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U.S. OFFSHORE WIND POWER: TIME FOR A REALITY-BASED RESET

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"Moonshot" projects, like sending a man to the moon, can transform societies and economies. They touch people's hearts and minds, rally the population, move the political agenda, and have the potential to create far-reaching, unforeseen benefits. For example, today's vibrant solar power industry was made possible by the U.S. space program six decades ago.

But some moonshot projects, like the fight against cancer or the search for the cure to the common cold, have not produced comparable successes.

In the power industry, President Joe Biden's goal of having 30 gigawatts of offshore wind power operating by 2030 is a moonshot project that needs to be rethought and reassessed. Marianne Goldsborough, Burns & McDonnell's HVDC business manager, explains why.

Why is it time to think outside the box and recalibrate the goal of having 30 gigawatts of offshore wind power operating in the U.S. by 2030?

Developers, utilities, and original equipment manufacturers (OEMs) all were very enthusiastic about the president's "30 by 30" goal when he announced it in early 2021. It was a bold stretch goal aimed at fighting global climate change, decarbonizing the power supply, building a new industry, and advancing U.S. energy independence. Developers responded to requests for proposals (RFPs) with a surge of project proposals (*Figure 1*).

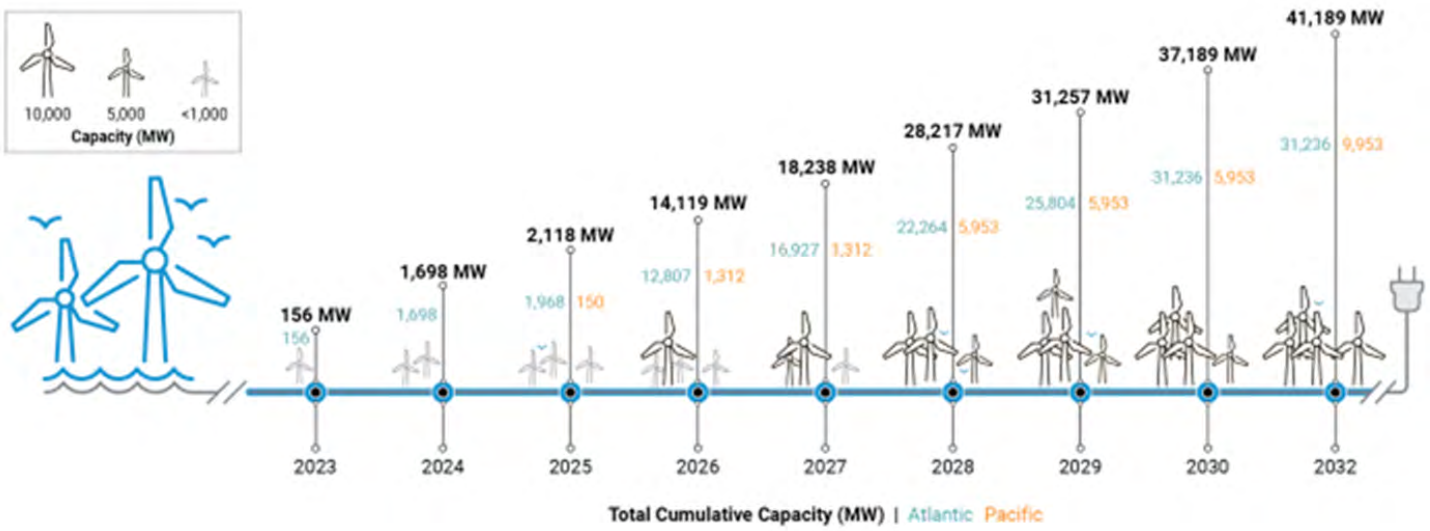

Figure 1: U.S. Planned Offshore Wind Capacity
Source: Enverus

Unfortunately, some of the early projects have run into challenges that require renegotiating purchase power agreements (PPAs) or outright project cancelation.[1] Supply chain bottlenecks have driven up project costs and led to delays in scheduled in-service dates, wreaking havoc on the early projects.

Another problematic factor is the bids' requirements: Developers were required to submit a fixed price and schedule for a project nearly a decade away from commercial operations. Modifying the terms of that bid to reflect changing market conditions has proved to be almost impossible, causing some projects to be canceled. There must be a better way to balance cost certainty for all sides rather than the current win-lose arrangement.

Also, OEMs were unable to nimbly pivot to accommodate changing market conditions. And today's federal and state regulatory agencies are not set up for creative approaches that cross state lines.

For all these reasons, when on-the-ground realities overwhelm plans, it's time to reassess the original plan and recalibrate it.

To prevent future problems, the U.S. needs to consider alternative approaches to building offshore windfarms. If President Biden wants to incentivize the development of this resource, perhaps a federal agency could be empowered to negotiate with OEMs and developers. A national approach would ensure consistency of terms and allow our country to capture economies of scale. The developers who operate globally already are purchasing direct current (DC) systems on a centralized basis, giving them a competitive edge over rivals.

Is this a supply chain problem?

Yes, but we can't blame all the offshore wind power supply chain problems on the COVID-19 pandemic. The industry's structural limitations have made a difficult situation worse.

Prior to the surge in renewable energy development, high-voltage direct current (HVDC) was not in high demand. There were limited situations where its advantages could be fully utilized; hence, not many projects were built over decades. That became a self-reinforcing vicious circle: Limited projects, limited experienced resources, limited manufacturing growth, and limited options.

For large offshore wind projects, developers typically favor HVDC transmission lines to bring large amounts of electricity from the turbines in the water to a receiving station on shore. Building HVDC transmission solutions are more expensive than high-voltage alternating current (HVAC) transmission solutions, but they work in large projects because of their significantly lower line losses and no requirement for underground line compensation, which HVAC systems require.

Most of the electricity on the grid is alternating current (AC). Therefore, offshore wind projects using HVDC lines require specialized equipment called converters in two places (HVDC converter system): in the water near the windfarm field, where the AC is converted to DC; and onshore, where the DC is converted back to AC (*Figure 2*).

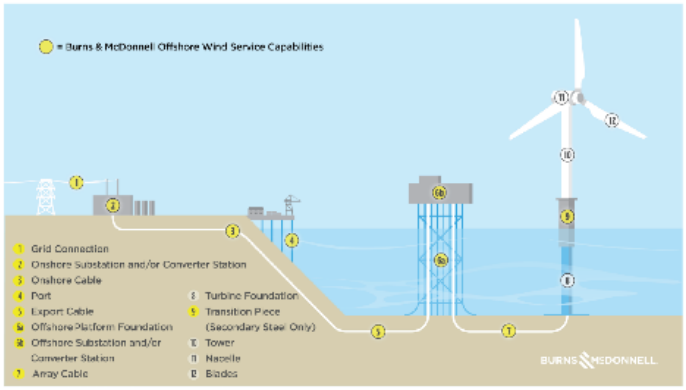

Figure 2: Diagram of Offshore Wind Power Project
Source: Burns & McDonnell

High-voltage converters systems (items 2 and 6b in *Figure 2*) are expensive. A pair of them typically accounts for about 25% of the cost of a wind farm. For large offshore wind farm projects, the converter system could cost between $800 million to over $1 billion.

Because they are highly customized for each project, manufacturers don't just make and stockpile these systems. They begin making them when they receive a purchase order from a developer, and they take years to design and manufacture.

Around the world, there are three main HVDC converter system OEMs — General Electric, Siemens, and Hitachi. In recent years, all of them have been awarded large orders, leading to significant backlogs. If you place an order today, you can expect to receive the converters in 2033 or beyond.

The U.S. lags far behind other countries in bringing commercial-scale offshore wind power projects online. Other nations and regions, such as the United Kingdom and the European Union (EU), have far more developed offshore wind power markets (*Figure 3*). As a nascent player in the offshore wind power market, the U.S. is unable to exert influence over supply-chain partners.

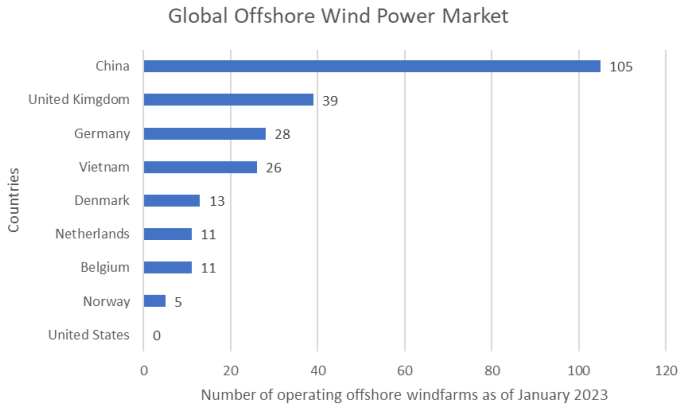

Figure 3: Global Offshore Wind Power Market
Source: Statista

Are there other reasons why 30 gigawatts by 2030 is not feasible?

Yes. One is practical, the other is a standards issue.

Offshore wind turbines can be 300 feet high or more. Transporting those turbines requires specialized ships, and there are only so many of them in the world. Not surprisingly, most of them operate in Europe and Asia, as that's where wind farms are being developed. Also, the Jones Act requires U.S.-flagged ships to transport goods from one U.S. harbor to another. There are only a few such U.S.-flagged ships that would be able to move these large wind turbines. Similar transport limitations exist to move the offshore converter station from its export port to its final location next to the wind farm. Few vessels are available; for certain HVDC offshore converter stations, there is an extremely limited number of vessels available worldwide.

Electrical equipment standards are another issue. Most of the world follows codes developed by the International Electrotechnical Commission (IEC), but the U.S. follows a different code, one developed by the Institute of Electrical and Electronics Engineers (IEEE). They are not entirely incompatible. Many North American purchasers of HVDC technology are forced to reconcile IEC-developed technology with their requirements. This is not to say HVDC technology cannot be integrated into North America; it requires purchasers to lean on industry experts for support.

Having the U.S. develop applicable standards for HVDC technology is a significant undertaking that may not get the

attention it needs due to the competing demands on industry technical leaders who are focused on developing and executing transmission projects. Developing North American standards is a significant process with a long duration, and the IEEE standards may not be accepted by the HVDC OEM's due to the time and cost required to have their HVDC solutions tested to different standards. It is expected that USA purchasers of HVDC systems will need to assess and consider European design solutions.

In addition, the market to manufacture HVDC electrical cable is somewhat constrained as well, mainly because the number of HVDC projects over the last 20 years has been far fewer in number than HVAC projects.

What can be done to alleviate these blockages?

Many offshore wind power and onshore HVDC projects were a long time in the making, and problems won't be fixed overnight. Unfortunately, 2033 is, effectively, "overnight" for an industry and a supply chain that thinks in terms of decades.

And these supply chain problems cannot be alleviated with an executive order from the White House.

However, there are several smaller steps that could be taken to start to resolve the blockages and address project cost escalation in the U.S. These include:

- Regionalizing or nationalizing the supply chain, rather than leaving it to state or local authorities
- Standardizing on HVDC on and offshore converter stations
- Standardizing applicable permitting
- Standardizing wind farm sizes
- Taking a more regional approach to transmission

All these steps — they are not the only ones that could be taken — can start to increase project certainty by finding a way to share risks and costs better, unkink still-snarled supply chains, and expedite project construction. The current procurement process hurts project certainty, which causes potential bidders to look elsewhere for business.

But even these steps will not fully resolve the issues impeding offshore wind power project development. One additional solution, which could take decades, would be for the U.S. to develop its own supply chain and ultimately become a net exporter of offshore wind products into the global economy. The U.S. is a very expensive market for offshore wind projects. Because of its late entry into this market and its rush to catch up, there is good reason to question whether the U.S. will ever be a major market for offshore wind.

The problems confronting the U.S. offshore wind power industry weren't created overnight. Fixing these problems will take time. The first step forward is to recognize the problem. Without diminishing the strategic importance of offshore wind power to its decarbonization agenda, the Biden administration should move the goalposts to reflect market realities.

Finally, parties should develop offshore wind projects with a true spirit of "win-win," meaning all parties gain, rather than structuring the business as "win-lose."[2] There are many subject matter experts from OEMs, developers, regulators, Energy, Procurement, and Construction (EPC) firms such as Burns & McDonnell, and national laboratories that could collaborate to smooth the offshore wind project development process so that it becomes more of a mutual gains endeavor.

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[1] See David Uberti and Joe Wallace, "How the U.S. Market Went Sideways for a Wind-Power Giant" *The Wall Street Journal* (November 20, 2023; Will Mathis and Bloomberg, "As renewable-energy demand soars amid extreme heat, rising costs are making offshore wind projects so expensive that 'it doesn't make sense to continue' " *Fortune* (July 23, 2023); Wayne Parry, "Orsted delays 1st New Jersey wind farm until 2026; not ready to 'walk away' from project," Associated Press (August 31, 2023); Maria Gallucci, "U.S. offshore wind pushes ahead despite industry turmoil," Canary Media (August 24, 2023); Adrijana Buljan, "Avangrid Terminates Long-Fought PPAs in Massachusetts at Cost of Almost U.S. $50 Million," Offshore Wind Biz (July 19, 2923).

[2] Roger Fisher and William Ury, *Getting to Yes: Negotiating Agreements without Giving In*, 2nd Edition (New York: Penguin Boks, 1991).