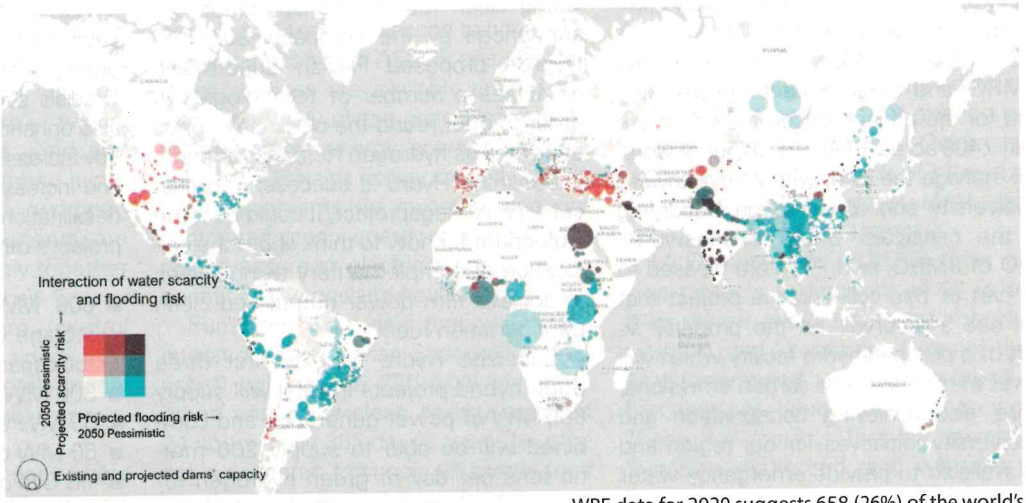
THE BIG PICTURE: Hydropower's Climate Risks

While hydropower provides about 16% of global electricity generation today, climate change is predicted to drive various changes in hydrology that could translate into a spectrum of risks for hydropower production. A recent study published in the journal *Water* estimates 61% of all global hydropower dams will be in basins with very high or extreme risk for droughts, floods, or both by 2050 under a "pessimistic scenario"—which assumes a global mean surface temperature increase of 3.5 degrees Celsius by the end of the 21st century. The study assesses the risks of water scarcity and floods for existing and projected hydropower projects using World Wildlife Fund's Water Risk Filter (WRF), a publicly available tool designed for companies and investors to assess water risks in their operations, supply chains, and investments. See the interactive version of this map at https://rcamargo.shinyapps.io/HydropowerClimateChange *Source: Opperman, J.J.; Camargo, R.R.; Laporte-Bisquit, A.; Zarfl, C.; Morgan, A.J. Using the WWF Water Risk Filter to Screen Existing and Projected Hydropower Projects for Climate and Biodiversity Risks. Water 2022, 14, 721.*

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

This map shows all hydropower dams studied, including existing and projected ones. The colors indicate the combined projected risks of water scarcity and floods by 2050 under the pessimistic scenario. The size of circles indicates the hydropower capacity of the dam.

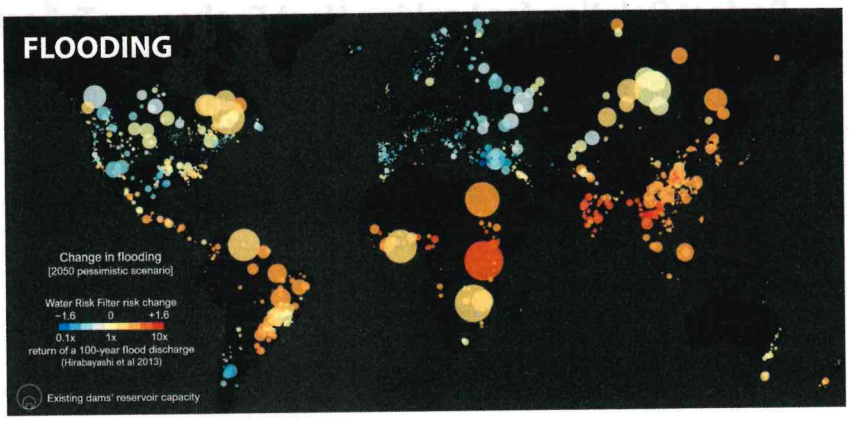


WRF data for 2020 suggests 658 (26%) of the world's more than 2,500 existing hydropower dams are already in basins with medium to very high water scarcity risk. By 2050, under the pessimistic scenario, 806 dams (32%) will be in basins projected to have increases in scarcity risk, of which 178 dams (7%) will be in basins changing from medium to high risk. Another 168 dams (7%) will be in basins changing from high/very high to very high/extreme risk.

Regions facing the greatest increase in scarcity risks include **China, Jordan** (Al Wedha dam), **Iraq, Morocco, Syria** (Tabqa dam), and Victoria state in **Australia.** Countries with high hydropower capacities that also face increased risks include the **U.S., India, Turkey, Mexico, Kazakhstan, Ukraine,** and **Spain.** In the U.S., increased risks are concentrated within several states, including Montana, Nevada, Texas, Arizona, California, Arkansas, and Oklahoma.

WRF data meanwhile suggests 1,877 (75%) of existing hydropower dams are already exposed to medium to very high flood risk. By 2050, this number is projected to decline. But under the pessimistic scenario, 963 dams (39%) will still be in basins with increased flood risk.

Regions slated to face the greatest increase in flood risk include **Myanmar, Cameroon, Laos, Thailand, Uganda, Bangladesh, Colombia, China, Ethiopia, India, Kenya,** and **Vietnam.** Among countries with high hydropower capacity are **Canada** (Quebéc), **Uganda, Russia** (Krasnoyarsk), **Zambia** (especially the Kariba dam), **Egypt** (High Aswan dam), **Ghana** (especially the Akosombo Main dam), **Venezuela** (Guri dam), and numerous dams in **India, China** (especially in the provinces Hubei, Yunnan, Guangxi, Sichuan, and Guizhou), **Brazil** (especially in the states of Goiás, Minas Gerais, and São Paulo), and **Mexico.**



Luke Sinclair, associated vice chancellor of Central Queensland University (CQUniversity), said, "Gladstone is 'ground zero' for the emerging clean energy economy and the announcement of the Superhybrid project is another exciting step in the right direction. CQUniversity is looking forward to working with Sunshine Hydro and other local partners in maximizing the value of this initiative to further grow Gladstone's clean energy generation capacity and capabilities, and to open the door to smart training, education and research opportunities."

Councillor Goodluck, acting mayor for the Gladstone City Council, said, "It's fantastic to know that Sunshine Hydro will apply their unique, world-leading hydroelectricity techniques within our region following an assessment of many localities around Australia. This is a strong vote of confidence in our region's ability to become a leader in sustainable energy investment and production. Gladstone Regional Council is an advocate for economic growth and diversification, and this announcement further emphasizes that we are on a path to becoming the green energy epicenter of Australia."

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

Rapid Progress for Japan's Offshore Wind Ambitions

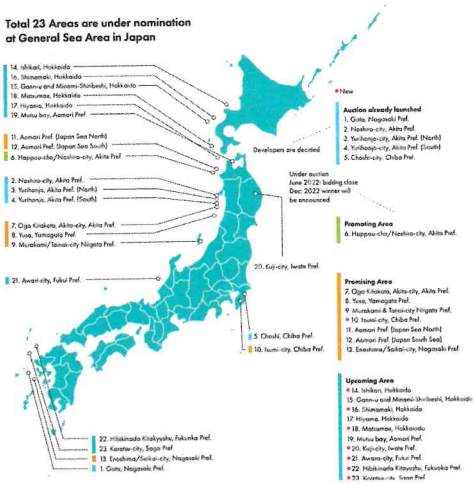
Japan's ambitions to install up to 10 GW of offshore wind power by 2030 have made rapid progress over the past month, driven partly by accelerated action to address a supply and demand mismatch. Weeks after construction kicked off at the 140-MW Akita Noshiro offshore wind farm—Japan's first commercial offshore wind farm—Siemens Gamesa Renewable Energy (SGRE) on July 29 reported it received a firm order for the 112-MW Ishikari offshore wind power project.

The Akita Noshiro offshore wind farm in Akita Prefecture in northern Japan will feature 33 Vestas V117-4.2 MW wind turbines when it begins commercial operation as expected at the end of 2022. The consortium of electric utilities and local companies that make up the Akita Offshore Wind Corp. (AOW) formally kicked off construction on July 2. Thirteen wind turbines will be installed at Akita Port, and 20 will be installed at Noshiro Port. The project, estimated to cost 100 billion yen ($746 million), has already secured a 20-year power purchase agreement (PPA) with Tohuku Electric Power Co.

Green Power Investment's Ishikari offshore wind power project, located 5 kilometers (km) offshore Ishikari Bay in Hokkaido, will feature 14 SG 8.0-167 DD offshore wind turbines, each with a capacity of 8 MW, SGRE said. Installation of the project is slated to begin in July 2023.

According to the Global Wind Energy Council (GWEC), Japan has approximately 128 GW of fixed-bottom offshore wind potential and 424 GW of floating offshore wind potential. "Considering Japan as an archipelago with strong wind speeds—even stronger and steadier offshore—the development of offshore wind is indispensable to increasing renewable energy supplies," the organization said in its latest global offshore wind outlook. "Despite the huge wind potential, Japan does not have any large-scale commercial wind operations but times are changing."

Japan's 6th Energy Strategic Plan, which the Cabinet approved in October



2. Since April 2019, Japan has been steadily working on expanding offshore wind generation by creating a certification system and licensed use of designated promotional sea areas. This image from the Global Wind Energy Council's (GWEC's) Offshore Wind Report 2022 shows nominated offshore wind areas in Japan's General Sea Area. Courtesy: GWEC

2021, raised its percentage of renewable energy to 36% to 38% by fiscal year 2030. Wind's share of the total is 5%. Japan's vision for an offshore wind expansion, however, was unveiled in December 2020. Along with the interim target of 10 GW of offshore wind by 2030, it envisions installations of a combined 30 GW to 45 GW by 2040, along with a cost reduction target by industry of 8 to 9 yen/kWh between 2030 and 2035.

So far, Japan has cleared several projects (Figure 2). In June 2021, it selected a consortium of six companies led by Toda Corp. to build Japan's first floating wind farm offshore Goto City in Nagasaki Prefecture. Meanwhile, consortia led by Mitsubishi Corp. in December 2021 won the rights to develop all three projects offered in Japan's Round 1 auction for bottom-fixed offshore projects under Japan's Offshore Wind Promotion Act. Representing an aggregate capacity of 1.7 GW, these projects include zones offshore Noshiro City, Akita Prefecture; Yurihonjo City, Akita Prefecture; and Choshi City, Chiba Prefecture.

The government, however, abruptly suspended a second round of the auction in March for a wind farm offshore Happo-Noshiro, Akita Prefecture. It said in June it planned to resume public auctions by the end of the year after revising auction rules to appeal to a broader range of bidders and accelerate development.

The government is now reportedly mulling new rules for future public auction processes, including preventing a single bidder or consortium from bidding for more than 1 GW of capacity. "Mitsubishi's success was underpinned by tariff prices well below the ceiling price of 29 yen per kilowatt-hour. This auction result is likely to have led to concerns amongst international developers regarding the low tariff pricing," noted an alert from law firm Greenberg Traurig in early July.

Japan's scramble to add offshore wind to its power profile stems from recent reliability near-misses that have cast new light on its power system's vulnerability to extreme weather events. The country mulled resuming operation of 10 thermal power plants to ensure electricity security this past summer. It has urged its nuclear fleet to return to service to mitigate tight supplies expected this winter.

Meanwhile, the country is suffering a surge in fuel prices, which stems from tight markets in the wake of Russia's invasion of Ukraine. In 2021, gas was Japan's dominant power source, making up about 36% of its generation mix, followed closely by coal at 29%.

"This could come in the form of ramping up power generation from coal, but the market's current situation requires it to diversify away from fossil fuel use amid carbon emission reduction targets," it added. "However, other power types are also facing challenges, nuclear's stringent conditions are delaying the sector's growth, offshore wind power is still nascent, and the solar power sector is small compared to gas power."

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

POWER Digest

New Transformer Improves Power System Reliability for Zimbabweans. An Emergency Power Infrastructure Rehabilitation Project funded by **ZimFund** reached the last leg of implementation on July 10 with the delivery of a 175-MVA transformer to the Sherwood Substation

in Kwekwe, Midlands Province, Zimbabwe. The transformer, funded to the tune of $22.74 million by ZimFund, in which the **African Development Bank (AfDB) Group** is a major partner, will feed customers spread over Midlands, Mashonaland East & West, and Masvingo Provinces, serving more than 1.2 million people. The AfDB said the new transformer will replace old equipment, which was beyond repair and caused numerous power interruptions. **Zimbabwe Electricity Transmission and Distribution Co. (ZETDC)** Network Development Engineer Edson Manyewe said the transformer would result "in improved reliability of supplies, efficient operation of the network as well as improved quality of supplies." Under its energy sector, the AfDB is also financing other infrastructure projects in Zimbabwe, such as the Kariba Dam Rehabilitation, Alaska-Karoi Transmission Line, and Energy Sector Reform Support projects with a total investment of $90.5 million.

Iberdrola Inaugurates 1.2-GW Hydropower 'Gigabattery.' Spanish power company **Iberdrola** on July 19 inaugurated the Tâmega Gigabattery, a 1.2-GW hydroelectric storage project that has been under construction for almost eight years and is slated to be completed in 2023. The $1.53 billion project, located at the Tâmega River in northern Portugal, comprises three dams and three power plants—Alto Tâmega, Daivões, and Gouvães—as well as two wind farms with a combined capacity of 300 MW. The three power plants represent 6% of Portugal's total installed capacity. Its annual production of 1,766 GWh is enough to meet the energy needs of neighboring towns and cities of Braga and Guimarães. So far, Iberdrola has begun operations at the 880-MW Gouvães and the 118-MW Daivões hydropower stations. Alto Tâmega is slated to come online in 2024. "This plant is reversible, i.e., it allows water from the Daivões reservoir to be stored in the Gouvães reservoir, taking advantage of the more than 650 metres difference in elevation between the two," Iberdrola said in July. "In this way, energy can be pumped out when there is excess production and recovered when necessary." The company noted that when complete, the Tâmega gigabattery will provide almost 900 MW of pumping capacity to the Portuguese electricity system, an increase of more than 30% compared to the megawatt capacity available to the country today.

U.S. Became World's Largest LNG Exporter in First Half of 2022. The U.S. became the world's largest liquefied natural

gas (LNG) exporter during the first half of 2022, the **U.S. Energy Information Administration (EIA)** reported on July 25. The federal statistical agency said U.S. LNG exports increased by 12% in the first half of 2022, averaging 11.2 billion cubic feet per day (Bcf/d). Exports have ramped up owing to increased LNG export capacity, increased international natural gas and LNG prices, and increased global demand, particularly from Europe. Europe has increasingly imported more LNG to make up for constrained pipeline supplies from Russia and fill natural gas storage inventories as winter approaches. As in 2021, the U.S. sent the most LNG to the European Union and the UK during the first half of the year, providing 47% of the 14.8 Bcf/d of Europe's total LNG imports, followed by Qatar at 15%, Russia at 14%, and four African countries, combined at 17%, the EIA said. U.S. export capacity has meanwhile steadily expanded since November 2021. Capacity additions include a sixth train at Sabine Pass LNG, 18 new mid-scale liquefaction trains at Calcasieu Pass LNG, and increased production capacity at Corpus Christi LNG. As of July 2022, the EIA said that U.S. LNG liquefaction capacity averaged 11.4 Bcf/d, with a shorter-term peak capacity of 13.9 Bcf/d.

National Grid Proposes UK Grid Expansion to Connect 23 GW of Offshore Wind by 2030. National Grid, a UK-based firm focused on transmission and distribution of electricity and gas, on July 7 unveiled a £54 billion ($65.4 billion) plan to upgrade the UK's grid and support the "large-scale" delivery of offshore wind power. The plan, described in the company's "Pathway to 2030 Holistic Network Design" (HND), is the first step toward more centralized, strategic network planning. It responds to the UK government's ambitious target to deliver 50 GW of offshore wind by 2030—a dramatic ramp-up compared to the nation's currently installed offshore wind capacity of 11.3 GW. Supported by the government's 2020-issued Offshore Transmission Network Review (OTNR), HND recommends connecting all 18 "in scope" offshore wind farms with a total capacity of 23 GW to the onshore network with 15 landing points to shore. It identifies 11 onshore transmission projects and offshore connections to transfer power and avoid bottlenecks on the network, particularly between west Scotland and north Wales, as well as between east Scotland and the east of England. Technology recommended in the offshore design includes a 275-kV high-voltage alternating current offshore circuit with substations and cables; 10 new 525-kV high-voltage direct current (HVDC) circuits with HVDC converter stations, offshore substations, and cables; and two new multi-terminal HVDC systems.

NTPC Commissions 100-MW Floating Solar Project. NTPC, India's largest power utility, has commissioned a 100-MW floating solar project at Ramagundam, in Peddapalli District, Telangana state. The project—India's largest floating solar installation to date—is located near NTPC's coal-fired 2.6-GW Ramagundam plant, spread over 600 acres of a reservoir. The project responds to the Indian government's ambitious target of building 500 GW of non-fossil capacity by 2030. NTPC is targeting 60 GW of renewable projects by 2032. Large-scale floating solar is a feasible solution given that it saves 2,000 million liters of water annually, NTPC said. The company has already commissioned 222 MW of floating solar projects. Another 40 projects are in the construction stage. ■

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