Cheap Electricity from Offshore Wind

Further offshore has the best wind. The water is deep there, so the wind turbines must be floating. Floating offshore wind could power the whole world - many times over. The only way to realize that huge potential is to make it cheap. Here are several ideas that could bring the cost down.

Cheap Spar Foundations

In storms, wave action roils the ocean surface. Any floating wind turbine foundation near the surface will be rocked by the waves. At the nacelle five hundred feet above, the rocking of the foundation will be magnified. That has got to be hard on the equipment. A short distance below the water surface, movement is much less. So, it would seem desirable to float our wind turbines as deeply as possible.

Spars are straight cylindrical floating foundations that extend deep into the water. They are the deepest type of wind turbine foundations. Because spars have a large vertical extent, they can be guyed in multiple directions both near the water surface and at the bottom. The wide spread of the resisting forces creates a large resistance against oscillation.

A rowboat in a storm is tossed about. An aircraft carrier much less so. Mass has a stabilizing effect. The heavier our foundation, the more inertia to resist movement. Conclusion: big, heavy, deep, spar foundations can resist oscillation better than lighter foundations floating near the surface. We might naturally think of concrete. It is heavy, cheap, and readily available most everywhere.

Let’s get an idea as to scale. The International Energy Agency has designed the “IEA 15 MW Reference Wind Turbine”. The turbine blades would be 117 meters (384 feet) long. The steel tower would be 6 to 10 meters (32 feet) in diameter and 150 meters (492 feet) in height. Our candidate spar foundation is a straight cylindrical tube extending 200 meters (656 feet) into the ocean (sketch available). It weighs 21,000 metric tons. How could this be cheap?

1. It is made near an aggregate plant located on the coast. With the aggregate sourced nearby, and mixed with ship delivered cement, we would have the cheapest concrete anywhere.

2. The spar would be built using a traveling form on a slightly sloped casting bed. Once cured, we would post-stress it and jack it off the casting bed onto two big floats in the bay (sketches available).

3. The floats would convey the spar either direct to a wind turbine array site or to storage in a deep-water fiord.

4. As turbine size increases, electrical output increases per dollar of investment. Bigger is thus cheaper. On land, trucking of giant components is prohibitive. Floating spar technology easily scales.

Economical Onsite Installation (No giant crane required)

At the array site the spar would be brought to vertical by ballasting the floats. Without the entire turbine weight, the spar top would be high out of the water. Ballast water would be added to bring the top surface down. A mid-size crane would place the first tower section on top of the spar. Upon release the spar would sink, but not as far as the added tower height. More ballast water would again be added to sink the spar**/**first-tower-section combo down to within easy reach. This could be repeated for any number of column sections *up to any height.*

At the point of nacelle addition, ballast water would again be added to lower the spar**/**tower combo within easy crane reach. The nacelle would be bolted on. With the crane still holding the nacelle, ballast water would be pumped out until the upward float force unweights the crane. Further unweighting keeps a balance as the blades are attached. After complete assembly, the spar is pumped out and the finished wind turbine rises to operating elevation. Any maintenance, years later, could be done in the reverse.

Economical Seabed Anchorages

Another important element of cost is anchoring the spar’s guy lines to the seabed. Piling and giant steel ship’s anchors are commonly used. But more economical would be steel rods cemented deep into the seabed. This is the same technology used to anchor the Golden Gate Bridge against earthquakes. A self-propelled autonomous underwater drill rig could drill high strength steel rods over 100 feet long into the seabed (drill rig sketch available). They would be cemented deep into the underlying strata. In this way, it is the weight of the seabed that holds the wind turbines in place.

Windmill Stores

With the Climate Crisis looming, electricity supply agencies around the world want *Green Energy Now*. But, as it stands today, the timing of permissions is frustratingly indeterminant. When permission finally comes the pent-up need should not require more waiting for manufacture. There is entirely too much waiting.

An alternative to waiting is Windmill Stores. In brief:

Some far-seeing and well financed wind development company starts the mass production of large wind turbines. They build giant spars, install store-bought giant turbines, and stock hundreds of the complete floating turbines in a few deep fiords around the world. These are ready-to-go. This might be financed by philanthropies, hedge funds, pension funds, sovereign wealth funds, or any other shrewd deep pockets. The most visionary of the oil majors might be likely. Windmill Stores, by offering immediate availability would corner the market. Profitability would thus be assured. More importantly, they would help abate the Climate Crisis in several ways:

Immediacy: After struggling through permitting, financing, and all the other delaying hindrances what organization wants to additionally wait through ordering and fabrication? Answer: probably none. Not when the Windmill Store offers immediate delivery.

In electricity starved regions around the world, in regions considering diesel, gas, or (still) coal, offshore green power immediately available might swing their choice. Just call the Windmill Store and, starting tomorrow, your own giant Wind Turbines will be headed straight to your offshore location.

The Windmill Stores would stock large numbers of large wind turbines on spar foundations. They would need deep fiords for Windmill Store sites. Some of the possible fiord sites are in Norway, Scotland, Alaska, Chile, and New Zealand - anywhere there is sheltered water and a deep path to the ocean.

Immediate availability would incentivize orders. Lots of orders will require mass production. Mass production generates profits and instigates low prices. The Model T got cheaper every year as Henry Ford got rich.

The country that pioneers this might very well become the Saudi Arabia of wind.

Further Considerations

Underwater sounds and lights to protect whales; radar guided drones to warn away migratory birds.

Boat and airplane warning lights only turned on when radar detects necessity.

Spar textures and guy line webs to provide habitat for marine life.