PART B: FALSE CLAIMS ABOUT WIND ENERGY (#15–#29)

False Claim #15: Electromagnetic radiation from wind turbines poses a threat to human health.

> *"Recently, concerns about exposure to EMF from wind turbines, and associated electrical transmissions, have been raised at public meetings and legal proceedings."*[225]

Multiple studies have found that the electromagnetic fields (EMFs) generated by wind turbines are lower than those generated by most common household appliances and that they easily meet rigorous international safety standards.[226] For context, the average home that is not located near power lines has a background level EMF of roughly 0.2 μT.[227] However, this value varies greatly depending on proximity to certain household appliances.[228] For example, from a distance of 4 feet, an electric can opener's EMF is 0.2 μT, but this value increases to 60 μT from a distance of 6 inches.[229] A 2020 academic study found that the EMF generated by turbines are approximately 0.44 μT at a distance of 1 meter but less than 0.1 μT at a distance of 4 meters, as shown below.[230]

[225] OHIO DEPARTMENT OF HEALTH, WIND TURBINES AND WIND FARMS: SUMMARY AND ASSESSMENTS at 8 (Apr. 12, 2022), https://odh.ohio.gov/wps/wcm/connect/gov/816f89dc-767f-4f08-8172-71c953b8ee02/ODH+Wind+Turbines+and+Farms+Summary+Assessment_2022.04.pdf?MOD=AJPERES.

[226] Lindsay C. McCallum et al., *Measuring Electromagnetic Fields (EMF) Around Wind Turbines in Canada: Is there a Human Health Concern?*, 13 ENV'T. HEALTH 1, 9 (2014), https://doi.org/10.1186/1476-069x-13-9; Aris Alexias et al., *Extremely Low Frequency Electromagnetic Field Exposure Measurement in the Vicinity of Wind Turbines*, 189 RADIATION PROTECTION DOSIMETRY 395, 397 (2020), https://doi.org/10.1093/rpd/ncaa053; Nektarios Karanikas et al., *Occupational health hazards and risks in the wind industry*, 7 ENERGY REP. 3750, 3752 (2021), https://doi.org/10.1016/j.egyr.2021.06.066.

[227] *Radiation: Electromagnetic fields*, WORLD HEALTH ORGANIZATION (August 4, 2016), https://www.who.int/news-room/questions-and-answers/item/radiation-electromagnetic-fields.

[228] *Id.*

[229] *Electromagnetic Fields (EMF)*, WIS. DEP'T. OF HEALTH SERV. (Sept. 14, 2022), https://www.dhs.wisconsin.gov/air/emf.htm.

[230] Alexias et al., *supra* note 226, at 397.

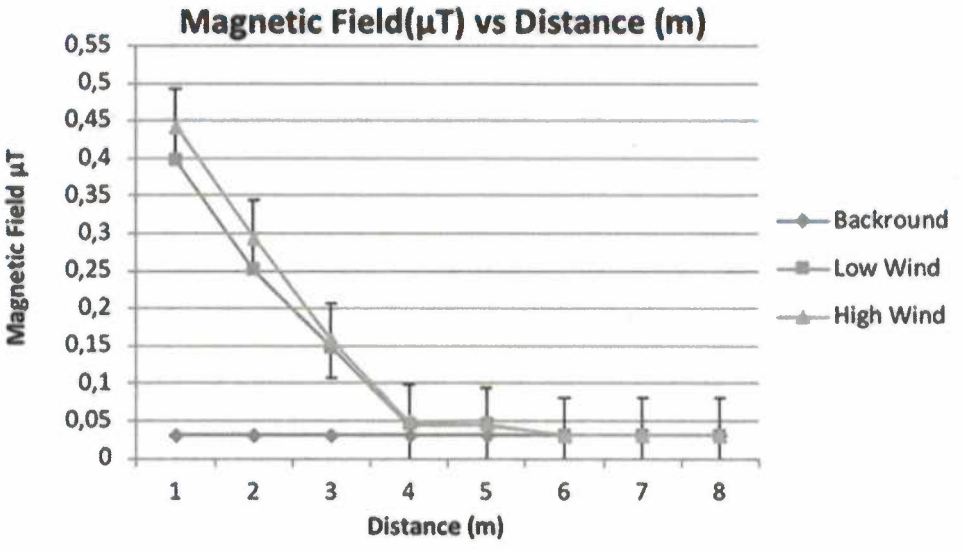

Figure 10: The EMF level, measured in microtesla (μT), is shown to drop dramatically with increase in distance from source.
Source: Alexias et al.[231]

These EMF levels are not dependent on wind speeds.[232]

False Claim #16: Wind turbines frequently fall over, and blades or other components easily break off, threatening human health and safety.

> *"There are many health hazards associated with living near turbines as a result of . . . broken flying blades."*[233]

Turbine collapse or breakage are extremely rare, and utility-scale wind turbines are fitted with safety mechanisms to survive extreme weather conditions, such as hurricanes.[234] Turbine blade breakage does not pose a significant threat to humans.[235] The Department of Energy has noted that, although the risk of turbine blades becoming detached during operation "was a concern in the early years of the wind industry," such failures "are virtually non-existent on today's turbines due to better engineering and the use of sensors."[236] Turning to all turbine blade failures, rather than just turbine blade detachment, a

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[231] *Id.*
[232] *Id.* at 398.
[233] *No Wind Turbines! Get the Facts!*, SAVE PIATT COUNTY, http://www.savepiattcounty.org/ (last visited March 25, 2024).
[234] *How do wind turbines survive severe storms?*, OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY, (June 20, 2017), https://www.energy.gov/eere/articles/how-do-wind-turbines-survive-severe-storms.
[235] M. McGugan et al., *Damage Tolerance and Structural Monitoring for Wind Turbine Blades.* 373 PHIL. TRANSACTIONS ROYAL SOC'Y A, 4 (2015), https://doi.org/10.1098/rsta.2014.0077.
[236] *Wind Energy Projects and Safety*, Dep't of Energy, https://windexchange.energy.gov/projects/safety (last visited March 25, 2024).

2015 study found that wind turbine blades fail at a rate of approximately 0.54% per year globally.[237] The Department of Energy has further reported that "catastrophic wind turbine failures . . . are considered rare events with fewer than 40 incidents identified in the modern turbine fleet of more than 40,000 turbines installed in the United States as of 2014."[238]

When looking at deaths per terawatt-hour of energy produced, the mortality rate from wind energy pales in comparison to the risks associated with fossil fuels. Brown coal causes 32.72 human deaths per terawatt-hour, while black coal causes 24.6 human deaths, oil causes 18.4 human deaths, natural gas causes 2.8 human deaths, and wind energy causes only 0.04 human deaths.[239]

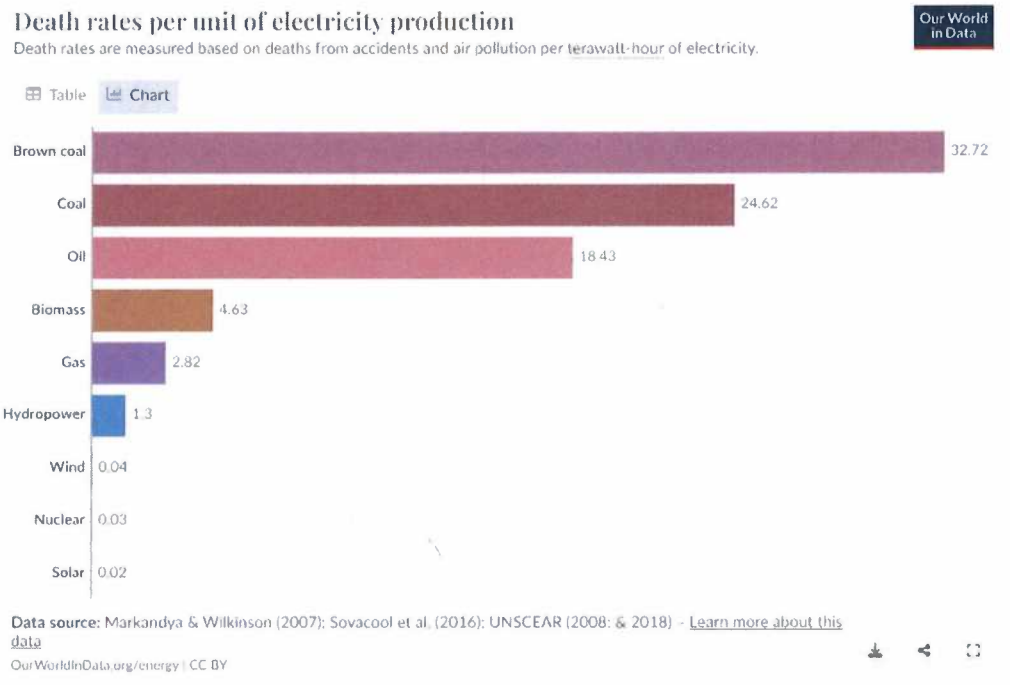

Figure 11: Death rates per unit of electricity production.
Source: Hannah Ritchie, Our World in Data.[240]

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[237] GCube Insurance Services, Inc. *GCube report: breaking blades: global trends in wind turbine downtime events* (2015), summarized in Xiao Chen, *A Critical Review of Damage and Failure of Composite Wind Turbines Blade Structures*, IOP CONFERENCE SERIES: MATERIALS SCI. AND ENGINEERING (2020), at 4, https://iopscience.iop.org/article/10.1088/1757-899X/942/1/012001/pdf.

[238] *Wind Vision: A New Era for Wind Power in the United States*, U.S. DEPARTMENT OF ENERGY, 105 (2015), https://www.energy.gov/sites/prod/files/WindVision_Report_final.pdf

[239] Hannah Ritchie, *What are the safest and cleanest sources of energy?*, *supra* note 13. To the extent that wind-related fatalities tend to occur disproportionately during the construction phase, this analysis may overstate the fatalities per terawatt-hour of wind, which would be expected to decline over time. *See* Benjamin K. Sovacool et al., Balancing safety with sustainability: assessing the risk of accidents for modern low-carbon energy systems, 112 Journal of Cleaner Production 3952, 3960, Jan. 20, 2016, https://www.sciencedirect.com/science/article/pii/S0959652615009877 (showing in Table 5 that most wind-related deaths occurred during construction).

[240] *Id.*

False Claim #17: Low-frequency noise from wind turbines harms human health and causes "wind turbine syndrome."

> *"As wind turbines spring up like mushrooms around people's homes, Wind Turbine Syndrome has become an industrial plague."*[241]

The weight of the evidence suggests that there is no direct causal correlation between low-frequency noise from wind turbines and human health.[242] Individual cases of sleep disturbance among people living in proximity to new wind turbines are more likely the result of annoyance about the presence of those turbines rather than inaudible noise emanating from them.[243]

One historical study looked at complaints filed in relation to 51 Australian wind farms from 1993 to 2012.[244] Prior to 2009, complaints related to health and noise were rare, despite the fact that many small and large wind farms were already in operation.[245] However, following the coining of the phrase "wind turbine syndrome" in a self-published book that year, there was a dramatic spike in complaints.[246]

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[241] Calvin Luther Martin, *Your Guide to Wind Turbine Syndrome...A Roadmap to this Complicated Subject*, NATIONAL WIND WATCH (July 2010), https://docs.wind-watch.org/WTSguide.pdf.

[242] Nathaniel Marshall et al., *The Health Effects of 72 Hours of Simulated Wind Turbine Infrasound: A Double-Blind Randomized Crossover Study in Noise-Sensitive, Healthy Adults*, 131 ENV'T HEALTH PROSPECTIVE, 1 (2023), https://doi.org/10.1289/EHP10757; Jenni Radun et al., *Health Effects of Wind Turbine Noise and Road Traffic Noise on People Living Near Wind Turbines*, 157 RENEWABLE & SUSTAINABLE ENERGY REV., 10 (2022), https://doi.org/10.1016/j.rser.2021.112040; Irene van Kamp et al., *Health Effects Related to Wind Turbine Sound: An Update*, 18 INT'L J. ENV'T RSCH & PUB. HEALTH, (2021), https://doi.org/10.3390%2Fijerph18179133; Wind Energy Technologies Office, *Frequently Asked Questions about Wind Energy*, OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY, https://www.energy.gov/eere/wind/frequently-asked-questions-about-wind-energy#WindTurbineHealth (last visited March 25, 2024); Jesper Schmidt et al., *Health Effects Related to Wind Turbine Noise Exposure: A Systematic Review*, 9 PLOS ONE, (2014), https://doi.org/10.1371/journal.pone.0114183; *NHMRC Statement: Evidence on Wind Farms and Human Health*, NATIONAL HEALTH AND MEDICAL RESEARCH COUNCIL (NHMRC), AUSTRALIAN GOVERNMENT, 1 (2015), https://www.nhmrc.gov.au/file/19045/download?token=0IAl7MHu; Tracy Merlin et al., *Systematic review of the human health effects of wind farms*, NATIONAL HEALTH AND MEDICAL RESEARCH COUNCIL, 2013, https://www.livingstoncounty-il.org/wordpress/wp-content/uploads/2015/01/PR-Ex.-281-2014-NHMRC-Australia.pdf; *but see* Richard R. James, *Wind Turbine Infra and Low-Frequency Sound: Warning Signs That Were Not Heard*, 32 BULLETIN OF SCIENCE, TECHNOLOGY, AND SOCIETY, 2012, https://journals.sagepub.com/doi/abs/10.1177/0270467611421845 (analyzing "historical evidence about what was known regarding infra and low-frequency sound from wind turbines and other noise sources during the period from the 1970s through the end of the 1990s" to conclude that wind energy may be causing adverse impacts to some people living near wind turbines); Anne Dumbrille et al., *Wind turbines and adverse health effects: Applying Bradford Hill's criteria for causation*, 6 ENVIRONMENTAL DISEASE 109, 2021, at 65, https://journals.lww.com/endi/fulltext/2021/06030/wind_turbines_and_adverse_health_effects__applying.1.aspx (concluding that, while "[i]ncontrovertible proof of causation has tended to be an elusive goal," when a lower standard of causality is applied, "recurring sleep disturbance, anxiety, and stress" can be attributed to industrial wind turbines).

[243] Irene van Kamp et al., *supra* note 242. A front-page newspaper article from 2015 that attempted to infer a direct causal relationship between turbine-related infrasound and human health impacts based on the findings of a non-peer-reviewed study was widely criticized. *See* Jacqui Hoepner & Will J Grant, *Wind turbine studies: how to sort the good, the bad, and the ugly*, Conversation, Jan. 21, 2015, https://theconversation.com/wind-turbine-studies-how-to-sort-the-good-the-bad-and-the-ugly-36548; Ketan Joshi, *Windfarm weirdness syndrome is real. Just look at our national 'debate'*, Guardian, Feb. 23, 2015, https://www.theguardian.com/environment/2015/feb/23/windfarm-study-author-threatens-to-sue-media-watch-for-misrepresentation.

[244] Fiona Crichton et al., *The Link between Health Complaints and Wind Turbines: Support for the Nocebo Expectations Hypothesis*, 2 FRONTIERS PUBL. HEALTH, 2-3 (2014), https://doi.org/10.3389/fpubh.2014.00220.

[245] *Id.*

[246] *Id.*

False Claim #18: Shadow flicker from wind turbines can trigger seizures in people with epilepsy.

> *"Wind farms are more than just an eyesore. They can cause epileptic fits."*[247]

Even at its peak, shadow flicker from wind turbines typically remains far weaker than what is known to trigger seizures in people with epilepsy.[248]

A 2021 academic study found that wind turbines operate between 0.5 to 1 Hz, much lower than the threshold frequency of 3 Hz typically required to cause a seizure.[249] Similarly, a 2012 report prepared for the Massachusetts Department of Environmental Protection found that shadow flicker frequencies from wind turbines are "usually in the range of 0.3–1.0 Hz, which is outside of the range of seizure thresholds according to the National Resource Council and the Epilepsy Foundation."[250] If shadow flicker were to reach 3 Hz, the probability of causing a seizure in a member of the photosensitive population would be approximately 1.7/100,000.[251]

Additional public-health studies have likewise found that wind turbines do not cause seizures.[252] Wind turbines with three blades, for example, would need to rotate at a speed of 60 rpm to cause a seizure. [253] However, modern turbines typically operate at maximum speeds between 15 and 17 rpm, depending on model, well below the 60 rpm threshold.[254]

False Claim #19: Wind turbines are a major threat to birds and bats.

> *"The evidence is clear . . . that wind turbines present yet another threat to the lives of birds and bats."*[255]

According to the National Audubon Society, two-thirds of all North American bird species are at heightened risk of extinction due to climate change.[256] Wildfires will destroy the nesting grounds of many species,[257] while extreme heatwaves will render

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[247] *Wind Turbines Can Trigger Epileptic Fits and Seizures, Say Scientists,* DAILY MAIL (Apr. 9, 2008), https://www.dailymail.co.uk/news/article-562841/Wind-turbines-trigger-epileptic-fits-seizures-say-scientists.html.
[248] Wind Energy Technologies Office, *Frequently Asked Questions about Wind Energy, supra* note 242.
[249] Nektarios Karanikas et al., *Occupational Health Hazards and Risks in the Wind Industry*, 7 ENERGY REP. 3750, 3752-3753 (2021), https://doi.org/10.1016/j.egyr.2021.06.066.
[250] *Wind Turbine Health Impact Study: Report of Independent Expert Panel,* MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION, 36 (2012), https://www.mass.gov/doc/wind-turbine-health-impact-study-report-of-independent-expert-panel/download.
[251] *Id.*
[252] Oleksandr Zaporozhets et al., *Environment Impact Assessment for New Wind Farm Developments in Ukraine, in* 2022 IEEE 8TH INTERNATIONAL CONFERENCE ON ENERGY SMART SYSTEMS 386, 387 (Institute of Electrical and Electronics Engineers, 2022), https://doi.org/10.1109/ESS57819.2022.9969323; Loren Knopper et al., *Wind Turbines and Human Health*, 2 FRONTIERS PUBL. HEALTH, 14 (2014), https://doi.org/10.3389/fpubh.2014.00063.
[253] Knopper et al., *supra* note 252, at 14.
[254] *Id.*
[255] *FAQ: Impact on Wildlife*, NATIONAL WIND WATCH, https://www.wind-watch.org/faq-wildlife.php (last visited March 25, 2024).
[256] Audubon Society, *Survival by Degrees: 389 Bird Species on the Brink*, NAT'L. AUDUBON SOC'Y., https://www.audubon.org/climate/survivalbydegrees (last visited March 25, 2024).
[257] Audubon Society, *How Wildfires Affect Birds*, NAT'L. AUDUBON SOC'Y., https://www.audubon.org/news/how-wildfires-affect-birds (last visited March 25, 2024).

their typical habitats uninhabitable.[258] For example, the American Goldfinch is projected to lose 65% of its range under a scenario of 3 degrees Celsius global warming, while the Allen's Hummingbird is projected to lose 64% of its range. [259]

By contrast, wind power is a relatively minor source of mortality for birds. The U.S. Fish and Wildlife Service has estimated that, throughout the United States, cats kill an average of 2.4 billion birds per year, and collisions with building glass kill an average of 599 million birds, while wind turbines kill an average of 234,000 birds per year.[260] Collisions with electrical lines cause an average of 25.5 million deaths per year, a number that could grow with the construction of new transmission lines to connect wind projects (and other renewables) to the grid.[261] These mortality figures rely on studies dating back to 2013 or 2014 and may be outdated due to the fact that there were fewer wind turbines 10 years ago than there are today.[262] However, research has found that wind power causes far fewer bird deaths than fossil fuels per unit of energy output, a metric that is not sensitive to the total number of wind turbines installed. While fossil fuels cause 5.2 avian fatalities per GWh, wind turbines cause only 0.3–0.4 avian fatalities per GWh.[263]

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[258] Audubon Society, *Survival by Degrees: 389 Bird Species on the Brink*, *supra* note 257.
[259] *Id.*
[260] *Threats to Birds*, U.S. FISH & WILDLIFE SERVICE, https://www.fws.gov/library/collections/threats-birds (last visited March 25, 2024).
[261] *Id.*
[262] *Do wind turbines kill birds?* MIT CLIMATE PORTAL (Aug. 17, 2023), https://climate.mit.edu/ask-mit/do-wind-turbines-kill-birds (noting that the cited studies were published in 2013 and 2014, and the numbers are likely to be higher today because more wind farms have been built since then).
[263] Benjamin K. Sovacool, *The avian benefits of wind energy: A 2009 update*, 49 RENEWABLE ENERGY 19, 19 (2013), https://doi.org/10.1016/j.renene.2012.01.074. Sovacool's 2013 study explains that fossil fuels cause avian fatalities upstream during coal mining, through collision and electrocution with operating plant equipment, and indirectly through acid rain, mercury pollution, and climate change. *Id.* at 21. The study is based on operating performance in the United States and Europe. *Id.* at 19. Note that an earlier version of Sovacool's study, published in 2009, was critiqued for conflating birds and bats, among other issues; Sovacool responded directly to these critiques in a 2010 article and addressed many of them in the 2013 version of the study that is cited in this report. *See* Craig K.R. Willis, et al., *Bats are not birds and other problems with Sovacool's (2009) analysis of animal fatalities due to electricity generation*, 38 Energy Policy 2067 (2010); Benjamin K. Sovacool, *Megawatts are not megawatt-hours and other responses to Willis et al.*, 38 ENERGY POLICY 2,070 (2010) (responding to critiques raised about an earlier version of the study on the avian benefits of wind energy).

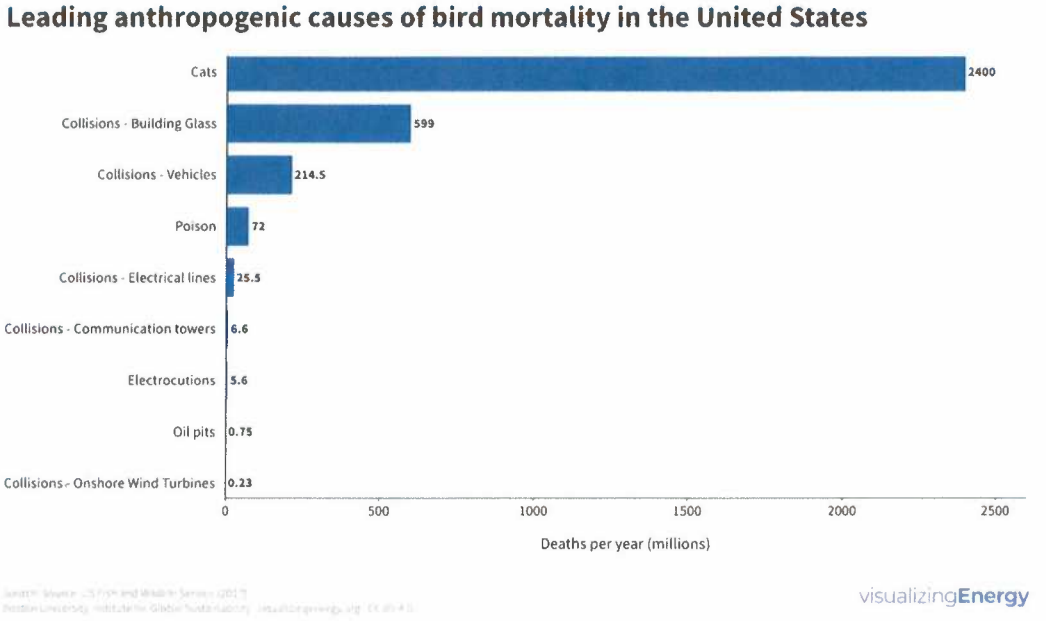

Figure 12: Leading anthropogenic causes of deaths to birds in the United States. ***Source: Boston University Institute for Global Sustainability.***[264]

The impacts of wind development on certain bat species may be more severe. One study published in 2021 estimated that the population of hoary bats in North America could decline by 50% by 2028 without adoption of measures to reduce fatalities.[265]

However, actionable steps can be taken to reduce bird and bat fatalities from wind turbines. With respect to birds, most deaths occur when turbines are sited near nesting places. Siting facilities to avoid where birds nest, feed and mate, as well as where they stop when migrating, has proved successful at reducing fatalities.[266] In addition, the wind turbine components that pose the greatest risk to birds are the blades and tower.[267] The relatively simple action of painting the tower black has been shown to reduce deaths of ptarmigans (a bird in the grouse family) by roughly 48%,[268] while painting one of the blades black has reduced deaths by 70%.[269] Other successful methods include slowing or stopping turbine motors when

[264] Cutler Cleveland et al., *Is Wind Energy a Major Threat to Birds?*, VISUALIZING ENERGY, Oct. 9, 2023, https://visualizingenergy.org/is-wind-energy-a-major-threat-to-birds/.
[265] Nicholas A. Friedenberg & Winifred F. Frick, *Assessing fatality minimization for hoary bats amid continued wind energy development*, 262 BIOLOGICAL CONSERVATION, 2021, at 1, https://www.sciencedirect.com/science/article/pii/S000632072100361X; see also Minho Kim, Wind Energy Could Get Safer for Bats with New Research.
[266] Sovacool, *The avian benefits of wind energy: A 2009 update*, *supra* note 263, at 19-20.
[267] *Id.* at 23.
[268] Bard G. Stokke et al., *Effect of tower base painting on willow ptarmigan collision rates with wind turbines*, ECOLOGY AND EVOLUTION, Apr. 29, 2020, https://onlinelibrary.wiley.com/doi/10.1002/ece3.6307.
[269] Roel May et al., *Paint it black: Efficacy of increased wind turbine rotor blade visibility to reduce avian fatalities*, ECOLOGY & EVOLUTION, July 26, 2020, https://onlinelibrary.wiley.com/doi/full/10.1002/ece3.6592; *see also* Neel Dhanesha, *Can Painting Wind Turbine Blades Black Really Save Birds*, AUDUBON MAGAZINE, Sep. 18, 2020, https://www.audubon.org/news/can-painting-wind-turbine-blades-black-really-save-birds.

vulnerable species are present, in order to reduce the likelihood of collisions.[270] Deployment of this method in Wyoming has contributed to an 80% decline in eagle fatalities.[271] With respect to bats, strategies to minimize fatalities include curtailment (*i.e.*, stopping wind turbines from spinning under certain circumstances), as well as ultrasonic acoustic deterrents[272] and visual deterrents.[273] In 2022, the U.S. Department of Energy awarded $7.5 million in research grants to study bat deterrent technologies.[274]

Overall, though it remains difficult to eliminate the risk of collisions entirely, wind power can ultimately help to protect bird and bat populations by displacing fossil fuels and mitigating climate change impacts.[275]

False Claim #20: Offshore wind development is harmful to whales and other marine life.[276]

> *"Record numbers of endangered whales [are] being killed by windfarms off America's East Coast"*[277]

When properly sited, offshore wind farms need not pose a serious risk of harm to whales or other marine life. During installation, the impact from construction noise can be mitigated by implementing seasonal restrictions on certain activities that coincide with whale migration. Once operational, wind turbines generate far less low-frequency sound than ships do, and there is no evidence that noise from turbines causes negative impacts to marine species populations.[278]

There has been considerable attention to how offshore wind development, including noise from pile-driving during construction, affects the critically endangered North Atlantic right whale, which has a total population of roughly 360.[279] But the main causes of mortality for right whales are vessel strikes (75% of anthropogenic deaths) and entanglements in

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[270] U.S. Dep't. of Energy Wind Energy Technologies Office, *Environmental Impacts and Siting of Wind Projects,* U.S. DEP'T OF ENERGY: OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY, https://www.energy.gov/eere/wind/environmental-impacts-and-siting-wind-projects (last visited March 25, 2024).

[271] Christopher J.W. McClure et al., *Eagle fatalities are reduced by automated curtailment of wind turbines*, 58 BRITISH ECOLOGICAL SOC'Y. 446, 450-451 (2021), https://doi.org/10.1111/1365-2664.13831.

[272] Friedenberg & Frick, *supra* note 265, at 8.

[273] *Chapter 4: Minimizing Collision Risk to Wildlife During Operations: Minimization: Deterrence*, RENEWABLE ENERGY WILDLIFE INST. (Dec. 27, 2022), https://rewi.org/guide/chapters/04-minimizing-collision-risk-to-wildlife-during-operations/minimization-deterrence/.

[274] U.S. Dep't. of Energy Wind Energy Technologies Office, *DOE Wind Energy Technologies Office Selects 15 Projects Totaling $27 Million to Address Key Deployment Challenges for Offshore, Land-Based, and Distributed Wind*, U.S. DEP'T OF ENERGY, Sep. 21, 2023, https://www.energy.gov/eere/wind/articles/doe-wind-energy-technologies-office-selects-15-projects-totaling-27-million.

[275] Audubon Society, *Wind Power and Birds*, NAT'L. AUDUBON SOC'Y. (Jul. 21, 2020), https://www.audubon.org/news/wind-power-and-birds.

[276] While outside the scope of this report, it bears noting that journalists have uncovered financial connections between fossil fuel interest groups and certain groups alleging that offshore wind development leads to considerable negative impacts on whales. *See* Marvell, *supra* note 11.

[277] Mike Parker, *Record Numbers of Endangered Whales Being Killed by Windfarms Off America's East Coast*, EXPRESS, (Sept 2, 2023) https://www.express.co.uk/news/us/1808681/endangered-whales-killed-east-coast-windfarms (capitalization edited to sentence case).

[278] Jakob Tougaard et al., *How Loud is the Underwater Noise from Operating Offshore Wind Turbines?* 148 J. ACOUSTICAL SOC. OF AMER. 2885, 2888 (2020), https://doi.org/10.1121/10.0002453.

[279] North Atlantic Right Whale, NOAA FISHERIES, https://www.fisheries.noaa.gov/species/north-atlantic-right-whale (last visited March 25, 2024).

fishing gear—not anything related to offshore wind development.[280] Critically, the National Oceanic and Atmospheric Administration (NOAA) has also found no link between offshore wind surveys or development on whale deaths.[281]

Moreover, any impacts to the North Atlantic right whale can be avoided or greatly minimized through proper planning. For example, in 2019, the developer of the 800-MW Vineyard Wind project entered into an agreement with three environmental organizations, which established seasonal restrictions on pile-driving during construction (to avoid excessive noise when right whales are present), as well as strict limits on vessel speeds during the operational phase (to avoid vessel strikes), among other measures.[282] In the final environmental impact statement for the project, the U.S. Bureau of Ocean Energy Management (BOEM) found that, "[g]iven the implementation of Project-specific measures, BOEM anticipates that vessel strikes as a result of [the project] alone are highly unlikely and that impacts on marine mammal individuals . . . would be expected to be minor; as such, no population-level impacts would be expected."[283] BOEM also found that project installation would be unlikely to cause noise-related impacts to right whales, due to the time of year during which construction activities would take place.[284]

Offshore wind development can have benefits for other marine species. For example, the base of an offshore wind turbine may function as an artificial reef, creating new habitats for native fish species.[285]

By contrast, offshore oil and gas drilling routinely harms marine life, while posing a persistent risk of catastrophic outcomes.[286] Sonar used for offshore oil and gas exploration emits much stronger pulses of sound than sonar used for wind farm surveying.[287] The 2010 Deepwater Horizon oil spill killed millions of marine animals, including as many as 800,000 birds.[288] More broadly, carbon dioxide emissions from fossil fuel use are making the ocean increasingly acidic, which inhibits shellfish and corals from developing and maintaining calcium carbonate shells and exoskeletons.[289] Finally, climate change is expected to have "long-term, high-consequence impacts" on whales and other marine mammals, including "increased energetic costs associated with altered migration routes, reduction of suitable breeding and/or foraging habitat, and reduced individual fitness, particularly juveniles."[290]

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[280] *Id.*; VINEYARD WIND 1 OFFSHORE WIND PROJECT FINAL ENVIRONMENTAL IMPACT STATEMENT Vol. I, March 2023, at 3-95, https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Vineyard-Wind-1-FEIS-Volume-1.pdf.
[281] Frequent Questions – Offshore Wind and Whales, NOAA, https://www.fisheries.noaa.gov/new-england-mid-atlantic/marine-life-distress/frequent-questions-offshore-wind-and-whales (last visited March 25, 2024).
[282] Vineyard Wind – NGO Agreement, Jan. 22, 2019, https://www.nrdc.org/sites/default/files/vineyard-wind-whales-agreement-20190122.pdf.
[283] Vineyard Wind Final EIS, *supra* note 280, at 3-95.
[284] *Id.* at 3-91.
[285] Steven Degraer et al., *Offshore Wind Farm Artificial Reefs Affect Ecosystem Structure and Functioning: A Synthesis,* 33 OCEANOGRAPHY 48, 49 (2020), https://doi.org/10.5670/oceanog.2020.405; *Offshore Renewable Energy Improves Habitat, Increases Fish,* RHODE ISLAND SEA GRANT (July 26, 2020), https://seagrant.gso.uri.edu/offshore-renewable-energy-improves-habitat-increases-fish/.
[286] Marvell, *supra* note 11.
[287] *Id.*
[288] Martha Harbison, *More Than One Million Birds Died During the Deepwater Horizon Disaster.* Audubon, NATIONAL AUDUBON SOCIETY (May 6, 2014), https://www.audubon.org/news/more-one-million-birds-died-during-deepwater-horizon-disaster.
[289] National Ocean Service, *What is Ocean Acidification?*, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, https://oceanservice.noaa.gov/facts/acidification.html (last visited March 25, 2024).
[290] Vineyard Wind Final EIS, *supra* note 280, at 3-85.

False Claim #21: Producing and transporting wind turbine components releases more carbon dioxide than burning fossil fuels.

> *"[W]indmills are perhaps the worst boondoggle . . . because they require much more high quality energy to manufacture, install, maintain, and back up than [they] will ever produce."*[291]

On a lifecycle basis, wind power emits far less carbon dioxide than fossil fuels per kilowatt-hour of energy generated.[292] According to the National Renewable Energy Laboratory (NREL), the average lifecycle emissions of offshore and onshore wind turbines is 13 g CO_2-eq/KWh.[293] Lifecycle emissions for fossil fuels are much higher, with natural gas and coal releasing 486 g CO_2-eq/KWh and 1001 g CO_2-eq/KWh emissions, respectively.[294] In other words, the average lifecycle emissions of wind energy is roughly 1/77th that of coal.[295]

Manufacturing accounts for only a small percentage (2.41%) of the lifecycle emissions for wind power turbines.[296] Most turbine emissions come from transportation, which accounts for over 90% of emissions for both offshore and onshore operations.[297] Once operational, wind turbines create clean, emissions-free energy that offsets the carbon dioxide emissions associated with production and transportation.[298]

False Claim #22: Wind turbines will generate an unsustainable amount of waste.

> *"This clean, green energy is not so clean and not so green . . . [i]t's just more waste going in our landfills."*[299]

Roughly 85% of the mass of a wind turbine, including the tower, gearbox, and generator, consist of metals that are easily

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[291] *Developer Claims: Wind Energy Efficiency*, INTERSTATE INFORMED CITIZENS COALITION, https://iiccusa.org/developer-claims/developer-claims-wind-energy-inefficiency/ (last visited March 25, 2024).
[292] Stacey L. Dolan & Garvin A. Heath, *Life Cycle Greenhouse Gas Emissions of Utility-Scale Wind Power,* 16 J. INDUS. ECOLOGY, S136-S154 (2012), https://doi.org/10.1111/j.1530-9290.2012.00464.x; Shifang Wang et al., *Life-Cycle Green-House Gas Emissions of Onshore and Offshore Wind Turbines*, 210 J. CLEANER PROD. 804, 807-808 (2019), https://doi.org/10.1016/j.jclepro.2018.11.031; Nat'l Renewable Energy Laboratory, *supra* note 68, at 3.
[293] Nat'l Renewable Energy Laboratory, *supra* note 68, at 3.
[294] *Id.*
[295] *Id.*
[296] Wang et al., *Life-Cycle Green-House Gas Emissions of Onshore and Offshore Wind Turbines*, *supra* note 292, at 807.
[297] *Id.* at 804.
[298] Sara Peach, *What's the Carbon Footprint of a Wind Turbine?,* YALE CLIMATE CONNECTIONS (June 30, 2021), https://yaleclimateconnections.org/2021/06/whats-the-carbon-footprint-of-a-wind-turbine/.
[299] Donnelle Eller, *Iowa's betting big on wind energy, but it's creating a problem: What happens to the blades once they're no longer useful?,* DES MOINES REGISTER (Nov. 6, 2019), https://www.desmoinesregister.com/story/money/agriculture/2019/11/06/few-recycling-options-wind-turbine-blades-head-iowa-landfills/3942480002/.

recycled.[300] The remaining 15%, including the blades, consist of composite-based materials, such as fiberglass, that are more difficult to recycle.[301] However, new technologies are in development for recycling turbine blades, and turbine blades are in fact being recycled in some facilities.[302] A recent breakthrough supported by the Department of Energy enabled all turbine components to be recycled,[303] and private companies in the United States have begun developing turbine blade recycling plants.[304]

One study from 2017 estimated that global annual waste of turbine blades will reach 2.9 million metric tons per year by 2050, with a total of 43 million metrics tons in cumulative waste generated between 2018 and 2050.[305] This is not insignificant. However, Nature Physics has projected that global cumulative waste from fossil fuel-based power generation between 2016 to 2050 is expected to produce roughly 45,550 million metric tons of coal ash alone, along with 249 million metric tons of oily sludge.[306] In other words, the cumulative waste from coal ash is expected to be roughly 1,000 times greater than that of turbine blades, and the cumulative waste of oily sludge is expected to be about 5-6 times greater than that of turbine blades. Importantly, both coal ash and oily sludge are known to be toxic.[307] For further context, in the United States alone, roughly 600 million short tons, or 544 million metric tons, of construction and demolition debris were generated across all sectors in 2018.[308] In effect, the annual construction and demolition waste in the United States alone is roughly 187 times greater than the anticipated annual waste from wind turbine blades across the globe in 2050.

False Claim #23: Wind turbines take up too much land.

> *"The wind's low power density means massive materials and land/sea area requirements."*[309]

Princeton University's 2021 report, *Net-Zero America*, concluded that the wind turbines needed for the United States to reach net-zero emissions by 2050 will have a direct footprint (*i.e.*, the area covered by turbine bases and access roads) of

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[300] Muhammad Khalid et al., *Recycling of Wind Turbine Blades Through Modern Recycling Technologies: A Road to Zero Waste*, 44 RENEWABLE ENERGY FOCUS 373, 375 (2023), https://doi.org/10.1016/j.ref.2023.02.001; Alejandro de la Garza, Time, Sept. 25, 2023, https://time.com/6316828/recycling-old-wind-turbine-blades/.

[301] *Id.*

[302] Jonas Jensen et al., *Wind Turbine Blade Recycling: Experiences, Challenges and Possibilities in a Circular Economy*, 97 RENEWABLE & SUSTAINABLE ENERGY REV.165, 171 (2018), https://doi.org/10.1016/j.rser.2018.08.041; *Recycling & recovery of wind turbines*, Roth International, https://www.roth-international.de/en/recycling-recovery/recycling-of-wind-turbines/ (last visited June 4, 2024).

[303] Wind Energy Technologies Office, *Carbon Rivers Makes Wind Turbine Blade Recycling and Upcycling a Reality with Support From DOE*, OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY (October 17, 2022) https://www.energy.gov/eere/wind/articles/carbon-rivers-makes-wind-turbine-blade-recycling-and-upcycling-reality-support.

[304] Dave Downey, *Here's How One Iowa Company is Taking Wind Turbine Blades Out of the Landfill*, WE ARE IOWA (January 24, 2023), https://www.weareiowa.com/article/tech/science/environment/recycling-wind-turbine-blades-regen-fiber-travero-alliant-energy-fiberglass-iowa/524-88fe0610-cede-4a56-a9a3-01a36319927c.

[305] Pu Liu & Claire Y. Barlow, *Wind turbine blade waste in 2050*, 62 WASTE MANAGEMENT 229 (Apr. 2017), https://doi.org/10.1016/j.wasman.2017.02.007.

[306] Mirletz et al., *supra* note 56, at 1376.

[307] *Id.*

[308] *Construction and Demolition Debris: Material-Specific Data*, United States Envt'l Protection Agency, https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/construction-and-demolition-debris-material (last visited Apr. 1, 2024).

[309] *Home*, NAT'L WIND WATCH, https://www.wind-watch.org/ (last visited March 25, 2024).

between 603,678 and 2,479,208 acres.[310] This is notably less than the 4.4 million acres currently used for natural gas extraction and the 3.5 million acres for oil extraction.[311]

Some analyses significantly overstate the amount of land required for wind energy, either by including the unused space between turbines or by using a metric called the visual footprint that measures the area from which turbines are visible. As Amory Lovins has stated, "Saying that wind turbines 'use' the land between them is like saying that the lampposts in a parking lot have the same area as the parking lot: in fact, about 99 percent of its area remains available to drive, park, and walk in."[312] When a wind turbine is sited on farmland, it typically uses only about 5% of the project area, leaving the rest available for agriculture and other purposes.[313]

Moreover, depending on the location and the technology used, wind turbines can also require less land per kilowatt-hour generated than fossil fuels.[314] A report by the United Nations Economic Commission for Europe (UNECE) found that total land occupation (agriculture and urban) for wind power ranged from 0.3–1 m^2/KWh for 2022.[315] The exact value depends on the type of wind tower, onshore or offshore siting, and the particular location of the turbine.[316] By comparison, natural gas values ranged from 0.6–3.3 m^2/KWh, and coal values from 7.2–23.8 m^2/KWh.[317] The UNECE report notes that these calculations do not include carbon capture and storage (CCS), which, if implemented, would decrease emissions but increase land use.[318]

Wind energy also uses far less land than biomass. Dedicated biomass consumes an average of 160,000 hectares of land per terawatt-hour per year.[319] By contrast, the land-use intensity of wind energy is only 170 hectares per terawatt-hour per year when looking at the direct footprint of wind or 15,000 hectares per terawatt-hour per year when including space between turbines.[320]

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[310] Larson et al., *supra* note 107, at 245. The report predicts that the "total wind farm area" will be significantly larger, but these numbers include the entire visual footprint of wind farms. *Id.* at 243, 245.
[311] Dave Merrill, *The U.S. Will Need a Lot More Land for a Zero-Carbon Economy,* BLOOMBERG (June 3, 2021), https://www.bloomberg.com/graphics/2021-energy-land-use-economy/.
[312] *See* Amory B. Lovins, *Renewable Energy's 'Footprint' Myth*, 24 ELECTRICITY JOURNAL 40, 41 (2011), https://www.sciencedirect.com/science/article/pii/S1040619011001436?via%3Dihub; Larson et al., *supra* note 107, at 245.
[313] McGill University, *Clearing the air: Wind farms more land efficient than previously thought*, SCIENCEDAILY, Apr. 17, 2024, www.sciencedaily.com/releases/2024/04/240417182834.htm.
[314] *Carbon Neutrality in the UNECE Region: Integrated Life-cycle Assessment of Electricity Sources*, UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE (UNECE), United Nations, 70 (2022), https://unece.org/sites/default/files/2022-08/LCA_0708_correction.pdf.
[315] *Id.*
[316] *Id.*
[317] *Id.*
[318] *Id.*
[319] Jessica Lovering et al., *supra* note 123, at 8.
[320] *Id.*

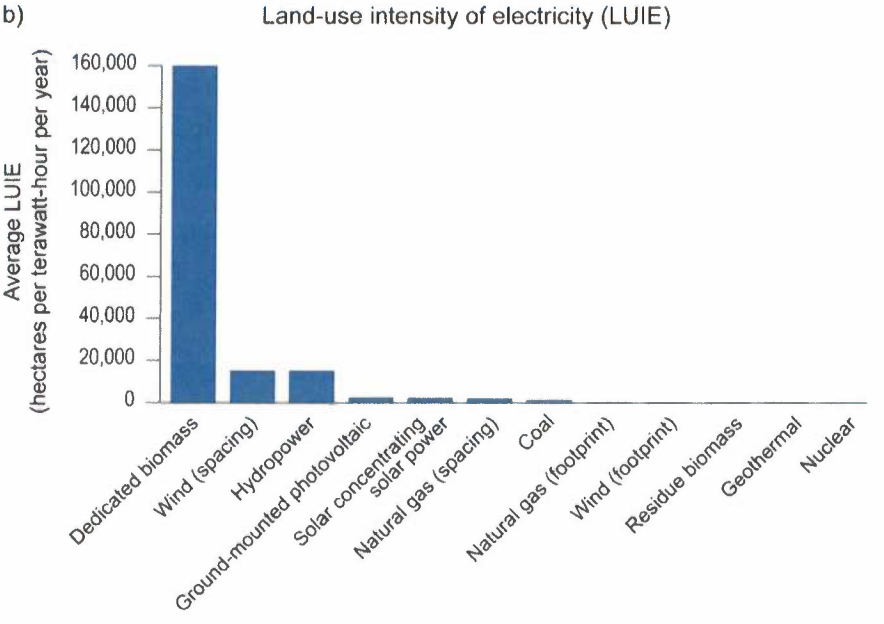

Figure 13: Average land-use intensity of electricity, measured in hectares per terawatt-hour per year.
Source: U.S. Global Change Research Program (visualizing data from Jessica Lovering et al.).[321]

Fossil fuel generation also has more harmful and enduring impacts on the land that it uses. Spills frequently occur as a result of the extraction, transportation, and distribution of oil and natural gas, causing soil and water damage. A 2017 study found that between 2% and 16% of unconventional oil and gas wells reported a spill each year, with more spills in some states than others.[322] Reclamation is difficult in areas surrounding extraction sites because of frequent leakage.[323] The land involved often suffers long-term damage and can only be used for limited purposes.[324] Moreover, abandoned coal mines and orphaned oil and gas wells can continue to threaten public health by contaminating groundwater, emitting methane and other noxious gases, and, in the case of abandoned coal strip mines, even result in continuing risk from falling boulders.[325] There are currently over 130,000 documented orphaned oil and gas wells in the United States[326]; in one state, Kentucky, nearly 40% of purportedly "active" coal mines are "functionally abandoned."[327]

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[321] U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 124, at 32-29 (visualizing data from Jessica Lovering et al., *supra* note 123, at 8).
[322] Lauren A. Patterson, *Unconventional Oil and Gas Spills: Risks, Mitigation Priorities, and State Reporting Requirements*, 51 ENVT'L SCIENCE & TECHNOLOGY 2563, 2563 (2017), https://pubs.acs.org/doi/full/10.1021/acs.est.6b05749.
[323] Brady Allred et al., *Ecosystem Services Lost to Oil and Gas in North America,* 348 SCI 401, (2015), https://www.science.org/doi/full/10.1126/science.aaa4785.
[324] *Id.*
[325] *See Orphaned Wells*, U.S. DEP'T OF INTERIOR, https://www.doi.gov/orphanedwells (last visited Apr. 1, 2024); James Bruggers, *Congressional Office Agrees to Investigate 'Zombie' Coal Mines*, INSIDE CLIMATE NEWS, Jan. 12, 2024, https://insideclimatenews.org/news/12012024/kentucky-zombie-coal-mines/.
[326] *Federal Orphaned Well Program*, U.S. BUREAU OF LAND MANAGEMENT, https://www.blm.gov/programs/energy-and-minerals/oil-and-gas/federal-orphaned-well-program (last visited Apr. 1, 2024).
[327] Bruggers, *supra* note 325.

By contrast, utility-scale wind farms can be incorporated into America's pasture and cropland with significantly less disturbance. Wind farms directly occupy relatively small amounts of land. According to the Department of Energy, powering 35% of our national electric grid through wind turbines would require 3,200 km^2 (790,000 acres) of land, a small fraction of the United States' 2.3 billion acres of land.[328] Furthermore, there is ample space for additional land uses within wind farms: the National Renewable Energy Laboratory estimates that about 98% of the area in a wind farm is available for agriculture or other uses.[329] Moreover, plant and animal species can safely grow and roam directly up to a turbine's base. This can help native species to flourish, as well as allowing farmers to continue cultivating crops and grazing animals after wind projects are installed.[330] And reclamation of wind (and solar) energy sites can begin as soon as plants begin operation, because wind and solar require only small amount of soil disturbance compared to other energy sources.[331]

Finally, climate change produced by burning fossil fuels directly harms forests, oceans, crops, and wildlife, including by causing wildfires, algal blooms, droughts, and extreme weather events that mar the visual landscape.[332] Wind energy, in contrast, further protects local landscapes by mitigating climate impacts.

False Claim #24: Wind power, particularly offshore wind power, is too expensive.

> *"[W]ind farms . . . cannot produce electricity competitively and require massive government subsidies for both installation and subsequent operation. Rate payers are hit [with] a double whammy, higher electric rates and higher taxes to pay the subsidies."*[333]

In the United States, onshore wind has the lowest unsubsidized levelized cost of energy (LCOE) of all utility-scale energy sources. Onshore wind's mean unsubsidized LCOE is $50/MWh, substantially lower than the mean unsubsidized LCOE of gas combined cycle ($70/MWh), coal ($117/MWh), and gas peaking ($168/MWh).[334] And, as the figure below from Lazard shows, although offshore wind power is more expensive than gas combined cycle when subsidies are not taken into account, the unsubsidized mean LCOE for offshore wind ($106) is still lower than that of gas peaking and coal.[335]

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[328] *Wind Vision: A New Era for Wind Power in the United States*, *supra* note 238, at 139; *Land and Natural Resources*, ECONOMIC RESEARCH SERVICE, U.S. DEP'T OF AGRICULTURE, https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/land-and-natural-resources/?topicId=a7a658d4-f209-4641-9172-066ca0896abe (last visited March 25, 2024).

[329] Paul Denholm et al., *Examining Supply-Side Options to Achieve 100% Clean Electricity by 2035* at 51, NAT'L RENEWABLE ENERGY LABORATORY, 2022, https://www.nrel.gov/docs/fy22osti/81644.pdf.

[330] Molly Bergen, *How Wind Turbines are Providing a Safety Net for Rural Farmers,* World Resources Institute (October 13, 2020), https://www.wri.org/insights/how-wind-turbines-are-providing-safety-net-rural-farmers.

[331] Amalesh Dhar, *Perspectives on environmental impacts and a land reclamation strategy for solar and wind energy systems*, 718 Science of the Total Environment 134602, 11 (2020), https://www.sciencedirect.com/science/article/pii/S0048969719345930.

[332] Savannah Bertrand, *Fact Sheet: Climate, Environmental, and Health Impacts of Fossil Fuels,* Environmental and Energy Study Institute (December 17, 2021), https://www.eesi.org/papers/view/fact-sheet-climate-environmental-and-health-impacts-of-fossil-fuels-2021.

[333] *Problems with Offshore Wind Farms Not Worth It*, NATIONAL WIND WATCH, https://www.wind-watch.org/news/2011/04/21/problems-with-offshore-wind-farms-not-worth-it/ (last visited March 25, 2024).

[334] LAZARD, *supra* note 169, at 2, 6, 9.

[335] *Id.*

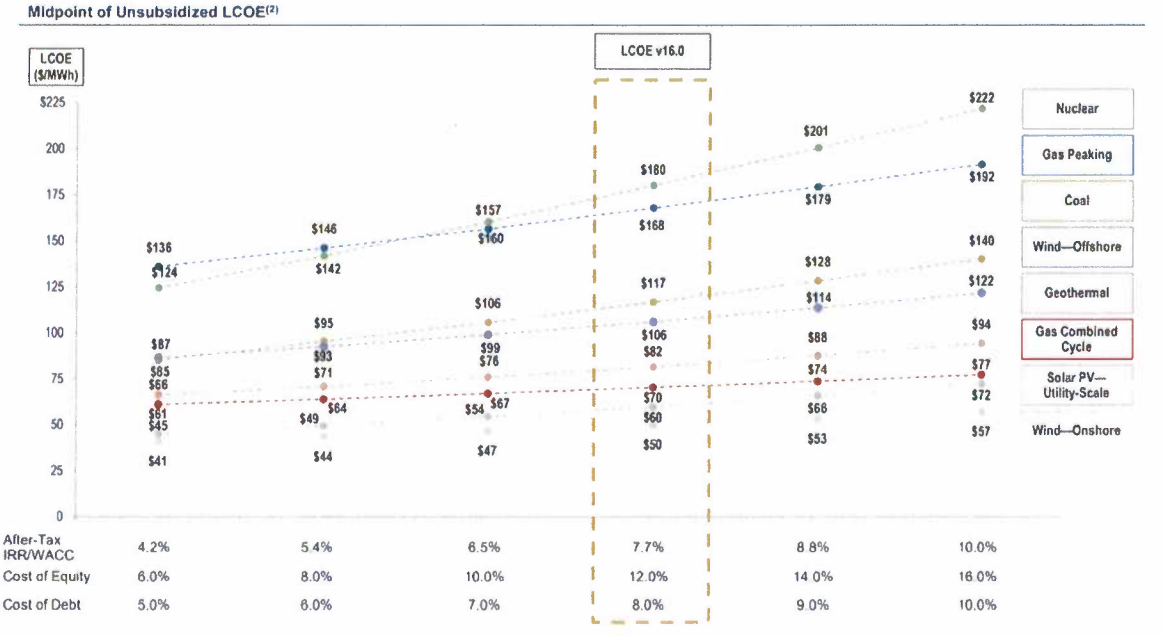

Figure 14: The range of unsubsidized LCOE for utility-scale energy sources across various cost of capital scenarios, highlighting the mean unsubsidized LCOE as of April 2023. "IRR" stands for "internal rate of return" and "WACC" stands for "weighted average cost of capital."
Source: Lazard.[336]

In addition, the LCOE for offshore wind power has declined substantially over the past decade.[337] The Department of Energy's most recent offshore wind market report estimates that the LCOE for a fixed-bottom offshore wind project beginning operations in 2022 would have been roughly 50% lower than one beginning operations in 2014, despite a 6% increase in costs compared to a 2021 cost estimate.[338] Researchers further project that the average LCOE for offshore wind energy will fall to $63/MWh by 2030.[339]

Due in large part to this dramatic price decline, deployment of offshore wind has surged in recent years, both domestically and globally. By the end of 2022, global capacity had reached 59,009 MW, up roughly 18% from 2021.[340] As of the end of May 2023, the pipeline of U.S. offshore wind projects in development and operation was estimated to represent 52,687 MW of wind energy capacity, a 15% growth compared to May 2022.[341] It bears noting, however, that several offshore wind

[336] *Id.* Reproduced with permission.
[337] *See* Walter Musial et al., *Offshore Wind Market Report: 2023 Edition*, OFFICE OF ENERGY EFFICIENCY & RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY, at xiii, 81-83 (2023), https://www.energy.gov/sites/default/files/2023-09/doe-offshore-wind-market-report-2023-edition.pdf; *see also* Ryan Wiser et al., *Expert Elicitation Survey Predicts 37% to 49% Declines in Wind Energy Costs by 2050*, 6 NATURE ENERGY, 555, 557 (2021), https://doi.org/10.1038/s41560-021-00810-z.
[338] Musial et al., *supra* note 337, at xiii, 81-83.
[339] *Id.*
[340] *Id.* at xii; Walter Musial et al., *Offshore Wind Market Report: 2022 Edition*, OFFICE OF ENERGY EFFICIENCY & RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY, ix (2022), https://www.energy.gov/sites/default/files/2022-09/offshore-wind-market-report-2022-v2.pdf.
[341] Musial et al, *supra* note 337, at viii.

projects have been removed from the U.S. offshore wind pipeline since May 2023 as a result of project cancellation.[342] This includes Ocean Wind I and II, canceled in October 2023, which were anticipated to deliver over 2,200 MW of wind energy capacity.[343]

Once operational, offshore wind turbines generate more energy and greater revenues than onshore wind farms, due to higher and steadier wind speeds; they also have the advantage of generating energy closer to many U.S. coastal population centers, thus reducing the need for long-distance transmission.[344] According to the European Wind Energy Association, while the average onshore wind turbine generates enough energy to power 1,500 homes, the average offshore turbine can power more than 3,300 homes.[345] Moreover, when factoring in costs associated with climate change and human health impacts, offshore wind becomes even less expensive compared to many fossil fuel energy sources.[346]

False Claim #25: Wind turbines are bad for farmers and rural communities.

> *"The construction of industrial wind turbines affects aquifers, water flow, tile lines, soil erosion, soil compaction, air pressure and current. In essence, it is destruction of the best soil in the world, the farmland that the generations before us were proud of and left for us to feed the world with."*[347]

Wind power offers farmers the opportunity to earn additional income from leasing out their land, while also growing crops or grazing livestock.[348] As a result, many farmers view wind turbines as beneficial for their farmland and the local community.[349] And wind farms leave ample space for continued agricultural use: the National Renewable Energy Laboratory

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[342] *See* Associated Press, *In a setback for the wind industry, 2 large offshore projects are canceled in N.J.*, NPR, Nov. 1, 2023, https://www.npr.org/2023/11/01/1209986572/offshore-wind-energy-new-jersey-orsted; Heather Richards, *Offshore wind faces more financial turbulence in 2024*, ENERGYWIRE, Jan. 8, 2024, https://www.eenews.net/articles/offshore-wind-faces-more-financial-turbulence-in-2024/.

[343] Ocean Wind 2, https://oceanwindtwo.com/ (last visited March 25, 2024).

[344] *What are the Advantages and Disadvantages of Offshore Wind Farms?*, AMERICAN GEOSCIENCE INSTITUTE, https://www.americangeosciences.org/critical-issues/faq/what-are-advantages-and-disadvantages-offshore-wind-farms (last visited March 25, 2024); Adrijana Buljan, *Offshore Wind Costs in 2050 Could be Lower than Previously Expected,* OFFSHOREWIND.BIZ (Apr. 19, 2021), https://www.offshorewind.biz/2021/04/19/offshore-wind-costs-in-2050-could-be-lower-than-previously-expected/; Laura Small et al., *Fact Sheet | Offshore Wind: Can the United States Catch Up With Europe?*, ENVIRONMENTAL & ENERGY STUDY INSTITUTE, 3 (January 4, 2016), https://www.eesi.org/papers/view/factsheet-offshore-wind-2016; *Wind Turbines: the Bigger, the Better*, UNITED STATES DEP'T OF ENERGY, Aug. 24, 2023, https://www.energy.gov/eere/articles/wind-turbines-bigger-better.

[345] Laura Small et al., *supra* note 344, at 3.

[346] *Id.* at 2; Paul R. Epstein et al., *Full Cost Accounting for the Life Cycle of Coal*, 1219 ECOLOGICAL ECON. REV., ANNALS OF THE N.Y. ACADEMY OF SCIENCES, Apr. 2011, 73-98 (Robert Costanza, Karin Limburg & Ida Kubiszewski eds., 2011), https://pubmed.ncbi.nlm.nih.gov/21332493/.

[347] SAVE PIATT COUNTY, *supra* note 233.

[348] *See Wind Energy's Economic Impacts to Communities Energy,* OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY, https://windexchange.energy.gov/projects/economic-impacts (last visited March 26, 2024); Elizabeth Weise, *Wind energy gives American farmers a new crop to sell in tough times*, USA TODAY, Feb. 16, 2020 (updated Feb. 20, 2020), https://www.usatoday.com/story/news/nation/2020/02/16/wind-energy-can-help-american-farmers-earn-money-avoid-bankruptcy/4695670002/.

[349] Kirsty Holstead et al., *Discourses of On-Farm Wind Energy Generation in the UK Farming Press*, 19 J. ENV'T. POL'Y & PLAN. 391, 399 (2017), https://doi.org/10.1080/1523908X.2016.1224157; Sarah Mills, *Wind Energy and Rural Community Sustainability, in* HANDBOOK SUSTAINABILITY & SOC. SCI. RSCH. 215, 219-221 (Walter Leal Filho, Robert W. Marans & John Callewaert eds., 2018), https://doi.org/10.1007/978-3-319-67122-2_12.

estimates that about 98% of the area in a typical wind farm is available for agriculture or other uses.[350] The New York Farm Bureau has stated that "[w]ind turbines are geared towards continued farming activities, because wind turbines are typically spaced one acre apart."[351] Moreover, "[l]ivestock are unaffected by the presence of wind turbines and will graze right up to the base of wind turbines."[352]

The additional income from lease payments can help farmers keep their land in production.[353] One 2017 University of Michigan study found that farmers with turbines tend to invest twice as much in their farms as farmers without wind turbines.[354] In addition, property tax payments from utility-scale wind projects provide revenue to rural communities for investing in schools, roads, and bridges.[355]

Farmers with turbines also appear more confident that they will continue to own their farms at the time of death. In the University of Michigan study, survey results showed 80% of those with turbines had a plan of succession for their farm, while only 62% of those without a turbine had a succession plan.[356] The researchers concluded that this difference was likely due to added income the wind turbine provided.[357]

Wind farms can likewise contribute to agricultural productivity. A 2019 study of Gobi Desert wind farms, from China's Zhejiang University, found that turbine proximity made local vegetation "more metabolically efficient, with higher community coverage, density, and AGB [aboveground biomass]."[358] Recent research from Iowa State's Agronomy department posits that related benefits to agricultural yields might stem from increased photosynthesis capacity as turbines draw additional carbon dioxide out of the soil.[359] Further studies suggest that wind turbines may even increase crop yields on neighboring farms, by minimizing harmful temperature extremes in the surrounding area.[360] Moreover, while recognizing that wind farm installation can contribute to short-term soil degradation, a 2020 analysis from Brazil's Universidade Federal do Ceará concluded that these installations produce impacts less intense than those "caused by agricultural use and rainfall in the same period" and that local farmers found it possible "to reconcile agriculture and wind power generation without major repercussions on rural lots."[361]

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[350] Paul Denholm et al., *supra* note 329 at 51.

[351] NEW YORK FARM BUREAU, LEASING YOUR FARMLAND FOR WIND & SOLAR ENERGY DEVELOPMENT: A BEGINNER'S GUIDE FOR FARMERS at 3 (2014), https://www.nyfb.org/application/files/2014/9780/6349/file_y349d211hx.pdf; *see also id.* ("Wind turbine installations are compatible with livestock grazing and growing crops.").

[352] *Id.*; *see also id.* ("Wind turbines are sturdy enough to withstand cattle using them as rubbing posts or for shade.").

[353] *Wind Energy's Economic Impacts to Communities*, *supra* note 348; Kirsty Holstead et al., *Discourses of On-Farm Wind Energy Generation in the UK Farming Press*, 19 J. ENV'T. POL'Y & PLAN. 391, 399 (2017), https://doi.org/10.1080/1523908X.2016.1224157; Mills, *supra* note 349, at 219-221.

[354] Mills, *supra* note 349, at 219-221.

[355] *Wind Energy's Economic Impacts to Communities*, *supra* note 348.

[356] Mills, *supra* note 349, at 215, 219.

[357] *Id.* at 215, 219-220.

[358] Kang Xu et al., *Positive Ecological Effects of Wind Farms on Vegetation in China's Gobi Desert*, SCI. REPORTS 9, 6341 (2019) https://www.nature.com/articles/s41598-019-42569-0.

[359] Ed Adcock, *Iowa State University Research Finds Wind Farms Positively Impact Crops*, IOWA STATE UNIVERSITY EXTENSION AND OUTREACH, Mar. 5, 2018, https://www.extension.iastate.edu/news/iowa-state-university-research-finds-wind-farms-positively-impact-crops.

[360] Daniel T. Kaffine, *Microclimate effects of wind farms on local crop yields*, 96 J. ENV'T. ECON. MGMT. 159, 159-160 (2019), https://doi.org/10.1016/j.jeem.2019.06.001.

[361] Manoel Fortunato Sobrinho Júnior et al., *Soil Use and Occupation of Wind Farm Agricultural Areas*, 19 MERCATOR - REVISTA DE GEOGRAFIA DA UFC, 1, 3, (2020), https://www.redalyc.org/journal/2736/273664287012/273664287012.pdf.

False Claim #26: Wind energy is bad for U.S. jobs.

"Subsidised wind and solar destroy far more jobs than they ever 'create'"[362]

Wind power is a fast-growing industry, creating many U.S. jobs. In 2021, wind energy production employed roughly 120,000 U.S. workers, creating roughly 5,400 new jobs (up 4.7%) since 2019.[363] The Department of Energy suggests that this sector could employ as many as 600,000 U.S. workers by 2050.[364] As noted previously, the United States' Fifth National Climate Assessment predicts that there will be nearly 3,000,000 new solar, wind, and transmission-related jobs by 2050 in a high electrification scenario and 6,000,000 new jobs in a 100% renewable scenario, with less than 1,000,000 fossil fuel-related jobs lost.[365]

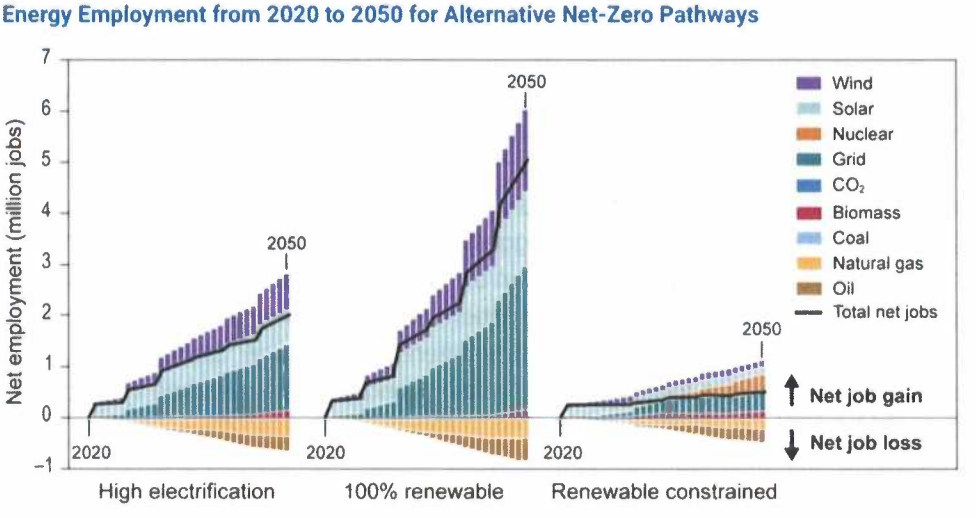

Figure 15: Energy employment from 2020 to 2050 under various U.S. net-zero GHG emissions scenarios.
Source: U.S. Global Change Research Program.[366]

Most of the current domestic jobs are in manufacturing.[367] Over 500 U.S. manufacturing facilities now specialize in producing components for wind power generation.[368] For turbines installed in the United States, approximately 70% of tower

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[362] *Renewable Energy Job Myth: Subsidised Wind and Solar Destroy Far More Jobs Than They Ever "Create,"* STOP THESE THINGS, May 11, 2020, https://stopthesethings.com/2020/05/11/renewable-energy-job-myth-subsidised-wind-and-solar-destroy-far-more-jobs-than-they-ever-create/ (capitalization edited to sentence case).
[363] *United States Energy & Employment Report 2022*, OFFICE OF POLICY, OFFICE OF ENERGY JOBS, U.S. DEPARTMENT OF ENERGY, 24 (June 2022), https://www.energy.gov/sites/default/files/2022-06/USEER%202022%20National%20Report_1.pdf.
[364] *Wind Vision: A New Era for Wind Power in the United States*, *supra* note 238, at 139.
[365] U.S. GLOBAL CHANGE RESEARCH PROGRAM, *supra* note 124, at 32-31.
[366] *Id.*
[367] James Hamilton et al., *Careers in Wind Energy*, U.S. BUREAU OF LABOR STATISTICS (Sept. 2010), https://www.bls.gov/green/wind_energy/wind_energy.pdf
[368] Wind Energy Technologies Office, *Wind Manufacturing and Supply Chain*, OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY, https://www.energy.gov/eere/wind/wind-manufacturing-and-supply-chain (last visited March 25, 2024).

manufacturing and 80% of nacelle assembly also occurs domestically.[369] Furthermore, the U.S. Bureau of Labor Statistics identified wind turbine service technicians as the fastest growing occupation between 2022 and 2023, growing roughly 45% in size during that time.[370]

False Claim #27: Wind turbines destroy nearby property values.

> *"[T]he presence of a wind power facility is likely to drive down the value of surrounding properties."*[371]

Multiple academic studies have assessed the impact of wind turbines on property values. Most recently, a March 2024 study found that having a wind turbine in a home's viewshed reduces the sales price by 1.12% on average.[372] The study found that the negative impact of turbines on property values was primarily observed for urban, rather than rural, properties, and that any negative impact on property values disappeared within ten years after turbine installation.[373] The study also found that turbine installations have become less disruptive to home values over time: the researchers found no statistically-significant impact on home values for turbines installed after 2017 and stated that the 1.12% average impact "is larger than the effect one would expect for recent and future installations."[374]

For comparison, a December 2023 study found evidence that, when a wind development is announced within one mile of a home, prices decline by up to 11% compared to homes three to five miles away. [375] However, home prices return to within 2% of inflation-adjusted pre-announcement levels roughly five years after the project enters operation.[376] The study found that the population of the county mattered: the decrease was roughly 15% in counties with over 250,000 people but statistically insignificant in counties with fewer than 250,000 people.[377] The study also found no statistically-significant adverse impacts on home sale prices outside of 1.25 miles from the nearest turbine.[378]

An earlier study from 2021 testing how turbine size affects property values at varying distances found that, on average, nearby turbine installation decreases home value by 1.8%.[379] The study also found that the farther a turbine was placed from a home, the less impact it had on property value.[380] The greatest impact, a price drop of 8.3%, occurred when a large turbine (>150 meters) was placed within 750 meters of a home.[381] The greatest impact from a medium sized turbine (50–

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[369] *Id.* The nacelle is the housing that holds the gearbox, generator, drivetrain, and brake assembly.
[370] *Fastest Growing Occupations*, U.S. BUREAU OF LABOR STATISTICS (Sept. 2023), https://www.bls.gov/ooh/fastest-growing.htm.
[371] *FAQ: Economics*, NATIONAL WIND WATCH, https://www.wind-watch.org/faq-economics.php (last visited March 25, 2024).
[372] Wei Guo et al., *The visual effect of wind turbines on property values is small and diminishing in space and time*, PNAS, March 2024, at 2, https://www.pnas.org/doi/epdf/10.1073/pnas.2309372121.
[373] *Id.* at 3.
[374] *Id.* at 3-4.
[375] Eric J. Brunner et al., *Commercial wind turbines and residential home values: New evidence from the universe of land-based wind projects in the United States*, 185 ENERGY POLICY 113837, at 1 (2023), https://www.sciencedirect.com/science/article/pii/S0301421523004226?via%3Dihub.
[376] *Id.* at 1.
[377] *Id.* at 9-10.
[378] *Id.* at 7, 10.
[379] Martijn Dröes et al., *Wind Turbines, Solar Farms, and House Prices*, 155 ENERGY POL'Y, 2 (2021), https://doi.org/10.1016/j.enpol.2021.112327.
[380] *Id.* at 8.
[381] *Id.*

150 meters) was 3.4%.[382] Beyond 2,250 meters, moreover, the 2021 study found no discernible price impact from turbines.[383] A separate study found no impact beyond 3 km. [384] The figure below shows how, for the 2021 study, size and distance of a turbine impacted property value.[385]

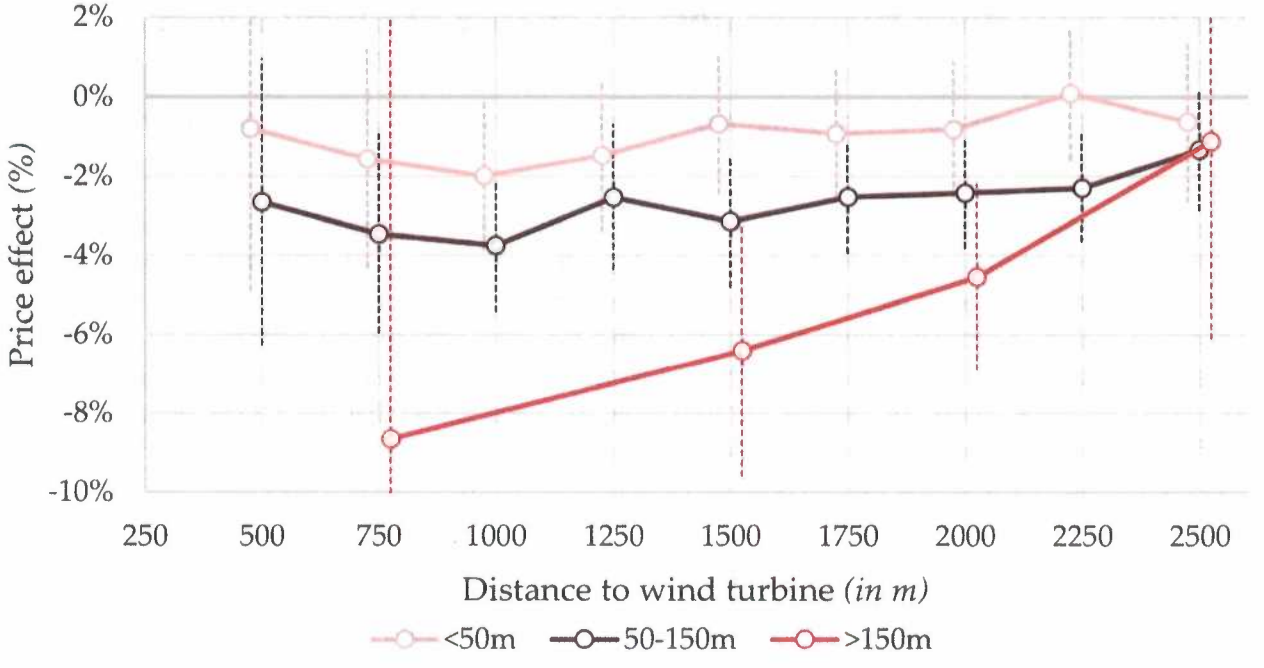

Figure 16: Graph shows how different size of wind turbines, and distance from property, affects home value. Turbine height is calculated as axis height plus half of the rotor blade diameter.
Source: Martijn Dröes et al.[386]

Another academic study of roughly 50,000 Rhode Island single-family home transactions located within 5 miles of a turbine site found no statistically significant price impact.[387] While yet another academic study of roughly 50,000 home transactions (spread across nine states) within 10 miles of a turbine site likewise found no statistically significant evidence of a price

[382] *Id.*
[383] *Id.*
[384] Cathrine Jensen et al., *The Impact of On-Shore and Off-Shore Wind Turbine Farms on Property Prices*, 116 ENERGY POL'Y 54, 50-59 (2018), https://doi.org/10.1016/j.enpol.2018.01.046.
[385] Martijn Dröes et al., *supra* note 379, at 8.
[386] *Id.*
[387] Corey Lang et al., *The Windy City: Property Value Impacts of Wind Turbines in an Urban Setting,* 44 ENERGY ECON. 413, 420-421 (2014), https://doi.org/10.1016/j.eneco.2014.05.010.

change. [388] By contrast, a 2011 paper found that the presence of a fossil fuel fired power plant within 2 miles of one's home decreased its value by 4–7%.[389] Among the fossil fuel power plants in the study sample, 92% were natural gas plants.[390]

Finally, these impacts can be mitigated. For example, multiple studies recommend clustering turbines within wind farms.[391] One of these studies found that adding a turbine within two kilometers of an existing turbine had a statistically insignificant impact on house prices.[392] It bears noting, however, that turbines must be spaced in such a way as to minimize wake interference, the phenomenon where an upstream wind turbine interferes with the production of a downstream turbine.[393]

False Claim 28: Wind energy is unreliable.

> *"[B]ecause of the wind's intermittency and high variability, they do next to nothing to reduce the need for other fuels."*[394]

As with solar energy, complete reliance on wind energy would pose intermittency challenges. However, wind, solar, and storage together can provide the majority of the country's electricity without compromising reliability,[395] and energy efficiency and grid flexibility mechanisms can support a renewable energy-based grid.[396] Hydropower has also been found to support wind and solar by compensating for intermittency in those sources.[397] Moreover, building more long-distance transmission infrastructure can enable greater reliance on wind and solar generation,[398] and linking offshore wind projects through offshore transmission networks is also expected to enhance grid reliability.[399] A National Renewable Energy Laboratory report concluded that "wind power can support power system reliability" by providing "active power controls,"[400]

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[388] Lucas Nelsen, *Are Property Values Affected by Wind Farms?*, CENTER FOR RURAL AFFAIRS (July 19, 2018), https://www.cfra.org/blog/are-property-values-affected-wind-farms.

[389] Lucas Davis, *The Effect of Power Plants on Local Housing Value and Rents*, 93 REV. ECON. STAT. 1391 (2011), https://doi.org/10.1162/rest_a_00119.

[390] *Id.* at 1400.

[391] Cathrine Jensen et al., *supra* note 384, at 51; Martijn Dröes et al., *supra* note 379, at 7.

[392] Martijn Dröes et al., *supra* note 379, at 7.

[393] *See* Daniel R. Houck, *Review of wake management techniques for wind turbines*, 25 Wind Energy 195, 195-96 (2022), https://onlinelibrary.wiley.com/doi/epdf/10.1002/we.2668.

[394] *Id.*

[395] *See* Eric Larson et al., *supra* note 107, at 88 (noting that, "[t]o ensure reliability, all cases maintain 500-1,000 GW of firm generating capacity through all years," compared to 7,400-9,900 GW for wind and solar in net-zero scenarios for 2050).

[396] *See* Amory B. Lovins, *Reliably integrating variable renewables: Moving grid flexibility resources from models to results*, *supra* note 190.

[397] Rui Shan et al., *Complementary relationship between small-hydropower and increasing penetration of solar photovoltaics: Evidence from CAISO*, 155 RENEWABLE ENERGY 1139, 1140 (2020).

[398] *See id.* at 97 (noting that "[l]imiting inter-regional transmission capacity to a maximum of 2x current capacity . . . leads to slightly more gas w/ [carbon capture] and less wind").

[399] OFFICE OF ENERGY EFFICIENCY & RENEWABLE ENERGY, U.S. DEP'T OF ENERGY, ATLANTIC OFFSHORE WIND TRANSMISSION STUDY, at vii (March 2024), https://www.nrel.gov/docs/fy24osti/88003.pdf.

[400] Erik Ela et al., *Active Power Controls from Wind Power: Bridging the Gaps* at xi, NAT'L RENEWABLE ENERGY LABORATORY, Jan. 2014, https://www.nrel.gov/docs/fy14osti/60574.pdf; *see also NREL Report Redefines Wind as a Grid Stabilizer, Not a Liability*, NAT'L RENEWABLE ENERGY LABORATORY, Jan. 2014, https://www.nrel.gov/docs/fy14osti/60993.pdf; Weihang Yan et al., *Synchronous Wind: Evaluating the Grid Impact of Inverterless Grid-Forming Wind Power Plants*, NAT'L RENEWABLE ENERGY LABORATORY, 2023 (preprint), https://www.nrel.gov/docs/fy23osti/84609.pdf.

which are mechanisms for balancing the power generated by wind farms with the power consumed on the electricity grid.[401] And although the reliability of wind and solar energy was questioned following Texas' widespread power outages in the winter of 2021, Texas' grid failure was primarily caused by freezing natural gas infrastructure, rather than failures at wind and solar farms, though nuclear, coal, and wind also experienced disruptions at a smaller scale.[402]

Wind energy has already been successfully incorporated into the United States' electric grid at significant scale.[403] Domestic energy production from wind more than tripled between 2011 and 2022, from 120 billion kilowatt-hours (2.9% of total energy production) to 435 billion kilowatt-hours (10.3% of total energy production).[404] Some states have seen even more rapid growth. In 2021, wind energy accounted for 58% of electricity production in Iowa, and 43% of electricity production in Kansas.[405]

Wind power has enabled Iowa not only to reduce energy costs, but to generate additional revenue by selling excess power to neighboring states during shortages.[406] Today, Iowa is considered one of the states with the most reliable energy systems.[407] In California, electricity generated from wind power increased from roughly 3% in 2009, to roughly 7% in 2022. Electricity generated from natural gas declined from roughly 56% in 2009, to roughly 47% in 2022.[408] Yet even with this increased reliance on wind power, California's grid reliability has remained consistent, and largely above national averages.[409] California has even been able to briefly meet 103% of its energy demands exclusively from renewable sources, demonstrating that a large economy can by powered by renewable energy.[410] The UK has also made substantial progress utilizing wind power, which was responsible for 26.8% of overall energy production in 2022, and which helped stave off the worse impacts from the energy crisis following Russia's invasion of Ukraine.[411]

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[401] Jan-Willem van Windergarden et al., *Active Power Control of Waked Wind Farms*, 50 IFAC 4484, 4484, (July 2017), https://www.sciencedirect.com/science/article/pii/S240589631730722X.

[402] Joshua W. Busby et al., *Cascading risks: Understanding the 2021 winter blackout in Texas*, 77 ENERGY RESEARCH AND SOCIAL SCIENCE 102106 (2021), 1-4, https://www.sciencedirect.com/science/article/pii/S2214629621001997; Adriana Usero & Salvador Rizzo, *'Frozen windmills' aren't to blame for Texas's power failure*, WASH. POST, Feb. 18, 2021, https://www.washingtonpost.com/politics/2021/02/18/frozen-windmills-arent-blame-texass-power-failure-neither-is-green-new-deal/; Dionne Searcey, *No, Wind Farms Aren't the Main Cause of the Texas Blackouts*, N.Y. TIMES, Feb. 17, 2021 (updated May 3, 2021), https://www.nytimes.com/2021/02/17/climate/texas-blackouts-disinformation.html.

[403] *Wind Explained: Electricity Generation from Wind*, U.S. ENERGY INFORMATION ADMINISTRATION, https://www.eia.gov/energyexplained/wind/electricity-generation-from-wind.php (last visited March 25, 2024).

[404] *Id.*

[405] Niccolo Conte, *Which US State Generates the Most Wind Power? There's a Clear Winner*, WORLD ECONOMIC FORUM (April 26, 2022), https://www.weforum.org/agenda/2022/04/us-wind-electricity-generation-renewable-energy/.

[406] Chazz Allen, *Iowa Leads in Homegrown, Reliable, Renewable Energy*, GAZETTE (November 12, 2022) https://www.thegazette.com/guest-columnists/iowa-leads-in-homegrown-reliable-renewable-energy/.

[407] *Energy Rankings: Measuring States' Energy Infrastructure,* U.S. NEWS AND WORLD REPORT, https://www.usnews.com/news/best-states/rankings/infrastructure/energy (last visited March 25, 2024).

[408] California Energy Comm'n, *Total System Electric Generation 2009-2022 with totals*, CALIFORNIA ENERGY COMMISSION, (2022), https://www.energy.ca.gov/media/7311.

[409] California Energy Comm'n, *Electric System Reliability Annual Reports*, CALIFORNIA ENERGY COMMISSION, (2022), https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/electric-reliability/electric-system-reliability-annual-reports.

[410] Lauren Sommer, *California Just Ran on 100% Renewable Energy, but Fossil Fuels Aren't Fading Away Yet*, NPR (May 13, 2022), https://www.npr.org/2022/05/07/1097376890/for-a-brief-moment-calif-fully-powered-itself-with-renewable-energy.

[411] Georgina Rannard, *Wind Generated a Record Amount of Electricity in 2022*, BBC NEWS, (January 6, 2023), https://www.bbc.com/news/science-environment-64179918.

False Claim 29: Wind turbines are very noisy.

> *"Noise created by commercial-scale wind turbines has become a major concern around the world as wind power development continues to proliferate."*[412]

In a 2021 environmental impact statement for the 120-turbine, 500-MW Rail Tie Wind Project in Wyoming, which is anticipated to serve the energy needs of 180,000 households, the Department of Energy found that noise generated by site operations likely would not exceed 55 A-weighted decibels (dBAs),[413] except in a worst-case scenario in which noise "might reach slightly above 55 dBA."[414] The DOE provides as a point of comparison that sounds at 60 dBA resemble those of a residential air conditioner 20 feet away, whereas sounds at 50 dBA resemble those of a residential air conditioner 50 feet away.[415]

When measured from inside a building located 124–330 meters from a wind turbine, noise produced by the turbine's motion has ranged from 30.7–43.4 decibels.[416] When measured from outside at the same distance, noise level has ranged from 38.2-50.0 decibels in summer, and 38.9–44.6 decibels in winter.[417] For context, a soft whisper is 30 decibels, a refrigerator hum is 40 decibels, and a typical conversation takes place at 60 decibels.[418] The CDC has set 70 decibels as the cutoff at which prolonged exposure can cause annoyance and hearing damage.[419] Also, noise has substantially decreased with turbine innovation: while earlier turbines created a steady noise from gears turning, modern turbines have been designed to insulate these sounds.[420]

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[412] *Noise Complaints on Rise with New Industrial Wind Power Projects*, NATIONAL WIND WATCH, https://www.wind-watch.org/faq-noise.php (last visited March 25, 2024).
[413] A-weighted decibel measurements factor into their assessment how the human ear actually perceives sound. *See Fundamentals of Noise and Sound,* FEDERAL AVIATION ADMINISTRATION, https://www.faa.gov/regulations_policies/policy_guidance/noise/basics (last visited March 25, 2024).
[414] RAIL TIE WIND PROJECT FINAL ENVIRONMENTAL IMPACT STATEMENT, Nov. 2021, at ES-vi, https://www.energy.gov/sites/default/files/2021-11/final-eis-0543-rail-tie-wind-wyoming-2021-11.pdf.
[415] *Id.* at 3-104.
[416] Chun-Hsiang Chiu et al., *Effects of Low-Frequency Noise from Wind Turbines on Heart Rate Variability in Healthy Individuals*, 11 SCI. REP. 17817, 17822 (2021), https://doi.org/10.1038/s41598-021-97107-8.
[417] *Id.*
[418] *What Noises Cause Hearing Loss?*, CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC), https://www.cdc.gov/nceh/hearing_loss/what_noises_cause_hearing_loss.html (last visited March 25, 2024)
[419] *Id.*
[420] *Wind Turbines*, ENVIRONMENTAL PROTECTION AGENCY, MINISTRY OF ENVIRONMENT OF DENMARK, https://eng.mst.dk/air-noise-waste/noise/wind-turbines/noise-from-wind-turbines/ (last visited March 25, 2024).

PART C: FALSE CLAIMS ABOUT ELECTRIC VEHICLES (#30-#33)