GTTSi

Minority Woman-Owned Enterprise

Serving the Nuclear and Energy Industry Since 1980

March 2022

March 2022 Newsletter

Individual Highlights:

Global Technical Training Services, Inc.

807 Bypass 123 – Suite 31

Seneca, South Carolina 29678

Telephone: ***864.882.3111*** ***Email:*** ***ginfo@gttsi.com***

OVER 40 YEARS IN BUSINESS

2020 BEST of the Upstate Greenville News

MWBE MINORITY AND WOMEN BUSINESS ENTERPRISE

- ***Clay Schile, Vice-President***
- ***Kaye Browder, Technical Staffing Manager***
- ***Chrissy Mulay, Technical Staffing Specialist***
- ***Sandra Carter, Administration***
- ***Sid Crouch, Chief Technical Consultant***
- ***Ken Schaaf, NRC Exam Developer***
- ***Pat McHale, Consultant***

May your Days be filled with BLESSINGS
like the Sun that lights the sky!
And may YOU always have the COURAGE
to spread your wings and FLY …

Zero Carbon by 2050 Requires 6 TW-hours of Battery Energy Storage

Table A-1. Results for Wind, PV, and Total Renewable Energy Contribution in 2050 Across all Resource Sensitivity Scenarios

Scenario	Wind Generation (%)	PV Generation (%)	Renewable Energy Generation (%)	Storage (GW)	Storage (GW-h)	Storage duration (hrs)
Reference	20.4	28.8	56.4	213	1,318	6.2
Low-Cost Battery	20.2	30.6	58.0	384	1,792	4.7
Low-Cost PV	14.5	41.2	63.1	278	1,672	6.0
High Natural Gas Cost, Low-Cost Battery	27.7	46.0	80.8	679	3,242	4.8
Zero Carbon	37.3	33.4	94.0	932	6,097	6.5

Renewable energy includes biofuel, geothermal, hydropower, solar, and wind generation.

"NREL research revealed that to achieve zero carbon emission by 2050 will require 94% of our electricity to come from renewable sources, 6% from nuclear, and 6 TWh (Terrawatt-hour) of battery energy storage to deliver 932 GW (GigaWatt) for up to 6½ hours. However, ~930 GW of battery energy storage with 6½ hours' worth of capacity will require 6.0 TWh of battery energy storage. Today we can purchase ~3 GWh (Gigawatt-hour) worth of battery energy storage for ~ $1 billion, and at these prices, it would cost about $2 trillion for 6 TWh or about $6,000 per person, spread out over the next 28 years."

OK, let's discuss zero carbon emissions by 2050.

Based on projected electricity demands, we will require 94% of our electricity to come from renewable sources, 6% from nuclear, and 6 TWh (***Terrawatt-hour***) of battery energy storage to deliver 932 GW (***GigaWatts***) for up to 6½ hours.

NOTE: A gigawatt (GW) is equal to one billion watts, and most of us are familiar with a watt. The light bulbs in our homes are typically between 60 and 100 watts. A GW could provide enough energy to power ~750,000 homes. A TW (terawatt) is equal to one trillion watts (10^{12} watts) and a TWh (Terawatt-hour) is a unit of energy equal to producing one trillion watts for one hour, and it is commonly used to express annual electricity generation for entire countries and is often used when describing major energy production or consumption.

The U.S. Department of Energy's National Renewable Energy Laboratory (***NREL***) recently released – *Grid Operational Impacts of Widespread Storage Deployment* – in their Storage Future Series. The purpose for this document was to analyze some of the effects of energy storage on the power grid as it evolves toward five unique scenarios in 2050, illustrated above in Table A-1.

The Zero Carbon scenario predicts the third highest total of solar power at 33.4% with wind at 37.3% and energy storage at 932 GW with the capacity to provide this power for 6.5 hrs.

This battery energy storage ranged from 213 GW to 932 GW across all five scenarios, with the average duration ranging from 4.7 to 6.5 hours – requiring 6.0 TWh (***Terrawatt-hour***) of battery energy storage for the Zero Emission scenario.

Today we can purchase ~3 GWh (***Gigawatt-hour***) worth of battery energy storage for ~ $1 billion, and at these prices, it would cost about $2 trillion for 6 TWh. If we divide the $2 trillion by the population of the U.S. (~330,000,00) it would cost each of us over $6,000 but spread out over the next 28 years an addition of ~$215 a year per person.

The research also revealed that the Zero Carbon scenario results in large amounts of curtailment of wind and solar nearly 24 hours a day, all year round. This leads to the batteries actually being used less than in other scenarios because the wind and solar is always running, and in its over producing nature, often will meet its grid demands.

As renewables grow, storage's charging needs align with solar power's generation curves, due to solar's daily predictability. In addition, oftentimes wind power's production will over-generate for days on end, far longer than the energy storage hourly durations that were considered. Although energy storage's capacity factor is relatively low across all scenarios – the actual time spent outputting electricity is only 10-20% but surprisingly its capacity factor exceeded 75% during the top 10 net load hours across all scenarios and years. Which is much better than combustion turbine generators– often referred to as peaking plants – which had an average capacity factor of only 11% in 2019.

This additional storage decreases the number of times fossil fuel generators will be needed to start up and greatly reduces the overall cost of providing energy, as well as the amount of particulates released by burning fossil fuels – primarily due to the cold start-up period of peaker plants being less efficient.

TerraPower / GE Hitachi's Natrium Reactor to be Built in Wyoming

"TerraPower teamed with PacifiCorp will build the Natrium LMBR at Rocky Mountain Power's Naughton Power Plant site, located in Kemmerer, WY. This design is different from light-water PWR's, like Watts Bar and Vogtle – instead of cooling with water, Natrium cools with liquid sodium, a metal that boils at a temperature much higher than water and solidifies at well above room temperature, it relies on fast neutrons for fission, inherently safer than PWR's, and less costly. We, at GTTSi, have consultants experienced in this technology and welcome the opportunity to provide consultation and support on this project."

In October 2020, the U.S. Department of Energy (***DOE***) awarded TerraPower $80 million in initial funding for their Natrium reactor design - TerraPower / GE Hitachi technology – LMBR (***liquid metal boiling reactor***).

TerraPower signed a cooperative agreement with the DOE in May 2021 and announced Bechtel Corporation as their contractor, but still needed a site where this reactor design could be demonstrated.

In 2021, Wyoming Governor Mark Gordon and their state lawmakers opened their arms to this endeavor based on their commitment to lead Wyoming to a carbon-net negative energy solution.

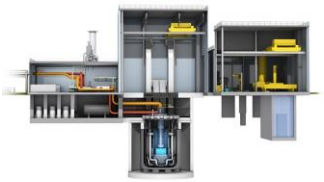
TerraPower (***firm founded by Bill Gates***), teamed with PacifiCorp to unveil their plans for the Natrium (***Latin for sodium***) reactor to be located in Wyoming at a retired coal-fired plant. In November 2021 they announced their choice - Rocky Mountain Power's Naughton Power Plant, located in Kemmerer, WY.

The Natrium reactor is a 345MW liquid sodium-cooled fast reactor with a molten salt-based energy storage system. The storage technology is capable of boosting the system's output to 500MW for more than 5 ½ hours, which is adequate to serve the energy requirement for about 400,000 homes. This allows the Natrium plant to easily integrate with renewable resources and could lead to faster, more cost-effective decarbonization of electricity generation, the company said.

The Natrium design is different from the light-water PWR's like Watts Bar and Vogtle – instead of cooling with water, Natrium cools with liquid sodium, a metal that boils at a temperature much higher than water and solidifies at well above room temperature. Another major difference is that the LMBR design uses fast neutrons instead of thermal neutrons – although fast neutrons have a smaller chance of being captured by the fuel (***uranium and plutonium***), when they are captured, they have higher probability of causing fission. Therefore, the inventory of transuranic waste is dramatically reduced. In addition, sodium has a low specific heat (***compared to water***), which enables greater heat absorption in the liquid phase, providing a greater safety margin from interaction with the fuel cladding. Moreover, the high thermal conductivity of sodium effectively creates a reservoir of heat capacity that provides thermal inertia against overheating and the liquid sodium need not be pressurized, since its boiling point is much higher than the reactor's operating temperature (***510 to 550 °C***), and one other advantage is that sodium does not corrode steel reactor parts – it actually protects metals from corrosion

TerraPower says this relatively small, 345-megawatt plant, will be able to power about 345,000 homes, it is safer than the light-water reactors, and less expensive – it uses a simpler less expensive system of unpressurized coolant and is not dependent on electricity to vent and halt fission during an emergency. This approach isn't new, the U.S. evaluated this design in the past (***EBR-1, EBR-2, Fermi, and a Sodium Reactor Experiment***) – back in the 50's and 60's – and Russia has had a commercial sodium-cooled reactor in use at full capacity since 2016.

GTTSi have consultants experienced in this technology and welcome the opportunity to provide consultation and support on this project.



Will PG&E's Emergence from Probation Renew a Spirit of Service ?

"California's largest utility, PG&E, recently emerged from criminal probation from the 2010 natural gas explosion in a San Bruno neighborhood. But since 2017 they have been blamed for more *than 30 wildfires that wiped out ~ 23,000 homes and businesses and killed more than 100 people. They have pleaded guilty to 84 felony counts and face more criminal charges in two separate cases, for a Sonoma County wildfire in 2019 and a Shasta County fire in 2020 - PG&E has denied any criminal wrongdoing in those fires and have a commitment to make things right and make Californians safe."*

Pacific Gas & Electric (***PG&E***) recently emerged from their five-year criminal probation issued due their conviction of six felony crimes from a 2010 explosion triggered by one of their natural gas lines that blew up a San Bruno neighborhood and killed eight people. This probationary period judgement was expected to promote rehabilitation, but U.S. District Judge William Alsup feels differently and published a report based on his oversight of the utility, "In these five years, PG&E has gone on a crime spree and will emerge from probation as a continuing menace to California".

During this probationary period PG&E plunged into bankruptcy for the second time in less than 20 years. Before emerging from bankruptcy last year, PG&E reached settlements of more than $25.5 billion, including $13.5 billion earmarked for wildfire victims that may fall short of doling out the amount initially promised.

Since 2017, PG&E has been blamed for more than 30 wildfires that wiped out more than 23,000 homes and businesses and killed more than 100 people. They have pleaded guilty to 84 felony counts of involuntary manslaughter for a 2018 wildfire that wiped out the town of Paradise, about 170 miles northeast of San Francisco. Now, they face more criminal charges in two separate cases, for a Sonoma County wildfire in 2019 and a Shasta County fire in 2020 - PG&E has denied any criminal wrongdoing in those fires.

Even more potential criminal charges are looming as California regulators have linked PG&E to the massive Dixie Fire last year, when a tree is believed to have hit the utility's distribution lines in the Sierra Nevada — part of a sprawling, often rugged service territory covering 16 million Northern Californian customers.

PG&E, a 117-year-old company, generates about $20 billion in revenue annually while serving a 70,000 square-mile service area in the northern and central part of California which includes farmland, forests, big cities, and the world's technology hub - Silicon Valley.

While acknowledging its problems, PG&E claimed in a report to U.S. District Judge William Alsup that their electricity grid is "fundamentally safer" now than in January 2017, and adamantly defended their 40,000 employees and contractors who maintain operations and provide reliable services. To evidence their progress, PG&E cited that more than 3.3 million trees near their electrical equipment have either been trimmed or removed in the past two years and noted that they are spending $1.4 billion annually to trim or remove trees, up from the $400 million annually in 2017. However, Judge Alsup estimates that PG&E still has a seven-year backlog of high-risk trees that need trimming or removal.

In addition, PG&E has conducted a sweeping overhaul of its board and management, including bringing in Patricia Poppe as its new CEO last year. Poppe, a former Michigan utility executive, became PG&E's fifth CEO in five years, part of an unusually high turnover rate that the company's federal monitor said makes reform more difficult.

"We know there is more to do," PG&E's lawyers told Alsup in their final probationary report. "These are not just words on a page or a poster, they are a commitment to make it right and make Californians safe."

TVA Advanced Nuclear Program Pursues GE-Hitachi BWRX-300

"TVA announces a new nuclear program that will explore advanced nuclear technologies as part of its de-carbonization goals to achieve net-zero emissions by 2050. One of its first tasks will be to pursue a construction license application for a light-water, small modular reactor (SMR) at the Clinch River site, and they are in discussions with GE-Hitachi to support their BWRX-300 light-water SMR design."

Tennessee Valley Authority's (***TVA's***) board recently approved an advanced nuclear program as one of several technologies it will explore as it moves to its long-term goal of achieving a 70% reduction in carbon emissions by 2030 and 80% by 2035, without raising costs or impacting reliability, with their aim to achieve net-zero emissions by 2050.

"We cannot meet the energy needs of tomorrow by making small changes in today's power system. We must work toward a net-zero carbon future today at a programmatic level and, combined with the efforts we've already undertaken over the past few years, that is what TVA's New Nuclear Program enables us to do. Achieving a carbon-free energy future is a shared priority and TVA is developing a diverse portfolio of clean energy sources - like advanced nuclear technologies - that will help address this challenge", TVA President and CEO Jeff Lyash said.

They plan a disciplined, systematic approach with the authority to explore advanced nuclear technology designs at potential locations where they could support TVA's future energy needs – with specific decision points that allow withdrawal from the plans or projects if needed. In addition, they plan to coordinate collaborative efforts with other utilities, government agencies, research institutions, and organizations on advanced nuclear technologies, helping spread the financial and technical risks associated with developing new, innovative solutions.

In 2019, the US Nuclear Regulatory Commission issued an early site permit (**ESP**) for the construction of small modular reactors at its Clinch River site near Oak Ridge, Tennessee (***artist conception pictured above***). More than a dozen reactor vendors have provided TVA with information to support an environmental impact statement for Clinch River.

However, Lyash believes that light-water SMR designs, which are "closely related" to TVA's existing large nuclear units, are more mature and closer to commercial deployment within the next decade. "For that reason, we are currently in discussions with GE-Hitachi to support their BWRX-300 light-water SMR design, which will help inform a future decision about potential deployment," he said.

The BWRX-300 is a 300 MWe water-cooled, natural circulation SMR with passive safety systems that leverages the design and licensing basis of GE-Hitachi's ESBWR boiling water reactor, which has been certified by the US Nuclear Regulatory Commission.

TVA provides electricity for 153 local power companies in Tennessee and parts of six surrounding states as well as providing flood control, navigation, and land management for the Tennessee River system.

TVA's nuclear fleet is the third largest in the U.S. producing more than 40% of their generation. This fleet consists of 7 nuclear reactor plants - three boiling water reactor units at Browns Ferry in Alabama, two pressurized water reactor units at Sequoyah, and two pressurized water reactor units at Watts Bar, both in Tennessee.

"TVA is a nuclear energy leader with extensive experience and expertise in building and operating nuclear facilities," Lyash said. "Clean, reliable advanced nuclear technologies will be an essential part of our region and nation's clean energy future."

Did You Know?

"That Dominion Energy plans to reduce methane emissions by 50% over the next decade. This will prevent more than 430,000 metric tons of methane from entering the atmosphere, the equivalent of taking 2.3 million cars off the road for a year or planting nearly 180 million new trees. This reduction will be accomplished by reducing or eliminating gas venting during planned maintenance and inspection, replacing older equipment with new low-emission parts, and expanding leak detection and repair programs."

Dominion Energy

U.S. Energy Secretary Grandholm visited S.C. State University's nuclear engineering program – it is the only HBCU in the country to offer a four-year nuclear engineering program.

That ***U.S. Energy Secretary Jennifer Granholm, accompanied by U.S. House Whip Jim Clyburn, visited S.C. State University to tour their nuclear engineering program. South Carolina State is the only HBCU (historically black college and university) in the country to offer a four-year nuclear engineering program.*** *During the visit she touted the $1 trillion bipartisan infrastructure package used for funding programs related to science, technology, engineering, and math (STEM) at HCBUs. Her trip featured a roundtable discussion with HBCU leaders, as well as a visit to Clemson University's Wind Test Facility, which tests wind turbine drivetrains. This visit followed similar funding initiatives to other HBCUs, such as her visit to Howard University in May, where she announced $17 million in funding to support college internships, research projects, and other opportunities to bolster investment in under-represented HBCUs and other minority-serving institutions. Just last June, the Energy Department awarded more than $2.85 million for nuclear and particle physics research trainee programs at HBCUs and other minority-serving institutions.*

Duke Energy will double its renewable energy by the end of the decade, eliminate coal-fired generation by 2035 – expanding wind and solar capacity from 10,000 MW to 24,000 MW by 2030.

That Lynn Good, Duke Energy's CEO, announced ***that Duke plans to double its renewable energy capacity by the end of the decade, and stop generating electricity from coal by 2035.*** *Duke intends to deploy $63 billion of capital over the next five years, 80% of which is expected to support investments in grid modernization and zero or lower-carbon emitting generation.* ***Duke's wind and solar capacity will increase from 10,000 MW currently to 24,000 MW by 2030.*** *As coal is phased out Duke's generation profile will grow with zero-carbon resources, such as renewables and hydrogen-enabled natural gas generation.* ***Since 2010, Duke has retired 56 coal units with a total capacity of 7.5 GW and are planning to invest ~$4 billion on hydrogen-enabled natural gas generation to ensure reliability in the absence of coal-fired generation. All total they plan to spend $15 billion on nuclear, renewables, energy storage, and hydropower over the same period, plus another $33 billion on transmission and distribution infrastructure.***

IEEFA - NuScale's SMR project for UAMPS is "too late, too expensive, too risky, and too uncertain".

That ***the Institute for Energy Economics and Financial Analysis (IEEFA) described NuScale's proposed small modular reactor (SMR) project for the Utah Associated Municipal Power System, as "too late, too expensive, too risky, and too uncertain".*** *IEEFA researchers doubt that NuScale has the ability to keep construction costs in check, thereby meeting the target power price of $60/MWh, set in mid-2021.* ***NuScale received approval from the U.S. Nuclear Regulatory Commission (NRC) on its SMR design 2020 and that October, UAMPS received a nearly $1.4 billion, 10-year award from the DOE (Department of Energy) to help fund the project.***

Renewables Reach Milestone – 200 GW of Utility Scale Capacity

"The nation now has more than 200 GW of operating utility-scale generation capacity, but the pace of growth has slowed. Clean energy installations declined by 3% in 2021, after a record year for installations in 2020. However, 27.7 GW of wind, solar, and energy storage was installed last year, the second-largest annual total on record, but "it is only 45% of what's required to stay on track for an emissions-free power sector", according to the ACP (***American Clean Power Association***). ***There are more than 1,000 clean energy projects currently under development across the U.S"***

The U.S. renewable energy industry says the nation now has more than 200 GW of operating utility-scale generation capacity, but the pace of growth has slowed as projects have been delayed due to regulatory and equipment supply issues, among other factors.

Clean energy installations declined by 3% in 2021, after a record year for installations in 2020. More than 11.4 GW of new projects that were scheduled to come online last year were pushed to this year, or as far out as 2023. However, 27.7 GW of wind, solar, and energy storage were installed last year, the second-largest annual total on record, but "it is only 45% of what's required to stay on track for an emissions-free power sector", according to the ACP (***American Clean Power Association***).

Although the U.S. has reached this incredible achievement – 200 GW of operating utility-scale generation capacity - more needs to be done. The ACP urges Congress to act and accelerate progress in order to reach the Biden administration's goal of a carbon-free power generation sector by 2035.

The group said its research shows the pace of installations for renewable energy projects must have a major increase to reach the Biden administration's goal of a carbon-free power generation sector by 2035.

The 27.7 GW of wind, solar, and energy storage was composed of 12,747 MW from wind, 12,364 MW from solar, and 2,599 MW from battery energy storage - more than double the ~1,000 MW installed in 2020.

Currently there are more than 1,000 clean energy projects under development across the U.S., accounting for 120,171 MW of new generation capacity - 37,802 MW under construction and 82,369 MW in advanced development.

The top five states for new installation additions in 2021 include Texas (***7,352 MW***), California (***2,697 MW***), Oklahoma (***1,543 MW***), Florida (***1,382 MW***), & New Mexico (***1,374 MW***).

The top five states for project development, either under construction or in an advanced development stage, are Texas (***17%***), California (***11%***), New York (***7%***), Indiana (***5%***), and Virginia (***5%***).

2021 was a record year for clean energy procurement, with 28 GW of power purchase agreements (***PPAs***) signed in 2021, and corporate customers surpassed the utilities in clean energy procurement for the very first time. Nineteen utilities accounted for 35% of the PPA's - Public Service Co. of Colorado was the greatest at 350 MW (***a subsidiary of Xcel Energy***), Entergy Louisiana, and Consumers Energy. 70% of these agreements were for solar generation.

Project economics have been impacted due to supply chain constraints, commodity price increases, expiring tax credits, and trade barriers. Overall, solar PPA prices increased by 5.7% and wind prices increased by 6.1%. Based on market data year-over-year, the average overall PPA price increased by 15.7% in 2021.

GTTSi Employee – Phillip Hernandez

Phillip Hernandez joined GTTSI in June 2019. He is a seasoned Project Manager, Construction Manager, Commissioning Engineer / Manager, and I&C Consultant. He began his career in the US Navy as a Nuclear Reactor Operator and Electronics Technician on board the USS Teddy Roosevelt. Currently, he is Construction Manager at NextEra's *Fish Springs Ranch Solar Energy Center* (***pictured below***), located just outside of Reno, Nevada. He took on this assignment after completing two other NextEra projects - Trailside Solar Project & Magnolia Springs Solar Project – in Florida and helping with the closeout of Blythe Solar Energy Center in California.

As Construction Manager at the *Fish Springs Ranch Solar Energy Center* some of his duties are outside what one might consider as construction, such as writing base procedures and test diagrams. In addition, he is mentoring junior engineers on best practices in the field, as well as ensuring thorough and concise EPC (***Engineering Procurement & Construction***).

Phillip earned his PMP from the Project Management Institute, has a BS degree in Nuclear Engineering Technology from TESU (***Thomas Edison State University***) and an MBA from Temple University. He has served numerous power generation projects on both coasts - nuclear and solar operations – with specific experience in instrumentation and control. When you combine this experience with his qualifications in field management and business, he is uniquely qualified to successfully lead complex projects supporting our customer's needs - technical performance, business goals, and ROI (***Return on Investment***).

We are so very proud to recognize YOU as one of our valued employees and want to thank you, Phillip, for your dedication and service to GTTSi and our CLIENTS. We are looking forward to your next big project with the Golden Hills Solar and Proxima Solar Complex – 300 MW total on ~2,900 acres in Stanislaus County, CA.

GTTSi
P.O. Box 1679
Seneca, South Carolina 29679

COMPANY OR PERSON's NAME
STREET ADDRESS
CITY, STATE, ZIP

GTTSi

Minority & Woman Business Enterprise

807 Bypass 123-Suite 31
Seneca, SC 29678

Clay Schile
Vice-President
Phone: 864.882.3111
Fax: 864.882.1026
clay.schile@gttsi.com

Kaye Browder
Technical Staffing Manager
Phone: 864.631.9325
Fax: 864.882.1026
kaye.browder@gttsi.com

Chrissy Mulay
Technical Staffing Specialist
Phone: 864.506.4647
Fax: 864.882.1026
chrissy.mulay@gttsi.com

Sandra Carter
Administration
Phone: 864.882.3111
Fax: 864.882.1026
sandra@lbsproperty.com

Sid Crouch
Chief Technical Consultant
Phone: 843.339.9874
Fax: 843.339.9528
sid.crouch@gttsi.com

Ken Schaaf
NRC Exam Developer
Phone: 864.882.3111
kenneth.schaaf@gttsi.com

Pat McHale
Consultant
Phone: 864.882.3111
pat.mchale@gttsi.com