Pollution, Contaminants, Threats Posed by Industrial Wind Turbines, and the Economic Realities of Offshore Wind

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History of Great Lakes Industrialization

There's an old saying: You don't know where you are going if you don't know where you have been. This is incredibly true when considering the notion of Industrial Wind Turbines installed offshore in the Great Lakes, and especially Lake Erie.

Starting shortly after WWI, and continuing unabated until 1969, the dumping and spillage of industrial contaminants into the Great Lakes was well known and well documented, which resulted in Lake Erie being declared dead @ 1970. Since that time, starting with the Great Lakes Protection Act of 1968, and further strengthened by the Clean Water Act of 1972, the Great Lakes, and especially Lake Erie due to its physical characteristics and small size and volume, comparative to the other 4 lakes, a rebirth was underway, as curtailing the industrial pollution and clean up efforts put the lakes on the long road to recovery.

According to the EPA, 362 different chemical contaminants are found on the lake beds of all the Great Lakes, with 17 of these substances extensively studied and confirmed that they are dangerous to not only human life, but to aquatic and terrestrial wildlife prompting strong regulations, stiff fines, and massive cleanup/ remediation efforts geared at restoring the health of the lakes, and the human communities that depend upon the water daily.

From advisories to eat no fish to now Lake Erie fish are safe for human consumption, according to NYS DOH, this success story is unparalleled. But the threats remain buried on the bottom, while more threats are emerging, and desired to be introduced with offshore wind turbine construction in Lake Erie.

Existing Chemical Contaminants

- Predominant known contaminants in Lake Erie consist of PCBs (polychlorinated biphenyls), a fat soluble industrial chemical that causes cancer, inhibits hormonal regulation, and reproductive problems.
- Murex, Dioxins, phenols, cyanides, heavy metals (chiefly alkylated lead,) pesticides, oils, fats and greases (chiefly from effluence, not oil wells or leaky pipelines, although accidents in shipping, poorly regulated vessels and well spills were also noted as potential severe problems).
- Some contaminants, like arsenic, cadmium, chromium and cobalt exist in "trace amounts", but these toxins bioaccumulate over time and biomagnify as they work up the food chain.

These are the known chemical contaminants that cause health problems, but an emerging contaminant family, known as PFAS, is also strewn along the bottom.

- These are considered forever chemicals.
- Over 400 different compounds in this family are known to be water soluble.
- In use since the 1940's, PFAS chemicals were extensively used to make some plastics, dyes and paints, food wrapper packages, waterproofing substances, pizza boxes, non-stick cookware, even post-it notepads, some paper products and fire fighting foams.
- These substances have been under study since @ 2000, and the dangers these chemicals represent were summed up well in a documentary from 2019 called Dark Waters.
- These substances were responsible for the Village of Mayville to shut down their 3 wells providing water to the village, and forcing a new well to be dug. Source of contamination was their fire training grounds.
- Re-exposure to these chemicals will impact the water quality and the health of the life in the lake, along with communities depending on the lake for drinking water, which it is estimated that over 11 million people depend on Lake Erie for their water across 4 states and Canada. This is an International health issue.
- PFAS substances can be carried by rainwater, bioaccumulate, and although studies to determine biomagnification have not yet been done, it is known that levels in living creatures far exceed environmental levels, even if those levels are measured in trace amounts. Human exposure comes from contaminated drinking water, both consuming it AND through skin absorption.

Wind Turbine-borne contaminants

Beyond disturbing the sediment for construction and transmission line installation, two additional emerging contaminants are found to be shed by operational wind turbines – bisphenol A and neodymium.

- Bisphenol A is the primary ingredient in industrial epoxies, and is extensively used in turbine blade construction to keep the blades as lightweight as possible.
- Due to what is known as leading edge erosion, this chemical, a known endocrine inhibitor and damaging to reproductive health in both people and fish.
- Half-life in air is roughly 0.2 days.
- In water, however, bisphenol A persists for a very long time, a duration not yet known.
- It is not readily diminished in live tissues, and presence does suggest bioaccumulation over time. Studies in France have found the landscape completely contaminated with this substance, causing fertility and other reproductive problems in the communities.
- Neodymium is the primary rare earth metal used in the permanent magnets contained in the nacelle of each turbine, with up to a ton or more of this metal contained in each nacelle.
- Due to erosion from the turbine spinning, neodymium dust is shed from the turbines, and studies in Norway and other heavy wind power dependent Nations have found this toxic metal in the hair of cattle, wildlife, in plants and even in people living near wind factories.

- OSHA has established protocols to protect workers who come in contact with this metal, as external skin contact can result is severe rashes.
- Unknown what impacts this metal has when inhaled or ingested, but if it causes skin irritation externally, internal impacts cannot be desirable.
- Wind turbines also hold petroleum-based lubricants to assure metal components do not seize up. The gear boxes require annual "oil changes".
- Nacelles over time see the gaskets deteriorate causing the gear oil to leak into the environment.
- Deicing in winter and glycol potentials, a known toxin to wildlife and people. How will this be addressed?

Physical Pollution

Pollution takes many forms, not just chemical or biological. Physical impediments placed in water bodies causes:

- Changes to current flow.
- Increase current velocity.
- Alter erosion and siltation patterns and introduce new dynamics altering the surroundings forever.
    1. Veteran's Bridge Chautauqua Lake altered the south basin fishery
    2. Black Rock Canal and Peace Bridge increased current velocity in UNR
- Unknown how current changes alters plankton flow, oxygen mixation, sedimentation and erosion.
- Head cutting from wind driven currents will require erosion control at the stanchion bases
- BOEM has just embarked on research solicitation to study these impacts in the ocean, from New Jersey to North Carolina.

Above the waves, these towering monstrosities become death for migrating birds, raptors on the hunt, feeding and migrating bats and even migrating monarch butterflies. Many endangered and threatened species of birds and bats use the Great Lakes, especially Lake Erie, for feeding and transit. Curtailing turbine operations seems to be the only mitigation, reducing output and increasing scarcity of electricity, and economically can bankrupt a developer. Interference with RADAR systems will harm border protection and could skew weather forecasting

Acoustic Pollution

The most insidious issue with industrial wind turbines is found in the low frequency noise emitted when operational. Also known as infrasound, this noise is considered a weapon of war by the US Military, and science has known since the early 1990's its negative impact on species with inner ear structures.

- Impacts on marine mammals are well known.
- Only mitigation is distance.
- Effects last beyond stimuli removal, in fish up to 2 weeks.

Studies conducted in 2006 on an offshore wind factory in the North Atlantic off the coast of Germany revealed the low frequency noise caused tremendous harm to the aquatic life.

- Construction noise created a disturbance radius of 50 km (or roughly 30 miles) from each turbine under construction.
- Lake Erie, at its widest is a mere 56 miles across, but only 12 miles spans between Sturgeon Point and Canada.
- The noise pollution is an International issue.

The species that show the largest susceptibility are those with fully gas-filled swim bladders, due to the nature of how sound bounces off gas when traveling through liquid.

- Operational turbines were noted to create a masking radius of roughly 5 km (or 3 miles) from each operational turbine.
- Masking is the phenomenon where aquatic life cannot detect their surroundings due to noise.

Larger turbines are noisier, units studied were 1.5 MW.
Units planned for Lake Erie are 4 MW

The fish cannot find their way, and behavioral changes will scatter fish, especially the migrating walleye, when encountering this noise. **This has international fisheries impact implications as well.**

EMF Pollution

Another unknown is the EMF pollution that will be present from the transmission lines. EMF is showing to have negative impacts on the benthic communities on land, specifically earthworms, and in marine environments, crustaceans are harmed in both creating sluggish and unresponsive adults, while impacting successful reproduction and recruitment. Mollusks like scallops are suffering greatly in the traditional fishing grounds off Scotland, attributed to the offshore wind factories dropped in off their coast.

Other important facts

- Over 11 Million people in the US and Canada depend on Lake Erie for drinking water.
- An estimated 56,000 jobs are supported by Lakes Erie and Ontario, from sport and commercial fishing, to scuba diving shipwrecks and bird watching, and more. This number was near ZERO in 1970.
- Boating is huge in the Great Lakes basin, top region of the country, and NY is #7 nationally, for boat registrations. Most are located on the Great Lakes.
- No go navigation zones to secure site for interconnect will occur.
- Community health costs will increase.

And when we consider NY has plenty of alternatives for electrical energy that carry a small footprint, low encroachment, high density delivery of electricity at a fraction of the cost, one must wonder why target the waters of life? NY has 7,000 unpowered dams that can be powered up and actually produce grid-friendly energy. Why not capitalize on that?

Actual costs of Offshore Wind Energy/ Economics and Production

Analysis being presented by ORES concerning this "new" technology is improperly investigating a plan for siting 9,000 MW Installed Capacity of offshore wind generation, presenting a much rosier picture in relation to actual costs. Our fellow colleague of CAWTILE, Mike Boismenu, a Professional Engineer, took a deep dive into the Department of Energy's Energy Information Administration's Report entitled **Cost and Performance Characteristics of New Generating Technologies,** ***Annual Energy Outlook 2021*** and found some very disturbing facts, as follows:

1 – Offshore Wind generation carries the highest costs of all renewable energy options with a total capital costs translating to $5,486/ KW. This applies to the Atlantic Ocean offshore wind scheme, part of the mandated 9,000 MW Installed Capacity by 2035. In other words, costs for offshore wind, according to EIA for the NYCW region stands at $5,486,000 per KW! If we translate this out to the full cost accounting for 9,000 MW of installed capacity (MW=1,000 KW), the cost of this Atlantic offshore wind push is approximately $49.374 BILLION! This is the cost to build the wind factories, alone, and represents how much each KW produced would actually cost factoring in the capital expenses – devoid of accumulated interest, and before taxpayers subsidize the project – subsidies and tax credits are made possible by the Production Tax Credit we all pay as part of our electric bill. Offshore wind projects in the Upstate NY Region (NYUP) are pegged at $6,642/ KW! This is a reflection of cost per potential production at maximum performance, and is 21% higher than ORES numbers reflect, at minimum.

2 – In Western New York, where we have an over-capacity of developed and potential hydro power, our cost of currently generated hydro power is an estimated $20/ MWH. Normalized costs for offshore wind energy based on NYS region estimates pegs the generation cost at $120.52/ MWH. While our electrical energy carries a production cost before factoring in profits and labor costs, maintenance costs and loss due to congestion or distance traveled, of $0.02/ kWh, the production cost before factoring in profits and labor, etc., would be 6 times higher, or $0.12/ kWh from offshore wind. This does not include the delivery costs and does NOT account for additional environmental mitigation costs, which are yet to be identified. These will certainly increase the costs of offshore wind!

3 – All of this is based on the assumption that output will actually be available! Costs increase as scarcity of power gets factored in – during times when the wind doesn't blow, or blows too strong! Costs for offshore wind in upstate NY carry a 21% premium above the oceanic capital cost projections.

4 – For the Atlantic Ocean offshore wind costs for transmission, NYSERDA has admitted the additional costs would run anywhere from $6 BIL - $13 BIL in additional spending, which, when considering the optimism factor, will more likely be far higher, surging that price tag and related rates and taxes to astronomical levels.

Meanwhile, NYS is blessed to harbor an abundance of untapped hydro electric generation capacity, as according to the DoE report on unpowered dams in NY, 2015, NY has approximately 7,000 dams that have the potential to generate dispatch-able, predictable, grid-

friendly power geographically spread out to diminish impacts of loss and related cost pressures due to Ohm's law (friction converting electrical energy to heat across the transmission lines). According to EIA, the cost to develop these existing facilities would be 50% less than developing offshore wind, while delivering reliable, always on power.

Energy forecasting and planning for output demands understanding of the capacity factor, which is the realistic production for any power plant. Installed capacity is the maximum any given generator can produce if running wide open. This is not a realistic expectation of any power plant. Many factors impact this. For hydro, the capacity factor is 78%, or in other words, one needs to build 100 MW of installed capacity to actually realize 78 MW of production. Wind energy, however, due to the variability of the wind, fluctuations in temperatures during the day and seasonally, the capacity value is roughly 26% for offshore wind. That same 100 MW of installed capacity will only deliver a planned 26 MW of output, requiring building 3 times the capacity to realize the same output. Unlike hydro, however, where water can be stored in a reservoir, and used during drier times, wind cannot be stored – it is there and gone.

And the trade off is the damage the lake and the waters will realize, and the economic development already in existence!

In 2020, based on output by fuel type available from NYISO's historical data, the following drives home the folly of wind energy. Bear in mind that reliability and dependability of any power plant is of paramount importance to avoid brown outs and keep the electricity available 24/7/365. For traditional power plants a rule of thumb is demonstrable capabilities to supply the grid with 60% of nameplate, or installed, capacity. Wind and solar capabilities have been halved to 30%, which acknowledges the variability of the fuel types themselves. This does not mean power plants are required to always deliver 60% or more (or 30% or more in the case of wind and solar) of their installed capacity, rather they are capable of doing so. These figures are over time, measured in HOURS:

Calendar Year 2020, 1/1/2020-12/31/2020						
	Wind Energy (installed capacity 1,987 MW)			**Hydroelectric (installed caapcity 5,387 MW)**		
Output value (MW)	**Hours**	**Days**	**% of year**	**Hours**	**Days**	**% of year**
0	26.5	1.1	0.30%	0	0	0
< 10	185.7	7.74	2.12%	0	0	0
< 25	426.4	17.8	4.88%	0	0	0
< 100	1635	68.1	18.66%	0	0	0
< 30% of IC	5700	237.5	65.10%	17.25	0.72	0.20%
Between 30%-60% of IC	2359.25	98.3	26.93%	3814.75	158.95	43.55%
>/= 60% of IC	848.9	35.4	9.70%	5076.9	211.54	58.00%

Source: NYISO output by fuel type archives, based on output measured every 5 minutes of every day for 2020.

Calendar Year 2021, to date 1/1/2021-10/31/2021						
	Wind Energy (installed capacity 2,200 MW)			Hydroelectric (installed caapcity 5,387 MW)		
Output value (MW)	Hours	Days	% of year to date	Hours	Days	% of year to date
0	19.67	0.819	0.27%	0	0	0
< 10	195.58	8.15	2.67%	0	0	0
< 25	412.83	17.2	5.64%	0	0	0
< 100	1350.92	56.29	18.46%	0	0	0
< 30% of IC	5662.67	235.94	77.36%	25.83	1.08	0.35%
Between 30%-60% of IC	1541.33	64.22	21.06%	3995.58	166.48	54.58%
>/= 60% of IC	204.67	8.53	2.78%	3387.25	141.35	46.27%

Source: NYISO output by fuel type archives, based on output measured every 5 minutes of every day from 1/1/2021 through 10/31/2021

The above analysis clearly illustrates the major issues with using wind as a fuel source. No power plant can provide ZERO energy to the grid. NONE! Further, the lack of significant output measured for wind energy is what drives scarcity and relative costs per MW upwards, tremendously. When lack of energy exists, costs skyrocket due to supply and demand, as was learned this past February in TX, where bulk wholesale costs for electrical energy, due to wind accounting for 23% of the electrical portfolio, and the problems frozen turbines presented, escalated to over $9,000/ MW.

This variability creates economic disaster for NY's energy-based economy. The 6-fold cost of offshore wind energy devoid of availability factors alone will cripple NY's economy, creating even greater cost exposure when the fuel is unavailable. We can also see from the above comparisons that unlike hydro, which is predictable and dependable, wind is anything but, creating higher costs in forecasting generating potentials for next year planning.

The Office of Renewable Energy Siting should review each of the regulated power company's (National Grid & Avangrid) Integrated Resource Plans (IRP) to determine the need and economic benefits the addition of these resources will bring the rate payers. An IRP provides a detailed plan by the utility to meet forecasted energy demand using both supply and demand side resources to ensure reliable cost-effective service to the rate payers. This is currently being omitted from ORES studies.

Conclusion:

- Wind energy as a viable component of any energy portfolio simply doesn't exist.
- Great Lakes Offshore Wind will cost 21% MORE on a per kW basis than Oceanic Offshore wind,
- Offshore wind will increase uncertainty and unreliability of the electric grid.

Therefore, with the facts at hand, it is clearly an idea without merit, delivers no benefit to the community at large, only higher costs, while creating destabilizing effects upon the already aged electric grid in NYS.

We should pursue expansion of our ample hydro power in NY, and leave the Great Lakes alone. The costs, the risks, the damage and the instability does not deliver economic benefits, and is contrary to the public interest, delivering no public benefit whatsoever.

Sources:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1253773/
https://response.restoration.noaa.gov/about/media/chemical-pollution-great-lakes.html
http://michiganintheworld.history.lsa.umich.edu/environmentalism/exhibits/show/main_exhibit/pollution_politics/great-lakes-pollution
https://www.wind-watch.org/documents/low-frequency-noise-and-infrasound/
https://americanhistory.si.edu/onthewater/exhibition/3_1.html
https://tethys.pnnl.gov/sites/default/files/publications/Effects_of_offshore_wind_farm_noise_on_marine-mammals_and_fish-1-.pdf
https://www.ahukini.net/
https://pubmed.ncbi.nlm.nih.gov/26515307/
https://pubmed.ncbi.nlm.nih.gov/15739094/
https://bergensia.com/bisphenol-a-in-wind-turbines-damages-human-fertility/
https://pubmed.ncbi.nlm.nih.gov/23994667/
https://greatlakeswindtruth.org/newsworthy/february-24-2021-na-paw-media-release-fatal-attraction/
https://www.epa.gov/pfas/basic-information-pfas

http://mis.nyiso.com/public/P-63list.htm
https://www.eia.gov/analysis/studies/powerplants/capitalcost/
https://www.eia.gov/outlooks/aeo/assumptions/pdf/table_8.2.pdf

White Paper: Offshore Wind Commercial Position Paper, Mike Boismenu, PE, November 15, 2021