

March 20th OSW Event Q&A

The following questions were asked of the panelists at the March 20th Offshore wind event, the answers were compiled in a joint effort by the event panelists and members of the RI Committee of the New England for Offshore Wind Coalition. The Questions have been grouped into topics and answered accordingly. Answers with quotations are direct quotes from the event panelists. You can watch the Recording of the March 20th event [here](#). If you have a question that you don't see answered below, please feel free to contact us by emailing info@ne4osw.org. Please note that we forwarded industry related questions to the developers which they have answered [here](#).

Preamble

Offshore wind is Rhode Island's best chance to address the climate crisis, meet our future energy needs, and grow our economy simultaneously. While offshore wind has many benefits, we acknowledge and appreciate the concern that, as with any energy resource, it has the potential to cause some negative impacts. The New England for Offshore Wind coalition strongly advocates for any impacts to be addressed and mitigated through careful planning and responsible development efforts. We believe the benefits of offshore wind energy far outweigh the potential negative impacts, and with proper planning and implementation, offshore wind can play a crucial role in reducing greenhouse gas emissions, benefit our economy, and protect wildlife. Offshore wind can be developed in a responsible way that respects our environment and our wildlife. We don't need to choose between clean energy development and wildlife protection; we can do both, and in doing both we're protecting wildlife from the greatest threat of all: climate change. To fully realize the benefits of this innovative technology, it's crucial that we educate ourselves with science-based evidence, dispel common misconceptions, and work together to build support for responsibly developed offshore wind.

Panelists Presentations

- [Captain David Monti – RI Saltwater Anglers Association, Charter Captain, Fishing Advocate & Writer](#)
- [Amber Hewett – National Wildlife Federation, Offshore Wind Program Director](#)
- [Dr. Shilo Felton – Renewable Energy Wildlife Institute, Senior Scientist](#)
- [Dr. Bob Kenney, University of Rhode Island, Oceanographer](#)
- [Dr. Timmons Roberts, Brown University, Climate & Development Lab](#)
- Mike Roles, Climate Jobs Rhode Island, Policy Director – No Presentation

Environmental Impacts

1. The Block Island Wind Farm (BIWF) is a small 5 turbine project, won't 100 turbines have a larger impact?

“Europe has wind farms with hundreds of turbines, and fish abundance has been shown to be greater in those areas than outside. The Nature Conservancy came out with a study where they were enhancing structure at the base of the turbines to act as an artificial reef and attract more fish. The study concluded that the enhanced structure would create positive impacts rather than negative. So far fish abundance studies in Europe and a fish abundance study done on Block Island show greater fish abundance in wind farms than in control areas outside of wind farms. So, I say more structure, more habitat, etc. creates even greater positive cumulative impacts as more are built.” - *Captain Dave Monti*

“The range of potential effects includes a lot of different things, and some of them no matter how many turbines. Noise from the Block Island turbines can't be heard above background noise within 50 meters. The turbines in the bigger farms are going to be a mile apart, so the noise isn't going to add up. It makes no difference how many there are it's still not going to be heard beyond short distances from each individual turbine. Pile-driving is a concern and that's what they need to mitigate.” - *Bob Kenney*

“We understand that there will be impact and that scaling up will have greater impact, but I really want to underscore that we are doing this because we have to, because saying no to offshore wind is saying yes to something else, and it will almost always be something with greater impact. In the New England region, we have these choices between building offshore wind and building more gas pipelines, between relying on offshore wind during a winter cold snap or firing up oil reserves. And so those are the pressures that we have to find a way to be able to make this resource as responsible as possible because at the outset it is a better path forward than so many of our terrible choices and the choices that got us into the place that we are today. As I went through in [my presentation](#), we take the impacts seriously and we will do everything we can to minimize those impacts and influence those projects to be responsible. We have this difficult decision right now as to how we will keep our lights on, how we will continue to power the lives that we all live, and this is a choice that we have to make.” - *Amber Hewett NWF*

“From a bird and bat perspective, fossil fuels are incredibly detrimental. Oil rigs in the Gulf of Mexico are lethal to birds. A lot of land birds rely on the Gulf of Mexico to migrate, and they get stuck at the oil rigs. The lighting brings them in, or the structure makes them think it is a good place to stop over and then they expend their energy, and they don't make it all the way to the coast. Most of the construction and operation plans for turbines are intending to use ADLS (aircraft detection lighting systems), the lights on the turbines that are using that system only go on as an aircraft is approaching” - *Dr. Shilo Felton*

- 2. The Bureau of Ocean Energy Management conducted a study to see if the wind projects off of RI and MA will affect ocean dynamics. They discovered that the planned installations would slow ocean currents, alter temperature stratification, and decrease wave height. The company that conducted the study recommended further study. We know that decreasing critical currents will raise sea levels. Has BOEM followed the recommendation to study this further? If not, why not?**

This question cannot be answered fully without knowing more about exactly which BOEM report you are referring to. However, more generally speaking, offshore wind turbines can potentially have some impact on local circulation, temperature stratification, and wave height, but the magnitude and extent of these effects are likely to be small and limited to the immediate vicinity of the wind farm and will depend on various factors. Regarding local circulation, the spinning blades of offshore wind turbines can create a drag force on the surrounding air, which can generate a small pressure difference between the atmosphere and the ocean surface. This pressure difference can cause a localized change in small currents near the turbines, but the overall impact will be minimal and limited to the immediate vicinity of the wind farm. There is absolutely no chance that this localized impact will have any effect on basin-scale ocean currents beyond the continental shelf (e.g., the Gulf Stream or the “ocean conveyor belt”) and therefore cannot affect sea levels. In fact, offshore wind energy will help mitigate the impacts of climate change, including sea level rise.

- 3. Are the same environmental standards that apply for offshore wind applied for fossil fuel extraction?**

The environmental and wildlife protections for the planned offshore wind facilities far exceed those imposed on offshore oil drilling in the USA. Offshore wind projects in the United States are subject to a rigorous environmental permitting process that includes compliance with various environmental standards and regulations. These standards aim to protect marine wildlife, habitats, and other ecological resources from the potential impacts of offshore wind development.

Here are some of the key environmental standards and regulations that offshore wind projects must go through:

- a. National Environmental Policy Act (NEPA): Under NEPA, prior to permitting and construction, an offshore wind project must undergo an Environmental Impact Assessment (EIA) which is a comprehensive study of the potential environmental impacts of the project. The EIAs evaluate the need for the proposed project, identify and assess any reasonable alternatives, and estimate the environmental, social, economic, and cultural impacts of the proposed project and any alternatives. Based on the results of an EIA, the Bureau of Ocean Energy Management (BOEM) prepares a more rigorous assessment, called an Environmental Impact Statement (EIS), which is open to public review and

comment, and responds to substantive public comments. BOEM acts as the lead agency for the EIS and coordinates with other federal and local agencies to ensure all relevant federal and state requirements are considered before it takes any action.

- b. Endangered Species Act (ESA): The ESA requires consultation with the US Fish and Wildlife Service and/or the National Marine Fisheries Service to ensure that offshore wind projects do not jeopardize the existence of threatened or endangered species, such as the North Atlantic right whale, sea turtles, and various bird species.
- c. Marine Mammal Protection Act (MMPA): Offshore wind projects must comply with the MMPA, which prohibits the harassment, hunting, capturing, or killing of marine mammals, including whales and dolphins.
- d. Clean Water Act (CWA): The CWA requires that offshore wind projects minimize the discharge of pollutants into navigable waters, including dredged or fill material from construction activities.
- e. Coastal Zone Management Act (CZMA): The CZMA requires offshore wind developers to obtain state permits and certifications to ensure that projects are consistent with state coastal management plans and policies.
- f. National Historic Preservation Act (NHPA): The NHPA requires offshore wind developers to identify and evaluate historic properties that may be affected by a project and to consult with the State Historic Preservation Office and/or Native American tribes to avoid or minimize adverse effects on these resources.

4. NREL has wake models that show 10% wind deficits blanketing Martha's Vineyard and Nantucket. Discuss the impact on absolute power and mitigation?

The wake effect is a phenomenon that occurs when wind turbines extract energy from the wind, creating a turbulence zone downstream of the turbines. This turbulence can reduce wind speeds and affect the performance of downstream turbines. The National Renewable Energy Laboratory (NREL) has developed wake models that show that wind farms located near Martha's Vineyard and Nantucket could experience up to a 10% wind deficit due to the wake effect. However, it is important to note that the impact of this reduction in wind speed would be local to the wind farms and would not extend to the islands. This localized wind deficit can be mitigated through a combination of the below measures.

Modern wind turbine designs and advanced control systems have made it possible to mitigate the effects of wake turbulence and maximize the overall power output of offshore wind farms. For instance, optimizing the spacing and orientation of wind turbines can reduce the impact of wake turbulence on downstream turbines, while using larger rotor diameters and advanced control systems can help capture more wind energy. Despite the impact of wake effect on absolute power output, offshore wind remains a highly attractive source of renewable energy due to its relatively consistent and strong wind resource. With the continued development of advanced wind turbine technology and design, the impact of wake turbulence on offshore wind

power output is decreasing, making it an even more competitive and reliable source of clean energy.

- 5. EcoRI just published an article on “superfund” toxic waste sites in New England and listed North Kingston as one of the most contaminated sites in the US. This is the site Revolution Wind intends to connect its submarine cables to an onshore transmission station. The forever chemicals, PFOS, have been a particular problem in this area. We know that Orsted plans to trench up the riverbed with jet plows that create sediment plumes all the way up the west passage to North Kingstown. These chemicals increase the risk of cancer as well as other life-threatening diseases and stay in the environment for centuries. We understand that Orsted has not tested any sediment samples for PFOS anywhere in the North Kingston area or in the bay. We are wondering why you have not tested for these chemicals, given their potential harm to human health, and the likelihood they will be found in this area.**

“This question confuses or exaggerates what the [EcoRI](#) News article said. The Davisville Naval Construction Battalion Center (DNCBC) Superfund site only encompasses about 4% of the Town of North Kingstown and is **not** "one of the most contaminated sites in the US." It's 8th or 9th on the priority list out of 12 in Rhode Island, down below 80th for the six New England states, and even lower nationally. The article mentioned PFAS (not PFOS, which is only one of the thousands of types of PFAS) for a site in Massachusetts, not DNCBC. The article actually listed the known contaminants for all the RI sites. For DNCDC they are solvents; paint thinners; degreasers; PCBs; sewage sludge; contaminated fuel oil; heavy metals; pentachlorophenol. Most of these are in the capped and monitored former landfill near Allen Harbor.” - *Dr. Bob Kenney*

- 6. Low-income minority communities in America are often faced with hazardous chemicals and fumes from natural gas plants in their neighborhoods. Should offshore wind be compared with those situations?**

Offshore wind farms and natural gas plants are fundamentally different in terms of their environmental impacts on local communities. While natural gas plants can emit hazardous pollutants and fumes that can negatively affect the health of nearby residents, offshore wind farms do not produce air pollution or toxic emissions. In fact, offshore wind farms can actually help to mitigate the negative impacts of natural gas plants by providing a source of clean, renewable energy that can replace fossil fuel-based electricity generation. This is especially important for low-income minority communities that are often disproportionately impacted by the health and environmental effects of fossil fuel-based energy production.

“Fossil fuel extraction, processing, transport, combustion, and waste disposal all directly threaten human lives and the ecosystems and species that surround them. The combustion causes global and largely irreparable impacts from destabilizing the global climate with the buildup of methane and carbon dioxide. Operating 13+ miles offshore, offshore wind has far

fewer impacts on communities. The location where offshore wind farms are sited is a separate issue than their emissions, but those locations can be surveyed to ensure they do not unequally impact marginalized communities. I lived in Louisiana for 10 years, and there are people living literally across their backyard fence from an oil refinery. There's minority and low-income communities living 50 feet from flaring natural gas, from highly explosive and highly toxic chemicals. The gas that we are burning to keep our homes warm did not appear magically, it's not clean, it is contaminating water, leaking methane all along the supply chain. We must look at ourselves and ask what are we asking other people to bear that we are not willing to bear? Turbines that are 13 miles away is quite a different situation than poor people who are unable to move away from an oil refinery or a fracked natural gas well literally across the street." - *Dr. Timmons Roberts, Brown University*

Emissions Reductions

1. What is the carbon footprint of wind farms?

The carbon footprint of wind farms is relatively small compared to other forms of electricity generation. The carbon footprint of a wind farm is primarily associated with the manufacturing and transportation of the wind turbines and their components, as well as with the construction of the wind farm infrastructure.

However, studies have shown that the carbon emissions associated with the construction and operation of wind farms are relatively small when compared to the emissions that would result from generating the same amount of electricity from fossil fuel-based sources, such as coal or natural gas. According to the [U.S. Department of Energy](#), "Wind energy produces around 11 grams of CO₂ per kilowatt-hour (g CO₂/kWh) of electricity generated, compared with about 980g CO₂/kWh for coal and roughly 465g CO₂/kWh for natural gas". Those ratios are 89 times more CO₂ emissions for coal, and 42 times more emissions for natural gas than wind. In other words, when we switch to wind, we reduce our emissions by 97 to nearly 99 percent.

In summary, while offshore wind farms do have a carbon footprint associated with their construction and operation, this is typically offset within the first year of operation by the emissions savings resulting from the displacement of fossil-fuel based electricity generation, making them an important tool for reducing greenhouse gas emissions and addressing climate change.

2. Is offshore wind the greenest way to create electricity? What is?

Offshore wind is considered one of the greenest ways to create electricity, as it is a clean, renewable energy source that generates electricity without emitting greenhouse gases or other harmful pollutants. However, whether it is the "greenest" way to create electricity depends on a variety of factors, including the location of the wind farm, the availability of other renewable resources, and local environmental considerations. For example, in some locations with abundant solar resources, solar power may be a more practical and cost-effective way to

generate electricity than offshore wind. Similarly, in areas with strong geothermal resources, geothermal energy may be the most attractive option.

In general, the greenest way to create electricity is to use a combination of renewable energy sources that are appropriate for the specific location and context. Rhode Island is well positioned to harness the full potential of offshore wind because:

- a. We have a densely populated coast with high energy demand near shore
- b. The shallow water on our continental shelf is ideal for turbines
- c. The wind off our coast is stronger than almost anywhere in the world – and it is the strongest and most consistent during the winter when we will most need energy for heating

Offshore wind is likely to be the backbone of New England’s clean energy economy due to its high capacity factor – in other words, it produces a lot of power per unit installed. That said, our energy system will need a diverse and complementary mix of renewable energy and storage to meet our needs. We will not be able to fulfill our energy needs with one renewable resource alone. Offshore wind will have a big role to play because the scale and power of the resource in our region is so vast.

3. Opposition often recognizes the need to minimize fossil fuel use- what alternatives do they propose in lieu of wind?

Clean energy alternatives to wind power include solar, geothermal, hydroelectricity, and nuclear power. These technologies each have their own advantages and disadvantages, but offshore wind is the most attractive source of renewable energy for the New England region due to its high-capacity factor, reliability, scalability, low cost, and low environmental impact. However, that doesn’t mean we shouldn’t also explore other renewable energy sources. The needed approach is a cost-effective, all-of-the-above approach that achieves our state’s required targets for clean energy and emissions reduction. It is also important to acknowledge that energy storage will be a key component of balancing the grid, and until developed, oil or other “Peaker” plants can be kept in service as back up. Solar power will be an important resource for our region as well, because it is cost-effective and highly complementary to offshore wind due to when each resource produces the most power.

“We are not choosing between or pitting one renewable against another. Offshore wind is tried and true. It’s a 31-year-old industry, there are thousands of offshore wind turbines around the world, we are just behind. This is untapped potential; it is an opportunity we are missing out on. Particularly in New England, here in the region we do not have any other cost-effective, utility-scale clean energy solution that is commercially available to us. The large-scale offshore wind projects slated to be developed are the size of an average coal plant. We don’t have as many solar and land-based wind resources at that scale. A land-based wind speed and consistency map compared to an offshore wind speed and consistency map shows that wind is a lot stronger and a lot more consistent offshore.” - Amber Hewett, NWF

“We need all renewable technologies because there isn’t enough space onshore to develop everything we need to meet our energy demand. There is a study from [Princeton called Net Zero America](#) that models how much renewable energy we need under different scenarios, including how much carbon capture you would need if you eliminated some renewable energy.” - *Dr. Shilo Felton*

4. Generic climate change claims are meaningless. How much carbon-based power will this project actually displace?

The [Revolution Wind project](#) is expected to provide 704 MW of clean, affordable offshore wind power to the New England electric grid. This clean energy can power over 350,000 homes and reduce CO2 emissions by over 1.7 million metric tons per year. This reduction in emissions is equivalent to taking approximately 370,000 cars off the road each year.

Offshore wind as a whole has the potential to displace a significant amount of carbon-based power in many regions. For example, a study by the National Renewable Energy Laboratory (NREL) in the United States found that if 86 GW of offshore wind were installed along the US East Coast by 2050, it could displace an estimated 67 million metric tons of carbon dioxide (CO2) emissions per year, which is equivalent to the emissions from over 14 million passenger vehicles. Similarly, a report by the European Wind Energy Association (EWEA) estimated that if 150 GW of offshore wind were installed in Europe by 2030, it could displace up to 444 million metric tons of CO2 emissions per year, or about 13% of the total CO2 emissions from the European Union's power sector.

In addition to displacing carbon-based power, offshore wind can also help to reduce other harmful pollutants such as fine particulate matter (pm 2.5), sulfur dioxide (SO2) and nitrogen oxides (NOx) that are emitted by fossil fuel power plants. Those are associated with asthma and severe cardio-pulmonary diseases. By replacing fossil fuel-based energy sources with offshore wind energy, air pollution can be reduced, leading to improved respiratory health and lower healthcare costs associated with air pollution-related diseases.

Transparency

1. How much funding has the New England for Offshore Wind Coalition received from wind projects and their parent companies?

New England for Offshore Wind has never received donations from offshore wind projects or their parent companies. The coalition is independently funded by environmental organizations, foundations, and individuals. Our supporters share our deep concern about climate change, recognize the potential for offshore wind to drive climate progress, and agree that we need to accelerate its responsible development.

“The National Wildlife Federation has a very firm policy around not taking a single penny from offshore wind developers. It is a firm and solid line, we don’t take a single dollar from anyone invested in the offshore wind industry, and this is also true of the New England for Offshore Wind Coalition.” - *Amber Hewett, NWF*

“The Audubon Society of RI and the Environmental Council of Rhode Island do not have funding coming directly from any developer. Anything that has to do with how Audubon gets their revenues is posted directly on our website.” - *Priscilla De La Cruz, Audubon Society of Rhode Island*

Marine Life

1. Are we trading our fishery resources, marine mammals, and migratory birds for a reduction in carbon output?

“This question presumes that offshore wind will kill marine mammals, for which there is no evidence. If mammals are still there, we haven’t “traded” them for anything.” - *Dr. Bob Kenney*

Offshore wind development can have an impact on marine ecosystems, including fishery resources, marine mammals, and migratory birds. However, it is possible to develop offshore wind in a way that minimizes these impacts and maximizes the benefits of renewable energy.

Firstly, offshore wind projects are sited and designed to avoid or minimize impacts on sensitive marine habitats, migratory routes, and feeding areas. This is done through the Bureau of Ocean Energy Management’s Environmental Impact Statement where there is careful planning, scientific research, and engagement with stakeholders and local communities.

Secondly, mitigation measures can be put in place to minimize the impacts of offshore wind on marine ecosystems. For example, researchers and engineers have developed bubble curtains to reduce underwater noise levels during piledriving. Other mitigation measures include pre-construction surveys, vessel speed restrictions, seasonal construction, and monitoring of marine mammals. You can read more about mitigation measures in Question #6.

Finally, it is important to consider the benefits of offshore wind for marine ecosystems and the environment as a whole. Offshore wind can help to reduce greenhouse gas emissions and mitigate the impacts of climate change, which is one of the greatest threats to marine ecosystems and the services they provide (from warming oceans and acidification). Offshore wind can also create new habitat and support marine biodiversity by providing a hard substrate for colonization by marine organisms.

In conclusion, developing offshore wind does not mean trading our fishery resources, marine mammals, and migratory birds for a reduction in carbon output. With careful planning, stakeholder engagement, and the implementation of appropriate mitigation measures, offshore wind can be developed in a way that maximizes the benefits of renewable energy while minimizing its impacts on marine ecosystems.

2. NOAA and NMFS has authorized or is in the process of authorizing “takes” of thousands of marine mammals. “Takes” are granted when an activity has a high likelihood of harming or disturbing these animals. This implies the understanding that harm will be anticipated. Why have the wind farm companies not been more upfront about these numbers?

Under the Marine Mammal Protection Act, the term *take* means to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal. While the definition does include the word kill, NOAA has **NOT** authorized any lethal take for offshore wind activities. Lethal takes are typically reserved for navy exercises where they’re using explosives in the water. However, NOAA fisheries has authorized incidental (unintentional) take of small numbers of marine mammals for offshore wind development. There are two types of incidental take:

1. Level A Harassment, which has the potential to injure a marine mammal or marine mammal stock in the wild (i.e. non-serious injury)
2. Level B Harassment, which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild (i.e. behavioral disturbance).

The developers provide tables summarizing the numbers of allowable takes in their permits, which are available to the public. The vast majority of permitted takes are Level B for behavioral disturbance, where harm (if any, since disturbance does not automatically imply harm) would be minor and temporary. Again, no permits have been issued for takes that would result in death or serious injury.

“If you’re at a rock concert and the speaker comes on, if you’re annoyed, you move away from the speaker. We experienced that out at Block Island particularly with the pile driving. There were no fish in the area when the Block Island Wind Farm was built, but it was temporary. Once the construction was complete the fish came back, and in greater abundance than before due to habitat creation. There are a lot of things that are going to annoy fish and mammals, but they are temporary. The animals move away from the area not to be annoyed, but do come back.” - *Captain Dave Monti*

3. Has there been research on the effects of underwater acoustics during the construction process?

Yes, there has been research on the effects of underwater acoustics during the construction of offshore wind farms. The construction process of offshore wind farms involves a range of activities that can generate underwater noise, including pile driving, drilling, and dredging. This noise can potentially have short-term, temporary, negative impacts on marine life, including marine mammals, fish, and invertebrates.

Research has been conducted to understand the potential impacts of underwater noise on marine life and to develop mitigation measures to minimize those impacts. This research has included studies of the hearing and vocalization of marine mammals, as well as studies of the behavior and physiology of fish and invertebrates in response to underwater noise. Based on this research, mitigation measures have been developed such as the use of bubble curtains and acoustic monitoring to reduce the sound level of pile driving and the establishment of exclusion zones around the construction site to protect marine mammals.

“Operational noise from the Block Island Wind Farm is not detectible above ambient sound beyond 50 meters, and the range at which disturbance might occur is much less. Even with larger turbines spaced about 2,000 meters apart, there would be zones of possible disturbance around each one, with quieter areas between them. The area of disturbance would not extend any farther beyond the wind farm, since the sounds from each do not add together to make something louder. Pile driving is a source of much louder sounds, which are capable at short ranges of causing permanent hearing damage. Construction permits typically require mitigation to minimize impacts. For example, soft starts entail beginning each pile-driving event with lighter taps and building up to full force, with the expectation that animals nearby will move away beyond the zone where they might be injured. Multiple studies of European wind farms show that marine mammals (seals and harbor porpoises, since there are few to no whales in those waters) move away during pile-driving and return afterwards.” - *Dr. Bob Kenney*

4. What about noise from Sonar for offshore wind site characterizations?

Air guns and Navy sonars are some of the most powerful man-made noise sources. For offshore wind site characterizations, they are not using seismic air guns. Seismic air guns, however, are used under BOEM’s programs for oil and gas. The offshore wind industry, on the other hand, uses high-resolution (HRG) sources to map the sea floor, which are lower in energy and have key characteristics that set them apart. There is no evidence that HRG sources used by offshore wind companies could cause mortality of whales, nor any evidence that they are responsible for the recent whale strandings. You can learn more by watching this [BOEM HRG Acoustics Video](#).

5. How do we determine if a whale death was related to or caused by offshore wind activity or other causes?

NOAA Fisheries uses necropsies to determine the cause of a whale death. Necropsies can help determine if there is evidence from vessel strikes or entanglement.

Vessel strikes are determined by cuts from propellers, and/or bruising and broken bones from the impact with a vessel hull. However, we are generally not able to definitively determine what specific kind of vessel (i.e., the size or type of vessel or what it was doing) caused the strike without a report from a mariner or other observer such as a protected species observer.

Entanglement injuries are often evident in external examination even when rope or other fishing gear does not remain on a carcass. Acute injuries, such as areas where line or rope has

rubbed through or broken the skin, can be very evident. In some cases, tissue analysis is needed to confirm whether the injuries are old and healing or may have contributed to the whale's death.

Some deceased whales are never necropsied because the floating carcasses are observed too far offshore to tow in. Budgets for investigations are limited, so priority goes to endangered species, especially North Atlantic right whales. In addition, a significant proportion of necropsies result in no conclusive findings. Whales are warm-blooded mammals with high body temperatures, and are superbly insulated by thick blubber layers, so they decompose very rapidly. In only a few days a whale carcass is so decomposed that internal organs cannot even be identified. NOAA Fisheries will be looking at samples collected from each necropsied animal to further understand other factors that may have contributed to the stranding, but they may not ever have a definitive answer for each of these cases.

“Strandings and inconclusive necropsies have occurred long before offshore wind was a factor, so correlating the two now is not based in science. For example, the number of humpback whales stranded from Florida to Maine, which opponents have been blaming on offshore wind developments, since the [Unusual Mortality Event \(UME\)](#) started in 2016 has averaged 25 per year. But it didn't begin from zero; the average over the four previous years was almost 13.” - *Dr. Bob Kenney*

6. What exactly is being done to protect North Atlantic Right Whales from offshore wind?

NOAA Fisheries is heavily invested in the conservation and recovery of endangered North Atlantic right whales. NOAA Fisheries recently [proposed a rule to modify existing vessel speed restrictions](#) that would apply to many offshore wind-related vessels. In their permits and authorizations, they also require mitigation measures to avoid and minimize impacts from offshore wind development.

In addition to vessel speed restrictions, examples of mitigation measures include:

- Pre-construction surveys: Developers conduct comprehensive surveys of the proposed construction site to identify any sensitive habitats, marine species, or cultural resources that may be affected by construction activities.
- Seasonal construction: To minimize disturbance to marine wildlife during sensitive times of the year, such as breeding or migration periods, construction activities may be timed to occur outside of these periods.
- Installation of bubble curtains: During pile driving, bubble curtains are used to reduce underwater noise levels.
- Monitoring of marine mammals: Developers may use acoustic monitoring devices and or protect species observers to detect the presence of marine mammals in the area and temporarily halt construction activities if necessary.

- Habitat restoration: In some cases, developers may undertake habitat restoration efforts to offset any unavoidable impacts on sensitive habitats.

Finally, NOAA Fisheries and the Bureau of Ocean Energy Management recently released a [joint draft strategy](#) to protect and promote the recovery of North Atlantic right whales while responsibly developing offshore wind energy. This strategy is part of NOAA Fisheries' comprehensive [Road to Recovery](#) for North Atlantic right whales.

7. Is there any reputable science that points to detrimental effects on the oceans as a direct result of Offshore Wind?

While Offshore wind farms are a relatively new technology to the United States, they have been producing clean power in Europe for over 3 decades. Many studies in Europe and now the United States suggest that the impacts of offshore wind farms on the ocean are generally limited and can be managed through careful planning and design.

One potential impact of offshore wind farms on the marine environment is the physical presence of the turbines and their associated infrastructure, such as cables and substations. This infrastructure can potentially cause damage to seafloor habitats and disrupt the migration patterns of marine animals, mostly during construction. However, research has shown that the impacts can be minimized through careful site selection, design, and operation of the wind farm. Another potential impact of offshore wind farms on the ocean is underwater noise pollution. The construction and operation of offshore wind turbines can create noise that can be harmful to marine mammals and other marine life. However, studies have shown that the noise levels can be reduced using bubble curtains and careful planning of construction.

Overall, while there is ongoing research into the potential impacts of offshore wind farms on the ocean, there is no reputable science that points to detrimental effects on the oceans as a direct result of offshore wind farms. In fact, offshore wind farms can help reduce carbon emissions and mitigate the impacts of climate change on the marine environment. The net benefits far exceed the potential negative impacts.

“There is an entire field of research dedicated to understanding the ways in which offshore wind interacts with wildlife and the environment. The majority of this research to date has been done at offshore wind energy facilities in Europe, and, as I mentioned in [my presentation](#), groups like RWSC, BOEM, and NOAA are pursuing research to better understand impacts in the U.S. so that impacts can best be avoided, minimized, and offset to produce a net positive outcome for wildlife and the environment. A list of resources can be found [here](#).” - *Dr. Shilo Felton*

- #### **8. I spend hundreds of hours a year fishing with my boys and friends on Coxes Ledge, the Claw, the Frigers (inside and out) and the Dump. Are we going to be able to access these areas freely during construction and has Homeland Security (or anyone else)**

committed who can whale watch and fish once the turbines are up? It'd really suck if we can't.

During the construction of offshore wind farms, access to the areas surrounding the construction site may be restricted for safety reasons. However, once construction is complete and the wind turbines are operational, it is expected that the surrounding areas will be open to the public for activities such as whale watching and fishing, as is the case with other offshore structures such as oil rigs.

“Developers have no right to restrict fishing in a wind farm lease area, and the Coast Guard has said many times on record that there will be no restriction at wind farms during operation. No restrictions at Block Island and no restrictions planned on the east coast. There are restrictions during construction, safety restrictions, perimeters around working vessels, pylons, etc.” - *Captain Dave Monti*

9. Whales are now near the coast. They are critically endangered. How can we start when you have pledged to maintain biodiversity and comply with the Marine Mammal Protection Act? Also, whales migrate along the path of the wind farm how will you keep them safe?

Offshore wind vessels are required to monitor for whales and other marine mammals during the construction and operation of offshore wind farms. This is typically done through a combination of visual and acoustic monitoring, using specialized equipment and trained protected species observers. Visual monitoring involves looking for whales and other marine mammals on the surface of the water, using binoculars. Acoustic monitoring involves listening for the sounds made by whales and other marine mammals, using hydrophones (underwater microphones). These monitoring efforts are conducted in accordance with regulations established by the National Marine Fisheries Service (NMFS) and the Bureau of Ocean Energy Management (BOEM). These regulations require developers to establish monitoring and mitigation plans to minimize the impacts of their construction and operations on whales and other marine mammals. For example, many developers will be implementing exclusion zones during construction — if whales or other marine mammals are detected within a certain distance of construction, the monitoring team may recommend that construction be temporarily halted or that vessel traffic be slowed or diverted to avoid any potential harm.

Furthermore, offshore wind developers are often required to abide by speed limits in the vicinity of their operations, particularly during the construction phase when there may be increased vessel traffic in the area. These speed limits are typically established by regulatory agencies such as the National Marine Fisheries Service (NMFS) or the Bureau of Ocean Energy Management (BOEM) and are intended to minimize the risk of collisions between vessels and marine mammals such as whales.

In summary, offshore wind vessels are required to monitor for whales and other marine mammals, abide by speed limits, and to establish monitoring and mitigation plans to ensure the protection of these important species.

“Only one species, North Atlantic right whale (NARW), is classified as critically endangered, but we have about three dozen species of marine mammals (whales, dolphins, porpoises, and seals; even the occasional manatee) that occur in our region. The whale that is currently being most affected by ship strikes and entanglements because it is coming closer to shore than in past years is the humpback, which has been removed from the endangered species list (i.e., recovered). NARWs are no closer to the coast now than they have ever been. To date, we have no evidence of any serious harm to marine mammals from wind farm development, and the conditions included under the permits being issued are designed to fulfill the Marine Mammal Protection Act requirements to minimize any potential harm.” - *Dr. Bob Kenney*

10. What is the story behind cod? NOAA reports they are rebounding in southern New England particularly on Cox Ledge and the Sakonnet River. Impact from wind?

“There is now more cod at Block Island wind farm compared to control areas outside of the wind farm. The Nature Conservancy study on wind farm pylons suggested that the pylons will complement natural habitat, creating an artificial reef effect. Cod spawning studies the RI Saltwater Anglers Association participated in at Cox Ledge did not bear fruit, not enough cod were caught to study. Subsequent studies that tagged cod showed better results to track cod movement. Pile driving during construction annoys fish and they seem to leave the area during construction, however, science is showing that the impact is temporary, and fish (like cod) returned and sometimes in stronger numbers due to enhanced habitat. There will be no pile driving in the Sakonnet, if the cable does go up the river impacts would be temporary for the 4- or 5-weeks the cable is laid down. The cable should be monitored for impacts on electro magnetics but as proven by Block Island study and science in general, there have been no impacts. The cod population increased in cable areas too.” - *Capt. Dave Monti*

11. Will the fish attracted to the structure displace fish caught commercially? Why is there so much press for fisheries about adverse effects? Should they be reimbursed?

“There is no doubt that fishermen should be reimbursed for loss of fishing during construction. Commercial fishermen report their catch to NOAA, so it is an easy matter of checking what is caught in a wind farm lease area and reimbursing them for loss of fishing during construction. What is more difficult to measure is how many fish will be there after construction and how much fishermen should be reimbursed. In witnessing negotiations over the years this has been the sticking point, with both sides - fishermen and developers posturing for mitigating both financial and other impacts. Proper research and monitoring plans must be provided moving forward.” - *Capt. Dave Monti*

In response to these concerns, many offshore wind developers have established compensation programs for fishermen who may be impacted by their projects. Orsted and Eversource have

agreed to a \$3.5 million dollar compensation package for RI fishermen due to potential impacts from Revolution winds cable burial plan.

12. So, 5 wind turbines have directly resulted in tuna increase? How did the BIWF impact commercial fishing?

“Warming water has enhanced bait profiles close to shore, i.e., zooplankton, squid, herring of all types, mackerel of all types, silversides, Atlantic menhaden, peanut bunker, etc. This has brought sharks, tuna and humpback whales close to shore. A seven-year fish abundance study in the BIWF (was published in the ICES Journal of Marine Science on March 29, 2022) shows greater abundance of cod and black sea bass in wind farm areas compared to two control areas outside of the wind farm area. All other species of squid, summer flounder, etc. were even. So, if squid was up or down in the wind farm area, it was up or down by a similar amount in the two control areas outside of the wind farm, this has been the case with European wind farms too. At Block Island there are gill nets set up in the wind farm area, fish traps and lobster pots, just like they had been before the wind farm. Commercial rod & reel fishermen fish there too alongside recreational anglers. And commercial trawlers trawl parallel to the wind farm. All fishing and catching fish as they were before.” - *Capt. Dave Monti*

13. We know that whales are “nature's solution to climate change” because they sequester carbon dioxide and promote plankton growth. The striking recent increase in whale deaths might indicate that offshore wind activity will add to the whale deaths in the upcoming decade. The International Monetary Fund values a single whale's life at 2 million dollars. Why wouldn't we ask the offshore wind companies to pay 2 million dollars for every whale that dies within the area of their construction and work?

“Any sequestration of carbon by whales (or any other living organism, since the chemistry of Earth-based life is built around carbon compounds) is only temporary...until it dies, sinks to the bottom, decomposes, and releases the carbon back into the ecosystem. A 40-metric ton (mT) right whale contains about 8 mT of carbon. The average passenger vehicle emits 4.6 mT of carbon per year. So, taking two cars off the road for one year has a bigger effect on the global carbon budget than saving one right whale. We could do both.

NOAA has stated that there is no evidence to support that recent whale deaths are linked to the offshore wind industry. However, if penalties were to be implemented, the maximum penalty for a criminal violation of the Marine Mammal Protection Act is \$20,000; raising it to \$2 million would require Congress to amend the law. Furthermore, assessing fines requires actual evidence and court proceedings, not just proximity in time and space.”

- *Dr. Bob Kenney*

14. We know that RI had to shut down its shellfish industry for the first time in the history of the state for the contamination of domoic acid, a deadly neurotoxin, soon after the Block

Island Wind Farm was constructed. We understand that invasive filter feeders on artificial structures can alter nutrient levels in the water. We are wondering if anyone has examined whether an association could exist between this outbreak and the wind farms and whether we will need to worry about more domoic acid in the future, given the number of artificial structures planned for our coastal waters.

“There is no evidence to suggest a link between the Block Island Wind Farm and the bloom of *Pseudo-nitzschia* (the diatom that produces domoic acid) in Rhode Island. However, climate change can potentially contribute to the conditions that lead to domoic acid outbreaks. For example, warmer ocean temperatures can create favorable conditions for the growth of algae that produce domoic acid. Offshore wind can be an important part of the transition to a more sustainable energy future, which can help mitigate the impacts of climate change and other human activities on our oceans and marine ecosystems.” - *Dr. Bob Kenney*

Energy Production

1. When offshore wind is up and running what percentage of Rhode Island’s electrical energy will it supply?

Rhode Island energy’s offshore wind solicitation of up to 1,000MW has the potential to meet at least 30% of Rhode Island's estimated 2030 electricity demand. The electricity from this project has the potential to power approximately 340,000 homes each year. When added to the 30MW Block Island Wind Farm and the planned 400MW Revolution Wind Farm, about half of the state’s projected energy needs will be powered by offshore wind. You can read more [here](#).

Additionally, Rhode Island shares a regional electric grid with the other five New England states. Electricity demand is projected to grow significantly in the coming decades as we electrify heating and transportation. We will need to expand the deployment of renewables including offshore wind to meet this increased demand while meeting required reductions of carbon emissions. Several analyses have predicted that offshore wind may provide around 50% of our region’s electricity by the year 2050.’

2. There is a well-documented problem with electricity transmission bottlenecks that are preventing many wind and solar projects from sending electricity into the grid. Current transmission capacity is not keeping pace with the burgeoning number of renewable energy projects around the country. How well positioned is this wind project in terms of being able to get electricity to consumers without encountering such bottleneck issues?

Bottlenecks on transmission development and interconnection of new generating resources is certainly an issue that needs to be resolved, and it is not one that is unique to offshore wind. We will need to double if not triple our regional electric grid in order to meet increased electricity demand in the coming decades. The current projects contracted by New England states including Rhode Island have interconnection agreements and once approved, will be able

to move forward with transmission connections to the onshore grid. Beyond these first projects, the New England states are leading the nation with an innovative proposal for offshore transmission that would be regional in scale and would reduce impacts and costs while increasing reliability.

“Transmission coming from the project to shore will be buried 4-6 feet beneath the sea floor. This will be monitored and tended to over time. The transmission impact, the siting of that transmission line is something evaluated in project evaluation at the earliest stages of identifying responsible areas for lease areas to be placed. Where will that power come to shore, where are the interconnection opportunities. In New England we are fairly limited in interconnection opportunities, so as the number of megawatts goes up that we hope to see generated offshore, the need for planning for what that transmission will look like becomes very important. Only so much power fits on a transmission line, there’s only so many places it can plug in to. Our grid currently cannot handle the scale of offshore wind development that we are talking about and that is something that needs to be resolved imminently. It’s something that New England is really leading on, given that we are at the forefront of offshore wind development, we’re the furthest along in that leasing and permitting timeline, so the New England states are working together right now on a transmission initiative to identify both the land-based upgrades that are needed as well as better approaches to transmission planning. With the passage of the Inflation Reduction Act last year there’s a lot of new resources dedicated to building transmission and upgrading transmission infrastructure.” - Amber Hewett, *National Wildlife Federation*

Economics

1. How can we trust that Offshore wind is a good investment given that Avangrid is pulling out from their Power Purchase Agreement for the Commonwealth Wind Project and Rhode Island Energy’s recent request for proposals only received one bid?

Commonwealth Wind (contracted with MA) was bid and contracted before the world economy abruptly changed course. According to Avangrid, a combination of inflation, Putin’s invasion of Ukraine, and supply chain shortages put them in a position where the project revenue from fixed price contracts would not enable financing and construction. Taking all this into account, Avangrid intends to terminate the contract, pay a hefty penalty, and free up their 1200 MW of capacity to be included in Massachusetts's next offshore wind solicitation. While it is disappointing that Avangrid intends to cancel their contract, geopolitical events impacting inflation and supply chain issues have had negative impacts economy-wide across the world, not just on the offshore wind industry and in the US. It is important to remember that electricity prices rose sharply this past winter due to fossil fuels, and the competitive bidding process for offshore wind will result in a beneficial cost of energy that will protect ratepayers from the ongoing price volatility of fossil fuels. In addition to lower energy costs, offshore wind is a good investment in jobs and workforce development.

Regarding Rhode Island Energy only receiving one response to their request for proposals for 600-1,000 MW of new offshore wind power, there were several factors at play. First, the procurement number was too low for some developers who have lease area and transmission cable capacity for 1,200MW or more. Second, some developers submitted their projects to NY in response to their latest solicitation, so couldn't respond to Rhode Island. With all that said, Orsted/Eversource wouldn't have known that they were going to be the only bid, and they will likely be able to capture economies of scale for this project since they are also developing the Revolution Wind project for Rhode Island. Furthermore, it is important to remember that the Public Utilities Commission has the ability to reject the project if it is not found to be in the ratepayer's interest.

Lastly, we would turn the question around. What constitutes a "good energy investment" over the long run? Per the Act on Climate and 100% Renewable Energy Standard by 2033, it is essential to procure emission-free power. Furthermore, due to the social cost of carbon, the impacts of climate change, and the volatile fossil fuel pricing, there are no longer "good investment" opportunities in fossil fuels as far as the public interest is concerned. And offshore wind is the zero-emission resource that is both affordable and large enough in scale to power Rhode Island.

2. Please explain what a Power Purchase Agreement is and how it impacts rate payers?

"A Power Purchase Agreement (PPA) is an agreement where a third-party installs, owns, and operates [a power generating resource]. The customer then purchases the system's electric output for a predetermined period. A PPA allows the customer to receive stable and often low-cost electricity with no upfront cost, while also enabling the owner of the system to take advantage of tax credits and receive income from the sale of electricity. Though most commonly used for renewable energy systems, PPAs can also be applied to other energy technologies such as combined heat and power (CHP)." ([Better Buildings Solution Center - US Department of Energy](#))

3. Politicians up and down the east coast seem to tout the economic benefits of offshore wind, particularly the number of jobs it will create. We understand from the governor's office, however, that Revolution Wind will only create approximately 50 permanent jobs. We also know that Rhode Island gets over 10% of its tax revenue from the tourist industry and tourism supplies thousands of jobs. Has anyone calculated how many jobs we will lose in RI from other sectors and will the 50 permanent jobs from Revolution Wind compensate for these losses?

There is no reason to believe that offshore wind energy development will negatively impact tourism or jobs. Several studies suggest that offshore wind energy may be positive for tourism. See the following examples of research: see [here](#), and [here](#).

"The University of Rhode Island did social science work to see how the view of the wind farms impact tourism and real estate values, (see studies [here](#) and [here](#)). They found there were no

negative impacts, in fact it created ecotourism for Block Island, and real estate values on Block Island did not go down.” - *Captain Dave Monti*

While it is true that offshore wind projects may have a higher number of jobs during the construction phase compared to the operational phase, offshore wind projects can create significant long-term employment opportunities in areas such as operations and maintenance, manufacturing, and supply chain services. In fact, a report by the National Renewable Energy Laboratory found that the offshore wind industry has the potential to create a significant amount of long-term jobs in the United States. The report estimated that the development of 86 gigawatts (GW) of offshore wind capacity by 2050 could support up to 160,000 direct jobs and 80,000 indirect jobs. Furthermore, offshore wind projects can also create additional economic benefits for local communities, including tax revenue, investments in local infrastructure, and the creation of new businesses and industries. While the exact number of jobs created by offshore wind projects can vary depending on several factors, including project size and location, it is clear that offshore wind has the potential to create significant employment opportunities and contribute to the growth of Rhode Island’s local economy.

4. How can we ensure the numbers developers are promising related to jobs are accurate?

“Holding management and bosses and corporations accountable is why the labor movement exists. That is our number one goal as Climate Jobs is to hold developers accountable to their prospects of jobs. Not only that but making sure this isn’t a race to the bottom. There is a real risk when you are investing in new technology that shady developers will come in and offer shoddy wages, take someone off the street and pay him minimum wage. That is not what this work is supposed to be. What we exist to do is to make sure we are raising that floor and holding developers accountable. We don’t use employer based (developers, corporations) research, we use independent research. We had a great partnership with the folks at the worker institute at Cornell University to model out those projections for us that are in the [report](#).” - *Mike Role, Climate Jobs RI*

Additionally, Vineyard Wind recently submitted its first annual report, entitled “[Vineyard 1 Impact on Jobs and Economic Output](#)”, to the Massachusetts Department of Environmental Management. The report states that Vineyard Wind has exceeded job creation and economic output projections during its development and early construction period. The project has generated over 4,000 jobs and \$678 million in economic output, surpassing the initial projections of 3,600 jobs and \$569 million in economic output. The report also highlights the project's efforts to prioritize local hiring and investment in the region.

5. Most of the jobs seem to be during the construction phase. How many long-term jobs will OSW provide?

While it is true that offshore wind projects may have a higher number of jobs during the construction phase compared to the operational phase, offshore wind projects can create significant long-term employment opportunities beyond construction. Here are some examples:

- a. **Operations and Maintenance (O&M) Technicians:** These technicians are responsible for maintaining and repairing offshore wind turbines and their associated equipment. O&M technicians may work on site or remotely, and they may be required to perform routine inspections, troubleshoot problems, and perform maintenance tasks.
- b. **Offshore Installation Managers (OIMs):** OIMs are responsible for overseeing the installation and commissioning of offshore wind turbines. They may work on site or remotely, and they are responsible for ensuring that all aspects of the installation process are completed safely and efficiently.
- c. **Engineers:** Engineers play a key role in the offshore wind industry, working on design, planning, and construction projects. Some examples of engineering roles include structural engineers, electrical engineers, and mechanical engineers.
- d. **Project Managers:** Project managers oversee all aspects of an offshore wind project, from initial planning to construction and operation. They are responsible for ensuring that the project is completed on time, within budget, and to the required safety and quality standards.
- e. **Support Services:** There are a variety of support services required for offshore wind projects, including logistics and transportation, environmental monitoring, and safety and security services.
- f. **Environmental Specialists:** Environmental specialists are responsible for monitoring the impact of offshore wind projects on the environment, including the effects on marine life and the surrounding ecosystems.
- g. **Safety & Security:** Safety and security personnel are responsible for ensuring that offshore wind projects are operated safely and securely, and that all personnel and equipment are protected from potential hazards.

These are just a few examples of the types of jobs that exist in the offshore wind industry outside of the construction phase. The exact number and types of jobs will depend on the size of the project and the specific needs of the project developers.

General

1. What is the total height of the turbines, including blades?

The BIWF turbines are [GE Haliade 150-6MW turbines](#) with a 150.95m diameter rotor. Each blade is 73.5m long, sweeping an area of 17,860m squared. The hub height of the tower is 100m. In feet, the BIWF turbines are 328 feet tall with a rotor diameter of 492 feet. You can read more [here](#). The expected wind turbine for Revolution Wind is the [Siemens Gamesa 11.0-200 DD](#). The turbine has a rotor diameter of 656 feet. The full height of the turbine will be 828

feet. They will each produce nearly twice the electricity of each Block Island turbine. One rotation of the blades will produce roughly the energy to power one home for a day.

3. When I look out from Sakonnet point at night, am I going to be able to see lights from Revolution wind?

While the Block Island Wind Farm can be viewed from Sakonnet point on a clear night, all of the new projects are planning to use a radar-based Aircraft Detection Lighting System (ADLS) which will only turn on the lights when aircraft are nearby. Read more [here](#).

4. Why do these turbines have to be so close to shore?

“Close” is a relative term. The current wind energy leases and proposed projects in federal waters are generally at least 10 miles from shore. As an example, Revolution Wind, the proposed project that is closest to RI and expected to produce power for RI, is 15 miles from shore at its closest point to RI and 12 miles from Martha's Vineyard. BOEM selects areas of the ocean to lease for offshore wind energy development based on several factors, including wind resource availability, reduced conflicts with other ocean users (e.g., commerce, fishing, military), and avoiding environmental impacts. The RI/MA wind energy areas underwent several public comment periods and analyses before being whittled down to the areas that were offered for lease.” - *Dr. Shilo Felton*

5. What about China and India's coal plants?

“China and India are quite different cases. China is now the world's largest greenhouse gas emitter, but the USA is still responsible for the most warming, because of all we've emitted in the past, most is still up there warming the planet. China has hundreds of millions of rural poor who have no access to electricity, so development remains a priority. Still, it has nearly leveled off in its emissions, and China has sharply increased wind and solar deployment and reduced the number of new coal plants it is building. It's not a perfect case, but we cannot wait for someone else to solve climate change for us. India is way poorer, and its emissions on a per capita basis are tiny compared with the USA. India is moving forward on solar, but not quickly enough; India needs some help avoiding using the cheap soft coal under their feet.” - *Dr. Timmons Roberts*

6. Why did scientists change the prediction from 1970-80s that the earth was getting too cold? Is 40-50 years enough to predict with such confidence that it's importantly getting hotter? What is the influence of the shifting hot lava earth core on temp change?

“The science has developed a LOT since the few predictions of temperatures lowering, and our understanding of the greenhouse effect has improved massively. Tens of thousands of scientific studies now confirm the world is warming, not cooling. Global temperature trends are consistent with rising carbon dioxide and methane concentrations in the atmosphere, which have risen sharply in the past 50-100 years, far above any levels measured over the past many

millenia. Global temperatures are rising measurably, right in line with predictions made by scientists, including those working for Exxon in the 1970s. See <https://www.science.org/doi/10.1126/science.abk0063> - *Dr. Timmons Roberts*