Offshore Wind Power

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Dead Humpback Whale on Lido Beach, New York, found near offshore wind operations on January 28, 2023. @ Justin Lane/EPA

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Offshore Wind Power is the installation of wind turbines in an ocean or lake environment, generally intended to feed electrical power into an Electric Grid. While this form of power generation is labelled as "green", the actual impacts can be more deleterious than other low carbon power sources such as Nuclear power, Hydroelectric, Combined cycle natural gas or Geothermal. While Offshore Wind Power was first pursued as an alternative to terrestrial installations to mitigate large down times, reducing bird kills and disturbance of wildlife, offshore installations have generally been found to produce greater adverse environmental impacts as well as much higher costs than their land based counterparts. (Haggett, 2008) While marine wind speeds are generally higher than on shore, the offshore turbines have a much greater downtime from excessive winds, since the turbines are always disabled above a threshold wind speed to avoid catastrophic damage.

In the USA as of 2024, the push for offshore wind power is being driven chiefly by the White House. Considerable independent analysis shows the U.S. plans to be uneconomical and threatening to marine biota, including cetaceans and a broad range of fisheries. One recent analysis shows "Installing grid-balancing and backup batteries for the entire U.S. could cost up to $290-trillion — again, based only on today's electricity needs." (Rucker, 2024) There is also great uncertainty about the cost effectiveness of maintaining the turbines, which are subject to frequent breakage of turbine blades and towers. Furthermore, the actual calculations of carbon emissions and life cycle air pollution demonstrate that offshore wind emissions are much higher than most conventional power plants (including nuclear, hydroelectric, and combined cycle natural gas), such that there is an increase in greenhouse gases from offshore wind, based upon a life cycle analysis. (Rucker, 2024)

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Description of Offshore Wind Installations

Fundamentally the wind turbines are turned by winds to generate electricity. This electricity is typically conveyed to terrestrial users who will consume the resultant power. The common method is method of sea to land transmission is via high-voltage alternating current (HVAC). (John, 2019) However, there are significant limitations that prevent HVAC from being practical, especially as the distance to offshore turbines increases. HVAC is limited by cable charging currents, which are a consequence of cable capacitance. Underwater AC cables have a much higher capacitance than overhead AC cables, so that line losses due to capacitance are much more significant, and the voltage magnitude at the receiving end of the transmission line can be significantly different from the magnitude at the generating end.

The sea to land cables are often laid on the ocean floor, but sometimes suspended in loops from turbine to turbine. In any case the cables are highly vulnerable to infrastructure attack, in the form of vandalism or foreign attack. For example, recently in the Middle East, undersea cable attacks were a prominent element of terrorist warfare, with cable cutting. (Gambrell, 2024) Additionally, for the looped or suspended cables, there is a risk of ship collision, but also an impediment to large marine mammals.

Impacts to Aquatic Biota

Offshore wind facilities generally have significant adverse impacts upon oceanic and lacustrine ecosystems. These effects include adverse effects on cetacean taxa; fisheries, including shellfish; avian species. The surveying, installation, operation and maintenance of offshore wind structures are known to produce substantially negative environmental impacts towards the marine environment. The timing of such disruption is important, since wind turbine activities during periods of migration and reproduction can have disruptive impacts on marine wildlife such as cetaceans, seabirds and fish. (Hernandez et al, 2021) The sea-to-land cables are often laid on the ocean floor, but sometimes suspended in loops from turbine to turbine. In any case, the cables are highly vulnerable to infrastructure attack, in the form of vandalism or foreign attack. Additionally for the looped or suspended cables, there is a risk of ship collision, but also an impediment to large marine mammals.

Cetacean Impacts

Many whale, dolphin and porpoise taxa inherently have extremely low populations, with many species being classified as Critically Endangered. Thus, even killing of one individual poses a threat to the species survival. Experiences of some of the early installations of wind turbines are correlated to significant numbers of whale deaths. Cetaceans are highly vulnerable to Offshore Wind Power development, since surveying, installation and operation of Offshore wind power all produce extremely high decibel impact to whale hearing. These impacts of up to 240 decibels cannot only impede whale communications and navigation, but also lead to permanent deafness (Nowacek et al, 2007) and ultimately death of cetaceans receiving these high sound levels, even on a short duration interval. Mooney et al have identified six separate equipment types used in ocean wind installations, each of which creates underwater sound intensities of over 212 decibels, a level much higher than that needed to produce permanent deafness in cetacean. (Mooney et al, 2020) Deafness can occur when high intensity sound level impacts to cetacean inner and middle ears occur even for very short time exposure. An estimated number of over one thousand whales have died along the coasts of the United Kingdom and Ireland since marine wind turbines began to be installed in these locales. In 2017, when Minke whales were washed dup, dead on the East coast of England, it was posited that noise from nearby offshore wind installations had affected the animals' delicate echolocation mechanisms. (Endfield, 2021) As of 2024 the recent three-year death toll for cetaceans has skyrocketed to 3000 cetaceans, with Endfield publishing that the connection to offshore wind is inescapable for a large number of these mortality events. (Endfield, 2024) Linnows and Turner have conducted a review of whale deaths off of the eastern USA coast since 2015 and concluded offshore wind to be a clear source of mortality. (Linnows & Turner, 2015)

It appears to be scientifically irresponsible that of the large number of dead whales found on the New Jersey shore in 2023, NOAA did not publicly report any results of whale or dolphin ear necropsy, (Oglesby, 2023) which is the obvious key to determining whether the cetacean suffered deafness from exposure to excessively high sound levels from offshore wind activities. Dr. Sean Hayes, a top NOAA scientist warned in 2022 that industrial wind projects "could have population-level effects on an already endangered and stressed species. Population-level effects include extinction." (Shellenberger, 2023)

Coincident in time and location of northeast USA offshore wind development: the Critically Endangered *North Atlantic right whale's population has dropped to 340 from over 400 over the last few years.* (Shellenberger, 2023) (Save KBI, 2023) Stern has mapped and analyzed whale deaths of beach stranded New England whales and found in these deaths one to one coincidence with locations and time of operations of offshore wind industrial activity over the 2022-2023 time frame. (Stern, 2024) Rob Rand is one of the world's leading underwater acoustics experts with over 30 years of experience; his investigations of wind industrial installations' decibel levels led to his assertion that the U.S. Government's assertions of wind power decibel emissions are factually incorrect, and that wind power sound emissions are at a level to cause permanent whale hearing loss (and necessarily death). (Shellenberger, 2023)

Many whale species utilize group feeding, notably Blue whales off the California coast, (where groups feed on aggregations of krill that can be hundreds of meters thick over an ocean canyon). For example, the krill tend to pile up on the Monterey Bay canyon edges during the upwelling season. Intrusion of offshore wind surveying, maintenance and operation can severely impact this group feeding, since the pod members are known to communicate extensively with their underwater acoustics.

One of the largest cetacean mass deaths in recorded history occurred in the Orkney Islands on July 11, 2024, coincident with the beginning stages of offshore wind surveying. Seventy seven Pilot whales washed up on a beach, with all being dead or in the last throes of dying; (Hobson, 2024) some governmental reports without any scientific basis suggested the cause might be climate change. The author of this present article, C. Michael Hogan, has been conducting ocean temperature studies in the Orkneys over portions of the last 18 months and found no data to support climate change.

In the Netherlands offshore wind farm areas, a 1693 percent increase in porpoise deaths has occurred since the beginning of offshore wind power surveying, installation and operation. (Endfield, 2024)

Independent scientific investigations illustrate that the anomalous number of recent cetacean deaths have no other logical explanation than derived from offshore wind power surveying, installation and operation. (Shepstone, 2024) One of the most definitive studies is by Gerasoulis, in which some of the salient conclusions were that the large number of recent cetacean deaths in the New England Atlantic could not be attributed to fishing gear entanglement or climate fluctuations. (Gerasoulis, 2024)

Mitigation proposed by the offshore wind industry to prevent cetacean deaths due to deafening sound levels has been shown to be inadequate, since tracking whales who move underwater is extremely difficult, and also follows faulty reasoning that cetaceans will navigate away from increasing sound levels. (Forneyl et al., 2017)

Marine and Lacustrine Bird Mortality

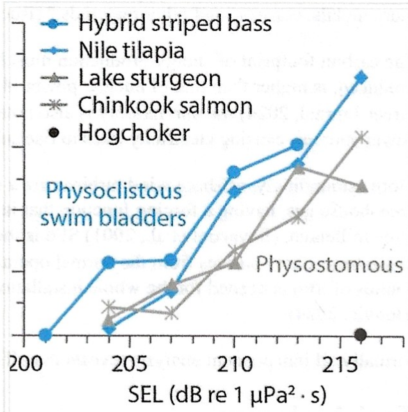
Bird mortality from wind turbines is a significant adverse ecological impact associated with offshore and terrestrial wind installations, threatening to expand in scope dramatically with the rush to develop new energy sources. (Hogan, 2021) This impact is measured as high due to the loss of threatened species and due to disproportionate mortality of top level predators, whose decline can unravel the integrity of entire regional ecosystems. (American Bird Conservancy, 2011) The rapid development of numerous large scale wind facilities may be a repeat of the ecological disasters of the 1970s, as the world rushed to produce hydropower from numerous rivers; decades later, we now realize the folly of that hydroelectric excess.

Over four million direct kill bird deaths per annum by 2030 are projected in some scenarios of wind turbine installation. The sheer volume of bird kill does not begin to depict the magnitude of ecological damage, since the most susceptible species tend to be those which are keystone species or species already threatened by other human pressures. (Brandon and Rodriguez, 2004). Additionally, bird mortality due to large wind industrial installations is exacerbated by inherent linkages between bird behavior and wind facility siting decisions. Proponents of large-scale wind installations (including some federal agencies), tend to favor sparsely vegetated saddles or other funnel-like landforms, which are highly correlated with high density bird migration routes or raptor soaring locations.

Important seabirds are at risk from offshore wind. In the USA, for example, wind industry executives recently petitioned the White House to provide them immunity from killing the U.S. National Bird, the Bald Eagle. Without special dispensation, killing a Bald Eagle would subject wind industry executives to a mandatory two-year prison term. Thus the White House over the period 2022-24 issued kill permits for Bald Eagles to wind industry executives. This number is larger than the number of chicks fledging in a given year. In Scotland, the Black-legged Kittiwake has specifically been studied on the coast of Eastern Scotland, and was found not only to have flight disturbance, but also mortality risk, including Important Bird Areas such as Fowlsheugh. This taxon is specifically protected by international treaty under the Migratory Bird Act of 1918.(Davies et al, 2024)

Fisheries

A considerable number of fisheries and mollusk populations have been adversely impacted by Offshore wind surveying, installation and operation. (Slabbekoorn et al, 2010) For example, in the United Kingdom a comprehensive fisheries impact study revealed that fishing activity suffered greatly after offshore wind installations commenced, with some landings for fish declining up to 96%. (Gray et al, 2016) In the USA, the agency responsible for offshore wind, BOEM, has had very little consultation with the fishery industry, resulting in decisions that are quite adverse to fishermen. (House of Representatives, 2024)



Fish injury rate as a function of decibel level from Offshore Wind Power. Halvorsen, et al. (2012)

There is clear empirical evidence that shellfish and cod fisheries along the Atlantic Coast of New England has been strongly adversely impacted by offshore wind surveys and initial operations; data has shown that one fishing vessel may return with more than 1200 scallops per day, in fisheries that were robust through 2021. (Stern, 2024) Some clupeids (a family of fishes that includes herrings, sardines, menhaden, and shad) have relatively sensitive hearing for fish and can detect not only the low frequencies typical of many fish but also mid-frequency sonar ranges (Mann et al., 1997)

Physical injury or death of fishes is strongly correlated with the decibel intensity to which fish are esposed, The figure to the right presents relative numbers of injuries to fish swim-bladders versus decibel level. (Hutchings, 2004) Note that the range of decibel levels studied in this experiment series are one thousandth of the levels that can be experienced in some offshore wind surveys and installations.

In terms of proposed fishery impacts off the California coast, the commercial fishing revenue is running at an average of $200,000,000 per year. Based upon fishery yield reduction after offshore wind power development in the United Kingdom, one can expect California fishermen to lose about ninety percent of that revenue, due to limitations of access and also diminution of fishery populations. In the Morro Bay fishery, there is a particularly rich fishery comprised of Albacore and Swordfish. (Hafer, 2024)

Large offshore wind installations such as proposed on California's Central Coast have been proven to reduce upwellings, and hence decrease fishery nutrients; as a result, fishery productivity will decline by at least ten percent merely from nutrient reduction. The offshore industrial wind installations proposed in the Morro Bay area will directly impact near shore fisheries by cable dragging, including significant adverse impacts to squid, near shore rockfish, Dungeness crab, salmon, rockfish and spot prawns. (Hafer, 2024)

The installation and maintenance of near shore cables will severely impact juvenile fishes, who begin their lives near shore, before migrating to deeper waters. These near shore wind power activities will also impact non-migratory fish, adversely affecting their feeding, breeding and mating activities. (Hafer, 2024)

There has been very little research on offshore wind impacts to marine invertebrates from surveying, installing or operation. Simulated pile driving is known to impair hermit crab (Pagurus acadianus) abilities to acquire necessary resources (e.g., find vacant shells}/ When exposed to sediment vibrations, important aquaculture invertebrates such as the blue mussel (Mytilus edulis) exhibit behavioral changes, for example, changes in valve gape and oxygen demand, that are costly as they reduce respiration rates and impair the ability to remove wastes (Roberts et al., 2015).

Phytoplankton

Phytoplankton, the base of the marine food chain, are severely impacted by offshore wind power; in fact there is a reduction of up to sixty five percent of phytoplankton populations, where offshore wind has been implemented. (Molyneaux, 2005) This diminution is also correlated with decline in species that are upward in the marine food chain, including fish taxa.

Deforestation

An unanticipated adverse impact of wind energy in general has arisen in accelerated Amazon rainforest deforestation. Balsa wood is consumed in large quantities in manufacture of the large turbine blades needed for offshore wind. This accelerating trend has led to massive amounts of rainforest reduction, with impacts being severe on the livelihood of indigenous peoples in the Amazon region. (Dalmases, 2021) Besides the deforestation, the practical consequences of this boom in balsa harvesting is actually associated with considerable increases in illegal harvest activity, and associated with spikes in drug and sex trafficking in the region. More broadly, the large addtional deforestation of the Amazon is having profound adverse impacts upon the ecosystem as a whole including avafauna and many threatened species, according to Dalmases and other researchers. The ultimate irony of this deforestation impact is the well known effect that loss of forest directly adds to increase in greenhouse gases.

Battery Backup Requirements

Due to the intermittency of offshore wind (turbines cannot produce power in low winds or in moderately high wind), battery backups are needed to insure reliablity of the electric grid. In addition, duplicate backup power plants must be constructed, since foreseeable battery plants are extremely expensive and typically only hold enough power to supply grids with several minutes of power supply. In a recent analysis of battery plant utility, one source reported: "No one in the Biden administration, Congress, the New York or Virginia legislatures, or anywhere else has a clue how many offshore wind turbines and batteries would be required to power and back up the entire nation under all-electricity, all-wind-and-solar schemes. It would likely approach a quadrillion dollars. Electricity costs would reach the stratosphere." (Rucker, 2024)

Carbon Footprint

The U.S. Bureau of Energy Management has stated that offshore wind will provide no net benefit to carbon emissions reduction (and hence climate impact). (Knight, 2024) In fact, due to the massive shipping activity in servicing and maintenance of offshore wind, the net impacts over life cycle are a net detriment to carbon emissions. Furthermore, the intermittency of offshore wind adds additional carbon emissions to the overall power generation contribution to the electric grid.

The UK's Climate Change Committee failing was highlighted by Sir Christopher Llewellyn Smith, the leader of a Royal Society study into the Net Zero energy system. It can now be revealed that the same error has also been made by the National Infrastructure Commission and the UK National Grid ESO. (Telegraph, 2024) Net Zero Watch director Andrew Montford states: "Sir Christopher Llewellyn Smith has highlighted the deficiency in the models of the Climate Change Committee and the National Infrastructure Commission, and National Grid ESO have confirmed to me in writing that their models contain the same mistake." Montford also notes that Sir Christopher has also publicly admitted that the Royal Society's own models contain a similar deficiency. Montford further elaborated: "We have four well-funded national institutions, all of which have failed to model the 2050 energy system correctly, and all of them in ways that understate the cost of Net Zero. It's a remarkable coincidence." Montford asserted that Net Zero Watch will publish a cost estimate that corrects these errors and shows the alarming effect on UK consumer bills. (Telegraph, 2024)

Manufacturing processes also contribute to carbon footprint and add enormous greenhouse gas volumes to the life cycle of wind power generation. One analysis concluded: "Offshore wind turbines require fourteen times as much in raw materials per megawatt as a modern combined-cycle natural gas power plant, yet only the latter generates electricity reliably and affordably and doesn't require backup. Add in batteries and extra transmission lines for offshore wind power, and we are talking about 20 to 30 times more metals, concrete and other materials." (Rucker, 2024) For example in the NE USA Martha Vineyard offshore wind facility has demonstrated this effect.

The carbon footprint of energy production must be calculated on a full life cycle. The life-cycle carbon footprint of wind power, around 15 grams CO_2 per kWh of electricity produced, is higher than that of nuclear power (4 g) and hydroelectricity (6 g)." (European Scientist, 2024) In addition to the higher carbon footprint of offshore wind, (Wall Street Journal, 2024) the unreliability is also notable; in fact, this inherent unreliability causes not only grid blackout risks, but also the need to construct duplicative reliable power sources, causing electricity rates to rise substantially, as one has seen in Germany and the Uk recently.

More astoundingly, offshore wind turbines are a major source of Sulfur hexafluoride (SF_6) atmospheric emissions. (Bergensia, 2020) In fact, SF_6 is the most powerful greenhouse gas, having a forcing function that is 23,500 times that of carbon dioxide; SF_6 also has an atmospheric residence time of over 300 times as long as CO_2, or over three millennia. (Sovacool et al., 2001) SF_6 is the necessary component of wind turbine switchgear; furthermore, ninety three percent of the wind turbine switchgear leakage to the atmosphere derives from the normal operation of wind turbines. (Bergensia, 2020) For example, in the Marthas Vineyard plant alone, Bonvie discovered that 11,949 pounds of SF_6 is needed for the whole installation; that is enough greenhouse gas equivalent to the CO_2 release of 60,000 automobiles operating over a one-year period. (Bonvie, 2024)

Virtually all independent analysis reveals the offshore wind will not only not reduce carbon emissions, but will increase CO_2 emissions. (Gelderloos, 2024)

Toxicity Issues

Offshore Wind intrinsically involves manufacture of many elements of the turbines that have large amounts of toxic materials. For example, "toxic Cobalt comes mostly from Congo. Its production involves extensive child and near-slave labor and, like most other metals and minerals for "renewable" technologies, it is controlled by Communist China. Toxic pollutants from unregulated overseas operations severely impact air and water quality. Their greenhouse gas emissions will likely exceed any reductions in carbon from offshore wind. (Rucker, 2024) For the proposed U.S. offshore wind, Copper "would require mining at a scale unprecedented in human history. Copper for 30 gigawatts of offshore wind would require extracting some 65 million tons of overlying rock and ore, then running the ore through crushers, refiners and other processes." (Rucker, 2024) Furthermore, the high corrosivity of the marine environment causes extensive rates of tower and blade corrosion, which bleeds continuous plastic toxins into the ocean, with no ability to capture or control this [water pollution].

In the turbine operational phase, wind turbine blades suffer erosion due to rain, hail and other environmental exposure. A turbine of 120 metre diameter, sheds around 62 kilograms of microplastics per year in the form of epoxy resin, containing Bisphenol A (BPA). BPA is one of the most potent man made neurotoxins, and is considered a forever contaminant in oceans. The World Health Organisation asserts that drinking water should contain a maximum of 0.1 micrograms of BPA per litre to be safe. One kg of BPA is sufficient to render 10 billion litres of water unsafe to drink. (Mallett, 2024) Thus, each of these turbines annually sheds enough BPA to contaminate billions of litres of water, (Khan et al., 2021) potentially poisoning marine wildlife as well as humans who consume ocean fish. One can multiply this toxicity by tens of thousands of installed turbines and planned turbines to grasp the magnitude of this microplastic toxicity. BPA is not only a toxin, but is also a carcinogen. (Vom Saal & Hughes, 2005) (Vom Saal and Vandenberg, 2021)

Infrasound Impacts on Human Health

Beyond the deafening impacts known from audible sound, there are significant adverse health impacts to humans and other animals from infrasound (frequencies below 20 Hertz) from wind turbines. (O'Neal et al, 2011) (Pedersen, 2011) (Beanz & Edwards, 2024) These impacts are well documented to have major adverse effects at a cellular level in disruption interfering with protein and lipid synthesis. Manifestations of these exposures cause tinnitus, headaches, nausea and vascular disorders. In his book *How Wind Turbines Make Us Sick*, biologist Wolfgang Müller noted that the extremely sensitive eardrum and middle ear are constantly affected by low-frequency infrasound. (Muller, 2019) It is known that the range of infrasound damage to human health can be up to twelve miles from a given wind turbine.(Beanz & Edwards, 2024)

National Security

Major deterioration of national security is occurring where offshore wind is being installed, notably in the United Kingdom, Taiwan, Germany, Scandinavian countries and the eastern USA. (House of Representatives, 2024) The Royal Air Force of the UK was one of the first entities to report that North Sea wind fields severely undermine routine radar protection. As Taiwan moves forward with offshore wind, its ability to defend itself from an attack from The Peoples Republic of China will be severely diminished. (House of Representatives, 2024) In 2024, the Swedish government completed a national security study that found offshore wind facilities compromise detection of Russian missiles; at that point the Swedish government decided to permit no new offshore wind facilities, due to risk to national security. (Bloomberg, 2024)

As of 2009, the U.S. Department of Defense stated that 38% of the USA military bases in North America had already had their radars compromised by ongoing onshore wind installations. (House of Representatives, 2024) Since that date, wind power installations have increased at least six-fold, further rendering many more U.S. military bases' radar to be undermined.

In addition to radar compromise for national defenses, there is a considerable risk of catastrophic power loss from an attack on cabling, particularly for floating installations, as proposed in California. There is a fundamental issue with even diagnosing the exact location of a breakage of underwater power cables. For example, in 2024, a major 38 megawatt undersea electrical cable serving Nantucket Island has been broken for over a week and there is no theory of where the breakage is, or how to proceed with repairing this cable. The issue has not been resolved or even a government comment has been issued at the time of this publication; however, the corporate owner has said it may take at least one more month to find and fix the breakage. (Graziadei, 2024)

There has been continuing exposure of the fact that several of the largest wind industry firms have significant Russian ownership interests. Thus, the USA and Europe be wise not to invest massive sums to create energy grid reliance on offshore wind generation, given that entities that are clear enemies of these Western nations could eventually control many offshore wind assets. (McLaughlin, 2024) There is also the potential for using the great height of wind turbines to spy on U.S. military and infrastructure facilities, (Dilworth, 2024) as noted in recent U.S. Senate calls to investigate 700-foot-high Chinese owned wind installations near U.S. military assets. (Dilworth, 2024)

Further, foreign companies having mapping knowledge of offshore wind cables posing a major risk in compromising electric grids, by simply severing major underwater cabl es; this phenomenon has happened repeatedly as in a 2024 cable severing in the Baltic Sea. (Clayton, 2024)

Floating Offshore Wind Installations

Floating wind turbines are a newer version of offshore wind facilities. These turbines have relatively little testing, and yet have several intrinsic design features that are clearly problematic. For example, the floating assemblies are prone to tipping, leading to even higher maintenance costs; additionally, they require extensive stretches of dangling cables, impeding cetacean movement as well as many types of ships.

It is already known that offshore wind power is much more expensive to build and operate than on shore wind or other power sources such as hydroelectric, nuclear, geothermal, or combined cycle natural gas (all of which are lower in greenhouse gas emissions than offshore wind power). The world's first commercial floating offshore wind installation, Hywind Scotland was commissioned in 2017. (The Engineer, 2017) Its capital cost was £264 million (£8.8m/MW). (Hywind, 2019) These cost values are approximately three times the capital cost of fixed offshore wind facilities are ten times the capital cost of natural gas power stations. The floating wind power operating costs, at approximately £150,000/MW were also higher than for fixed offshore wind installations. A second United Kingdom project, the Kincardine Floating Offshore Wind installation, has been reported as costing £500 million to build (£10m/MW). (McPhee, 2021)

Offshore Wind Power Maintenance

Maintenance and port operations contribute a staggering total of 69% of overall offshore wind costs, dwarfing the initial installation costs. Being much less accessible than their onshore counterparts, offshore turbines require much more extensive service demands. Enormous costs and energy expenditures are required, using service vessels and helicopters for routine access, and a jackup rig for heavy service such as gearbox replacement. These service demands have become much more apparent in the last few years, with high incidence of blade breakage, high replacement costs, tower collapse, corrosion damage and other mechanical failures. As a consequence, offshore wind power is one of the most unreliable sources of energy, certainly relative to onshore wind. (Madsen & Krogsgaard, 2011)

Some wind facilities situated far from onshore bases are forced to have service teams available 24/7 who live on site in offshore accommodation units. (Oersted, 2011) To reduce blade corrosion, a protective tape of elastomeric materials is applied, though the droplet erosion protection coatings provide better protection from the elements. Ironically, maintenance and repair issues consume massive amounts of fossil fuels and petroleum products. The result is that the installation and operation of offshore wind power, emits more greenhouse gases over its life cycle than hydroelectric, solar, geothermal, nuclear power, or combined cycle natural gas power sources. (Röckmann C., Lagerveld S., Stavenuiter J., 2017)

The maintenance and installation costs of offshore wind power were dramatically underestimated and continue to rise beyond any previous calculations. Correspondingly electricity rates where offshore wind is utilized is skyrocketing. The maintenance costs of large vessel intensive use to service the offshore turbines are particularly large. (Niezrecki, 2024) These realizations have caused numerous wind companies to cancel or withdraw altogether from previously agreed upon lease sales. Maintenance costs of offshore wind turbines are staggering, both for the labor, carbon produced in ship movements and outright breakage of hardware. For example the hardware breakage costs of annual parts replacement often exceeds six percent of original installation costs, including tower breakage, gear breakage and other hardware failures. (Novik and Millard, 2024) This rate of breakage is over three times original projections, and is one of the reasons wind industry projects are being cancelled at a very high rate. In the USA alone, five major windfarm projects have been cancelled in the last twelve months, as of May, 2024. Furthermore, the breakage rate of turbine parts has increased by a factor of 2.5 over the last six years, leading the wind industry to increase electricity costs by a massive amount, with no convergence in sight. This is particularly troubling, since many parts such as blades often have an ordering time of over 18 monthsB, leading to extensive outage times.

Maintenance costs of the turbine gearbox alone has been grossly underestimated, and is adding to the escalating actual maintenance costs of offshore turbines. In addtion to much more frequent changes in fossil fuel based lubricants, the servicing costs of gearbox maintenance is contributing massively to offshore wind costs and petrol consumption. (Barr, 2024) For example Barr states: "The engineer will have to gain access up the tower via an internal ladder (or elevator in some cases), which is demanding and specialized work." Barr further asserts: "“To date, we have seen very poor maintenance procedures in the field. These will have to change dramatically, especially for the larger sizes of wind turbines and gearboxes where exposure to higher oxidative and wear stresses will occur quickly.” The detailed support for the latter quote was render by Jo Ameye, a global executive of Fluitec International.

Inadequacy of Environmental Documentation

To conform with laws of the USA and California, thorough analyses must be performed to comply with the federal Environmental Impact standards (NEPA) and the California Environmental Quality Act (CEQA) appurtenant to any major project in California. The proposed offshore wind installations off the California coast are massive experiments which would involve construction of huge acreages of ocean extent, dwarfing all other prior floating wind turbine assemblies. Cumulative impacts of massive increases in wind installations in the USA have never been addressed, leading to an understatement of the magnitude of total impacts of cetaceans, bird kills and fisheries impacts. (Wojick, 2024) The US Bureau of Ocean Energy document (Reeb & Schroeder, 2022) addressing environmental issues falls far short of an impact analysis that would be needed under both NEPA and CEQA. Some of the numerous deficiencies are:

- Lack of analysis of empirical data on cetacean deaths from northeastern USA Atlantic Ocean wind surveying and installations from the 2022-2023 period. In particular no information on inner and middle ear biopsies from the unprecedented number of whale deaths in 2023. Such necropsy data is essential to understand the permanent deafness rates (with ensuing certain mortality).
- Complete lack of relevant detail on whale vocabularies and necessity of cetacean acoustic communication with pod members, as well as cetacean sonar for essential navigation.
- Incomplete cumulative impact analysis of adverse fishery consequences combined with cetacean and total food chain impacts.
- Over-reliance on "likelihood" criteria for such things as cetacean occurrence, rather than observational or other hard data.
- Paucity of marine water quality baseline data and lack of quantitative water chemistry outcome data.
- Lack of independent scientific analysis by objective scientists, since the sole report authors were federal employees; this is a blatant conflict of interest. On a project of this importance and scale, it is imperative that the report authors must be independent scientists, who are not in the chain of command of the proposing entity. Furthermore, it is essential that authors should embrace a much wider skill set to include scientists and experts in underwater acoustics, marine water chemistry, seabed geology, mechanical engineering, electrical engineering, cetacean medical biology (especially cetacean inner ear biopsy experience), cetacean vocabulary and navigation expertise, cetacean intra-pod communication specifics. One should demand an author team of at least a dozen specialty scientists and at least four marine practical experts in vessel navigation, practical fishing experience and ocean diving/mapping.

U.S. Federal Agency Involvement

The U.S. House of Representatives held a comprehensive hearing on the subject of offshore wind power on January 20th, 2024. Numerous experts and certain federal agency comments were included to examine economic, environmental, public safety and national security impacts. NOAA and the U.S. Bureau of Ocean Energy Management strangely declined to attend, (House of Representatives, 2024) despite vigourous efforts by House Members stressing the importance of their appearance. Economic testimony included that offshore wind installations are expected to cause massive increases in energy costs compared to conventional power sources (nuclear, hydroelectric, geothermal, combined cycle natural gas, solar, onshore wind) and subsequent skyrocketing consumer electric rates, similar to outcomes of offshore wind in the UK and Germany.

Diminishing of Search and Rescue

The U.S. Coast Guard has issued a statement that offshore wind installations will eliminate routine search and rescue operations normally available during the very times (of inclement weather) that they are most needed. (Knight, 2024) (House of Representatives, 2024) This outcome is not only due to restriction of vessel movement by wind facilities, but chiefly due to (already experienced) blockage of essential coast guard radar, from helicopters, vessels and fixed wing aircraft. (House of Representatives, 2024)

Injury Risks to Workers

Installation and maintenance workers for offshore wind face some of the highest risks of injury and death of any occupation. For example, injury rates for offshore wind power workers are four times as high as for marine oil rig workers, which industry is already one of the highest risk for workers. (Rowell et al, 2024) This outcome also increases greatly the maintenance costs and liabilities for offshore wind companies.

Public Opposition

There is considerable public opposition to offshore wind power from a variety of constituencies, including those concerned about aquatic biota and species extinctions; those concerned about industrialization of scenic coastal towns and beaches; those concerned about rising electrical rates and taxpayer subsidies for an intrinsically uneconomic form of power. Increasing public opposition to offshore wind installations are being seen in 2023 to present in coastal California, with chief concerns being expected deaths of cetaceans, decline in fishery productivity, increased seabird kills, and actual increase in greenhouse gases (life cycle) and increases in electricity costs.

There has been considerable concern raised by indigenous peoples, who have roots to both the land and the sea all over the world. Correctly, indigenous peoples have a stake in protection of natural areas whose character is threatened by both on and offshore wind power. This arises both from damage to the native flora and fauna as well as aesthetic factors. (Rush and McDermott, 2024)

Campaign poster opposing Offshore Wind Power in California. Courtesy: REACT Alliance

Economic Factors

The Cato Institute and virtually all other independent scientific research has shown that offshore wind is inherently uneconomical and unsustainable. (Lesser, Cato Institute, 2024) This conclusion arises from the extremely expensive manufacturing and installation costs, but also the massive maintenance costs. These calculations also project that enormous subsidies are only expected to increase as operations progress. In fact, one wind farm alone (Block Island Installation, Rhode Island) is projected to require over 160 billion dollars of subsidy from the US taxpayers. (Lesser, Cato Institute, 2024)

Wind energy subsidies were misleadingly advertised to reduce carbon emissions and spur innovation, have instead "distorted markets and hindered the development of cost-competitive clean technologies". Taxpayers and ratepayers bear the economic burden of offshore wind energy subsidies, which raise costs and reduce actual growth. (Oil Price, 2024)

Major adverse economic impacts have already begun to occur for taxpayers, electricity ratepayers and entire national economies. Many of these negative economic impacts stem from very expensive installation, difficulty of access, and harsher conditions for the marine or lacustrine installations. Positioning wind turbines offshore exposes the units to high humidity, saline water and concomitant spray which adversely affect service life, cause corrosion and oxidation, increase maintenance and repair costs and make each phase of installation and operation more difficult, time-consuming, more dangerous and far more costly than terrestrial based wind industrial installations. The humidity and temperature is typically controlled by costly air conditioning of the sealed nacelle. (Prinds, 2011)

As further elaborated in the following under "Maintenance", the service costs as well as surveying and installation costs make offshore wind power one of the costliest forms of energy production, as well as the most unreliable. The early European adopters of offshore wind (especially UK and Germany) have learned this in a harsh way, leading to enormous taxpayer subsidies and much higher consumer prices for electricity. For example, in the United Kingdom over 40% of the population is now in Energy Poverty, largely due to the overinvestment in offshore wind (combined with large solar subsidies).

Environmental challenges of ocean-based wind facilities make each phase of installation and operation more difficult, time-consuming, more dangerous and far significantly more costly than terrestrial land-based wind power. The humidity and temperature is typically controlled by costly air conditioning of the sealed nacelle. (Prinds, 2011) The life cycle costs of offshore wind power make it one of the most expensive forms of energy production.

The Cato Institute has calculated that offshore wind is effectively not cost competitive with other types of power generation; in particular, CATO calculated that Maryland middle class taxpayers would need to subsidize the state's offshore wind projects by $1660 per household annually until 2039; that cost would primarily be paid by consumer increased utility bills. (House of Representatives, 2024). Those costs to residents would be further amplified by steep maintenance costs expected over the life cycle of the turbines. (Stern, 2024)

It has been extensively documented that wind industry economic analysis as well as many governmental analyses have been strongly biased so as to understate true life cycle costs of maintenance as well as installation, surveying and decommissioning. The true costs of offshore wind in their life cycle are often understated to the public by a factor of forty to fifty percent. (Rolling and Orr, 2024) Continuing into 2024, the escalating maintenance costs of offshore wind are making projected power costs for offshore generation to rise dramatically. In the northeast USA some costs have jumped 100 percent in one year's time. (Mohl, 2024) In the areas first being introduced to offshore wind power in the USA (New England) the electric rates are often increasing 2.5 times more rapidly than the rest of the USA, exclusively due to massive unexpected costs of grid infrastructure and high maintenance costs associated with offshore wind power. (Brooks, 2024)

Decommissioning of offshore wind operations will occur after 15 to 18 years of operation, in the most optimistic scenario. The costs of this decommissioning is generally not guaranteed by the original installing industry; thus the decommissioning costs will generally fall on the consumers in their future power bills. Decommissioning of even one large offshore wind industrial operation has been estimated to be in the range of 150 billion dollars.

A recent example of the lack of cost effectiveness of offshore wind power was reported by the Wall Street Journal: "New York state signed a contract in June to buy electricity generated by two large wind farms, Empire Wind 1 and Sunrise Wind, off the coast of Long Island. The projects are expected to begin in 2026 and 2027, with power delivered to Brooklyn (Empire) and Long Island (Sunrise). The state will pay $155 and $146 per megawatt-hour, respectively. These prices are steep, at least four times the average grid cost paid over the past year. New Yorkers should be asking why." This does not include over a billion dollars per wind field subsidized by the U.S. taxpayers under the Biden Harris wind industry subsidies. Thus, the public is paying in two ways: much higher rates and via taxpayer dollars.

There is a very high breakage rate of wind turbines, both onshore and offshore. There are currently about 53,000 turbines in the U.S. Wind-turbine rotor blades fail at a rate of approximately 3,800 a year, (Yoders, 2024) which is the highest breakage rate of any form of energy source; offshore wind has the highest rate of failure due to the severe corrosive marine environment and very high winds, as well as hurricane incidence. Electrical system breakage is the most common failure mode, which often leads to massive release of sulfur hexafluoride, one of the most potent greenhouse gases known (with atmosphere residence time of thousands of years). This very high rate of failure of turbines is a fundamental reason why offshore wind is the most expensive form of energy on a life cycle basis.

In addition to massive maintenance costs, there are severe economic losses incurred when winds are too high and entire turbine installations are switched off. In the UK alone, this leads to the government paying the wind industry a subsidy each year. "So far this year the payments across Great Britain stand at a staggering £216,124,168, with Scottish sites taking in the lion's share at £205,832,350." This results in the UK government reducing old age pensioners benefits by the like amount. (Murray, 2024)

Corruption of Government and Environmental Entities

There are numerous documented examples where the Offshore wind industry has exerted questionable unethical influence over governmental and charitable environmental organisations. This effect is evidenced in two different mechanisms: (a) Overt transfer of money (Knight, 2024) and industry job promises from the wind industry to key government employees, government employees or entities; and (b) Government employees appearing on Boards of Directors of wind companies and environmental organizations.

During the Obama administration, there began a federal push for greatly expanded onshore wind installations. During that time the authority was taken away from local military base commanders to veto new nearby wind installations, which most military commanders had concluded could significantly interfere with military radar. That decision was repositioned to a central clearinghouse within the U.S. Department of Defense (DOD); when the director of that department left the DOD, he was given an executive level position with one of the major wind industry private firms (House of Representatives, 2024); that chain of events is a revolving door issue, that compromises the integrity of government.

There is massive funding to scientists from the wind industry making it difficult to derive objective information on the adverse impacts of offshore wind. Norberg et al state: "It is difficult to find good and impartial sources for the problem of emissions from wind turbine blades. Reports that have been published and research that has been done on the topic are most often carried out by authors who have their most important source of income from wind power" (Norberg et al, 2021)

Even certain USA Federal Agencies have been corrupted to participate in the legalization or cover up of killing of protected animals in order to protect wind industry executives from prosecution. It has been demonstrated above in the section on cetacean killing that the US NOAA has issued kill permits (also called IHAs) for numerous whales and dolphins since the offshore wind industry has been operating in the New England area. It has further been discovered that the U.S. Department of Fish and Game has issued kill permits for 15,000 Bald Eagles, the USA National Bird, in order to protect wind industry executives from criminal prosecution for Bald Eagle deaths. (Baethke, 2024) In the USA, kill permits began to be issued a decade ago and have now increased by a factor of fifteen from the inception year; the new federal kill permits endure for thirty years to give maximum protection to wind industry executives. (Daly, 2013) Note that the present number of annual kill permits are roughly equal to the number of chicks fledged each year in the USA. Without the kill permit protection, a wind industry executive would be considered a felon subject to two years imprisonment per Bald Eagle death.

Numerous non-profits that are nominally conservation oriented have received cash stipends from the wind industry to buy their silence or support. For example: "$4.2 million between wind developers like Vineyard Wind, Bay State Wind, and Orsted to environmental groups in Massachusetts such as the Environmental League of Massachusetts, New England Aquarium, and the Woods Hole Oceanographic Institute." (Boston News, 2022)

Geographical Considerations

Some of the first major regions to deploy significant volumes of Offshore Wind include the United Kingdom, other European countries, Australia, (Mayers and Martin, 2021) and the Atlantic Coastal area of the northeastern USA. (Oglesby, 2023) Under study are significant new installations along the California coast.

An estimated number of one thousand whales have died along the coasts of the United Kingdom and Ireland since marine wind facilities began to be installed in these locales. In 2017, when some Minke whales were washed up as dead on the East coast of England, it was posited that noise from nearby offshore wind operations had affected the animals' delicate echolocation mechanisms. (Endfield, 2021)

In South Australia one large wind project has been proposed in a Southern right whale migration and breeding corridor; this is expected to have a significant adverse impact to the species, especially since the calving areas for this species are very limited. (Mayers and Martin, 2021) Furthermore, the migration corridor of this cetacean is narrowly limited to near shore coastal waters, precisely where the proposed turbines are proposed to be located. (Mayers and Martin, 2021)

See Also

- Bald Eagle
- Cetaceans
- Electric Grid
- Energy Poverty
- USA Greenhouse Gas Policies Target the Wrong Gas from 2021-2024
- Wind power

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