The Future of Offshore Wind in America Begins with Block Island

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  - The Sane Energy Project is a grassroots activist group dedicated to a vision of a 100% renewable energy New York City and New York State. I had the chance to meet with the group and learn about their efforts to inform the public and pressure New York's elected officials to focus on the transition to renewable energy rather than expand on fossil fuel projects in the state. The panel discussion they organized gave me the connections that made this report possible.

- **Clint Plummer** – Vice President of Development at Deep Water Wind
  - Mr. Plummer provided the technical details on the project as well as their plans for future wind farms in the region. He laid out the vision offshore wind industry has for the country.

- **Amber Hewett** – Regional Campaign Coordinator at the National Wildlife Federation
  - Ms. Hewitt detailed the coordination Deepwater Wind had with the National Wildlife Federation during the process of planning and construction of the Block Island Wind Farm to ensure the protection of local ecosystems and the migration routes of the North Atlantic Whale.
- **Ben Arana and Richard Duva** – International Brotherhood of Electrical Workers (IBEW) labor union representatives
  - Mr. Arana and Mr. Duva explained the role labor unions will play in the transition to renewable energy in New York
- **Dr. Mark Z. Jacobsen** – Professor of Civil and Environmental Engineering at Stanford University
  - Dr. Jacobsen and his colleagues has developed state by state plans for the United States to transition to 100% renewable energy by 2050. as well done studies on the effect large scale wind farms on hurricanes and tropical storms.

Abstract

Utilizing the same energy source that propelled Columbus' ships from Spain to the new world, America aims to harness the wind over our seas once again by building the country's first offshore wind farm. The five turbine, thirty megawatt wind farm being built off the coast of Block Island, RI hopes to spark the beginning of a brand new industry in the United States. Five turbines in the water is miniscule in comparison to the renewable energy efforts in the European Union, which currently has 3,230 wind turbines installed and supplying power to the grid (EWEA). A little late to the party, America has the opportunity to not only catch up, but overtake Europe with the vast potential of the untapped energy source found a few miles off the country's coastline. A clean and sustainable energy source, offshore wind will play a major role in contributing to the energy mix from renewable sources if the country hopes to meet the goals of reducing its greenhouse gas emissions. With the main goal in mind being progressing towards the mitigation of climate change, renewable energy and offshore wind will prove to play an even larger role with the impacts it will have on national security from the decrease in dependence from foreign oil to stimulating our local economies by creating jobs in the country to manufacture, install, and maintain this new infrastructure. Better late than never and hopefully not too late, The Block Island Wind Farm marks the beginning of the offshore wind industry in America and this report will analyze how the future of harnessing this energy will positively affect the environmental and economic pillars of sustainability for the local region and the state of New York.

Introduction

This report aims to analyze the impacts offshore wind will have on the different pillars of sustainability in both the local region as well as the state of New York. The Block Island Wind Farm, America's first offshore wind project, serves as a prototype for what hopes to be an emerging new industry in this country. With the offshore wind projects already proposed to line the northeast Atlantic coastline, Deepwater Wind's Block Island Wind Farm will set the precedence for future wind farms to come. Studies done by the National Renewable Energy Laboratory (NREL) show the vast energy potential that lies off our coastlines and countries in Europe prove it can be harnessed with the technology that is available today. Beyond the positive impacts on the environment through reducing the greenhouse gas emissions from the power the country generates, offshore wind hopes to create thousands of jobs locally to build the infrastructure needed to manufacture, install, and maintain the turbines.

By moving the turbines off the land and out to the sea, it allows wind farms to take advantage of economies of scale by building bigger turbines in greater numbers which would harness the wind where it blows the strongest and during peak energy demand times. When it comes to competing with energy generated from fossil fuels, it is time to add the detrimental environmental cost from climate change to the price of fossil fuels through a carbon tax. Yet, lobbying from the fossil fuel industry has set back the government's efforts to act aggressively on climate change and prevent the implementation of a carbon tax on fossil fuels. The ability to utilize economies of scale would allow energy generated with wind

power to compete with energy produced from a fossil fuel fired plant by reducing the price of electricity generated.

This report will begin by analyzing both the benefits as well as the negative aspects of offshore wind. It will then move its focus towards America's first wind farm, the impacts it will have on the local environment and economy, and the initiative it took to protect ecosystems and migratory patterns of the North Atlantic Whale. From there it will progress towards analyzing the future of offshore wind in the northeast and the role the industry will play in New York achieving its goal of having 50% of its energy generated from renewable sources by 2030 and beyond.

I. Why Offshore Wind?

The efforts to act aggressively on climate change and transition to renewable energy has been met with extreme resistance in the United States from the industries that profit from an economy that runs on fossil fuels. A corrupt campaign finance system has essentially allowed private industry to buy politicians and influence their decisions to drive subsidies and legislation over the years that work in favor for the fossil fuel industry and against renewables. The energy crisis in 1973, when OPEC (Oil and Petroleum Exporting Countries) cut off the supply of oil to America, rose the public awareness on the risks involved with dependence on foreign oil and a finite energy source. Then years of perpetual warfare in the Middle East to ensure the continuous flow of oil to power our economy has left generations of Americans never living a day without their country in a state of war. Piling all of this on top of the devastating effects from climate change being experienced across the globe, is why transforming our energy system away from fossil fuels should be considered a top priority by elected officials. The stimulus package President Obama passed within his first month in office in 2009 was quoted to have "essentially saved the renewable energy industry in the United States" (Green, 2009). A total of $90 billion in funding would be directed towards renewable energy, the largest bill for renewable energy of any president, and it would spur the wind industry to grow. The electricity generated from wind turbines has tripled since his administration has been in office. Fast forward to the summer of 2016, the foundations for America's first offshore wind farm are installed off the coast of Block Island, RI. By harnessing the abundant and renewable energy found off of our coastlines, offshore wind

has the ability to play a major role in the future of our energy independence as well as to tackle the challenges created by climate change.

II. What we can learn from Europe

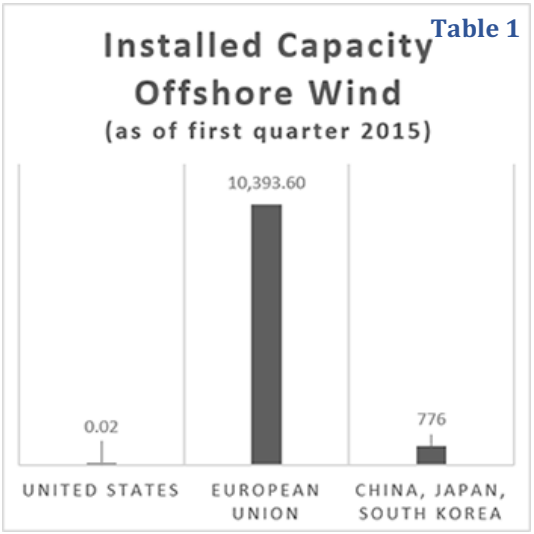


Table 1

America has a lot of catching up to do if it hopes to follow the successes of the offshore wind industry in Europe. The European Union currently has 3,230 turbines installed and connected to the grid, providing a total capacity of 11,027 MW as of 2015. Using the the average consumption for a home in the US, one megawatt would power 650 homes. With Europe's offshore generating capacity, it would be enough to power 7,167,550 homes. That is 84 offshore wind farms in eleven different European countries. Denmark was the first country to install an offshore wind turbine back in 1991, twenty-five years before America installs the foundation for their first. The infrastructure to manufacture and install offshore wind turbines is already established, as the top offshore wind suppliers all originate from Europe with Siemens (Germany) leading the way. With concerns of the environmental impact of offshore wind farms, studies were done to assess the impact of Denmark's two largest wind farms. The study analyzed the number of species

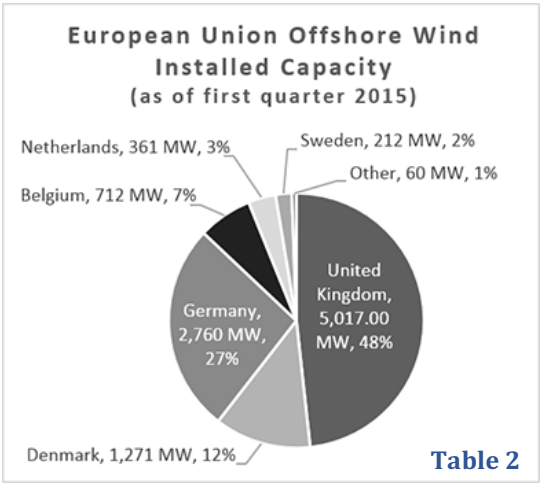
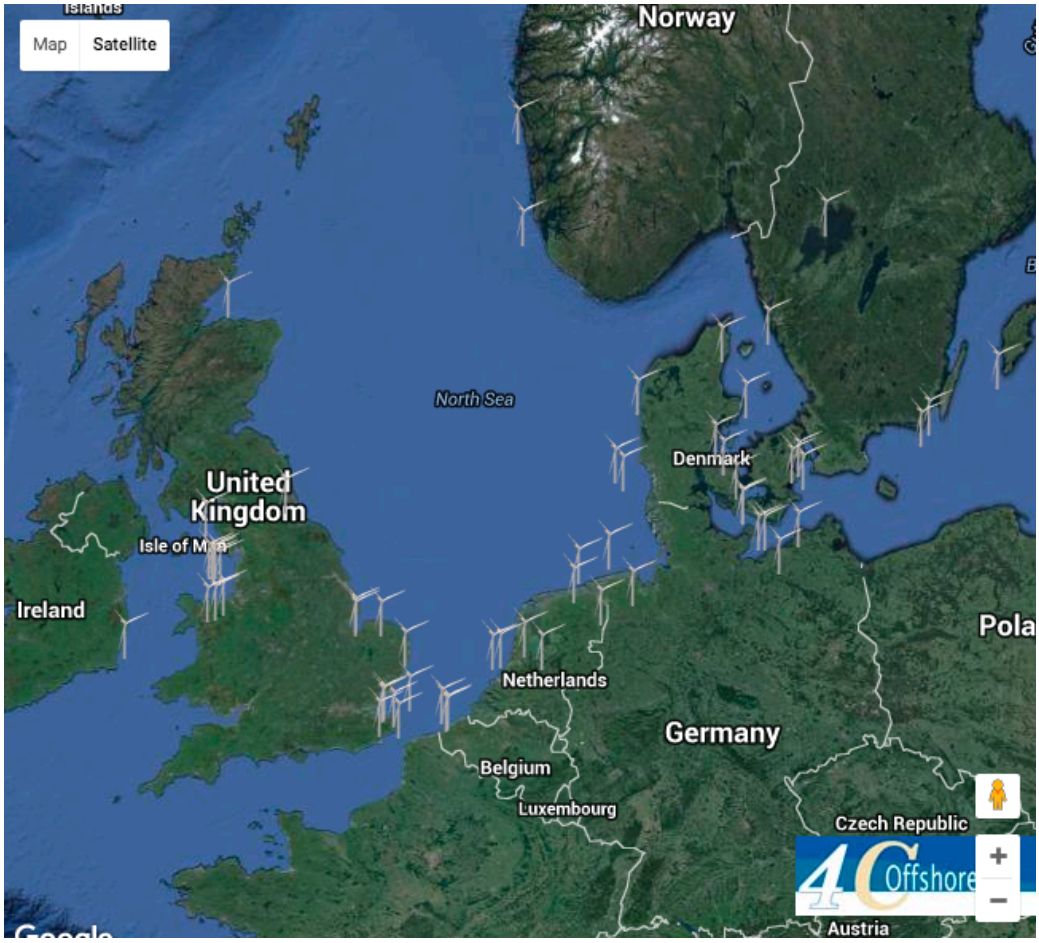


Table 2

and biomass within the area of the wind farm, and found the numbers actually increased after installation. Offshore wind in Europe currently serves 1.5% of the total electrical consumption of the European Union, but keep in mind that not every country in the European Union produces energy from offshore wind. The United Kingdom in particular, who currently generates the most electricity from offshore wind than any other country, has grown their offshore wind efforts enough to meet 5% of its electricity requirements.

Total EU electricity consumption (TWh)	Onshore wind energy production (TWh)	Offshore wind energy production (TWh)	Wind energy production (TWh)	Share of EU consumption met by onshore wind (TWh)	Share of EU consumption met by offshore wind	Share of EU consumption met by wind energy
2,770	274.5	40.6	315	9.9%	1.5%	11.4%

Map of Europe's Offshore Wind Farms



III. Reducing the carbon footprint from electricity generation

Wind turbines give us the ability to transform the kinetic energy from wind into electricity without emitting any greenhouse gasses. The emissions of greenhouse gasses from offshore wind does not come from the generation of electricity, but instead the manufacturing, shipping and installation. The life cycle analysis of offshore wind farms have shown that overall emissions over the existence of a wind farm are low in relation to other electricity generation projects such as a fossil fuel fired generating plant. Significant CO_2 reductions are seen from the countries that have offshore wind supplying power to their grids. Table 4 displays the total emissions of an offshore wind farm consisting of 80 wind turbines. The minimum and maximum values show the emissions if the wind farm was produced in one country and shipped to another. This shows the best way to reduce emissions over the life of the wind farm is to develop the infrastructure to manufacture, ship, and install the major materials locally. Now, to put the total emissions from an offshore wind farm into perspective, the highest emitting coal fired plant in the United States is located in Georgia. It produces 23,861,000 tons of CO_2 each year, while a large scale wind farm here can produce CO2 emissions as low as 60,600 tons over its whole lifetime (CARMA).

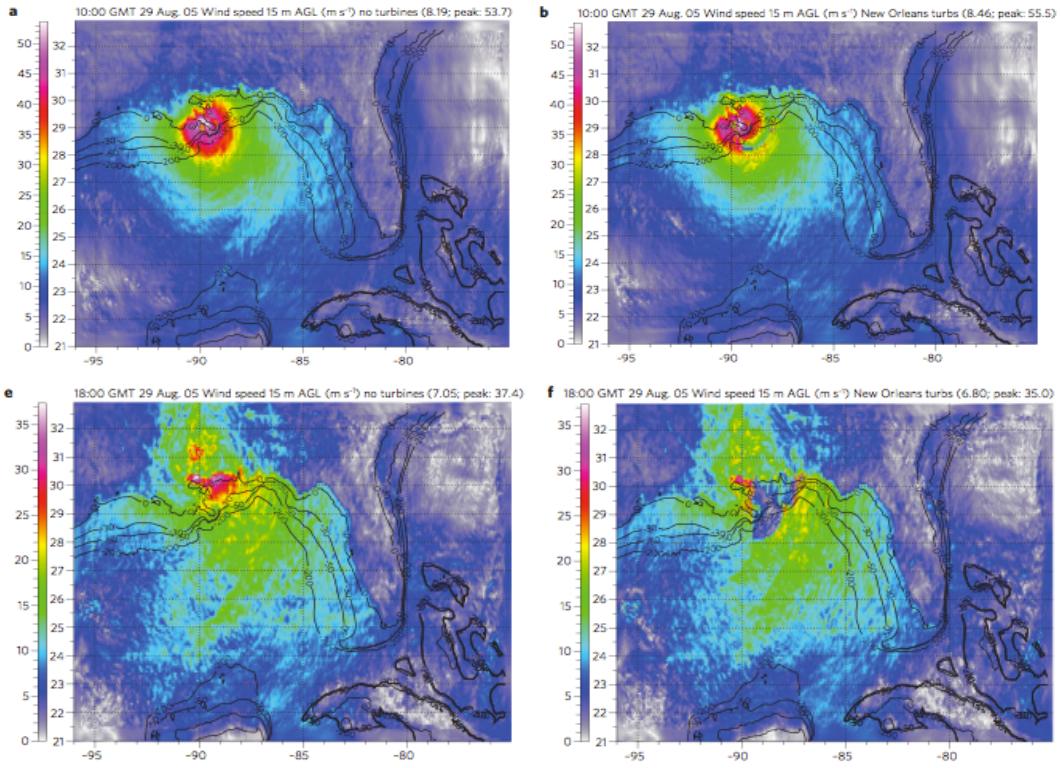
Table 4-1: Total Emissions of for Base Offshore Wind Farm for Several Countries

	South Korea	Mexico	Brazil	China	India	USA
Maximum Emissions (tCO_2)	73,146 (to Brazil)	65,089 (to India)	63,780 (to China)	123,641 (to Brazil)	136,482 (to Mexico)	82,087 (to Thailand)
Minimum Emissions (tCO_2)	50,825 (if kept in S. Korea) 51,686 (if sent to China)	43,524 (if kept in Mexico) 44,775 (if sent to El Salvador)	41,434 (if kept in Brazil) 44,145 (if sent to Guyana)	101,294 (if kept in China) 102,155 (if sent to S. Korea)	114,917 (if kept in India) 115,908 (if sent to Pakistan)	60,600 (if kept in the USA) 61,435 (if sent to Cuba)
Average (tCO_2)	64,192	54,976	52,346	114,748	127,108	70,896

IV. Offshore wind farms effect on hurricanes

With climate change causing the increasing the occurrences of hurricanes and superstorms like Sandy, researches from Stanford University were interested to see if large scale windfarms can not only withstand but also possibly affect the hurricane in any way. Marc Jacobsen and his team utilized computer modeling software to simulate and analyze the affects offshore wind farms have on hurricanes. One of the obvious concerns would be if the wind turbines can even handle the extreme conditions of a storm the magnitude of Hurricane Sandy or Katrina, but their data shows that turbines utilizing today's technology can withstand and also weaken the storm through extracting its energy. Their research shows that wind turbines in the water can weaken the hurricane by reducing its wind speeds and minimizing storm surges. In comparison to costly sea walls that have been proposed to be built to add resiliency to our coastal cities, offshore wind farms would add the dual benefit of mitigating the storm surge while also generating electricity. In this effect, an investment in offshore wind as opposed to sea walls would pay itself back over time. The researches ran the test simulating three different hurricanes, Sandy, Isaac, and Katrina. The data returned for Hurricane Katrina showed that with 78,000 turbines installed in the Gulf of Mexico would have been able to reduce wind speeds between 80 to 98 miles per hour and storm surges up to 79%. Hurricane Sandy also returned positive results, as the hurricane was weakened with wind speeds dropping by 78 to 87 miles per hour and a reduction of 34% in the storm surge (Hurricane, Jacobsen et al.). The software models shown on the next page illustrates the wind

speeds of Hurricane Sandy dissipating due to the thousands of offshore wind farms as it reaches land fall.



V. Green Illusions? A critical view on wind energy as a technocratic solution

Ozzie Zehner, a visiting scholar from University of California Berkley, authored a critique to heralding renewable energy sources as the technocratic solution to climate change. While researching for this book, he found there was little research done on what negative effects may come from renewable energy. For the "20% Wind by 2030" proposal from the Obama Administration, Zehner noted that it was primarily written by the people that would profit off the growth of the industry. For wind in particular, he offered a critical view on its ability to power the country. One concern was over the intermittency of wind as an energy source, basically "how will it produce energy when the wind does not blow?" This

argument is valid, yet studies have shown that it would take a mix of renewable energy sources rather than just wind to sufficiently supply enough electricity to the grid while also ensuring resiliency. For offshore wind, this would be less of an issue as the strongest and most consistent wind patterns can be found off of the coast. Researchers at the Massachusetts Institute of Technology are also trying to solve the problem of intermittency with large commercial scale batteries, created with local abundant materials, that would store the energy for times when it is needed. Another argument is that wind turbines are not completely green, as it still uses fossil fuels to manufacture, ship, and install them. A life cycle analysis proves this, but comparing the lifetime emissions of a wind farm to what the annual emissions of a coal fired plant, as explained in section III., defeats this critique. Zehner admits that this book is only a critical take on renewable energy and that eventually renewable sources would primarily power the grid. He argues that relying on these technocratic solutions only distract us from focusing on and addressing the real issue, overconsumption.

VI. Deepwater Wind's Block Island Wind Farm

The five turbine, thirty megawatts offshore wind farm being constructed off the coast of Block Island, RI marks the first of its kind in America. While there have already been multiple projects already proposed for the United States, all are either still stuck in legislative debates or planning, Deepwater Wind was able to break through the logjam by collaborating with developers, labor, environmental, and community groups in the process of planning. Compared to the large wind farms found in Europe, Block Island will be small in scale, but it will serve as a prototype for future projects in the country. At a capacity of thirty megawatts, it will generate enough electricity for about 17,000 homes in Rhode Island. In generating electricity from a renewable source, the wind farm will lower CO_2 emissions by 40,000 tons each year.

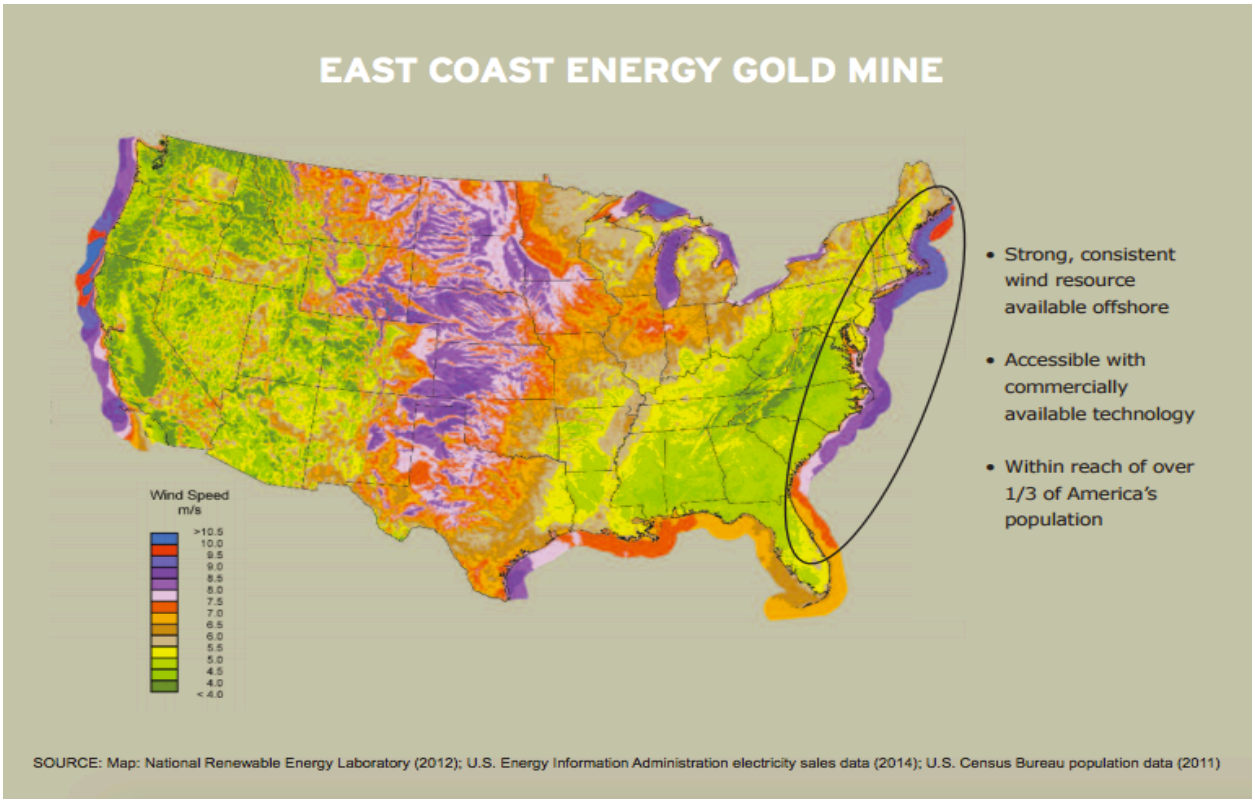
By generating the electricity locally, offshore wind gives the added benefit of keeping jobs in the area. For the installation of the foundations done over the summer of 2015, Deepwater Wind sought the help of local labor unions to do the job. Union leaders spoke out in support for the project, referencing it as the ladder out of Rhode Island's economic hole as the state currently faces a high unemployment rate. The project in the short run would create over 300 jobs, but as the demand for offshore wind will increase, the growth of the market

and jobs will follow. Being the first offshore wind farm in America is not easy, as the infrastructure to manufacture and install offshore wind on a massive scale is lacking. The primary parts of an offshore wind turbine are the turbine, the foundation, and the undersea cable. For Block Island, the General Electric-produced turbine was manufactured and shipped from France, the undersea cable is coming from South Korea, and the foundation originates from Mexico. As stated earlier, and seen in table 4, to reduce the carbon emissions over the lifecycle of the wind farm, the turbines and major parts would have to be manufactured locally. Block Island hopes to be the stepping stone in spurring the development of the infrastructure to implement offshore wind on a large scale.

One of the major groups that has collaborated on the development as well as the construction phase is the National Wildlife Federation (NWF). The NWF has been a strong advocate for offshore wind, and the organization was at the table during planning to ensure wildlife and biological sensitive areas were taken into consideration. The development of the Block Island Wind Farm proposed the challenge of being within the vicinity of migration routes for the endangered North Atlantic Whale. Prior to construction, studies were done on the migration period and routes of the whales to ensure construction does not interfere. Beyond the planning phase, NWF was also present during the installation of the foundation structure. Organization representatives set strict times to restrict construction and pile driving during migration periods. Then pile driving and sonic pings would be stopped when a whale entered the vicinity in order to reduce the noise pollution in the water which would interrupt the whale's communications. All the steps taken to protect the North Atlantic Whale and the local ecosystems have been said to be stricter and that it goes farther than normal government regulations.

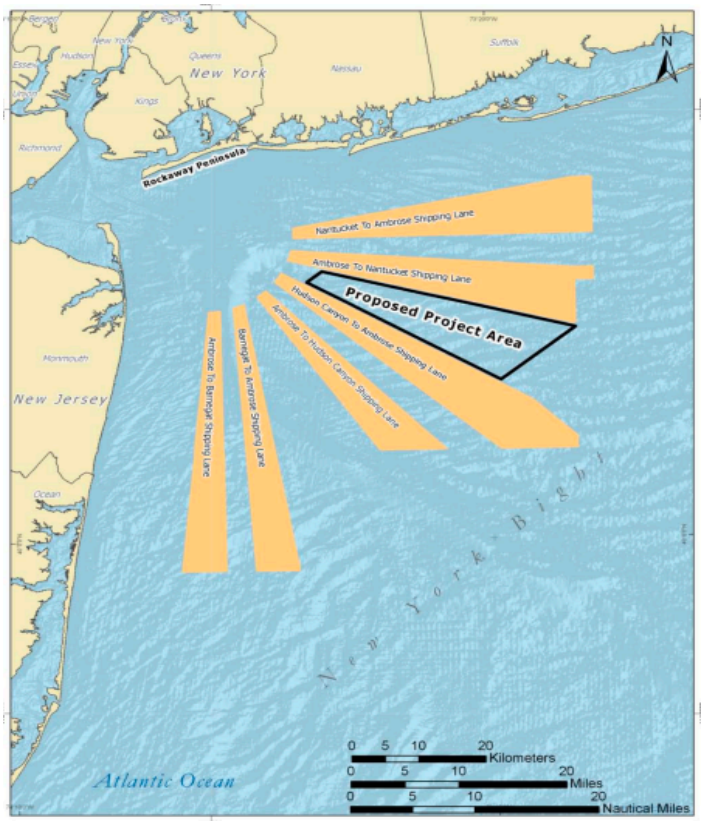
VII. Future of Offshore Wind in New York

The completion of the Block Island Wind Farm has the potential to raise interest and demand in offshore wind, but the project highlights the necessity to develop the infrastructure to implement offshore wind on a much larger scale. Studies done by the National Renewable Energy Laboratory (NREL), as seen in this map, show that our strongest



and most consistent winds can be found along the country's coastlines. In order to create an offshore wind industry, it would require dock builders, steelworkers, electricians, engineers, and numerous others. NREL estimates that the Atlantic states "would generate $200 billion in new economic activity and create more than 43,000 permanent high-paying jobs if available offshore wind resources were utilized" (NWF). Realizing the potential for offshore wind in the region, it is a brand new industry with the ability to grow and benefit the local

areas. With the resources on the Atlantic Coast, it has the ability to generate as much power as 52 coal fired plants emitting 97.2 million tons of CO_2 annually.



Currently New York has already set energy goals to be achieved by the year 2030. Those are:

- **40% Reduction in Greenhouse Gases from 1990 levels**
- **50% Generation of electricity from renewable energy sources**
- **23% Decrease in energy consumption in buildings from 2012 levels**

In order to meet these goals, known as New York's Reforming the Energy Vision (REV), offshore wind will have to play a major role in the mix. Beyond the Block Island Wind Farm, Deepwater Wind also has a larger wind farm that would provide power to Long Island. The map above shows the proposed wind farm off the coast of Rockaway Beach, which would supply electricity to New York City and Long Island. Preliminary proposals have the wind farm capacity to be rated at 350 Megawatts (112,000 Homes), but future developments would raise its capacity up to 700 Megawatts (224,000 Homes).

The International Brotherhood of Electrical Workers (IBEW) and other labor unions will play a significant role in the transition to renewable energy. As the grid shifts towards renewables, jobs in the fossil fuel industry would decline steadily. To ensure their union

members would not be put out of work, the IBEW has stated it would help members with the transition by providing classes and a new training facility in Long Island City. Employing labor union members means hiring people from the local communities and ensuring workers in the industry have a voice to receive decent pay and benefits. IBEW has even been vocal about its stance on climate change, acknowledging that the transfer to renewable energy is bigger than jobs and the economy. Allen Durand, manager of Local 99 of IBEW, on the issue of cheaper fossil fuels has stated, "[C]oal is cheaper to burn because it does not include the price of treating people who contract black lung disease and other pollution related illnesses. The benefits of the Deepwater Wind project are the damage we avoid to the environment" (Stycos).

Looking even further ahead than New York's REV initiative of 50% renewable energy by 2030, Marc Jacobsen from Stanford has been leading a team of researchers to develop plans on a state by state basis to transition to 100% renewables by using today's technology. In order to provide enough power to New York's grid, it would take a grand mix of different technologies to provide a system that is both sufficient and resilient. To choose which renewable energy technologies would be supplying the grid, they analyzed eleven different criteria: carbon-dioxide equivalent emissions, air-pollution mortality and morbidity, resource abundance, footprint on the ground, spacing required, water consumption, effects on wildlife, thermal pollution, water chemical pollution/radioactive waste, energy supply disruption, and normal operating reliability (100% RE NY, Jacobsen et al). Using these determinations, the biggest contributor to the grid at 40% would be supplied using offshore wind. The rest of the electricity generated would come from a mix of onshore wind, concentrated solar plants, solar photovoltaic plants, rooftop solar panels on commercial and

residential buildings, geothermal, wave, tidal, and hydroelectric. A total of 50% of energy would come from wind and 38% from solar as they are the most readily available resources for the state. The study also outlines the benefits of transition to 100% renewable energy, from reducing the mortality rates from air pollution, boosting the economy in the state from the development of new industries, and reducing the overall environmental damage in the state by making the switch to 100% renewables.

Table 2
Number of WWS power plants or devices needed to provide New York's total annually-averaged end-use power demand for all purposes in 2030 (0.061 TW from Table 1) assuming the given fractionation of demand among plants or devices and accounting for transmission, distribution, and array losses. Also shown are the footprint and spacing areas required to power NYS as a percentage of New York's land area, 122,300 km^2.

Energy technology	Rated power of one plant or device (MW)	Percent of 2030 power demand met by plant/device	Number of plants or devices needed for NYS	Nameplate capacity of all devices (MW)	Footprint area (percent of NYS land area)	Spacing area (percent of NYS land area)
Onshore wind	5	10	4020	20,100	0.000041	1.46
Offshore wind	5	40	12,700	63,550	0.00013	4.62
Wave device	0.75	0.5	1910	1435	0.00082	0.039
Geothermal plant	100	5	36	3600	0.010	0
Hydroelectric plant	1300	5.5	6.6[a]	8520	3.50[a]	0
Tidal turbine	1	1	2600	2600	0.00061	0.0095
Res. roof PV system	0.005	6	4.97 million[b]	24,900	0.15[c]	0
Com/gov roof PV system	0.10	12	0.497 million	49,700	0.30[c]	0
Solar PV plant	50	10	828[b]	41,400	0.25	0[c]
CSP plant	100	10	387	38,700	0.60	0[c]
Total		100		254,000	4.82	6.13
Total new land required					0.96[d]	1.46[e]

VIII. Conclusion

After weighing the pros and cons that come from offshore wind, it is hard to argue with the vast beneficial potential the industry has for America. The first American offshore wind farm in Block Island aims to be completed and in operation by the fall of 2016. By following Deepwater Wind's collaborative effort with environmental, local community, and labor groups, future offshore projects now have a game plan to get the industry off the ground and running. Energy and the transition to renewables spans a whole wide array of

issues, which makes a strong case to act aggressively on this matter. Offshore wind addresses the need to reduce our emissions to avoid catastrophic events from climate change. It helps address issues of national security, as offshore wind can reduce our dependence on foreign oil. Doing so would minimize the necessity to have military presence in conflict-ridden regions like the Middle East. It would benefit the economic and social pillars of sustainability by creating well-paying and long-term jobs, strengthening the middle class, and giving workers a fair shot towards upward economic mobility. With Europe's offshore industry already in place for over twenty years, we have the added benefit of learning from both their setbacks and successes. America's first windfarm will certainly not be the last, as this brand new industry has the ability to grow and even possibly overtake Europe. Offshore wind gives America the ability to harness a vast untapped renewable energy source found just a distance off of our coastlines, and it will prove to play a significant role in the coming years as the country hopes to build towards a cleaner and more sustainable future.

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