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Brochure Talking Points | Save the Jersey Shore and the North Atlantic Right Whale

2 messages

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Offshore wind may not reduce CO2 emissions

By David Wojick | May 31st, 2023 | Comments Off on Offshore wind may not reduce CO2 emissions

There is a common assumption that offshore wind electricity generation greatly reduces CO2 emissions. In fact this is the primary justification for the horrendous cost and adverse impact of these offshore megaprojects.

As with many green assumptions, this may well be false. First, given the way power generation actually works the reduction in fossil fuel emissions may not be all that great. In fact offshore wind could actually increase fossil fuel emissions. This is explained below.

Let’s take New Jersey as an example because they aspire to be the leader in offshore wind development. Their stated goal is a whopping 11,000 MW of offshore generating capacity, at a cost of something like $100 billion. If reducing CO2 emissions is the justification for this incredible cost, there had better be a lot of

reduction. Turns out there may be very little, which makes the project very expensive, or even an increase which would make it worse than worthless.

On the generation side there are several factors to consider. To begin with New Jersey already shut down its 2,000 MW of coal fired power so those potential emission reductions are gone. Even worse half of their present generation is nuclear, which has no CO2 emissions. So if wind replaces some nuclear output there is no reduction.

The remaining half of the generation is gas fired and here things get interesting, as well as complex.

Keep in mind that the gas fired system is designed to generate when people need electricity. Wind on the other hand generates when the wind blows. It generates most when the wind blows hard, less when it blows less, and none when it blows low. Roughly speaking output increases linearly from no power at 10 mph to full power at 30 mph.

These are sustained wind speeds, not gusts, so 30 mph is rare. On the other hand less than 10 mph is relatively common, with no power produced, sometimes for days at a time. In between what happens is that the wind and power output go up and down, up and down. A 20% change in output in an hour is common.

These irregular wind oscillations will have a profound impact on gas power emissions. This is because there are two very different kinds of gas fired power plant. These are called, respectively, the simple cycle and the combined cycle plant.

A simple cycle plant is a generator driven by a combustion turbine. This turbine is like a jet engine running on natural gas. These plants are relatively inefficient, with an efficiency of 30 to 38% depending on how old they are

Combined cycle uses a combustion turbine too, but it then uses the extremely hot exhaust to boil water that in turn runs a steam turbine generator, so there are two different generators run in combination, hence the

name. Combined cycle plants are much more efficient than simple cycle at around 60%.

Simple cycle plants feature quick start so they are used mostly for meeting peak needs when power usage spikes. For this reason they are often called peakers. Peak need is unlikely to coincide with strong wind, especially heat waves and cold snaps which are often marked by very low to no wind. Both weather extremes are often caused by stagnant high pressure systems.

Thus it is unlikely that offshore wind will do much to reduce the peaker emissions. The coal emissions are gone, nuclear has no emissions and the peaker emissions mostly remain, so this just leaves the combined cycle emissions for possible reduction.

Here the constant variability of wind creates a huge obstacle to emission reduction. The problem is that the huge amount of water in the combined cycle boiler takes a long time to heat up, and once heated the combustion turbine must run flat out to keep it boiling.

This is not a rapid response technology, in fact it is designed to run more or less steadily. It cannot ramp up and down in time to match the wind's rapidly ramping down and up.

There are two ways the combined cycle system can be run in order to supply the erratic need created by the oscillating output of the wind generators. Unfortunately both are highly inefficient, meaning a lot more gas must be burned per unit of electricity produced, which creates a lot more emissions.

One way is to keep the steam pressure up during the time the wind output is high, which means burning a lot of gas with little or no generation. The other way is to shut down the steam system and just run as a simple cycle combustion turbine. This burns a lot more gas than was the prior-to-wind case when the combined cycle unit ran relatively steadily.

In short adding a lot of intermittent offshore wind to the generation mix radically degrades the efficiency of the gas fired generation. The

result is that CO2 emissions are not likely to be greatly reduced and can even increase.

What actually happens is a research question I have not seen studied. A lot depends on the specifics of the intermittency, which likely vary from year to year and place to place.

The point is that if the primary justification for building enormously expensive offshore wind megaprojects is to reduce CO2 emissions then there may be no justification.

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Best,

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