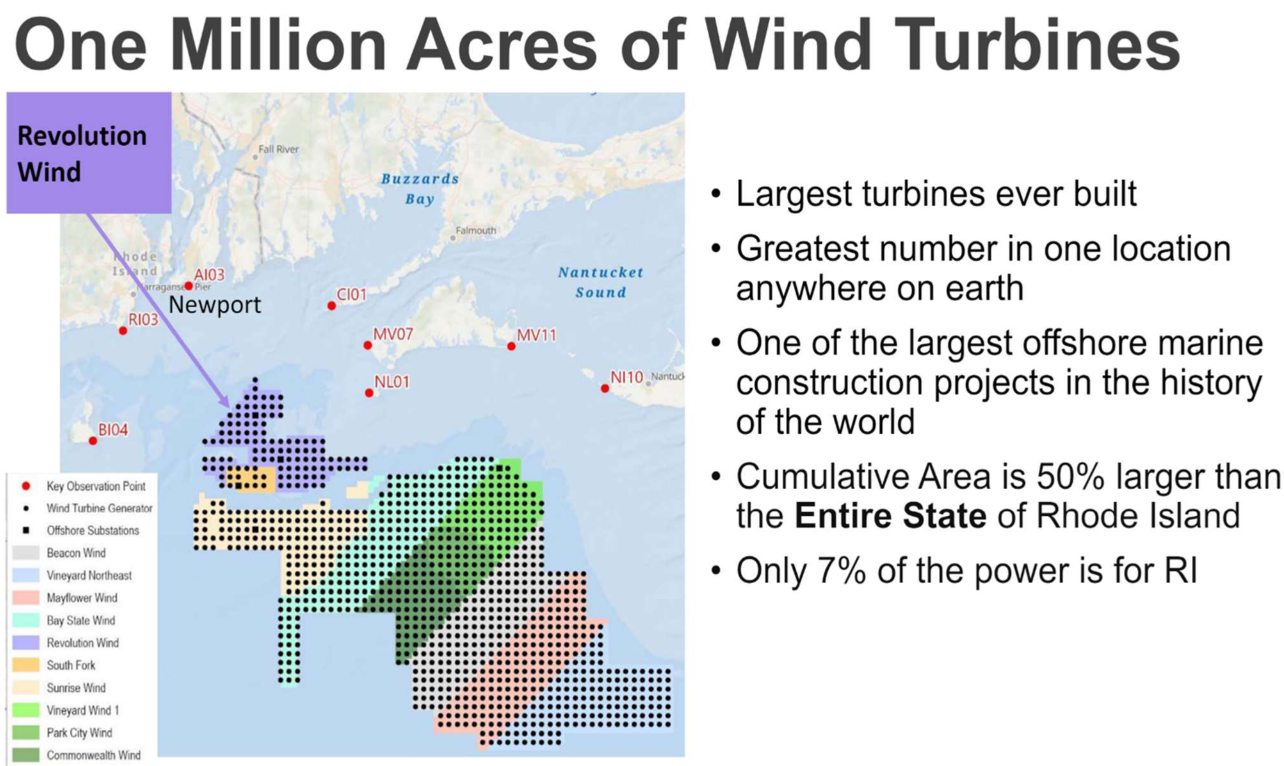
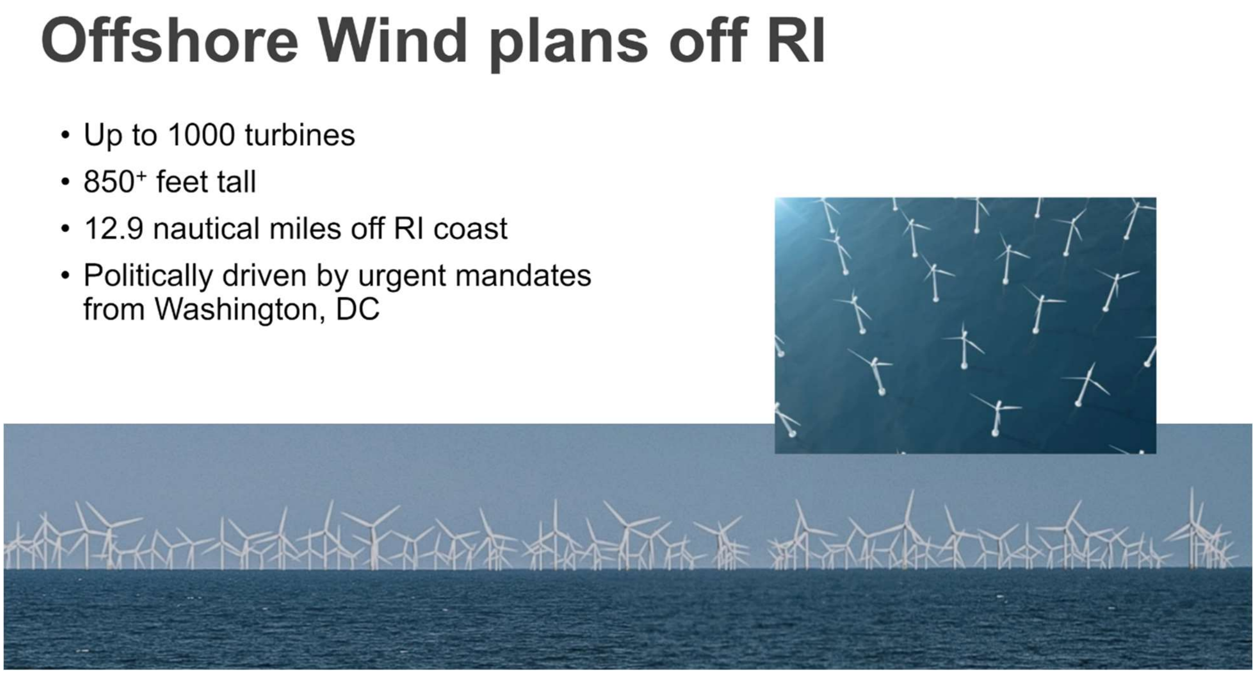
The Myth of Wind Farm CO_2 reduction

By Miles Bidwell

Our government, Federal and State, plans to build 872 giant wind turbines off New England. The following pictures are from Green-Oceans.org. Their web site provides more information.



They will look like this:



This map shows the location which covers major fishing grounds, is in the path of migratory birds and, for sailors, the path of ocean races including the Newport-Bermuda race and the Marion-Bermuda race. The excuse for building these turbines is that they will save the planet by reducing the amount CO2, but the wind farms will not reduce CO2 and may increase it.

The Myth of Wind Farm CO2 reduction

Generating electricity with windfarms causes existing plants to emit more CO2.

Generating electricity with wind farms may increase the total amount of emissions and make emissions greater than they are now without the wind farms. Thus, the wind farms and all the environmental damage from building them may have no offsetting benefit at all. Studies in Ireland, the Netherlands, Colorado, and Texas have found that adding wind farms causes the existing fossil plants to produce more CO2 and that as the amount of wind farms increases, the total CO2 becomes more than it would have been with no wind farms (see endnote). I understand that this assertion appears counterintuitive to people who have been inundated by politicians and media insisting that building wind farms will reduce the amount of carbon in the air. Here is an explanation of how adding windfarms can increase the total amount of CO2 emissions.

The fuel efficiency of a generating plant varies the same way as the fuel efficiency of a car varies. A generating plant, or car, is most efficient when it is operating steadily at its most efficient output. When the generating plant is varying its output up and down like a car in traffic, it can use twice as much fuel to generate the same amount of electricity. When it is accelerating rapidly, called ramping, it requires much more fuel.

Before windfarms, electricity systems, like that in New England, were designed so that different plants steadily supplied electricity for the number of hours at which they were most efficient like cars driving on a highway. In the following discussion, it is important to remember two important characteristics of electricity:

1) electricity cannot be stored at reasonable cost and not in any significant amount, and
2) the amount of electricity being produced must always exactly equal the amount being consumed or the system collapses causing widespread blackouts.

In an electricity system without windmills, the amount of electricity that is consumed at different times is predictable. Each day the system operator estimates how much electricity will be consumed at different times for the next day. This is predictable and stable, and different generators bid to supply the predicted quantity in each period. Almost all the generation is done by plants that are designed to run steadily, as if they were cars on a highway.

The addition of windfarms disrupts this efficient process. Windfarms produce electricity that is unpredictably intermittent, and this is what makes windfarms an inferior source of electricity. No one controls how much electricity a windmill produces. The amount produced depends on and varies with the strength of the wind. Recall that the amount of electricity being produced must exactly match the amount being consumed. Since the amount of electricity being consumed is predictable and almost constant at any time, the fossil generating plants now must continually change their outputs to compensate for changes in the wind, including having to increase output very quickly when the wind drops. This is equivalent to a car changing from driving the speed limit on a highway to driving in traffic with intermittent rapid acceleration. Not only does mileage get very bad, but total wear and tear increases, and the life expectancy of the machine decreases substantially (in Europe some of the most efficient new combined cycle plants (CCGTs) have had to be removed because the frequent changes in output were causing major damage).

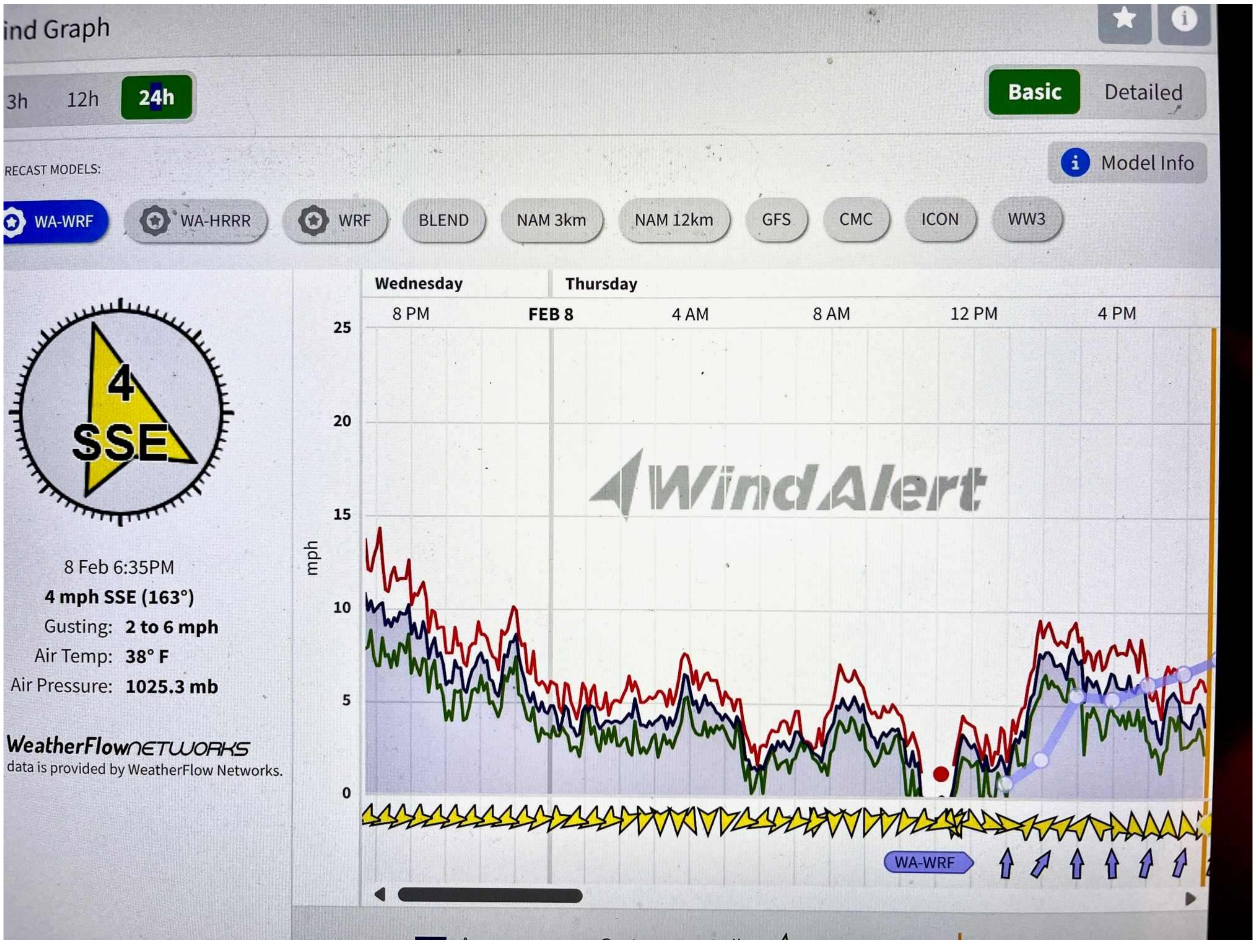
To make up for the drop in windmill generation when the wind drops, there must be fossil plants that can start and accelerate to full power very quickly. The single cycle gas turbine (SCGT) is such a plant. It is a big jet engine like the ones used on airplanes. Because the existing power plants are designed to run quite evenly, it may be necessary to add these inefficient fossil fuel generating plants to the system to follow the ups and downs of the wind gusts and lulls. These plants consume almost twice as much gas as the CCGT plants that are efficient and are now very widely used but cannot start or stop quickly and are damaged by constant acceleration and deceleration.

As a car in stop and go traffic may use twice the amount of fuel to go the same distance as it would driving steadily on a highway, the fossil generating plants compensating for the changes in wind production may consume the same amount of fuel to produce half as much electricity. In other words, when the wind is blowing and the wind farm generates electricity, the fossil generators must generate exactly that much less. But, the fossil generators cannot be turned off. They must keep running and continually changing output to match the continually changing wind speed. If the inefficiency of operating this way causes an increase in total fuel consumed, the wind farms cause an increase in total emissions. This is similar to the car in traffic that uses more fuel to go only half as far.

To know exactly how much extra fuel each plant is using would require individual plant monitoring, which should be required, but is not. Where this has been done, the results have shown that the total emissions can be and are sometimes greater with the wind farm than without the wind farm. How much extra fuel the generating plant consumes depends on the plant and on how much and how quickly the plant must change its output to match the wind. To illustrate the reality of trying to chase the wind, the following are graphs of typical 24-hour days of wind recorded by a wind station on the Block Island jetty.

The first graph shows the wind at the wind station on the Block Island Jetty over a 24-hour period ending on 6 February 2024.

The second graph shows the wind at the Block Island Jetty over a 24-hour period ending on 8 February.



In both graphs, the red line represents the gusts, and the green line represents the lulls. The blue line representing the average wind speed is irrelevant to the output of the wind farms. These graphs show how the fossil generation plants must constantly and instantly alter their output to keep the total supply of electricity equal to the total amount being used, and by so doing keep the grid from collapsing. For example, on Feb 6 at 11:00 PM the wind was blowing at over 25 MPH. The windfarms would have been generating their maximum potential output and the fossil generators would have had to reduce their generation by a similar amount. In contrast, on February 8th there was very little wind and between about 10:30 AM and 11:30 AM there was no wind at all. During this hour, all of the fossil plants would have had to generate as much electricity as they did before the wind farms were built but would now be emitting more CO_2 because some of them had to start and accelerate quickly including some that were fuel intensive SCGT (big jet engine) generators. Because the wind does not blow all the time, windfarms cannot replace any fossil generation plants.

The implications of this are staggering. Our government is spending vast amounts of taxpayer money to build huge environmentally damaging machines at a cost that is greater than any other form of electricity generation, and there is no benefit from doing so. Even if the wind farms do not cause more CO2, they only reduce it by a small amount. The assumption that one unit of electricity generated by a wind farm will cause one unit of electricity to be not generated by a fossil plant is simply not true. Thus, the fuel and CO2 reduction benefits attributed to the wind farms in all the studies, evaluations, and PUC reviews are wrong.

The story does not end here; not only do the wind farms not reduce the amount of CO2 being released. Building windfarms releases vast amounts of CO2 as I explain in the next section.

Building Windfarms is a Carbon Intensive Process

Concrete

Here's a simplified breakdown of the stages involved in the manufacture of concrete and the carbon dioxide (CO2) emissions associated with each stage:

1. **Extraction and Production of Raw Materials**: The primary raw material for cement (the key ingredient in concrete) is limestone. The extraction of limestone and other raw materials like clay, shale, and sand involves energy-intensive processes that emit CO2.

2. **Manufacture of Cement**: This is the most carbon-intensive phase of concrete production. Cement is produced by heating limestone (calcium carbonate) along with other materials to 1,450°C in a kiln, in a process called calcination. This process decarbonizes the limestone (releasing CO2) and forms clinker, the main ingredient in cement. Approximately 0.52 tons of CO2 are emitted for every ton of clinker produced, which is about 60-70% of the total emissions from the entire cement and concrete production process.

3. **Mixing Cement with Water and Aggregates to Make Concrete**: The actual mixing of cement with water, sand, and gravel to produce concrete is less energy-intensive compared to cement production; however, the transportation of these materials to the mixing site and the mixing process itself also contribute to the overall carbon emissions.

4. **Transportation**: CO_2 emissions from transportation occur at multiple points in the supply chain: transporting raw materials to the cement plant, transporting cement to the concrete manufacturing plant, and transporting concrete to the construction site. The impact of transportation on the overall carbon emitted depends on the distances involved and the modes of transport used.

The exact amount of CO_2 released per ton of concrete produced can vary significantly; however, a commonly cited figure is that the production of one ton of cement (not concrete) results in the emission of approximately 0.82 tons of CO_2. Since cement represents about 10-15% of a typical concrete mix, the CO_2 emissions for concrete are proportionally lower per ton but still significant when considering the large volumes of concrete used in constructing a wind farm. One report estimated one acre of concrete on the ocean floor for each windmill.

Steel

The production of steel is a carbon-intensive process, involving the following stages:

1. **Iron Ore Extraction and Preparation**: This stage involves mining iron ore and preparing it for the blast furnace, including processes like crushing, sorting, and beneficiation to concentrate the ore. Emissions come from diesel used in mining equipment and electricity for ore processing.

2. **Coking Coal Production**: Coking coal is a crucial input for the Blast Furnace-Basic Oxygen Furnace (BF-BOF) process. It involves mining coal and then processing it into coke. This stage emits CO_2 through the combustion of coal and the release of methane from coal mines.

3. **Iron Production in Blast Furnace**: Iron ore is reduced to iron in the blast furnace, using coke as both a fuel and a reducing agent. This stage is highly carbon-intensive, as it involves the combustion of coke and the release of CO_2 from the chemical reduction of iron ore (iron oxide) to iron metal.

4. **Steel Production in a Basic Oxygen Furnace (BOF)**: The molten iron from the blast furnace, along with scrap steel, is then converted into steel in the BOF. Oxygen is blown into the furnace, which burns off impurities and converts the molten iron into steel. This process also emits a significant amount of CO_2.

The average carbon emissions are typically around 1.8 to 2.2 tons of CO_2 per ton of steel produced. Each steel tube holding one wind turbine weighs 2000 tons! It looks like

this:

"Giant hammers ram the turbine's upright steel tube called a monopile that weighs 2,000 tons, into the seabed"

--GE Turbine Website

- Monopile is 40 ft in diameter with walls 5 inches thick

Fiberglass

1. ** Mining and transportation of silica sand, limestone, and soda ash**. The emissions from extracting and transporting raw materials are relatively low compared to the melting process; however, the fossil fuels used for these operations increases the carbon emissions, potentially adding several tens of kilograms of CO_2 per ton of fiberglass produced.

2.**Furnace operation to melt the raw materials into molten glass**. This is the most carbon-intensive phase of fiberglass production. Melting requires temperatures exceeding 1,500°C, leading to high energy consumption. Assuming a furnace powered by natural gas (a common fuel for such processes), emissions can be significant. For glass production, emissions can range from 1000 lbs. to over 1 ton of CO2 per ton of product, depending on furnace efficiency and specific process parameters.

3. **Application of a binder to the fibers and curing (hardening) in an oven**. This stage also involves significant energy use, especially for curing ovens. Emissions can vary but could add an additional few hundred kilograms of CO2 per ton of fiberglass, depending on the specifics of the process and the efficiency of the ovens.

4. ** Final processing steps and packaging**. These steps are less energy-intensive but still contribute to overall emissions. The impact is small compared to melting and curing, possibly adding tens to a low hundred kilograms of CO2 per ton of fiberglass. For the proposed wind farms, the blades are very large and must be transported to the wind farm site and installed. The blades may last 20 years, or much less, after which they cannot be recycled.

Adding these stages together the total emissions to produce 1 ton of fiberglass could easily exceed 1 to 2 tons of CO2, depending on the efficiency of the processes and the specific types of fossil fuels used (coal, natural gas, oil). And, there will be at least 872 windmills, plus substations that look like oil drilling rigs and add additional CO2 emissions.

All of these estimates ignore the eventual decommissioning which will add significantly more carbon and waste to the environment; and add significantly more taxes and higher electricity rates to consumers and businesses.

If you think that building these wind farms is a bad idea, please contact Green Oceans, the local non-profit formed to protect our waters. Their excellent web site is very informative. They have a major lawsuit against government agencies for not following their own regulations for environmental review in the rush to build these things. See Green Oceans - Home (green-oceans.org) for more information.

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Dr. Bidwell has a Ph.D. in economics from Columbia University. He has worked on electricity market design and pricing for more than 30 years. He was a major architect in the design of the current New England capacity market.

Endnotes

References on CO_2 increase with windfarms

1. Kent Hawkins: Wind Integration Realities: Case Studies of the Netherlands and of Colorado. (http://www.masterresource.org/2010/05/wind-integration-realities-part-i)

2. C. le Pair & K. de Groot: The impact of wind generated electricity on fossil fuel consumption. (http://www.clepair.net/wind-SPIL-2.html)

3. F. Udo, K. de Groot & C. le Pair: The impact of wind generated electricity on fossil fuel consumption. (http://www.clepair.net/windstroom%20e.html")

4. Kent Hawkins: Peeling away the onion of Denmark Wind and many other articles in: (http://www.masterresource.org/2010/05/wind-integration-realities-part-i/#more-9977)

5. Bentek Corporation: How less became more; Power and Unintended Consequences in the Colorado Energy Market.

6. B. Ummels: Wind Integration; Thesis Delft 2009. (http://www.uwig.org/Ummels_PhDThesis.pdf)

7. W. Post: Wind Power and CO2 emissions. (http://theenergycollective.com/willem-post/57905/wind-power-and-CO2-emissions)

8. Hugh Sharman: Wind energy, the case of Denmark. (http://www.cepos.dk/fileadmin/user_upload/Arkiv/PDF/Wind_energy_-_the_case_of_Denmark.pdf)

9. David Wojick, Ph.D. & Paul Driessen, Ph.D. ! How Offshore Wind Drives Up Global Carbon Emissions.pdf