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Global Technical Training Services, Inc. Newsletter

The State of the Industry

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There is a real problem on the horizon that could stifle a nuclear renaissance. That problem is FUEL. Despite decades of assurance that the supply of uranium was secure, the war in Ukraine has revealed this is not true. Russia controls about half the world's enrichment market ***(the process of increasing the percentage of Uranium-235 in the fuel***) and about a third of the conversion market (***turning yellow-cake into UF_6***). As Congress is leaning towards a complete cutoff of Russian imports, the nuclear utilities are nervous. If this supply is lost, the remaining suppliers cannot meet the global demand. In the U.S., most of the nuclear utilities are somewhat prepared with a supply lined up for a couple of years. For example, Constellation president and CEO, Joseph Dominguez, testified to Congress that his company had enough inventory and supply contracts to meet the needs of their 21 reactors until 2028. In addition, the Department of Energy maintains a reserve of UF_6 enrichment at nearly 5% through the American Assured Fuel Supply Program, although it is only enough fuel for five or six reloads according to the Nuclear Energy Institute. Since the problem is both conversion and enrichment, it will likely take 4-7 years for the remaining suppliers to fill the gap. The three enrichment suppliers are Centrus (***formally USEC - United States Enrichment Corporation***), Urenco (***Britain, Germany, Netherlands***), and Orano (***France***). The four conversion suppliers are Orano (***France***), CNNC (***China***), Cameco (***Canada***), and ConverDyn (***US***). To learn more, see the June Nuclear News article entitled, ***On the verge of a crisis: The US nuclear fuel Gordian knot.***

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

Highlights

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THE SUPREME COURT LIMITS THE EPA'S AUTHORITY…ONCE AGAIN

The EPA (***Environmental Protection Agency***) just received its second setback within a year. Last year the Supreme Court limited the EPA's ability to address climate change under the Clean Air Act. This year, the Supreme Court has limited the EPA's authority under the Clean Water Act concerning our wetlands.

In response to the EPA action, Justice Samuel A. Alito Jr. indicated that the Clean Water Act does not allow the agency to regulate discharges into wetlands near bodies of water unless they have "a continuous surface connection" to those waters.

Environmental experts, opposed to the ruling, say this ruling will leave many wetlands subject to pollution without penalty, sharply undercutting the EPA's authority to protect the wetlands under the Clean Water Act. Those opposed also say that the court has appointed itself as the national decision maker on environmental policy and rendered a narrow decision based on the facts of a case in Northern Idaho, where a small wetland area is not connected to a lake, and applied it throughout the country.

Those in favor of the ruling said it was another example of the court's skepticism of the authority of administrative agencies. Jonathan H. Adler, a law professor at Case Western Reserve University, said, "The current court is clearly unwilling to defer to an agency about the scope of that agency's own power."

Damien Schiff, a lawyer with the Pacific Legal Foundation, which represents the homeowners in this case, praised the Supreme Court's decision. "Courts now have a clear measuring stick for fairness and consistency by federal regulators," he said in a statement. "Today's ruling is a profound win for property rights and the constitutional separation of powers."

Top – left to right - Ketanji Brown Jackson, Sonia Sotomayor, Clarence Thomas

Middle – left to right - Elena Kagan, Neil M. Gorsuch, Amy Coney Barrett

Bottom – left to right - Brett M. Kavanaugh, Samuel A. Alito, Jr., John G. Roberts Jr. – Chief Justice

TWO-THIRDS OF NORTH AMERICA AT RISK OF ENERGY SHORTFALL THIS SUMMER

Two-thirds of North America is at risk of energy shortfalls this summer during periods of extreme demand due to temperature spikes, according to the North American Electric Reliability Council's (NERC's) 2023 summer assessment.

Although NERC identified no "high-risk" areas, the number of areas that are at "elevated risk" has increased from last year. NERC's assessment found that adequate resources exist for normal summer peak demand, but there will be shortfalls if summer temperatures spike in seven areas: the U.S. Western Interconnection, SPP (***Southwest Power Pool***), MISO (***Midcontinent Independent System Operator***), ERCOT (***Electric Reliability Council of Texas***), SERC (***Southeastern Electric Reliability Council***) Central, New England, and Ontario.

The cause is attributed to the retirement of fossil plants, coupled with supply chain issues affecting maintenance and summer preparedness, and delays affecting the addition of supply resources, such as wind, solar and battery energy storage, which has increased the risks for supply shortages - especially in the western two-thirds of North America if summer temperatures should spike.

NERC stated:

- Areas in the U.S. Western Interconnection are at elevated risk due to wide-area heat events that can drive above-normal demand and strain resources and the transmission network.
- In SPP and MISO, wind energy output will be key to meeting normal summer peak and extreme demand levels due to little excess firm capacity.
- The risk of drought and high temperatures in ERCOT may challenge system resources and may result in emergency procedures, including the need for operator- controlled load shedding during periods of low wind and high generator outages.
- The SERC Central region is forecasting higher peak demand and less supply capacity, creating challenges for operators to maintain reserves in extreme scenarios.
- New England has lower available capacity than last year, resulting in a higher likelihood of system operators using emergency procedures to manage extreme demand conditions.
- In Ontario, extended nuclear refurbishment has reduced available capacity, limiting system reserves needed to manage peak demand.

One positive that recently occurred this May that could help keep supply sources available was a ruling by the 5th Circuit Court that halted the EPA's Good Neighbor Air Quality Plan. It couldn't have happened at a better time, as the plan would have limited the operation of coal-fired power plants in 23 states.

GREEN STEEL PLANT ORDERS 700 MW OF HYDROGEN ELECTROLYZERS

While there is no widely recognized material called “Green Steel”, the term “Green Steel” refers to the concept or idea of producing steel in an environmentally sustainable and low-carbon manner. The steel industry is one of the largest contributors to global greenhouse gas emissions due to the carbon-intensive nature of traditional steelmaking processes. Green steel aims to reduce or eliminate these emissions by employing renewable energy sources and implementing carbon capture and storage technologies.

A Swedish start-up company, H2 Green Steel, just ordered more than 700MW of alkaline electrolyzers for the plant they are building in Boden, Sweden. This plant is currently scheduled to come online in 2025 and will become one of the largest green hydrogen producers in Europe, while producing two-and-a-half tonnes of steel by the end of 2025, with plans to ramp up this process to produce five tonnes per year by 2030. Although traditional steelmaking uses coal to extract the iron from the iron-oxide ore, both to melt it and to remove its oxygen content, the H2 Green Steel plant will use green hydrogen instead, and then use renewable-powered electric arc furnaces to turn the iron into steel in an almost entirely carbon-free process.

The 700MW of electrolyzers will make the H2 Green Steel plant one of the largest green hydrogen projects in Europe when it comes online. “The electrolysis plant in Boden will be many times bigger than most existing electrolysis plants today,” says H2 Green Steel’s chief technology officer Maria Persson Gulda.

H2 Green Steel was founded in 2020 and reports that by 2030, they will produce five million tonnes of green steel annually in Boden, located in Northern Sweden. Photo credit: H2greensteel.com

THE MYTH OF SOLAR AND WIND POWER

Many in the US and the western world believe that solar and wind power can bring us to net-zero by 2050. In fact, the US and the UK's respective governments have promoted and heavily subsidized them to achieve it, but this plan is reliant upon an affordable way to store wind and solar's surplus electricity for use whenever solar and wind are unavailable. This is not possible today.

A wind farm's output often drops below 10% of its rated capacity for days at a time. And solar capacity disappears completely every night and drops to 50% or less on cloudy days. This concept, capacity, is almost a misnomer, as you need about 3000 MW of solar or wind to replace a 1000 MW conventional power plant over time due to the decrease in their capacity over time.

The government is convinced that solar and wind are the answer and are continuing to develop it, but in reality, they have had to resort to operating the fossil fueled power plants they had kept for backup to "keep the lights on". This change in operational protocol – using plants originally designed for continuous operation to load follow - has caused increased operating and maintenance costs, and in some cases termination of the older plants due to the increased costs. For example, efficient combined-cycle gas turbines are being replaced by open-cycle gas turbines, because they can be throttled up and down easily to back up the rapidly changing output of wind and solar farms. However, these open-cycle gas turbines burn about twice as much fuel as combined-cycle gas turbines. And on top of that, these open-cycle gas turbines are high-emissions machines – putting a real hole in the so-called effort to reduce emissions!

As more renewables are built, there will be a need for additional infrastructure to support them – larger capacity power lines or more of them, the towers needed to support the power lines, and the land on which to build them.

Some countries have interconnectors to adjacent regions that have surplus power available. (***An interconnector is a structure which enables high voltage DC electricity to flow between electrical grids. An electrical interconnector allows electricity to flow between separate AC networks, or to link synchronous grids.)*** This allows renewable plans to look practical, but this is not sustainable in the long term, with more and more renewables being added and eventually being the major source of energy supply. Under net-zero plans, all nations will need to generate many times more electricity than they can now produce, as the majority of energy used today is delivered by fossil fueled power plants. Neighboring regions will be unable to provide the backup power needed; emissions from open cycle gas turbines (***or new coal powerplants, as in the case of Germany at the moment***) will become unacceptable; more existing base load stations will be forced to shutdown by surges in renewables; more and more wind and solar power will have to be expensively dumped when the sun is shining and the wind is blowing.

Only one thing can save renewables – reasonable cost, large scale energy storage that can keep the lights on for several days as a minimum. Let's consider a few examples to get an idea of the scale necessary to accomplish this.

California would need 200 megawatt-hours (***MWh***) of storage per installed MW of wind and solar power. Germany could probably manage with 150 MWh per MW. Perhaps this could be provided in the form of batteries?

The current cost of battery storage is about $600,000 per MWh. For every MW of wind or solar power in California, $120 million would need to be spent on storage. In Germany it would be about $90 million. Wind farms cost about $1.5 million per MW so the cost of battery storage would be astronomical: 80 times greater than the cost of the wind farm! A major additional constraint would be that such quantities of batteries are simply not available. Not enough lithium and cobalt and other rare minerals are being mined at the moment. If prices get high enough supply will expand, but prices are already ridiculously, unfeasibly high.

Some countries are gambling on hydro pumped storage. Here the idea is to use electricity to pump water uphill into a high reservoir using surplus renewables on sunny, windy days: then let it flow back down through generating turbines as in a normal hydropower plant when it's dark and windless.

Many pumped systems have been built in China, Japan and United States but they have storage sufficient for only 6 to 10 hours operation. This is tiny compared with the several days storage that is needed to back up wind and solar power through routine sunless calm periods. Much larger lakes at the top and bottom of the scheme are needed. There are very few locations where two large lakes can be formed with one located 400-700 m above the other and separated by less than 5-10 km horizontally. Such a location must also have an adequate supply of make-up water to cope with evaporation losses from the two lakes. Another problem is that at least 25 per cent of the energy is lost while pumping and then generating. Hydro pumped storage will seldom be a feasible option. It cannot solve the problem on a national scale even in countries like the USA which have a lot of mountains.

Carbon capture and storage (CCS) for fossil fuel stations is also touted as way of avoiding the problems of wind and solar power. But in spite of many years of work and enormous amounts of money spent, nobody has yet devised a technology that can provide large scale, low cost CCS. Even if capture worked and didn't consume most or all the energy generated, storing the carbon dioxide is a huge problem because three tonnes of carbon dioxide are produced for every tonne of coal burned.

Hydrogen is another technology which is often suggested for energy storage: but its problems are legion. At the moment hydrogen is made using natural gas (so- called "blue" hydrogen). This, however, will have to stop in a net-zero world as the process emits large amounts of carbon: you might as well just burn the natural gas. Proper emissions-free "green" hydrogen is made from water using huge amounts of electrical energy, 60 per cent of which is lost in the process. Storing and handling the hydrogen is extremely difficult because hydrogen is a very small molecule and it leaks through almost anything. At best this means that a lot of your stored hydrogen will be gone by the time you want to use it: at worst it means devastating fires and explosions. The extremely low density of hydrogen also means that huge volumes of it would have to be stored and it would often have to be stored and handled cryogenically, creating even more losses, costs and risks.

Wind and solar need to be backed up, close to 100 per cent, by some other means of power generation. If that backup is provided by open-cycle gas or worse, coal, net zero will never be achieved: nor anything very close to it.

There is one technology that can provide a cheap and reliable supply of low-emissions electricity: nuclear power. Interest in nuclear power is increasing as more and more people realize that it is safe and reliable. If regulators and the public could be persuaded that modern stations are inherently safe and that low levels of nuclear radiation are not dangerous, nuclear power could provide all the low cost, low emissions electricity the world needs for hundreds or thousands of years.

BOTTLENECK LIMITS RENEWABLE TRANSITION – ESPECIALLY IN THE PJM

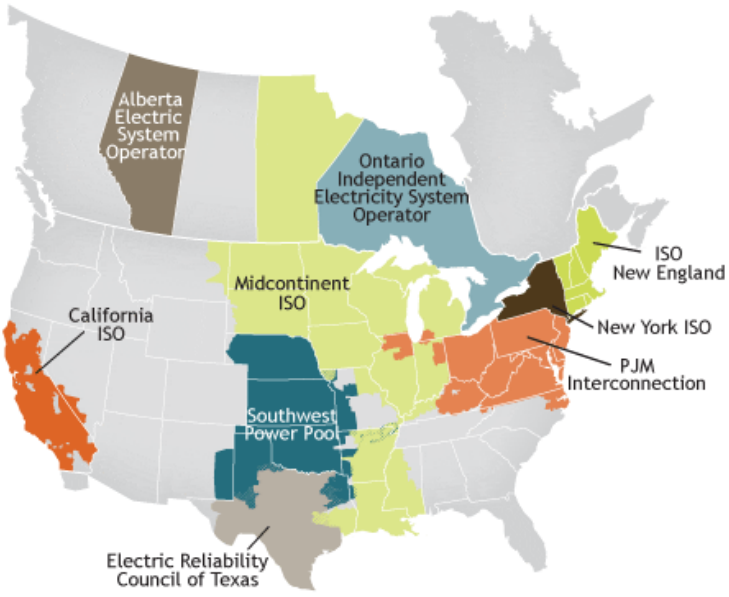
A recent report by the Natural Resources Defense Council (***NRDC***) finds that states partially or entirely in the PJM regional transmission territory may not be able to achieve their renewable portfolio standard targets through 2027 because of the long queue for connecting projects to the electric grid.

The PJM (***Pennsylvania-New Jersey-Maryland***) Interconnection coordinates the movement of electricity through all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and the District of Columbia.

David Kolata, executive director of the Citizens Utility Board in Illinois, noted that Illinois has no problems with energy supply, especially given its nuclear plants. But it has an important role to play as a clean energy supplier for the region. “We’re in the midst of an energy transition that potentially has really tremendous consumer and environmental value, and we’ve made a lot of strides in this direction, but in order to keep the progress going we need to make sure we’re building more renewables,” he said. “There are a lot of projects ready to go, but they can’t get connected to the grid. Especially as we have transportation electrification and as buildings electrify, it’s going to be important that we build new renewables.”

In 2022, the PJM came to an agreement with the Federal Energy Regulatory Commission to reform its interconnection process which included reviewing interconnection requests in batches rather than individually. These reforms will also prioritize proposals that are more developed and more likely to proceed, to reduce withdrawals from the queue that slow down the process. However, these reforms will not take effect until this summer, and renewable projects put on an expedited fast track will be considered under the new rules. The backlog of proposals filed before 2021 still need to be dealt with under the old procedures. Most new projects — like the expected “onslaught” incentivized by the Inflation Reduction Act, as NRDC phrased it — can’t be considered until the interconnection backlog is gone, likely in 2026, according to PJM and advocates’ estimates.

If you would like to learn more go to our June Newsletter and check out “The State of the Industry” and article “Renewable Power Available but with Nowhere to Go”.



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