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GTTSi

Global Technical Training Services, Inc. Newsletter

The State of the Industry

Sid Crouch, GTTSi Chief Technical Consultant

Due to surging electricity demand driven by data centers, manufacturing reshoring, and transportation electrification, a sobering reality has emerged. The US power industry needs more than 500,000 workers by 2030. For every energy sector worker under the age of 25, we have ~2.5 workers retiring. Nuclear and grid-related professionals make up the steepest decline. Applied technical roles are particularly scarce-pipefitters, electricians, line workers, plant operators, and nuclear engineers. This workforce shortage threatens to bring the expansion of our energy infrastructure to a halt, delaying projects and raising costs. Some firms have reported it takes 6 - 9 months to fill an open position. Employers in the transmission, distribution, and storage sector have reported acute hiring challenges, with 89% indicating difficulty in finding workers, according to the U.S. Department of Energy's 2025 U.S. Energy and Employment Report. Faced with this shrinking talent pool, many energy sector companies have turned to technology to increase their existing workforce capabilities. Utilities are deploying augmented reality(AR) tools that enable senior technicians to assist less experienced colleagues remotely, and are utilizing AI-driven predictive maintenance systems to help the operators identify and address issues before they escalate, reducing the need for large maintenance crews. With that said, many utilities still lack the talent to deploy AI effectively. It is critical that we find ways to bridge this gap in 2026, as 2030 is fast approaching!

I welcome your comments or questions - sid.crouch@gttsi.com

HIGHLIGHTS

X-energy LEADING IN THE SMR RACE

CONSTELLATION SETTLEMENT CLEARS PATH FOR LONG-TERM HYDROPOWER LICENSING

U.S. TRANSFORMER SHORTAGE HAS REACHED CRISIS LEVEL

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X-energy EMERGING IN THE RACE FOR SMRS

The U.S. nuclear energy comeback may not begin with the gigawatt-scale reactors of the past. Instead, small modular reactors (*SMRs*), once dismissed as niche, seem to have moved into the center of the global energy and geopolitical stage.

The SMR appeal is based on scalability, siting flexibility, and a reliable carbon-free baseload source of power, that vital ingredient needed in this era of Artificial Intelligence energy demand and industrial decarbonization.

Globally, dozens of SMR designs are under development, ranging from light-water reactors which are closest to commercial readiness to more advanced technologies such as high-temperature gas reactors and fast reactors. What has changed over the past two to three years is that governments, utilities, and large industrial customers are committing real capital to first-of-a-kind projects. SMRs are increasingly viewed as tools for grid-scale clean power, industrial heat, hydrogen production, energy security, and replacement of retiring coal and nuclear units.

Several reactor designs are emerging as near-term contenders, particularly those that build on familiar technologies and operating experience. These designs aim to reduce construction risk, simplify systems, and leverage existing nuclear sites and workforces. A clear lesson has emerged across the industry: reactors that feel familiar to regulators, utilities, and operators tend to move faster than more experimental concepts.

NuScale Power, the only SMR manufacturer with an NRC-certified design, was considered

Image Credit: Energy –northwest.com

the leader of the SMR movement in the past, but X-energy seems to have moved into the top position as the SMR manufacturer of choice. X-energy has closed deals to build ~150 reactors in the U.S. and the U.K.

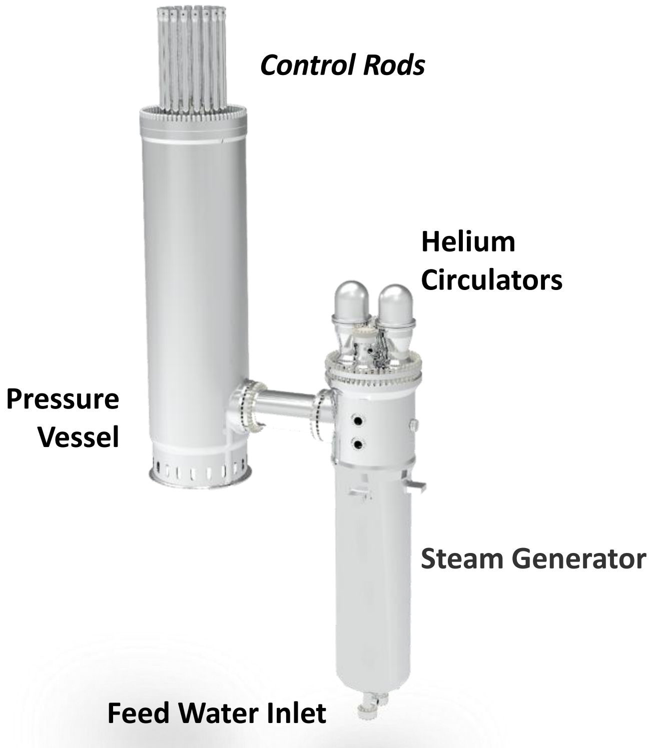
X-energy's SMR development is centered on its advanced high-temperature gas-cooled reactor (HTGR), the Xe-100, which is transitioning from engineering design toward commercial deployment. The Xe-100, as a HTGR, is in a class of reactors that has existed for decades. Similar HTGRs have been built and operated in the U.S., Germany, Japan, and China. The most important inherited technology is its **TRISO fuel**, which has been extensively tested and irradiated over many decades and is widely regarded as one of the most robust nuclear fuels ever developed. The Xe-100 uses helium as a coolant and the proprietary TRISO-X fuel, enabling high outlet temperatures and inherently safe operation, and is designed in modular 80 MWe units that can be grouped into larger plants for electricity or industrial heat applications. X-energy has partnered with Dow Inc. to develop a first commercial four-unit Xe-100 plant at the Dow UCC Seadrift *(continued)*

site on the Texas Gulf Coast, and has submitted a construction permit application to the U.S. Nuclear Regulatory Commission, which set an 18-month review timeline—marking a key licensing milestone. The company is also advancing a major project with Energy Northwest and Amazon in Washington state, aiming to deploy up to 12 Xe-100 reactors as part of a larger plan to bring gigawatts of clean power online by 2039.

X-energy recently closed one of the largest fundraising rounds for SMR technology, locking in a $700 million offer from a group of venture and private equity firms that have pushed X-energy's total capital base to more than $1.5 billion. The deals will deepen partnerships and build out its supply chain, and include agreements for graphite and core materials with suppliers like Toyo Tanso and Doosan Enerbility. X-energy is also constructing a first-of-its-kind advanced fuel fabrication facility in the U.S. to produce TRISO fuel pebbles. These developments collectively position X-energy as one of the leading advanced SMR developers moving toward first-of-a-kind commercial deployment in the coming decade.

Despite the progress, significant challenges remain. First-of-a-kind projects are expensive, supply chains must scale to nuclear-quality standards, and workforce availability continues to be a limiting factor. Licensing and construction timelines are still measured in years, not months, even for modular designs. SMRs are not a silver bullet, but they are increasingly viewed as a necessary complement to renewables rather than a competitor.

Looking ahead, the next several years will be defined by execution. The industry will be



X-energy's Xe-100
Credit: x-energy.com

watching for the start of construction on U.S. projects, cost and schedule performance of early builds, utility decisions around fleet deployments, and industrial offtake agreements for power and heat. Construction of the 1st commercial-scale SMR facilities will be a challenge due to their high initial capital costs. (Cost overruns resulted in the cancellation of NuScale's UAMPS project that was to be built on INL property), their unproven designs, SMR licensing and regulatory process unknowns, and the risks associated with supply chain and an unskilled workforce. The most successful SMR programs are unlikely to be the most futuristic; instead, they will be the ones that deliver reliably.

X-energy CEO Clay Sells said, "Wall Street is becoming much more open to SMRs." This is evidenced by SMR technology being viewed in a positive light as investors become more educated about its technology.

MARYLAND-CONSTELLATION SETTLEMENT CLEARS PATH FOR CHESAPEAKE BAY RESTORATION AND LONG-TERM HYDROPOWER LICENSING

Maryland's long-delayed $340 million settlement with Constellation Energy over environmental concerns tied to the Conowingo Dam is officially moving forward, following the withdrawal of legal challenges by a group of Eastern Shore counties. The agreement marks a major milestone after nearly a decade of litigation and negotiation and removes one of the most significant regulatory obstacles facing one of the state's most important energy assets.

Under the settlement, Maryland will receive $340 million in exchange for issuing a critical water quality certification for the Conowingo Hydroelectric Dam—an approval Constellation needs to secure a new 50-year operating license from the Federal Energy Regulatory Commission (FERC). Without the certification, the dam's prior license had been invalidated by a federal court, creating uncertainty around the long-term operation of a facility that plays a central role in Maryland's renewable energy supply.

"After nearly a decade of legal challenges we can now put this $340M to work to accelerate progress on the Bay," said Maryland Department of the Environment spokesperson Dave Abrams. "We are all on the same team and will work closely with local governments and other stakeholders as we move forward."

Built in 1928 on the Susquehanna River, the Conowingo Dam once played a significant role in trapping sediment and pollutants before they reached the Chesapeake Bay. The Susquehanna provides roughly half of the Bay's freshwater and is its largest tributary, emptying into the northern end of the estuary

Conowingo Dam, on the lower Susquehanna River
Image Credit: Chesapeake Bay Magazine

near Havre de Grace, Maryland. For decades, the dam effectively acted as a buffer for the Bay, capturing sediment, phosphorus, and nitrogen that would otherwise degrade water quality downstream.

Today, however, the reservoir behind the dam is essentially full. As a result, it can no longer reliably trap sediment and, during major storm events, can release large volumes of sediment-laden water downstream. These releases have the potential to bury underwater vegetation, disrupt aquatic habitat, and carry excess nutrient pollution into the Chesapeake Bay—undermining broader restoration efforts that have been underway for years across the watershed.

The settlement directs tens of millions of dollars toward environmental restoration initiatives designed to offset those impacts. These include large-scale tree plantings, expansion of underwater grass beds, improvements to fish passage, ***continued***

trash and debris removal, and remediation of invasive species. Collectively, the investments are intended to deliver measurable water quality benefits while supporting habitat restoration throughout the Bay system.

The agreement also addresses one of the most debated—and controversial—options for managing accumulated sediment: dredging. Over the next 25 years, Constellation will contribute $18.7 million to a dedicated dredging fund. Whether dredging will ultimately move forward remains uncertain, as the U.S. Army Corps of Engineers is currently evaluating the technical feasibility, cost, and environmental implications of dredging the Conowingo reservoir—a process that has drawn both support and skepticism from scientists, policymakers, and local communities.

If the Army Corps determines dredging is viable, Maryland may use the funds to conduct additional studies or begin the permitting process. If dredging is deemed inadvisable, the state retains flexibility to redirect the money toward other environmental projects that advance Chesapeake Bay restoration goals, ensuring the funds are put to use regardless of the outcome. With the water quality certification now issued, Constellation is turning its focus back to securing its new 50-year FERC license. Maryland has stated that it intends for the settlement's environmental conditions to be incorporated directly into the federal operating license, effectively tying long-term hydropower operations to ongoing environmental performance.

The Conowingo Hydroelectric Plant remains a cornerstone of Maryland's clean energy portfolio. Operating continuously since 1928, the facility features 11 hydroelectric turbine generators with a combined capacity of 572 megawatts, making it the largest renewable energy source in the state. As Maryland balances climate goals, grid reliability, and environmental restoration, the Conowingo settlement underscores the growing intersection between energy infrastructure and ecosystem accountability.

Conowingo Dam
Image Credit: Constellation

U.S. TRANSFORMER SHORTAGE HAS REACHED CRISIS LEVEL

The U.S. electrical transformer shortage has been a major supply chain story since 2020. Now it is being viewed as a crisis.

After years of under investment in transformer manufacturing, factors such as adding the post-pandemic surge of electrification, construction of high electrical demand projects, and the availability of grain-oriented electrical steel and copper markets, has resulted in transformer supply being overcome by demand.

This in turn has steadily increased delay times for receiving large power and generator step-up (GSU) transformers beyond historical norms. Obtaining a utility-sized transformer currently takes from 12-26 weeks for standard models, 18-36 months for large, custom, or transmission-scale units, with some specialized transformers facing a 4+year delay. Lead times of a few months were common prior to 2020, but now long delays are common for all types, with even smaller distribution units taking over a year.

Consulting firm, Wood Mackenzie (WoodMacs), warned that the U.S. transformer market remains structurally out of balance, and that demand continues to outpace any realistic near-term increase in manufacturing capacity. The firm noted that power-transformer demand has risen 119% since 2019, and distribution-transformer demand is up 34%, driven by faster-than-expected load growth, an expanding clean-energy pipeline, and a wave of end-of-life replacements. One of the summary findings put it bluntly: “Supply shortage persists as demand growth remains robust.”

Our aging infrastructure is in desperate need of upgrade. More than half of the distribution transformers (~ 40 million units) are beyond their expected service life. When you couple the rising need for new build with the need to replace these

aged transformers, you can understand why experts are calling our transformer shortage a crisis. WoodMacs estimated a 30% shortfall for power transformers and a 10% shortfall for distribution units across our national fleet.

The tightening is most severe with the higher-voltage transformers. Since 2019, the demand for generator step-up units has grown 274%, and substation power transformers are up 116%, reflecting both grid modernization needs and the acceleration of large-scale generation and data center development. Although the availability of distribution transformers has improved, the larger units remain locked-in for two years or more, with power transformers averaging 128 weeks and GSUs 144 weeks in WoodMac’s second quarter 2025 survey. Meanwhile, costs have also climbed. Since 2019, unit prices have increased 77% for power transformers and 45% for GSUs, with some classes of distribution transformers rising as much as 95%. Without intervention, extended lead times and elevated costs will become the new normal, potentially derailing our grid modernization efforts.

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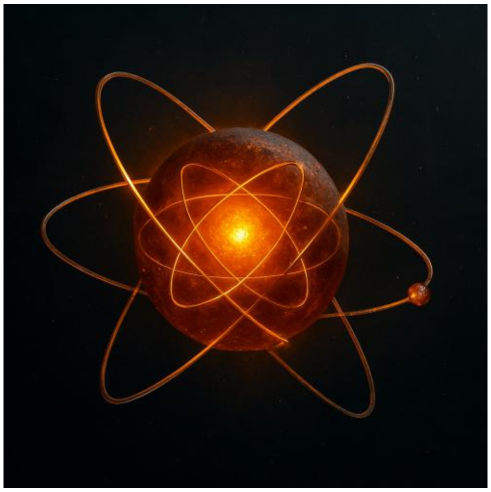

Heisenberg (Nobel Prize-winning German theoretical physicist famous for co-founding quantum mechanics) said it was impossible to know both the exact position and the exact momentum of a subatomic particle simultaneously, but research scientists have just proved him wrong. Australian and British researchers at the University of Sydney, have re-imagined Heisenberg's uncertainty principle, engineering a trade-off that allows precise measurement of both position and momentum. Using quantum computing tools like grid states and trapped ions, they were able to demonstrate Woodhacks sensing precision beyond classical limits. This breakthrough could fuel ultra-sensitive sensors for navigation, medicine, and astronomy.

Conestee Dam, located on the Reedy River in Greenville County, South Carolina, has completed its massive Restoration Project. Water is already flowing over the new dam, which will contain the toxic sediments from the old dam site. This state-funded project addresses long-standing environmental concerns about the failing 130-year-old dam. The project was completed 18 months ahead of schedule and under budget. The new structure is expected to protect Lake Greenwood's drinking water source and the dam's downstream communities from the potential hazards posed by the hazardous waste sediment being contained by the old dam's deteriorating state. The Project involved complete removal of the old dam and construction of the new dam.

Photo Credit: lakeconesteedam.org

Jiangmen Underground Neutrino Observatory
Photo Credit: Xinhua News Agency

Antineutrinos can be used to detect and monitor reactor operations. Because they are a byproduct of the nuclear fission process and cannot be shielded by matter, this allows for remote, non-intrusive verification of reactor status and fuel use. By analyzing the rate and energy spectrum of these antineutrinos, researchers and inspectors can determine a reactor's power level, identify its fuel composition (like uranium or plutonium), and detect potential shifts to weapons-grade material production, thus supporting nuclear non-proliferation efforts. This also allows remote monitoring of reactor operations for anomalies such as power reductions or fuel changes that might indicate diversion of nuclear material, helping ensure safeguard agreement compliance. There are several facilities where anti-neutrino monitoring can occur. One is operational and located In southern China, the Jiangmen Underground Neutrino Observatory (JUNO) with two more facilities planned. The US has one facility called the Deep Underground Neutrino Experiment (DUNE) planned for operation in 2031.

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