The 2018 BOEM Lease Sale for Offshore Wind Power: Understanding the numbers and their significance

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On December 14, 2018, the US Bureau of Ocean Energy Management (BOEM) concluded their most recent lease auction for ocean space to be used for offshore wind power (OSW), with a record take of $405,100,000 for 390,000 acres of ocean in Federal Waters off Massachusetts (MA). The area was auctioned in three parcels, with winning bids about $135,000,000 each. In the previous auction for a Massachusetts OSW lease in April 2015, the highest parcel (of 187,523 acres) went for $281,000. No, I didn't mis-count zeros—from 2015 to 2018, the price of MA offshore wind space has gone up by a factor of 500. What could have changed the value so? Did the new winning bidders pay too much? Will these high lease payments increase the cost of electricity produced? Can these companies make a business at this scale by building offshore wind generation and selling electricity? What is the significance of this for the industry and for US energy policy?

Summary answers: Yes this is a reasonable price if the area is fully developed, but arguably is too high if only a fraction is developed. What changed was sector-specific state policies (those policies defined below). Given these policies and the resource purchased, electricity can be provided at or below market prices without subsidy. Part of the significance of the new bids is that they represents a half-billion dollar commitment by large companies, several from the oil & gas sector, to go big on this new renewable energy source. From the leased areas alone, these companies could build enough offshore wind generation to power 100% of Massachusetts' electricity.

Below, I outline how I arrived at these conclusions, and provide specifics to understand this dramatic development in policy and in US clean energy development.

Winning bidders: Of 11 total bidders in the December 2018 auction, three won new leases: Equinor (formerly Statoil), Mayflower (JV of Shell New Energies and EDP Renewables Offshore), and Vineyard Wind (JV of Copenhagen Infrastructure Partners and Avangrid Renewables). Note that two of the three are oil and gas majors, with large balance sheets and vast experience and equipment for building energy platforms at sea. And yes, their offshore O&G experience is highly relevant and helpful to building large offshore wind projects. (In 2016, Equinor leased an area off New York for $42.5 M; at the time many thought that bid a high-price anomaly. Now we see that rather, if the local state's policy is right, these prices are the new reality.) Here I'm focused on just the MA leases, why the price of this ocean space has increased 500-fold, and what this tells us about viability and likely size of the US OSW industry.

Real estate: Combining the three bids, 390,000 acres (=1,578 km^2) were just leased for 30-year periods. The map (end of this document) shows the area shared with RI North-most, prior lease holders on the NorthWest side, and the three newly-leased areas to SouthEast. Convert this area to wind turbines: using a 10 MW turbine with 164m rotor, 10d spacing, each turbine requires 1.64 km x 1.64 km = 2.69 km^2 of ocean space. So this newly leased 1,579 km^2 can host 586 x 10 MW turbines.

Power capacity: Per above, 586 x 10MW turbines is a potential capacity of 5860 MW or 5.86 GW. Let's conservatively assume only 75% of area is built; thus 4.4 GW capacity. For comparison to that 4.4 GW, MA now has traditional generation capacity of 13 GW (EIA State Electricity Data, 2017), with some generators uneconomic and/or scheduled to be decommissioned. So, by capacity alone, the new area would be a significant addition to the local power system.

Energy production versus MA load: Because the wind fluctuates, average energy production is less than the maximum capacity; in these windy waters off MA, current turbines produce at least 50% capacity factor, meaning that 4.4 GW of capacity, will produce on average 2.2 GW_a. The previously-leased MA-proximate offshore wind areas, by similar calculation (McClellan 2018), offer 8.4 GW capacity, so all near-MA leased areas (new+old) are 12.8 GW capacity and could produce 6.4 GW_a. Electric load for all MA is 6 GW_a (EIA State Elec. Profiles). So the total MA leases could produce more than 100% of the electricity used by the Commonwealth of Massachusetts.

Some provisos: This calculated potential of 100% electricity for MA does not mean that all MA power plants would be retired, because some older plants may still have system value in less-frequent use, because they sell into the regional ISO-NE system not just MA, and because the OSW lessees may choose not to build out all of their wind area. MA law now requires 3.2 GW offshore wind capacity to be purchased by utilities, only 1/4 the ocean area's potential capacity. (Nevertheless, additional policy requirements to continue past 3.2 GW may not be needed if OSW stays at or below the competitive prices of all other wholesale electricity sources, see below on price.) And, since wind is variable generation, before reaching 100% of load, it would require balancing from other ISO-NE generation resources and perhaps Canadian hydro.

With those provisos, there is nothing theoretical about saying that 6.4 GW_a production of offshore wind can meet 100% of MA load—the turbine technologies are already available and deployed, the resource is sufficient (with vastly more shallow ocean available for load growth if/when current lease areas are fully developed), and these new leases show that large corporations are now betting $ 1/2 Billion (prior leases + new $405M) that this resource is worth developing.

Project Cost and Revenue: The currently-economic build size is 800 MW, based on lowest price from the MA power purchase and based on EU experience. To simplify and understand the project economics, rather than analyzing a series of 800 MW projects, I calculate cost and revenue for the three new areas together as if they were all one project of 4.4 GW capacity.

Building out 4.4 GW of OSW at $3/watt would be a capital cost of about $13.2 Billion. This does not include the costs of lease, financing or O&M.

Did they pay too much? Given the capital cost of $13.2B, the seemingly-large lease payment will represent only about 3% of capital cost. One wants to control a 3% cost, but it should not make a substantial difference in electricity price. On the other hand, if only half the area were built, 2.2 GW rather than 4.4 GW, the lease cost becomes a more burdensome fraction, 6% of project cost. If the project budget had to bear this cost (as opposed to treating it as the cost of market entry) the added 6% could make the bid price of electricity less competitive with other OSW generation. In short, since the lease payments are small relative to the overall cost of building out the leased area, quantitative analysis confirms these lease payments were not excessive.

Price, project revenue and payback: In 2011, the previous single offshore wind proposal in MA was Cape Wind, with a negotiated PPA price of 24¢/kWh levelized. The big news on the price of OSW electricity came in August of 2018, when the 800 MW Vineyard Wind power contracts were finalized and their price became public. The unsubsidized price is about 7.67 ¢/kWh (after removing ITC credit). At that price, annual revenue from only the new MA leases would be 2.2 GWa * 8760 h/y * 7.67 ¢/kWh = $1.5 B/year revenue.

Can development companies make money at this new, low price without subsidy? Full analysis requires considering cost of capital, O&M, profit, risk, etc (see SIOW 2016), but a simple sanity check via payback analysis (capital cost/annual revenue) shows a payback period of $13.2B/$1.5B = 8.8 years (much less than the 30 year lease). Adding lease cost to capital cost would increase payback period to $13.6B/$1.5B = 9.06 years, again showing that the high lease cost increases payback by a measurable but minimally significant amount. (We'll do a more complete project cost analysis in a subsequent analytical paper.) Also, this simple payback calculation suggests that the income from planned MA projects should cover costs, even at prices like 7.67¢/kWh.

Consumer price: The MA government calculated that the Vineyard Wind contract would save $1.4B for ratepayers. As another consumer benchmark, MA consumers can buy their energy separately from transmission, distribution and services. That separate electricity supply is offered at 11 to 12.5 ¢/kWh—so, this benchmark also suggests that the 7.67 ¢/kWh from Vineyard Wind is at or below electricity market price. The conclusion is that the price of electricity from new OSW generation is not over-market in the MA region, rather, it saves consumers money.

Policy: The policies that led to favorable market conditions were itemized by the Special Initiative on Offshore Wind (SIOW) in state-specific documents making recommendations for policies that the states of New York and Massachusetts could use to lower the price of OSW electricity. Those states appear to largely be following the roadmap laid out in those reports. Most important policies recommended by SIOW were: 1) "market visibility" (certainty of market volume and duration, a.k.a. a pipeline of projects), 2) industrial scale (800 MW per project or larger), 3) reduction of project risk (most important being a secure and predictable revenue mechanism), and 4) predevelopment steps, such as offshore wind measurements by the state, provided to all bidders, 5) multiple qualified bidders compete, 6) bids should be evaluated primarily on price of energy (minimizing local content requirements intended to create jobs).

For Massachusetts, Gov Baker signed H. 4568 requiring 1600 MW on August 8, 2016. Most of these policies were implemented in an RFP, issued quickly after the enabling legislation was signed by the Governor. This RFP was ultimately won by Vineyard Wind. Then the dramatic post-policy changes were that the price of OSW electricity dropped by 2/3, from 26¢ to 7.67¢, and, per the lead paragraph of this essay, the sale value of MA offshore wind ocean space increased by 500 times.

Compare MA with the Nov. 2017 North Carolina offshore wind bidding, using the same BOEM process, for a similar 122,000 acres. NC has none of the policies mentioned for MA and NY. The NC lease auction attracted only 4 bidders (versus 11) and the winning bidder paid $9.1 M (versus $135 M). That is, with no state OSW policy, the lease auction achieved 1/3 of the bidders and 1/10 the value for ocean area. A second comparison, this one at the power purchase stage—Maryland, an early pioneer, requested bids for an expected single project (not a pipeline), 368 MW (not 800 MW), and required a large amount of local content, including developers paying for port upgrades and steel fabrication. The Maryland power price was 13.2¢/kWh (versus 7.67¢/kWh for Vineyard Wind)—again evidence that not implementing the best policy and RFP terms leads to higher electricity prices. (The more recent low power prices also benefit somewhat from technology advances and developer experience, but the sum of technology effects are much smaller than the sum of policy effects, per McClellan 2015). Both NC and MD comparisons show empirically that the right sector-specific policies, and rapid state implementation of those policies, make a huge difference in both increasing the value of the ocean space and reducing the amount ratepayers ultimately pay, or save, in the price of offshore wind electricity.

National or state policy? Coincident with the time period of the MA bidding, global carbon policy agreements moved only a small incremental step forward at COP24, votes or protests opposing carbon taxes in several jurisdictions prevented implementation, and the current US national government continued to verbally oppose CO_2 policies. National cross-sector policies such as carbon taxes presumably would help implement low-carbon generation. Nevertheless, it is worth contemplating that OSW in the US Northeast is already starting a huge ramp-up, demonstrating the power, speed, and potential effectiveness of sector-specific regional (or state) policies. Sector-specific local policies work regardless of global agreements and national goals. But further, let's consider whether, say, a carbon tax would have accomplished as much. As a stretch, assume that a 5¢/kWh carbon tax on fossil generation could be implemented (I judge that politically unlikely for the US now.) Before the MA law, OSW for MA was contracted to be purchased at 26¢/kWh. After the law's passage and implementation, the contracted price is 7.67¢/kWh. A 5¢/kWh carbon tax would not have bridged this gap, and would not have led policymakers to the specifics of how to enable this industry. Solar PV and land-based wind each have different policy schemes specific to their market and financing mechanisms. In this case, the result of policy was to lower the cost of a new resource, a result far less likely to be opposed that a policy of taxing a resource already in common use. The general policy conclusion is, there is no reason to wait for national and international policy that applies to all industries—sector-specific policies enacted by regions or states may be faster, more effective, and less opposed anyway, and can be pursued while international and national debates proceed.

Conclusions:

The average production of the new+prior MA offshore wind leases, if those areas fully built-out, would be greater than 100% of MA electricity load. Offshore wind is a very large resource.

Large corporations have placed a bet, a half billion dollars, that OSW is practical and profitable in the MA region, and that more electricity can be sold after MA's mandated 3.2 GW is satisfied. My analysis supports their expectation. Beyond MA, this is likely true in NY and some other US states, not analyzed here.

The lease payments were at a reasonable price. Assuming most of the area will be built out, those payments will have a minimal impact on profit, bid competitiveness, or electricity rates.

The policies that made the higher lease payments and lower energy costs possible were sector-specific policies, enacted and promptly carried out by states. Global or national policies may be helpful but in this case were not needed to achieve this transition. For example, a carbon tax alone would not have achieved this result.

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Author statement

I am not currently supported nor have financial interests with any entities in the wind industry, and declare no conflict of interest on the topics of this essay.

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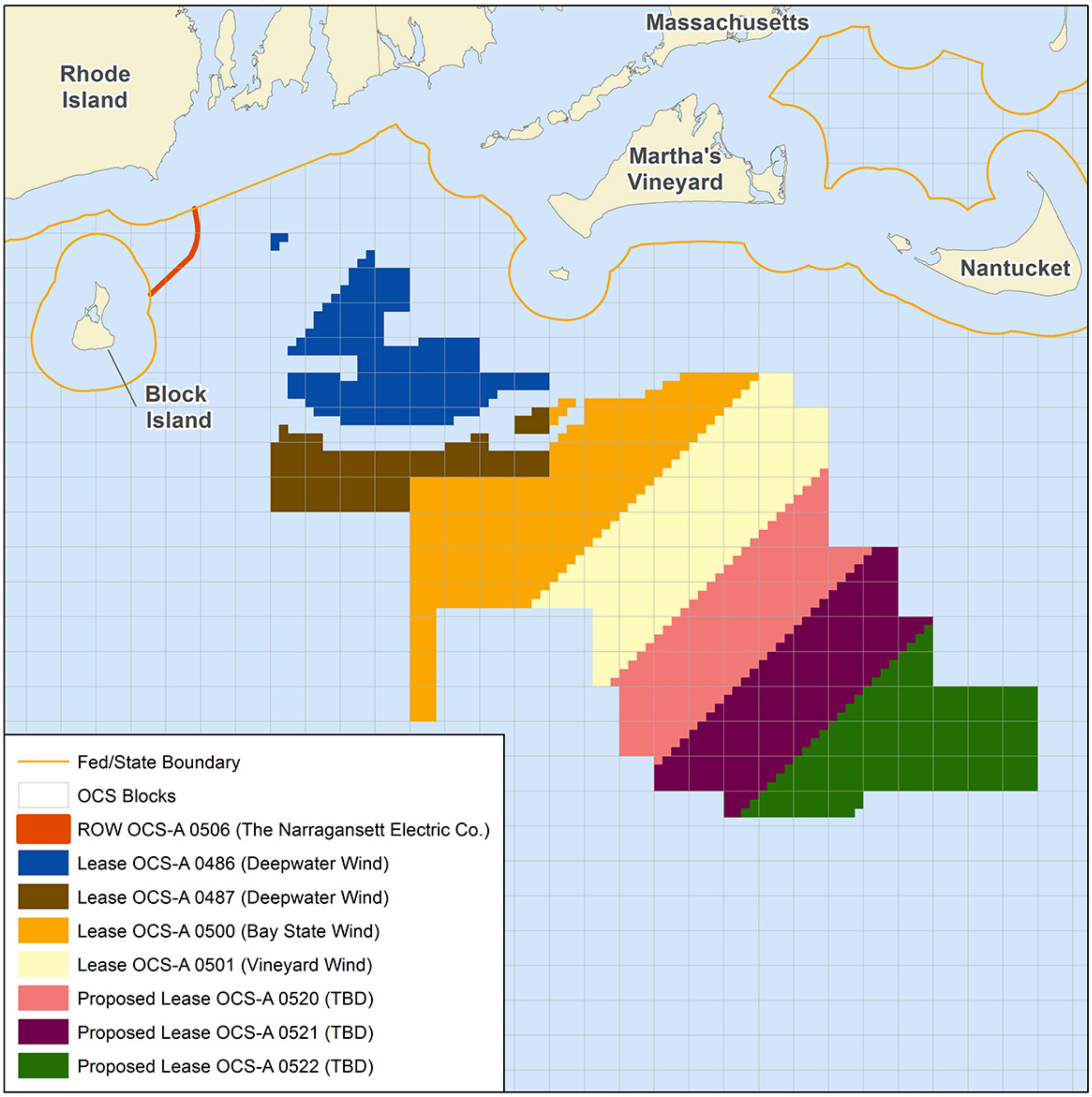

Figure. BOEM lease parcels for offshore wind power. The three lower right ones (SouthEast) were auctioned in December 2018.