figure 1).

EnergyLink International—a firm with more than 25 years of experience in air emissions control, noise management, and turnkey building and modular solutions—embodies this evolution. Through its research and development (R&D) programs, push toward hyper automation, and acquisition of UECompression Inc. (UEC), the company is aligning technical execution with efficiency and performance to close the gap between engineering feasibility and project delivery.

Building on its legacy of environmental and modular innovation, EnergyLink is also automating project controls and using AI-driven technology to optimize engineering, purchasing, logistics, and onsite performance. Its collaborative contracting approach—combining early engineering integration with transparent risk-sharing models—seeks to ensure projects stay on schedule and within budget. Finally, the company is also fielding a growing global footprint and strategic partnerships with original equipment manufacturers (OEMs), EPCs, and data center developers, leveraging deep engineering expertise and data-enabled insights to de-risk every phase of delivery. The fusion of technical execution, financial strategy, and advanced digital tools positions EnergyLink at the forefront of next-generation EPC partnerships.

POWER spoke with Harold Wong, president and CEO at EnergyLink International, about how EPC partnerships are being redefined—and what it now takes to deliver complex energy infrastructure in a fast-changing market.

POWER: Project pipelines across the power and industrial sectors have expanded sharply while execution risks have multiplied. Have you seen owners' priorities shift—from lowest cost to delivery certainty—and what does that reveal about how the EPC value chain itself is changing?

Wong: EnergyLink International's primary market is gas-fired power plants, where we sell our air and noise emissions control equipment and structures. Our clients are the EPCs, OEMs, and, less often, utilities and independent power producers. As a supplier to the power sector, we have seen owners' priorities shift, but the extent of that shift depends on the power plant application. For example, cost remains king for large utility-sponsored combined cycle and cogeneration projects. However, on backup peaking and highly reliable data center power projects, speed and delivery certainty are most important.

1. Developers are increasingly valuing execution confidence over initial cost. A low bid that leads to delays, overruns, or quality issues ultimately costs more. Source: Envato Elements

This shift in owners' priorities—from low cost to speed and volume of delivery, almost at any cost—has had a significant impact on our EPC and OEM clients. What we are noticing is that project kickoffs are beginning more often with incomplete engineering—two power plant projects in 2024 for EnergyLink, on which our powerhouse and administration building scopes were 50% and 60% engineered, respectively. The same holds for our OEM clients who are cutting out the "balance of plant" scope they had taken on in the past to focus on equipment manufacturing.

What this has meant for EPCs and

OEMs is the need to find suppliers who can do more. On the two building projects last year, EnergyLink completed the design and drawings in addition to the supply and construction. Another example is an OEM of large reciprocating engines that is directing its clients to EnergyLink for start-to-finish noise control, a function it had handled before. Another OEM/power developer has executed a long-term agreement with EnergyLink for prioritized supply and delivery of selective catalytic reduction (SCR) units for their increasing fleet of peaking power plants.

While speed and volume of delivery matter more than ever, keeping costs down—or at least not increasing them—gives a supplier like EnergyLink considerable advantages over competitors. We have implemented measures to sustain our price advantages, including innovative low-cost designs, bulk ordering of materials from mills, consolidating shipments, and managing low-cost fabrication. Some of our fabricators had never built our type of equipment, but were successful the first time with the guidance of our fabrication experts helping to manage use of efficient jigs and shop sequencing. Most importantly, the effort in both time and money we allocate to R&D. As an example, EnergyLink built, at our own cost, a full-sized SCR behind one of our clients' LM6000 gas turbines to test our new direct injection (DI) technology. The test unit demonstrated that we could ensure compliance with air emissions laws while achieving a significantly smaller footprint and much lower cost.

In terms of the changing EPC landscape, we notice that their supply options have narrowed, and they need to rely on suppliers who can support them more effectively.

POWER: Fixed-price EPC contracts are giving way to shared-risk or reimbursable frameworks. What's driving that shift, and how does early integration of modular or environmental systems change how risk is actually distributed between owner and contractor?

Wong: As a supplier of equipment to OEMs and EPC companies, we primarily enter into fixed-price contracts. Fixed-price contracts help eliminate risks for both the owner-operator and the EPC. Additionally, these contracts often include performance guarantees, which add further reassurance.

One of the most appealing aspects for our EPC customers is EnergyLink's noise guarantee. This make-good noise guarantee entails fixing or replacing any faulty silencing equipment and structures at our own expense to ensure compliance with site noise guarantees.

Another risk mitigation strategy our EPC clients employ is bonding. Bonding provides complete coverage for the purchaser in the event of the supplier's nonperformance. However, the monetary value of the bonds—and, consequently, the size of the project awarded—is limited by the supplier's safety record, credit score, experience, and revenue.

Over the past five years, the EnergyLink team has worked diligently to position ourselves with increasing bonding capacity to undertake large projects, including the entire Champlain Hudson Power Express (CHPE) building scope in Astoria, New York, on behalf of Kiewit. Kiewit selected EnergyLink because of our team's successful project delivery for both Phases 1 and 2 of the Astoria Generating Station in Queens. Completing the CHPE project in the heart of New York City using union labor was no easy task, but the EPC aptly managed its risk through bonding and insurance in the event of any supplier defaults and by selecting the right vendor partners.

POWER: Modularization is widely viewed as the strongest hedge against schedule and labor risk, yet, adoption still varies by project type and region. What's making modular delivery the default approach—and what structural or logistical barriers still limit how far it can go?

Wong: The push to limit installation time is driving the adoption of modular designs for our noise and air emissions equipment. For example, EnergyLink has optimized our SCR ductwork to be shipped on standard-sized truck beds in the fewest possible pieces. Once onsite, our quick-connect designs expedite the erection process, allowing each SCR ducting system to be installed in just seven hours with an experienced field crew.

Additionally, EnergyLink is developing modular SCR units for mobile power applications. These compact, modular SCR systems can remain on a truck and be easily relocated from site to site. We are co-developing this product with several mobile power companies.

Acoustic products in our lineup are also modular, including enclosures, combustion inlet and discharge systems, ridge vents, panelized wall systems, and more. By utilizing modularization, we help reduce transportation and installation costs for EPC contractors and owners alike.

POWER: Labor shortages have become a permanent constraint rather than a temporary challenge. How is EnergyLink redesigning around that reality—through automation, digital tools, or new fabrication strategies—and what long-term changes do you expect in workforce composition and culture?

Wong: A challenge is meeting the high-volume demand for our air and noise emissions products—as an example, we are involved in 35 data centers as I speak. In actual SCR orders, we have gone from three or four units per month to 15 or more. The same applies for our noise management products—where we used to build one to two acoustic powerhouses per year, we may shortly be booking as many as 10.

> ***Staffing correctly has been critical. Finding experienced engineers, design drafters, construction managers, site superintendents, and project managers for our highly engineered products is an entire company effort.***
>
> —Harold Wong, president and CEO of EnergyLink International

To meet this demand, staffing correctly has been critical. Finding experienced engineers, design drafters, construction managers, site superintendents, and project managers for our highly engineered products is an entire company effort. We've been able to acquire expertise by hiring from all over the U.S., Canada, and globally, supporting home offices and outsourcing when required. Outsourcing is typically to local individuals or companies who we've worked with successfully. We've also developed fabrication shop management skills that allow us to deploy multiple third-party shops to accommodate high volumes.

Automation also plays a big role. In fact, we are halfway through our next-gen software development for purchasing and tracking of materials, fabrication, and delivery, which will dramatically reduce the number of manual inputs and save time.

We also have a one-year program to automate all facets of our company. I believe the term is "hyper automation." The aim of this project is to reduce manual inputs prone to error as much as possible, improve our response times to our customers, and refocus our staff from paperwork to what matters in our project-based company. Key performance indicators (KPIs) have been established for all major functions including project management, human resources, finance and accounting, estimating, purchasing, manufacturing, transportation, and business development to gauge the success of this effort.

Two important KPIs we use are project margin variance and contingency usage, and revenue per employee. These KPIs are particularly important to securing necessary bonding capacity to take on our large building and acoustic projects for our EPC clients. Our low project margin variance and low use of contingency caused one bonding company to comment that our performance is the best they have seen in the EPC business. Our per employee revenue value is benchmarked against 20 "like" companies including EPCs, general contractors, and specialty manufacturers and contractors. Against this benchmark, EnergyLink's revenue per employee is much higher than the average for construction services ($1.8 million) or specialty manufacturing ($479,000), and even better than Netflix or Apple ($2.4 million).

We are enormously proud of our efficiency, which is a tribute to our experienced staff and automation programs. When we started building our company after the power industry downturn from 2018 to 2020, our average age of employee was 49.5 years. As we've grown to catch this new wave of power plant buildouts, our staff is becoming younger every year. This poses its own challenges and the need to transfer knowledge quickly from our senior team members to our new hires. We are facing this challenge with a new employee onboarding and training platform. As a result, a software platform for onboarding and training is under development along with our whole-company automation effort.

Two important KPIs we use are project margin variance and contingency usage, and revenue per employee. These KPIs are particularly important to securing necessary bonding.

—Harold Wong, president and CEO of EnergyLink International

POWER: Noise and emissions control have evolved from regulatory boxes to value drivers as siting pushes closer to populated loads. How early are owners integrating environmental engineering into project scopes, and what measurable impact does that have on cost, schedule, and permitting outcomes?

Wong: Noise and air emissions control have become essential considerations in the siting of power and industrial plants. Owners and producers are taking environmental regulations seriously, as failure to comply can lead to significant consequences, including the potential shutdown of facilities. As a result, owners engage EnergyLink as early as the site selection phase and when making financial investment decisions. They need to ensure that their power plants, data centers, or industrial facilities will meet emissions limits—whether regulatory or otherwise—while staying within budget.

At EnergyLink, we conduct modeling and design for noise and air emissions control at our own expense during the pre-front end engineering design (FEED) and FEED stages. We also provide pricing for these solutions. As designers, fabricators, and installers of this equipment, we offer accurate and low-cost pricing that enables owners, developers, and EPCs to make informed decisions about the budget required for noise and air pollution controls. And, our designs for noise control are guaranteed right from the start.

The cost of these controls varies depending on the project type and the level of mitigation required. For example, for a single simple-cycle LM6000 power plant, air pollution control measures—including a post-combustion SCR system and an exhaust stack with sound attenuation—constitute approximately 1% to 2.5% of the total cost of the power unit.

Noise control costs also vary, ranging from simple solutions like acoustic blankets or equipment enclosures to larger structures like acoustic engine or turbine halls. In combined cycle gas turbine (CCGT) plants, turbine halls represent the most significant noise-control expense, accounting for an average of 2% to 3% of the overall project cost. Acoustic elements can add about 10% to a building's price, and for highly specialized acoustic applications, this can increase to 30% or even 40%.

For instance, we provided noise control for a 150-MW reciprocating internal combustion engine (RICE) station with nine 18-MW engines, located 1,000 feet from residential homes. Each engine emitted sound at a power level of 128 decibels (dB)—comparable to the sound of a jet engine at takeoff. The EPC requested that EnergyLink guarantee noise levels of no more than 55 dBA (the sound level of a refrigerator hum) at the nearest homes, as well as a maximum of 70 dB at lower frequencies (31.5 and 63 Hz) to prevent structural vibrations and rattling of windows and doors. To achieve this noise attenuation, we housed the engines within a building. The cost of this building—between the initial precast concrete design by the owner's acoustic consultant and the metal-clad structure featuring EnergyLink's acoustic walls and roof—was balanced out, and we expedited the delivery time by six months.

POWER: New low-carbon facilities—especially for blue hydrogen and sustainable fuels—demand EPC partners who understand both emissions systems and evolving permitting frameworks. How is EnergyLink adapting its environmental and modular expertise to address those complexities in real projects?

Wong: In 2022, EnergyLink acquired UEC in Denver to enhance its capabilities in clean energy projects. This acquisition aims to support initiatives in areas such as carbon capture and storage, hydrogen fuel utilization, and other advanced gas projects. UEC is an authorized dealer for leading compressor manufacturers, including Ariel, and is among the few dealers worldwide authorized to package specialty gases. Additionally, UEC is a significant supplier of methane-reduction equipment through its UECleanAir brand.

As a global company, EnergyLink is also engaged in projects across Europe, Canada, and other regions as an emissions management provider for fuels beyond natural gas. In Europe, for instance, hydrotreated vegetable oil (HVO) is increasingly being adopted as the preferred fuel for power plant projects utilizing simple-cycle turbines. Although nitrogen oxide (NO_x) emissions limits in Europe are higher than those in the U.S.—approximately 8 parts per million (ppm) compared to 2 ppm to 2.5 ppm—SCR technology is required when using HVO. This is because HVO tends to produce higher NO_x emissions at full load and elevated temperatures compared to natural gas, and European Union authorities designate SCR as the best available technique (BAT).

Lastly, EnergyLink's gas turbine OEMs are hydrogen-ready and our SCR technology can handle the higher NO_x emission levels from the gas turbine using H_2 fuel.

POWER: Supply chain volatility remains a drag on schedules, with some components still on multi-year lead times. What concrete strategies have proven most effective for EnergyLink—whether design sequencing, parallel procurement, or domestic fabrication—and how are clients recalibrating expectations around delivery?

Wong: As a supplier of noise and air emissions control equipment for companies like GE, Siemens, Solar, and Baker Hughes, we understand that waiting times for gas turbines can be as long as three to four years. Consequently, power producers are exploring options worldwide for the necessary drivers or turning to innovative solutions. For instance, one of our clients is utilizing three different gas turbine models from three separate OEMs for a total of 16 SCRs at a data center in Texas. Another long-time client of EnergyLink is converting decommissioned aircraft engines into power generators, while yet another client has obtained turbines from a retired pipeline.

We do not anticipate a decrease in the demand for gas turbines in the near future. According to a recent S&P Global study, U.S. electricity consumption is projected to double by 2040, with much of the immediate demand driven by data centers and renewable energy backups. This poses a challenge for EnergyLink, as well as our OEM and EPC clients, regarding how we can scale our operations and accelerate delivery to meet this growing demand.

We have established strategic, long-term agreements with suppliers for critical components and services. This essentially locks in our most reliable suppliers.

—Harold Wong, president and CEO of EnergyLink International

So far, we have successfully navigated equipment and material shortages. One strategy involves pre-ordering carbon steel in bulk directly from mills and warehousing it, which helps reduce price volatility and ensure the availability of materials. Additionally, we have established strategic, long-term agreements with suppliers for critical components and services. This essentially locks in our most reliable suppliers, integrating them more closely with EnergyLink's operations.

EnergyLink has a vast network of fabricators in low-cost countries around the world. Significant efforts were made in prior years to build up this network of fabrication subcontractors and EnergyLink's in-house fabrication management team to handle increases in load and geographies.

POWER: As capital costs rise and accountability deepens, EPC excellence may no longer mean scale but adaptability. Looking five years ahead, what traits—technical, financial, or cultural—will truly define the next generation of high-performing EPC partners?

Wong: EnergyLink has been in business for over 25 years, with key personnel boasting more than 40 years of experience. Throughout this time, we have observed several exceptional EPC companies come and go, often due to projects that failed to meet their financial targets. Currently, only a handful of EPC companies in the U.S. continue to thrive in the power industry. The successful ones either have strong infrastructure or defense divisions that support their industrial work or have chosen to focus on the "E" (engineering) and "P" (procurement) aspects by outsourcing the "C" (construction) to general contractors that are less risk averse. Moving forward, the future of high-performance EPCs will hinge on establishing strong working relationships and partnerships between EPCs and their suppliers and contractors.

POWER: Many EPC firms describe this period as a structural reset. Do you think the changes underway—contracting models, digitalization, financing—represent an evolution or a fundamental reinvention of the EPC business model?

Wong: In EnergyLink's world of power and industrial projects, the EPC model for contracting and financing has remained consistent. Whenever possible, our EPC customers rely on suppliers who can provide a lump sum scope backed by financial instruments, including bonding and lines of credit (LOC). Like many businesses, our customers are striving to do more with fewer resources. They aim to improve efficiency by automating processes from project initiation to completion. EnergyLink is well on its way to digitalizing all functions within our company, and we see that our customers are also working diligently toward this goal. ■

—***POWER***

Beyond Traditional Controls: Managing Power Project Schedule and Cost Overruns

From financial dashboards to factory-based assembly, utilities and their contractors are deploying new tools and processes to improve project cost performance.

Sonal Patel

In decades past, the decision to pursue a major energy infrastructure project rested on financial viability. Projects moved forward only when forecasts showed that construction costs could be contained within projected budgets and that expected revenues would justify the capital outlay. Budgets defined scope and technology choices, and engineering, procurement, and construction (EPC) firms engineered solutions to fit within that framework. But according to research published by Benjamin K. Sovacool and Hanee Ryu of Boston University in the journal *Energy Research & Social Science* (March 2025), cost overruns appear to have become structurally embedded in energy infrastructure delivery.

The analysis examined 662 energy projects spanning 83 countries built between 1936 and 2024, representing more than 400 GW of capacity. It found actual costs of $1.358 trillion against $812 billion budgeted—a 66% overrun. More than three-fifths of all projects exceeded budget, and the average escalation was 40.6%.

Perhaps more striking is that the pattern varied sharply by technology. Nuclear power projects exhibited the most extreme escalation—102.5% on average, roughly doubling initial estimates—followed by hydropower (36.7%), geothermal (20.7%), and fossil-thermal (9.7%). Solar and transmission projects delivered the most consistent results, finishing 2.2% and 3.6% below budget, respectively. Time delays mirrored this technology divide: nuclear builds averaged 64% schedule overruns, geothermal 58.8%, while solar remained near baseline.

In addition, Sovacool and Ryu's regression analysis identified two critical structural breakpoints—1,280 MW and 1,561 MW—beyond which diseconomies of scale accelerate sharply. Projects exceeding 1,561 MW showed disproportionately

1. Plant Vogtle Units 3 and 4 in Georgia encountered notable delays and cost overruns, but future AP1000 projects could benefit greatly from the experience. Courtesy: Georgia Power

higher cost escalation. A second threshold emerged at 87.5% of schedule delay, where cost relationships shifted nonlinearly as projects were re-scoped or restructured.

And contrary to conventional wisdom, high-income economies exhibited 37% higher escalation than low-income ones. North America posted 74% higher cost growth than sub-Saharan Africa—potential evidence that governance density, layered oversight, and regulatory change amplify cost risk rather than contain it.

According to the findings, technological maturity remains a decisive factor. After 1976, learning effects reduced overruns in modular technologies like solar and wind, but not in nuclear or thermal plants, where design complexity and safety requirements expanded faster than learning gains could compensate. Hydrogen and carbon-capture projects, predictably, already show "significant time and cost overruns, casting doubt on their ability to be rapidly scaled up to meet energy and climate policy priorities," the research says.

Industry Solutions: Real-Time Architecture and Visibility

The energy and construction sectors, historically hindered by cost overruns and schedule delays at power projects, have increasingly recognized that many of these issues are preventable—stemming from outdated information systems and fragmented decision-making processes. According to a December 2024 analysis from construction management software provider CMiC Global, "Projects frequently exceed their budgets by 20% to 30%, causing financial strain and damaging reputations. In 2025, the problem is compounded by fluctuating material costs, labor shortages, and supply chain disruptions."

To counteract this, forward-thinking firms are shifting away from traditional monthly status reports, adopting daily monitoring systems that flag variances in real-time, enabling proactive intervention before issues escalate, CMiC says. These firms rely on cloud-based financial dashboards, which now provide comprehensive tracking of labor, equipment, materials, and waste streams, with automated alerts that highlight deviations as they happen. Additionally, many are using mobile field applications that allow onsite personnel to log expenses instantly, eliminating the reporting delays that historically obscured project cost trajectories until critical phases were reached.

"Weekly reviews concentrate on identifying early warning signs of potential overruns—this proactive approach steadily enhances financial control and project predictability," CMiC reports. Other tools include advanced scheduling software that analyzes historical productivity data to recommend optimal crew sizes, eliminating both overstaffing and understaffing bottlenecks. Additionally, it points to cross-project resource pooling—becoming standard at multi-site organizations—which could centralize equipment and labor, maximizing utilization across project portfolios rather than allowing assets to sit idle, which reduces waste and improves efficiency.

The firm also encourages strategic vendor partnerships that incorporate long-term agreements with volume pricing and guaranteed delivery commitments to replace speculative spot purchasing. Early procurement has also become critical—many utilities maintain vetted networks of pre-qualified suppliers and backup vendors, ensuring the availability of long-lead items amidst ongoing supply chain uncertainties.

However, according to a Bain & Co. analysis of energy transition capital challenges, energy companies may be taking it even further. "Large projects often running 15% to 20% over budget" expose utilities to "$1.5 billion of capital risk annually through 2030," the global management consulting firm notes. Most energy and natural resource companies still manage projects individually rather than systematically across portfolios, Bain suggests. It recommends that power entities think simultaneously across portfolio, program, and project levels to identify synergies—such as consolidated vendor agreements or shared permitting strategies—that individual project teams cannot see. It cites one example where a U.S. electric utility reduced the construction costs of a multi-year solar program by 15% by elevating program-level decisions to senior leadership and implementing rigorous, data-driven land selection protocols, while negotiating leaner scope requirements and improving schedule visibility with vendors. The result: procurement costs fell sharply when suppliers received comprehensive bid requests instead of incremental project-by-project solicitations.

Technology Enablers: Collaboration, Workforce Innovation, and Modular Construction

As discussed at length in this *POWER* special report—and as part of all *POWER's* deeply reported Top Plant profiles—collaboration, workforce innovation, and digital project management are also poised to play a pivotal role in reshaping energy project delivery. Leading firms are deploying advanced digital tools—integrated project platforms, artificial intelligence–driven analytics, and real-time data dashboards—that enable seamless coordination among stakeholders. Workforce development, notably, has emerged as an industry-wide imperative, and leading EPC firms report launching construction academies, mobile training units, and apprenticeship pipelines to address craft labor shortages.

But at the same time, industry is increasingly turning to modular construction and factory assembly as transformative enablers that directly address scheduling and cost challenges. While advanced digital tools and workforce initiatives foster tighter coordination and higher quality in traditional project execution, modularization takes this a step further by shifting significant portions of engineering, fabrication, and assembly into controlled factory environments.

According to Brendan O'Brien, senior business development manager in the Power Group at Burns & McDonnell, "Modular construction has many benefits in the power sector. It reduces time in the field and puts it into a more controlled environment, which is safer and more predictable. Prefabrication can deliver higher quality, better cost control, and improved ability to control critical path scheduling." Burns & McDonnell has demonstrated success in fabricating temporary power skids, helical piles for power projects, and repetitive components such as solar pile caps—applications where factory precision directly translates to field efficiency, he noted.

Safety represents a direct economic benefit. According to O'Brien, "Our fabrication shops have gone several years without a lost time accident," a safety record that translates directly to cost avoidance through eliminated workers' compensation claims, schedule continuity, and reduced owner liability.

O'Brien cited a peak-shaving liquefied natural gas (LNG) project that exemplified the problem-solving capability of modularization. Facing stringent Pipeline and Hazardous Materials Safety Administration (PHMSA) siting requirements and unique piping configurations between liquefaction systems, tanks, and vaporizers, the project team required running LNG piping in concrete trenches installed on top of pipe racks. "Our prefabrication shop supplied, prefabricated, inspected, and delivered 18 fully assembled pipe rack modules for both LNG facilities. The work done at the shops, including pre-alignment, allowed for efficient module installation onsite, saving time and resources." Each module incorporated structural steel, process and utility piping, pipe supports, insulation, coating, cable tray, and precast concrete trenches—work that would have extended field timelines by weeks, he said.

Modularization's greatest strength often emerges in crisis response. On a reciprocating internal combustion engine project, a piping dimension mismatch threatened delays. O'Brien recounted: "Our onsite team identified the problem, our design team in India developed a solution overnight, and our construction subsidiary, AZCO, used the prefabrication shop to deliver a custom fix. This seamless coordination across disciplines and time zones turned a potential crisis into a testament to our team's agility and commitment to keeping the project on schedule. These scenarios truly embody the importance of prefabrication."

Regulatory, Permitting, and Legal Risks: New Realities for 2025

Some risks, however, may prove unavoidable. Despite industry-wide improvements in project controls, permitting bottlenecks and regulatory uncertainty will likely continue to drive schedule and cost escalation. According to Lawrence Berkeley National Laboratory, the interconnection queue now totals about 2,300 GW—almost double the nation's installed capacity—with solar and wind projects waiting five years or more for grid connection, up from two years in 2008. High-voltage transmission remains even more constrained: only 322 miles of 345-kV lines or greater were completed in 2024, far short of the Department of Energy's (DOE's) 5,000-mile annual target.

Meanwhile, legal challenges compound delays. According to Resources for the Future, nearly one-third of solar projects and half of wind projects that complete National Environmental Policy Act (NEPA) reviews face litigation, extending timelines by an average of 4.2 years, and agencies prevail in 80% of cases. Notably, however, the Supreme Court's May 2025 ruling in *Seven County Infrastructure Coalition v. Eagle County* narrowed NEPA's scope, potentially reducing future litigation risk.

For nuclear projects, the Nuclear Regulatory Commission (NRC) faces dual pressures. An executive order issued in May 2025 directed the NRC to establish 18-month licensing deadlines for new reactors and 12-month limits for license extensions, with fee caps tied to those timelines. The NRC has since introduced reduced hourly rates—$148 versus $318—for advanced reactor applicants effective October 2025, cutting review costs by more than 50%, but accelerated timelines have raised concerns about staffing capacity and safety review adequacy.

Finally, the Environmental Protection Agency's (EPA's) June 2025 proposal to repeal greenhouse gas and mercury standards for power plants created more regulatory uncertainty for operators who had already begun compliance investments. Most utilities are now bolstering legal risk assessment and crafting parallel-path permitting strategies to maintain schedule flexibility amid evolving federal policy. ■

—***Sonal Patel*** *is a POWER senior editor.*

The EPC Partnership Paradigm: How Smart Collaboration and Digital Tools Are Driving New Delivery Models

Traditional owner-EPC relationships relied on sequenced approvals and risk allocation tied to project maturity. Today's interdependent infrastructure, including for the grid, generation, storage, and transmission, requires simultaneous optimization of design, procurement, and construction decisions. That is fundamentally changing how contracts are structured and teams are organized.

Sonal Patel

As the U.S. power infrastructure landscape evolves, the relationship between utilities and engineering, procurement, and construction (EPC) firms is also beginning a transformation. Compared to past decades, where project owners finalized design, secured permits, and then solicited fixed-price bids, new models are prioritizing integrated, risk-transparent partnerships driven by real-time data, collaborative planning, and portfolio-level coordination. The transformation appears to be underpinned by a simple but profound insight: Power projects of the 2020s demand simultaneous optimization—of design, procurement, construction, and operations—across multiple assets and stakeholders.

At the core of the shift are fundamental supply chain disruptions, such as transformer and turbine lead times stretching several years, compounded by workforce scarcity, permitting challenges, and utility infrastructure constraints. At the same time, the demand imperative remains acute: U.S. data center electricity demand could double to 409 TWh by 2030, with artificial intelligence (AI) as a prime driver, according to an October 2025 Bain & Company analysis. Bain notes that hyperscalers are under extraordinary time pressure. Meta, for example, is building gigawatt-scale AI campuses like Richland Parish in 24 to 36 months, and phased commissioning could bring some mission-critical zones online in well under three years. Industry-wide, standard timelines for new data centers now range from 18 to 30 months for most greenfield builds, though permitting, power connection, and equipment procurement could extend those durations by a year or more when hurdles arise.

These converging pressures appear to be redefining risk, including who bears it and when. Under traditional lump-sum contracts, EPCs assumed nearly all financial risk, and while owners locked scope, schedule, and price, contractors either delivered or absorbed losses. But in a market where equipment lead times exceed project timelines by years, and where labor scarcity and supply volatility are structural realities, that model is looking less attractive. At the 2025 EPC Show in Houston, EPC leadership publicly acknowledged a growing shift away from fixed-price delivery toward collaborative, transparent cost-sharing models.

Essentially, they explained, when contractors can no longer price risks that have become uninsurable—supply volatility, multi-year equipment lead times, or constrained labor—the burden inevitably shifts upstream. Some are looking at more amenable contracting models, including progressive design-build, reimbursable with pain/gain share, and open-

1. Entergy Mississippi's $1.2 billion Vicksburg Advanced Power Station marks the next phase of the utility's Superpower Mississippi initiative to replace 50-year-old gas units with modern combined cycle generation. The 754-MW plant, to be built by TSL Power Partners—a joint venture of TIC (The Industrial Company) and Sargent & Lundy—along with Mitsubishi Power Americas, will use advanced 1x1 combined cycle technology capable of future hydrogen blending. Courtesy: Entergy book transparency, which distribute risk. So, for example, instead of locking in a lump-sum price that conceals exposure until change orders pile up, owners are accepting greater scope definition and cost-escalation risk earlier in exchange for realistic cost visibility and speed. What appears to be emerging is a pragmatic partnership model, where owners carry the financial exposure tied to procurement and schedule compression, while EPCs retain performance and execution risk within a clearly defined scope.

Why Early Engagement Works for Utilities: The Demand Certainty Advantage

At least for now, utilities are embracing early EPC engagement because binding customer agreements now shape project economics. American Electric Power (AEP), for example, reports 28 GW of incremental load growth under executed letters of agreement (LOAs) and electric-service agreements (EASs), about 80% of which is from hyperscalers such as Google, AWS, and Meta. "We have evolved our contracting strategy to sign full take-or-pay agreements earlier in the development cycle, helping us to filter out speculative load," noted AEP Vice President and CFO Trevor Mihalik. "Commission-approved tariff reforms have strengthened these contracts, especially in our vertically integrated businesses, but generation investments must be tightly aligned with the real demand to protect customer rates." The agreements, often signed earlier in the development cycle, may give the utility's EPC partners the real data needed to model commodity, labor, and equipment risk, he suggested.

Entergy has taken a similar approach. The company's "Superpower Mississippi" initiative (Figure 1), which includes a $300 million investment to harden the grid and improve reliability, funded through new revenues from Amazon and other large industrial customers' investments in Mississippi, has enabled customer rates to be 16% lower than they otherwise would have been, according to Entergy Mississippi CEO Haley Fisackerly. Separately, Google is covering the full cost of powering its West Memphis data center and committed to a $25 million fund for local energy efficiency and workforce development. Entergy told investors it has EPC agreements for generation projects through mid-2029 and has secured 90% of materials required for planned transmission projects through 2030, as its data center pipeline expanded from 7 GW to 12 GW. That contractual visibility strengthens confidence in cost recovery and reduces speculative exposure, it noted.

Entergy's staged approach to large customer contracting underscores how utilities are using binding milestones to manage risk and stage investment. As of October 2025, Dominion reported about 47 GW of data center demand "in various stages of contracting," divided into 28 GW under substation-engineering letters of authorization, 9 GW under construction letters of authorization, and nearly 10 GW in electric-service agreements. CEO Bob Blue explained that as customers move from one stage to the next, their financial commitment increases and that "should a customer in this stage elect to discontinue a project, they're obligated to reimburse the company for its investment to date." The framework ensures cost recovery and gives Dominion and its EPC partners predictable triggers for mobilizing resources. That same alignment was echoed at Southern Co., where executives highlighted minimum-bill provisions that "cover all of our costs, whether or not the meter spins," allowing utilities and contractors to commit labor and materials earlier, supported by stable revenue streams.

The shift, meanwhile, appears to be recasting the EPC's role (see sidebar). Instead of minimizing costs within rigid budgets, contractors are helping owners understand and manage uncertainty through data. "We start by defining clear procurement and hedging objectives," said Brian Despard, senior project manager with 1898 & Co., the business and technology consulting arm of Burns & McDonnell. "From there, we use probabilistic modeling to quantify both price and volume risks. That kind of analysis helps you see the full range of possible outcomes and gives you a strong,

Speed Over Scale: Fresh Prospects for Smaller, Specialist EPCs

The pressure for speed and flexibility is reshaping the engineering, procurement, and construction (EPC) competitive landscape across multiple fronts. While mega-contractors remain dominant for utility-scale projects, a cohort of specialized, mid-sized and smaller EPCs—and notably, a new class of fast-deployment integrators and orchestrators—is capturing market share that requires rapid mobilization.

Fagen Inc., a Minnesota-based non-union EPC, reports that it "maintains a database of over 10,000 craftworkers" and publicly lists recent thermal work that includes simple-cycle gas and reciprocating-engine projects. USP&E Global explicitly markets "gas turbine power plants deliverable in 90–180 days—bypassing grid constraints and enabling immediate data center deployment." New APR Energy is promoting mobile aeroderivative turbine packages with stated 30- to 90-day deployment windows for large commercial loads, including data center applications. ProEnergy is also targeting this niche by repurposing aviation-derived engines into modular fast-start blocks intended to help developers bridge equipment shortages. Touted advantages often include direct labor, self-performance, reducing subcontracting overhead, regional presence, and agility in compressed timelines.

A similar shift is unfolding behind the meter (BTM). VoltaGrid has reported deploying large fleets of modular natural gas units (Figure 2) to support data center growth in Texas through partnerships with INNIO Jenbacher, Vantage Data Centers, and with hyperscalers like Oracle. Calibrant Energy and Aligned Data Centers recently completed an onsite battery system at a Pacific Northwest campus intended to accelerate interconnection. DEPCOM Power continues to build turnkey solar-plus-storage solutions for industrial customers, including BTM installations. Wärtsilä has likewise highlighted U.S. data center projects using its flexible engine platforms. Dozens of other companies are competing for fast-track natural gas turbine deployments.

2. VoltaGrid has established partnerships with INNIO Jenbacher for engine supply, Vantage Data Centers for project execution, and hyperscalers including Oracle to deploy modular, onsite gas generation fleets for data centers. Courtesy: VoltaGrid data-driven basis for conversations with regulators about prudent risk management." Despard added that once that framework is in place, teams can test hedge strategies and adapt to changing market conditions. "That combination of structure, diversity, and flexibility really resonates with regulatory commissions," he said, "because it shows that decisions aren't reactive or speculative. Instead, they're disciplined, transparent, and grounded in a clear understanding of risk and market dynamics."

How Digital Tools and Real-Time Analytics Are Reshaping Execution

From a different plane, the integration of digital platforms and AI into project delivery is also allowing EPCs and owners to translate procurement and scheduling visibility into actionable performance metrics. Rather than reacting to overruns after they occur, forward-looking teams are embedding analytics and automation into project workflows from the start. The tools are also allowing EPCs to communicate risk and progress in real time, creating a pivotal shared-data environment where owners, engineers, and constructors can make decisions based on the same live information, experts told *POWER*.

The range of digital strategies now being deployed across the EPC industry reflects different competitive approaches, but most seek to eliminate friction between design, procurement, and construction. Some firms have invested heavily in proprietary AI platforms that automate design and estimating at enterprise scale. Kiewit has developed two transformative AI tools: KADE (Kiewit Algorithmic Design and Engineering) and ADAPT (Advanced Data Analytics Platform Tool). "KADE was tailored from an off-the-shelf solution, while ADAPT was developed entirely in-house. Both use deterministic AI to meet real project needs," Kiewit noted in a July announcement.

KADE seeks to speed up 3D model creation for complex industrial facilities by automatically generating full models from basic inputs—process diagrams, equipment lists, and site layouts. "KADE was built to follow the same processes an engineer or designer would, using the same software and data," said Matt Lawrence, director of Engineering Technology Solutions for Kiewit Technology Group. "The difference is automation. It streamlines the work and delivers the same quality output you'd expect from a person, but in a fraction of the time." The business impact has been substantial, given that it allows teams to explore more design options and engage clients earlier, while changes are less costly.

"KADE's speed allows estimators to put more 'hooks in the water' (more bids)," Lawrence noted. However, the transition introduces organizational challenges. As Lawrence explained: "The perspective can be, 'I only have one job that's supposed to last me eight weeks, but you just completed it in eight minutes. Now what do I do?' " The goal, he emphasized, is not replacement but elevation: "It's to remove the tedious steps so they can focus on critical thinking and, ultimately, win more work."

ADAPT is Kiewit's ground-up custom platform addressing gaps that off-the-shelf software cannot solve. Ryan Jisa, leading ADAPT's development, described it as a platform that "guides you through the process and taps into powerful algorithms along the way." He is scaling it for enterprise deployment: "My focus has been on transitioning ADAPT from a prototype to an enterprise-scale platform." One application is for solar layout optimization—determining where panels and metal racks go across thousands of acres. "Before ADAPT, generating even one layout could take days or weeks, making it tough to stay competitive in a four-week bid cycle. Now, we get multiple layouts within the first few days of an estimate kickoff, with our standards, constructability, and quantities built in," said Todd Eiter, Kiewit's director of solar engineering. Earthwork planning has been similarly transformed.

Burns & McDonnell exemplifies an end-to-end integration strategy combining augmented reality visualization, automated design workflows, and collaborative robotics. "We are using augmented reality technology to optimize our construction projects and prevent costly rework in the field," Joey Mashek, vice president in the Power Group at Burns & McDonnell, told *POWER*. "By overlaying our digital 3D models onto the physical job site, we can perform real-time verification of everything from underground utilities to the precise placement of anchor bolts and pipe stubs before concrete is poured. This allows us to instantly detect any potential discrepancies between the design model and field conditions, effectively optimizing the construction sequence and eliminating the schedule delays and budget overruns."

Mashek also described Burns & McDonnell's approach to automating design-intensive processes. "On the solar side of things, we developed an automated grading design tool that transformed what used to be a two-week manual process into a four-hour digital workflow," he said. "That shift doesn't just save time—it redefines how our teams think about design. For the industry, that means better cost control, faster execution, and fewer surprises in the field." The firm has extended this philosophy to fabrication: "Our fabrication teams are integrating collaborative robots (cobots) to sharpen precision and redefine productivity in our production shops. Using the tech to automate repetitive tasks empowers our skilled professionals as they collaborate to create prefabricated metal components that meet exacting standards. And we're also exploring various forms of robotic technology in the field."

The Convergence: Data-Driven Collaboration

The data-driven sophistication now embedded in project delivery is inseparable from a broader shift toward transparent, collaborative contracting, experts told *POWER*. When EPCs have real-time visibility into design-construction trade-offs, cost drivers, and schedule dependencies, they can move from adversarial fixed-price models to partnership-based risk sharing, suggested Brendan O'Brien, senior business development manager in the Power Group at Burns & McDonnell.

For example, "A client's load was projected to double, making it imperative to add significant generation capacity to the grid by 2026 to continue providing grid stability and reliability," he said. "The accelerated timeline precluded a conventional, multi-stage project development process. To meet this challenge, we formed a close partnership with the client and executed the project using a progressive EPC model." That project began with full transparency, he noted. "We began with an open-book contract, allowing for transparent collaboration on design and procurement," he explained. "This phase was crucial for building trust and aligning on key decisions regarding equipment and construction strategy. After achieving client confidence in the project's direction and cost structure, we closed the book and converted the contract to a firm-lump-sum agreement."■

*—**Sonal Patel** is a POWER senior editor.*