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ARE TAXPAYERS EXPOSED AS RENEWABLE ENERGY IS PUT ON THE FAST TRACK?

THE COUNCIL TO MODERNIZE GOVERNANCE

Government Spending and Financial Assurance Regulations Should Be Revisited

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Are Taxpayers Exposed as Renewable Energy is Put on the Fast Track? Government Spending and Financial Assurance Regulations Should be Revisited.

I. Executive Summary

Renewable energy sources—wind and solar—are a quickly growing industry. But renewable energy is not a miracle solution to any energy crisis—no matter how you define an energy crisis. Like oil, coal, natural gas, or nuclear, it comes with its own set of problems that need to be sufficiently regulated and financially sound.

If your concern is finding potentially cleaner sources of energy, solar and wind power come with their own set of environmental dilemmas, including massive disposal problems when these facilities reach their end of life and harm to wildlife and ecosystems while they are in operation.

If your concern is finding cheap and reliable energy, solar and wind power come with a different set of issues. Solar and wind both rely on sources of energy that are inconsistent. Sometimes wind and solar produce too much energy, which cannot be stored, and sometimes they do not produce enough to meet demand. Moreover, neither industry has proven to be self-sustaining, financially, without substantial government subsidies.

The existing regulatory and financial standards are inadequate to account for the costs of the industries, which may mean the companies, too, are underprepared. In Canada, at least one moratorium on renewable energy projects has been instituted due to concerns about financial feasibility of

decommissioning and site restoration. Renewable energy technologies are new and quickly evolving and, thus, unpredictable. As with Vineyard Wind's recent incident where a wind turbine fell into the ocean, unexpected problems are sure to arise as the technologies develop. Additionally, the costs to decommission solar and wind plants are often far greater—as much as 25 times—than the bonding and other financial assurances project and the federal governments currently require. Sufficient bonding should have already been required to meet the impending need to decommission these plants. This is especially true given that these technologies are not lasting as long as original estimates suggested.

Government, the renewable energy companies, and their financial backers, need to prepare for looming demands. Are they accounting for the sooner than intended decommissioning costs? Do they have plans for where to put the waste? Are they headed toward a financially viable and self-sustaining business model? This paper explores these topics, concluding that further study by relevant government bodies is necessary and there appears to be a strong case for a new regulatory scheme to protect the environment and taxpayers.

II. History of Renewable Energy

A. Wind

Windmill energy dates back millennia. Hammurabi himself, supposedly, created plans to harness the wind to advance irrigation.[1] Then Greek and Chinese

[1] "History of Windmills," History of Windmills, 2024, http://www.historyofwindmills.com/.

cultures actually used this technology 1500 years ago for smaller energy needs, like playing the organ.[2] Windmills were used in the United States by colonists to grind grain, pump water, and cut wood at sawmills.[3] Small electricity generating turbines were developed for use on remote farms as far back as 1887.[4]

However, efforts to commercialize the mass use of wind energy is a far more recent development. In the 1970's, oil shortages caused an effort to find other sources of energy.[5] The United States was the first to develop land-based wind plants, beginning in California and New Hampshire in the early 1980's.[6] The first commercial offshore wind plant was built in 1991 in Denmark.[7] The United States began planning an offshore wind energy strategy in 2011,[8] which led to the first off-shore wind plant in Rhode Island in 2016.[9]

B. Solar

Solar energy is a much more recent technology. In 1883, a New York inventor created a solar cell by coating selenium with a thin layer of gold,[10] that produced a

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[2] Ibid.
[3] "Wind Explained," U.S. Energy Information Administration, accessed November 29, 2024, https://www.eia.gov/energyexplained/wind/history-of-wind-power.php.
[4] Ibid.
[5] Ibid.
[6] "The History of Wind Energy," Nationalgrid, accessed November 29, 2024, https://www.nationalgrid.com/stories/energy-explained/history-wind-energy#:~:text=The%20first%20wind%20farm%20in,30%20kilowatts%20(kW)%20each.&text=In%20November%201991%2C%20the%20Delabole,wind%20farm%20in%20the%20UK.
[7] Ewing, Tom. Marine Technology, "Offshore Wind-A Brief History," Marine Technology News, June 16, 2019, https://www.marinetechnologynews.com/news/offshore-brief-history-590397.
[8] Ibid.
[9] Ibid.
[10] Elizabeth Chu and D. Lawrence Tarazano, "A Brief History of Solar Panels," Smithsonian Magazine, accessed November 29, 2024, https://www.smithsonianmag.com/sponsored/brief-history-solar-panels-180972006/.

current that was "continuous, constant, and of considerable force."[11] But this current was only a fraction of what silicone solar cells produce, which began in 1954 when Bell Labs created the first.[12] This set in motion additional milestones, including the first solar panel in 1960 and the first solar powered house in 1973.[13] The first utility-scale solar plant was created in 1982 in California.[14] As of 2016, there were 1 million solar installations in the United States.[15]

C. Renewable Energy's Reliance Upon Government Subsidies

The United States government's involvement in renewable energy began with the National Energy Act of 1978 and the Public Utilities Regulatory Policy Act (PURPA), which included a regulatory mandate that required existing utilities to generate electricity from renewable energy sources.[16] During the 1970's and 1980's, the Department of Energy sponsored a "U.S. Wind Energy Program" and worked with NASA to develop a large wind turbine program.[17] In the late 1980's, the National Renewable Energy Laboratory, operated on behalf of the U.S. Department of Energy, was formed to assist "the wind industry with the design, development,

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[11] Ibid.
[12] SEIA Comms Team, "The Solar Century: Landmark Moments in the History of Solar Energy," Solar Energy Industries Association, April 29, 2024, https://seia.org/blog/solar-century-landmark-moments-history-solar-energy/#:~:text=To%20help%20the%20growing%20U.S.,with%20other%20forms%20of%20energy.
[13] Ibid.
[14] Ibid.
[15] Ibid.
[16] James A. Duffield and Keith Collins, "Evolution of Renewable Energy Policy," Choices Magazine, 1st Quarter 2006, https://www.choicesmagazine.org/2006-1/biofuels/2006-1-02.htm.
[17] Linscott, B.S., National Aeronautics and Space Administration, *DOE Large Horizontal Axis Wind Turbine Development at NASA Lewis Research Center,* August 25, 1983, 5, https://ntrs.nasa.gov/api/citations/19830022836/downloads/19830022836.pdf.

and testing of advanced wind turbine systems that can compete with conventional electric generation."[18]

Concurrent with these developments in wind, beginning in 1974, the Solar Energy Industries Association was founded, which worked alongside the Carter administration to develop the solar industry.[19] This led to Congress passing the PURPA which, as noted, required electric utilities to buy power from cogeneration facilities, which helped launch solar power as a source of energy.[20]

In the 1990's, the United States federal and state governments established financial incentives and requirements to use renewable energy sources.[21] The Energy Policy Act of 1992 gave tax credits to develop wind and other renewable energy production.[22] The Investment Tax Credit (ITC) has been used primarily for solar developments and is a dollar-for-dollar credit for investments.[23] The Production Tax Credit (PTC) has been used primarily for wind developments and is also a dollar-for-dollar credit.[24] Since enacted in 1992, the PTC has always been temporary, but has continued to be extended through present day.[25]

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[18] S.M. Hock, R.W. Thresher, and P.R. Goldman, "The Federal Advanced Wind Turbine Program," NREL, December 1991, 3, https://www.nrel.gov/docs/legosti/old/4625.pdf.
[19] SEIA Comms Team, "Landmark Moments."
[20] "The Public Utility Regulatory Policies Act of 1978," American Public Power Association, accessed November 29, 2024, https://www.publicpower.org/policy/public-utility-regulatory-policies-act-1978.
[21] "Wind Explained."
[22] Duffield and Collins, "Evolution of Renewable Energy Policy."
[23] "About Renewable energy Tax Credits," Novogradac, accessed November 29, 2024, https://www.novoco.com/resource-centers/renewable-energy-tax-credits/about-renewable-energy-tax-credits.
[24] Ibid.
[25] Congressional Research Service, *The Renewable Electricity Production Tax Credit: In Brief,* R43453, updated April 29, 2020, Summary, https://sgp.fas.org/crs/misc/R43453.pdf.

The Inflation Reduction Act (IRA) extended the ITC to 2032 as a 30 percent credit for qualified expenditures, which then drops to 26 percent in 2033, to 22 percent in 2034, and expires in 2035.[26] The PTC was also extended by 10 years as a result of the IRA.[27] The IRA gave solar projects access to the PTC, which is viewed as the more lucrative tax credit.[28] And, the IRA committed significant amounts of money for the domestic manufacture of renewable energy components.[29]

III. Problems Raised by Renewable Energy

A. Environmental Concerns

While renewable energy seeks to address some environmental issues, both wind and solar power come with a host of environmental concerns of their own. First, they use a lot of land. Turbines have to be spaced 5-10 times the rotor diameters apart so that the turbulence from each turbine does not disturb the surrounding turbines.[30] For 500 kW turbines, that means 272 yards must be placed between them. For 2.5 MW turbines,446 yards or nearly four and one-half football fields.[31] As a result, 30-141 acres can be required per megawatt of power output.[32] For offshore facilities, even more space is required because the turbines and blades

[26] "Renewable Energy Tax Credits."
[27] "What the Inflation Reduction Act Means for the Renewable Energy Industry," RWDI, accessed November 29, 2024, https://rwdi.com/en_ca/insights/thought-leadership/inflation-reduction-act-renewable-energy-industry/.
[28] Ibid.
[29] Ibid.
[30] "Location/Size/No. of Wind Turbines," Renewables First, accessed November 29, 2024, https://renewablesfirst.co.uk/renewable-energy-technologies/windpower/community-windpower/location-size-no-of-wind-turbines/#:~:text=The%20number%20of%20wind%20turbines,turbine%20it%20is%20410%20metres.
[31] Ibid.
[32] "Environmental Impacts of Wind Power," Union of Concerned Scientists, March 5, 2013, https://www.ucsusa.org/resources/environmental-impacts-wind-power.

are longer.[33] Similarly, solar utilities use 3.5 to 10 acres of land per megawatt.[34] And, while wind sites can share use for agricultural or other purposes, solar sites cannot.[35]

Another concern is the impact to wildlife and habitat. First, it is well-known that wind turbines kill bats and birds, through direct impacts and changes in air pressure.[36] This is problematic for both land and offshore sites.[37] One estimate is that wind turbines kill 300,000 birds per year.[38] The turbines can also disrupt migration patterns and reduce the quality of habitat for birds.[39] And, the construction of offshore sites can disrupt the seabed habitat, which is particularly risky to whales, but also has impacts to fish and other marine animals.[40] It is estimated that decommissioning can destroy 95% or more of the average fish biomass and annual somatic production at the site.[41] The transmission cables can also impact the "diversity of benthic organisms" and disturbance to the seafloor can impact plankton in the water column.[42]

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[33] Ibid.
[34] Ibid.
[35] Ibid.
[36] "Environmental Impacts of Wind Power."
[37] Ibid.
[38] Gibbons, Whit, "Wind Power Comes with Environmental Costs, Hazards," Tuscaloosa News, April 8, 2023, https://www.tuscaloosanews.com/story/opinion/columns/2023/04/08/wind-power-comes-with-environmental-costs-hazards-ecoviews/70074099007/.
[39] "Wind Energy & Environmental Impacts," University of Maryland-Center for Environmental Science, accessed November 29, 2024, https://www.umces.edu/wind-energy.
[40] Ibid.
[41] Angeliki Spyroundi, "End-of-Life Planning in Offshore Wind," Catapult Offshore Renewable Energy, April 2021, 6, https://cms.ore.catapult.org.uk/wp-content/uploads/2021/04/End-of-Life-decision-planning-in-offshore-wind_FINAL_AS-1.pdf.
[42] "Wind Energy & Environmental Impacts."

Solar sites can also have a negative impact on wildlife. Some solar projects are extensive and look like large bodies of water, causing water fowl to collide with them.[43] They can also change stormwater runoff, which can sweep away some smaller animals and cause soil erosion and plant harm.[44] And, solar sites on water can cause disruption to migration and can impact water temperatures, harming marine life.[45]

Finally, impacts to humans are also of concern. People living close to wind facilities complain of sound and vibration issues.[46] And, many think they are an eyesore.

B. Maintenance And Deterioration Concerns

Like any complex technical system, wind turbines need routine maintenance. The towers' foundations suffer from corrosion and the rotor blades can be susceptible to erosion and lightning strikes.[47] These systems contain electronics, sensors and hydraulics that require "frequent repair."[48] While these systems can be easier to repair, turbines also contain gear boxes and generators, which, along with the blades themselves, are expensive to repair and can cause significant down-

[43] "Are Solar Panels Bad for Wildlife?," Sistine Solar, accessed November 29, 2024, https://sistinesolar.com/solar-panels-and-wildlife/#:~:text=Lake%20effect%3A%20Some%20solar%20projects,be%20detrimental%20to%20nearby%20animals.
[44] Ibid.
[45] Ibid.
[46] "Environmental Impacts of Wind Power."
[47] "Wind Turbines Maintenance and Reparation," Renolit, accessed November 29, 2024, https://www.renolit.com/en/industries/wind-energy/renolit-cp/wind-turbines-maintenance-and-reparation/wind-turbines-maintenance-and-reparation.
[48] Ibid.

times.[49] The cost to maintain these plants increases as the structure ages.[50] And, the energy output deteriorates with each year of operation, reducing by 1.6% per year of operation.[51]

Currently, the typical lifespan of a wind turbine is 20 years — dependent upon certain factors such as weather — which is a much shorter lifespan than other traditional electricity plants[52] which last more than 50 years.[53] This contrasts with the pre-project cost-estimates provided by companies, which state 30 years.[54] In one example, in Iowa, the turbines needed repowering, *i.e.*, updating in favor of technological advances, at just 14 years.[55] Wind turbines are also "particularly prone to damage," because, "as a moving component, the rotor blades are subject to higher levels of lading and fatigue" and suffer from birds or other objects striking them, high wind speeds, and extreme weather.[56]

Additionally, given that wind plants require newer and untested technology, problems do persist. For example, Vineyard Wind recently had a blade on one of its turbines snap near its base, sending a nearly football field-long piece of blade into

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[49] Ibid.
[50] "How Long do Wind Turbines Last?," TWI, accessed November 29, 2024, https://www.twi-global.com/technical-knowledge/faqs/how-long-do-wind-turbines-last.
[51] Iain Staffell and Richard Green, "How Does Wind Farm Performance Decline with Age?," Renewable Energy 66, (June 2014): 775-786, https://www.sciencedirect.com/science/article/pii/S0960148113005727.
[52] IER, "The Cost of Decommissioning Wind Turbines is Huge," Institute for Energy Research, November 1, 2019, https://www.instituteforenergyresearch.org/renewable/wind/the-cost-of-decommissioning-wind-turbines-is-huge/.
[53] Rolling, Mitch, "Limited Lifespans of Wind Turbines Result in Higher Costs of Energy," American Experiment, June 26, 2018, https://www.americanexperiment.org/limited-lifespans-of-wind-turbines-result-in-higher-costs-of-energy/.
[54] Ibid.
[55] Ibid.
[56] "How Long do Wind Turbines Last?"

the ocean.[57] This required search vessels and cleanup crews on the beaches, which had to be closed to clear out the chunks of fiberglass out of the water.[58] These problems not only impose unexpected costs to clean up and repair, but also raise environmental risks with large swaths of inorganic material falling into the ocean.

Solar provides less maintenance and lifespan concerns, but they do exist. If there are flaws in production quality, installation, extreme climate (such as heat, humidity, and wind), or lack of maintenance, solar panels can prematurely wear out.[59] Even in cases where the panels themselves continue to provide energy output for their anticipated lifespan, the inverters (used to convert DC current to usable AC current) are not meeting expectations, with most failing at the 10-15 year mark despite being designed for a 20-25 year lifespan.[60] As a result, one solar expert said that "the market is going to have to repair a lot of inverters over the next ten years."[61]

IV. Renewable Waste Crisis

A. What is Decommissioning?

At the end of the productive life of an energy site, the structures have to be removed and the components have to be disposed of. This can cause challenges

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[57] Heather McCarron, "'Three large blade pieces.' Vineyard Wind Wind Turbine Blade Snaps. Search Underway," Cape Cod Times, July 15, 2024. https://www.capecodtimes.com/story/news/environment/2024/07/15/vineyard-wind-investigating-damaged-turbine-blade-avangrid-copenhagen-infrastructure-partners/74416617007/.
[58] Ibid.
[59] Richardson, Mark, "How Long do Solar Farms Last?," US Light Energy, November 17, 2023, https://uslightenergy.com/how-long-do-solar-farms-last/.
[60] Emma Penrod, "US Solar Farms Are Aging. Is It Time to Begin Repowering?," Utility Dive, October 6, 2023, https://www.utilitydive.com/news/us-solar-farms-are-aging-is-it-time-to-begin-repowering/690978/.
[61] Ibid.

because the components are not always environmentally friendly, recyclable, or actually disposed of. With the impending, and accelerated, end of life of these facilities looming, it must be determined what to do with all of these components.

Across the energy sector, facility operators are obligated by law to remove the physical structures and restore the site so that it does not pose an environmental or safety risk. This means that the facilities will not only remove the physical structure, but also restore the site to a usable condition or to its original condition, depending upon the type of site. As applied to wind and solar projects, this obligation includes disassembly of the components, transportation of the components to their end-of-life destination, the restoration of the physical location, and management of the residual components.[62] However, the legal obligations are not as well developed or stringent as other energy sectors.

B. Wind Decommissioning

Regardless of whether a turbine is located onshore or off, rotor blades are challenging to remove because they contain fiberglass and carbon fibers that give off dust and toxic fumes.[63] While some can be recycled, most blade material will have to be disposed of over the next 20 years.[64] The materials are not worth much, making the cost of what recycling can be done not worthwhile.[65] As a result, the turbines

[62] Tovar, Daniel Pardo, "Begin at the End: The Cost of Decommissioning Renewable Energy Projects," DNV, October 16, 2023, https://www.dnv.com/article/begin-at-the-end-the-cost-of-decommissioning-renewable-energy-projects-248187.
[63] IER, "The Cost of Decommissioning Wind Turbines is Huge."
[64] Ibid.
[65] Paddison, Laura, "Wind Energy Has a Massive Waste Problem. New Technologies May be a Step Closer to Solving It," CNN, May 28, 2023, https://www.cnn.com/2023/05/28/world/wind-turbine-recycling-climate-intl/index.html.

are already piling up in landfills.[66] Turbine blade waste is projected to reach 2.2 million tons by 2050.[67]

An on-shore wind energy site is made up of turbines, an underground electricity collection system, a collector substation, roads and an "operations and maintenance " building, all of which must be removed.[68] The foundations are difficult to remove because they consist of cement bases going down 15 feet.[69] The structure is largely made of steel, copper, and concrete.[70] The turbines are so large that each has to be cut to a manageable size but, even then, specialized trucking is required.[71] It is estimated that room for disposal of roughly 3,000 football fields of turbines from land-based plants will have to be made by 2030.[72] But, many landfills do not have capacity for the enormous blades.[73]

Decommissioning of an offshore wind turbine requires removal of the composites, which are mostly in the blades (that will go into landfills), the steel foundations and towers, and the copper and other materials in the cables.[74] The sheer volume of material is astounding. In the United Kingdom, for example, there

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[66] Martin, Chris, "Wind Turbine Blades Can't Be Recycled, so They're Piling Up in Landfills," Bloomberg, February 5, 2020, https://www.bloomberg.com/news/features/2020-02-05/wind-turbine-blades-can-t-be-recycled-so-they-re-piling-up-in-landfills?embedded-checkout=true.
[67] Paddison, "Wind Energy Has a Massive Waste Problem."
[68] Tovar, "Begin at the End."
[69] IER, "The Cost of Decommissioning Wind Turbines is Huge."
[70] Furness, Virginia, "Decommissioning: The Dark Heart of Renewable Energy Finance," Capital Monitor, December 14, 2021, https://www.capitalmonitor.ai/analysis/decommissioning-the-dark-heart-of-renewable-energy-finance/?cf-view.
[71] IER, "The Cost of Decommissioning Wind Turbines is Huge."
[72] Ben Tracy and Analisa Novak, "A Black Eye for Green Energy? Renewable Energy Growth Brings Mounting Waste Challenge," CBS News, May 1, 2023, https://www.cbsnews.com/news/green-energy-waste-problem-used-solar-panels-wind-blades/.
[73] IER, "The Cost of Decommissioning Wind Turbines is Huge."
[74] Maslin, Elaine, "£ Billion+ Offshore Wind Decommissioning Bill," Offshore Engineer, December 16, 2019, https://www.oedigital.com/news/473730-10-billion-offshore-wind-decommissioning-bill.

are 2,225 turbines, which consist of 200,000 metric tons of composites, 1.3 metric tons of steel, 100,000 metric tons of copper (some of which could be scrapped),[75] and 50,000 tons of lead.[76] Similar to land-based plants, the question remains, do landfills have capacity for this much waste?

Although repowering turbine sites has been proposed as alternatives to complete decommissioning,[77] in reality, this is an end around to try to keep turbines active after wearing out or becoming obsolete much quicker than predicted. Repowering involves either complete removal of turbines and replacing them at the same site with larger ones or replacing some component parts of the old turbine.[78] At times, however, a primary driver of repowering is the desire to requalify for the Production Tax Credit, which provides a perverse incentive for companies to "repower" when not necessary.[79] Regardless of the motivation, repowering still results in the creation of a huge amount of waste.

Moreover, many older structures may not even be able to repower because they are incompatible with the increased size of modern turbines.[80] And, ultimately, all sites will have to be fully decommissioned, so these solutions are merely delays

[75] These metals would recoup value, but the volume is astounding.
[76] Ibid.
[77] Spyroudi, "End-of-Life Planning in Offshore Wind."
[78] Isaac Orr and Mitch Rolling, "The Death of a Wind Farm," Energy Bad Boys, January 20, 2024, https://energybadboys.substack.com/p/the-death-of-a-wind-farm?utm_source=share&utm_medium=android&r=vuih1.
[79] Ibid.
[80] Bills, Gary, "Turbine Lifetime Limits Require a Reality Check," IJ Global, July 30, 2021, https://www.ijglobal.com/articles/157132/turbine-lifetime-limits-require-a-reality-check.

to the eventual need to remove the turbine and restore the site. As of now, there appears to be no viable solution to the renewable waste crisis.

C. Solar Decommissioning

The solar industry is growing rapidly, from 222GW of global capacity in 2015 to a projected 4,500GW by 2050.[81] 40% of all new electricity capacity is solar.[82] As previously stated, these solar panels require inverters, which are wearing out faster than anticipated. Industry leaders project that, instead of repowering these facilities, companies will opt toward new builds, meaning large swaths of these materials will have to be decommissioned.[83]

With this, there will also be an increased volume of decommissioned panels, most of which will end up in landfills.[84] Specific to solar energy, the United States is expected to produce roughly 1 million tons of solar panel waste by 2030.[85] This is, in part, because it costs $20-30 per panel to recycle versus $1-2 to send to a landfill.[86] Clearly, there is a financial deterrent to recycling.

The sheer volume of solar panel waste flowing to landfills makes it necessary to regulate its disposal; yet only the European Union has adopted regulations on

[81] Nadig, Smruthi, "Recycling Renewables: What Happens to Waste from the Solar Industry?," Power Technology, August 10, 2023, https://www.power-technology.com/features/recycling-renewables-what-happens-to-waste-from-the-solar-industry/.
[82] Ibid.
[83] Penrod, "US Solar Farms Are Aging."
[84] Nadig "Recycling Renewables."
[85] Ibid.
[86] Atalay Atsu, Serasu Duran and Luk N. Van Wassenhove, "The Dark Side of Solar Power," Harvard Business Review, June 18, 2021, https://hbr.org/2021/06/the-dark-side-of-solar-power.

how to process photovoltaic cells.[87] Photovoltaic modules, which are used convert sunlight, are expensive to recycle.[88] While these panels can be recycled in-part, regulations do not require this.[89] As a result, only about 10% of panels are currently recycled, while over 78 million tons are set to be decommissioned by 2050.[90]

Do landfills have room for this volume of material? Some sources suggest that they don't.[91] Even if they do, these panels contain materials like lead and cadmium, which have harmful effects on human health and the environment.[92] With the combination of landfill space limitations and the toxic materials that would go in them, it begs the question: is this a wise solution if the goal is "clean" energy?

V. Can Renewable Energy Sources Be Economically Operated or Are They Doomed to Remain Reliant on Subsidies?

As noted above, renewable energy, as of now, is largely subsidized by the taxpayers through the PTC—a per kilowatt-hour federal tax credit for electricity generated by qualified renewable energy resources.[93] Additional financial incentives were added by the IRA if domestic steel is used or the project is constructed within an "energy community" where fossil fuels are traditionally harvested.[94]

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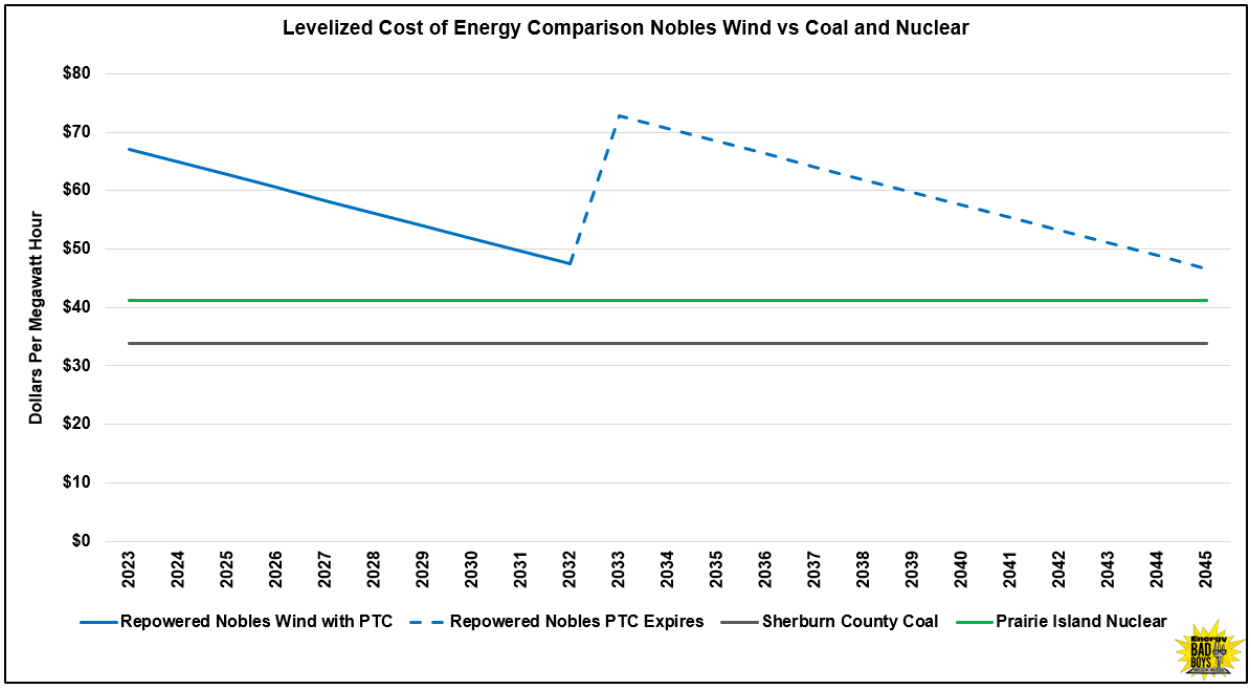
[87] Nadig, "Recycling Renewables." The United States does have regulations for solar panel materials in their general waste regulations. Ibid.
[88] Furness, "Decommissioning: The Dark Heart of Renewable Energy Finance."
[89] Nadig, "Recycling Renewables."
[90] Furness, "Decommissioning: The Dark Heart of Renewable Energy Finance."
[91] IER, "Wind Turbine Blades Will Continue to Pile Up at U.S. Landfills," Institute for Energy Research, March 6, 2020, https://www.instituteforenergyresearch.org/renewable/wind/wind-turbine-blades-will-continue-to-pile-up-at-u-s-landfills/.
[92] Nadig, "Recycling Renewables."
[93] United States Environmental Protection Agency, "Renewable Electricity Production Tax Credit Information," updated December 18, 2023, https://www.epa.gov/lmop/renewable-electricity-production-tax-credit-information.
[94] Ibid.

One problem with the PTC is that it pays wind project owners $26 per megawatt-hour, whether or not that electricity is needed.[95] This means that electricity generated from wind plants could potentially be sold into the market at a price of *negative* $25 per MWh and still turn a profit.[96] With the subsidies, operators are not forced to deal with the realities of supply and demand because they are paid regardless of consumption or even when the cost to generate is greater than the market price.[97] But once the PTC expires, which is still set to happen long before the end of the productive life of most of the projects, they would likely be uneconomical.[98]

Moreover, even the PTC subsidy is often not sufficient on its own to make wind energy economically viable in comparison to energy generated by coal or nuclear plants. This disparity is evident from a recent comparison of the cost of energy generated at an Xcel wind plant with nuclear and coal plants:[99]

[95] Orr and Rolling, "Death of a Wind Farm."
[96] Ibid.
[97] Ibid.
[98] Ibid. As the author explains, wind energy comes in surges, causing an oversupply of energy at times, which drives the prices so far down that it can cause negative pricing. Without the subsidies, these plants would have to close, or curtail, in order to avoid losing money.
[99] This graphic is attributed to the Energy Bad Boys. Ibid.



Solar power suffers from similar economic inefficiencies. Because tax credits pay the producers for their energy no matter what, peak sunlight localities might produce far more energy than is needed, yet the utility is paid for all of the energy output.[100] As a result, the solar energy producer may also pay the grid to take its energy because the credits pay the company even more.[101] It is clearly problematic if a solar company has to pay the grid to take their energy. It is even worse that they currently still make money from the effort because the tax credits incentivize them to do so. Such an arrangement would never work absent the subsidies.

This practice of paying for energy output that is not even needed is not only a waste of taxpayer dollars, it also puts other sources of energy at a disadvantage. Coal and nuclear plants do not receive this same benefit, and must regulate their

[100] Dever, Grant, "The Unintended Consequences of Tax Credits for Renewable Energy," Opp Blog, May 13, 2022, https://freopp.org/oppblog/the-unintended-consequences-of-production-tax-credits/.
[101] Ibid.

energy output consistent with market conditions.[102] The disadvantage is causing coal and nuclear power plants to struggle financially, with some even shutting down.[103]

Driving traditional energy producers out of the market artificially is also risky because renewable energy is weather dependent. If wind or sun conditions are not cooperating, energy is not produced. This is literally by design: wind technologies are designed to shut down when wind speeds are too fast to avoid damage to the structures.[104] The end result is increased reliance on inconsistent renewable sources of energy coming at the cost of increased grid vulnerability.[105]

This sets up a potential house of cards. If renewable energy becomes a primary source of energy, could taxpayers be stuck paying subsidies indefinitely? Or if the subsidies end, could taxpayers be at risk of having to pay for decommissioning if the companies cannot survive?

VI. Financial Assurance

In addition to the concern of what to do with the waste from renewable energy plants, there is an added concern of accounting for the cost. Since off-shore wind is relatively new, examples of decommissioning are few, making the future cost and cost reduction potentially difficult to ascertain.[106] Installation itself has proved costly and difficult and a lack of experience for dismantling the structures

[102] Ibid.
[103] Ibid.
[104] "How Long do Wind Turbines Last?"
[105] Dever, "Unintended Consequences of Tax Credits."
[106] Spyroudi, "End -of-Life Planning in Offshore Wind," 3.

could bring delays and heightened costs.[107] Additionally, the technology is changing to larger turbines, a wider range of water depth, and harsher conditions, so existing examples may not be able to forecast future processes and costs.[108] However, the similarities with on-shore wind are apparent when it comes to decommissioning.[109]

Xcel Energy, which manages a land-based wind plant in Minnesota, estimated that it will cost $532,000 (in 2019 dollars) to decommission *each* of its wind turbines.[110] Excel's Minesota plant consists of 134 turbines, making that decommissioning process cost over $71 million.

Decommissioning a solar plant is similarly expensive. While decommissioning has not been conducted for a full solar farm yet, estimates (based upon small projects) suggest that a 30-acre plant would cost $8.4 million, or $278,000 per acre.[111] While solar power companies are conveniently estimating considerably lower estimates,[112] the fact remains that solar plants hold the potential for significant decommissioning costs.

The cost of decommissioning can vary, as it is dependent upon factors like location, whether it is onshore or offshore, and the age of the technology (newer

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[107] Ibid.
[108] Ibid.
[109] Ibid.
[110] IER, "The Cost of Decommissioning Wind Turbines is Huge."
[111] Heiniger, Ronnie W., "Cost of Reclaiming Land Currently Used for Solar Panels Back to Farmland," North Carolina State University-Department of Crop and Soil Sciences, October 17, 2017, 3, https://craven.ces.ncsu.edu/wp-content/uploads/2022/11/Cost-of-returning-solar-facilities-back-to-their-original-use-as-farmland.pdf?fwd=no.
[112] Bloomfield Community Solar Farm, for example, says it would only need to account for $211,381.00 in decommissioning funds, but it also assumes a $677,837.00 salvage value for its materials, which, as stated above, may not be realistic. Eden Renewables, "Bloomfield Community Solar Farm Decommissioning Plan," Town of Ballstonny, New York, February 2022, 8, https://www.townofballstonny.org/AgendaCenter/ViewFile/Item/225?fileID=496.

turbines are much larger).[113] But regardless of facility, decommissioning appears to be expensive. One estimate from England for offshore wind found the cost to be around 285 Pounds per kilowatt, or 1.6% of total levelized cost of energy and 12% of total capital cost.[114]

In the United Kingdom, if goals to install more than 30GW of offshore wind power by 2030 are met, the price for decommissioning the UK's installed offshore wind base alone could be in excess of £10 billion.[115] Although this figure is based on projections, it points out a problem: if nobody knows how much decommissioning will actually cost (other than it will be expensive), how can one continue to erect new plants at such an aggressive pace?

A. How are Decommissioning and Financial Assurance Planned for?

As a part of the permitting process to produce energy, all operators are required to provide bonds or other assurances of their ability to pay for the decommissioning. However, some energy industries are much more regulated than others.

1. Offshore Oil

The federal Bureau of Ocean Energy Management (BOEM) implements a thorough and complex system of regulation of off-shore oil wells in the outer continental shelf (OCS). BOEM and the federal Bureau of Safety and Environmental

[113] IER, "The Cost of Decommissioning Wind Turbines is Huge."
[114] Spyroudi, "End-of-Life Planning in Offshore Wind," 5.
[115] Maslin, "£10 Billion+ Offshore Wind Decommissioning Bill."

Enforcement (BSEE) recently promulgated a new rule regarding financial assurances.[116] Generally, companies operating offshore oil wells must provide financial assurances that they can decommission at the conclusion of the project. The new rule waives that requirement for any company that has a BBB or Baa3 credit rating or if the company can satisfy the agencies' test based on the value of gas and oil reserves for the site.[117] Additionally, the rule made the process more vague as to whether decommissioning liabilities would truly be joint and several between current and past operators of a well site.[118] The surety industry has stated that this vagueness would be difficult or impossible to underwrite.[119] Consequently, the current status of this approach to financial assurance—or even the status of small and independent oil companies altogether—is very much unstable in the current moment. But what is certain is that BOEM and BSEE have become *more* strict with its regulations in recent years.

If financial assurance is required, the base amount of financial assurance is $200,000 for lease exploration and $500,000 before commencing development,[120] subject to the BOEM Regional Director's adjustment.[121] To satisfy this obligation,

[116] Bureau of Ocean Energy Management, Interior, "Risk Management and Financial Assurance for OCS Lease and Grant Obligations," *Federal Register* 89, No. 80 (April 24, 2024): 31544, https://www.govinfo.gov/content/pkg/FR-2024-04-24/pdf/2024-08309.pdf. ("OCS Rule").
[117] Ibid 31558.
[118] Schube, Curtis, "BOEM and BSEE's Proposed Financial Assurance Regulations: Protecting the Public or Effort to Underline Independent Oil and Gas Companies?," Council to Modernize Governance, November 2023, https://modernizegovernance.org/boem-and-bsees-proposed-financial-assurance-regulations/.
[119] Ibid. 2, 9.
[120] 30 C.F.R. 556.901.
[121] 30 C.F.R. 550.166.

surety bonds would be purchased.[122] It is estimated that the yearly burden on small and independent oil companies, who are the ones likely to be required to post these surety bonds, would be $379 million per year,[123] which almost certainly would have a crippling effect on these smaller businesses.

2. Onshore Oil

For onshore oil wells on federal lands, the process for restoring a lease site is called "reclamation." Onshore lease holders, operating rights owners (sublessees), or oil well operators must submit a bond to ensure the ability to pay for reclamation costs.[124] Bonding is premised on an initial minimum bond amount, which is presently $150,000 for lease bonds and $500,000 for statewide bonds.[125]

According to the Bureau of Land Management (BLM), reclamation is performed in phases. Prior to construction, a reclamation plan must be created and entered into a database.[126] During construction, there must be minimized surface disturbance.[127] After construction, partial reclamation must occur, whereby surrounding areas used during construction, but unused during production, are restored.[128] The post-operation phase consists of timely plugging of wells,

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[122] 30 C.F.R. 556.901.
[123] Kevin Bruce et. al., "Risk Management and Financial Assurance for OCS Lease and Grant Obligations,
(RIN 1010-AE14)," Gulf Energy Alliance, Sept. 7, 2023, 17,
https://www.regulations.gov/comment/BOEM-2023-0027-2165.
[124] 43 C.F.R. § 3104.10.
[125] 43 C.F.R. § 3104.1.
[126] Department of the Interior Bureau of Land Management, "Oil and Gas Reclamation," accessed November 29, 2024, https://www.blm.gov/programs/energy-and-minerals/oil-and-gas/reclamation.
[127] Ibid.
[128] Ibid.

restoration of the lease site and any lands or surface waters adversely affected by lease operations after the abandonment or cessation of oil and gas operations.[129]

The cost of oil well reclamation varies based upon the depth of the well. For example, in 2017, estimated costs to reclaim a well was $4,500 for 1,000-foot depth and $123,000 for 10,000-foot depth.[130] Therefore, if enforced consistently, the minimum bond amounts of $150,000 for a lease and $500,000 for statewide bonds, appear to cover the costs of reclamation.

3. Renewable Energy on Federal Lands

Facilities for the generation, transmission, and distribution of electric energy may be sited on federal land under Title V of the Federal Land Policy and Management Act of 1976 ("FLPMA").[131] Under FLPMA, BLM is authorized to issue leases, licenses, and permits, including leases for solar and wind facilities.[132]

BLM regulations require a bond to be posted based on a cost estimate for decommissioning and site restoration.[133] For solar, this bond must be no less than $10,000 per acre of land.[134] For wind, it must be at least $10,000 per turbine less than 1 MW nameplate capacity and at least $20,000 per turbine greater than 1 MW.[135] These assurances are not merely inclusive of decommissioning costs, but also cover environmental liabilities, hazardous materials, and risks such as

[129] 43 C.F.R. § 3104.10.
[130] Econorthwest, "Reclaiming Oil and Gas Wells on Federal Lands: Estimate of Costs," Western Priorities, 10, https://westernpriorities.org/wp-content/uploads/2018/02/Bonding-Report.pdf.
[131] 43 U.S.C. §§ 1761-1771.
[132] 43 C.F.R. § 3809.
[133] 43 C.F.R. §2805.20; 43 C.F.R. §2809.18.
[134] Ibid.
[135] Ibid.

herbicide use, petroleum fluids, dust control materials, and soil stabilization materials.[136]

With regard to solar, operators must provide an upfront estimate of decommissioning costs including a cost estimate for the necessary reclamation and restoration activities.[137] The estimate is to cover hazardous waste use and disposal, decommissioning, disposal of equipment, and land restoration.[138] The financial assurance required from the operator is based upon the cost estimate provided.[139]

B. Are Government, Energy Companies, and Financial Institutions Prepared for Decommissioning?

At the inception of wind and solar projects, more attention was paid to the reliability and costs associated with running the facilities than what to do with the projects when they reach their end of life.[140] But consideration to this end-of-life phase is imminent. The shorter than expected lifespan of turbines and inverters along with higher than anticipated decommissioning costs has made the financial assumptions developed as wind and solar projects were first being installed highly questionable.[141] For example, the original 30-year projection for lifespans now requires repowering to get to that age, which bears additional costs.[142] In Canada,

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[136] Ibid.; Hoefner, Dietrich C., "Federal Approaches to Renewable Energy Facility Decommissioning," Lewis Roca Blog, November 5, 2021, https://www.lewisroca.com/blog/federal-approaches-to-renewable-energy-facility-decommissioning.
[137] Taylor L. Curtis et. al., "A Survey of Federal and State-level Solar System Decommissioning Policies in the United States," National Renewable Energy Laboratory, December 2021, 6, https://www.nrel.gov/docs/fy22osti/79650.pdf.
[138] Ibid. 6-7.
[139] 43 C.F.R. § 2805.20.
[140] Tovar, "Begin at the End."
[141] Spyroudi, "End-of-Life Planning in Offshore Wind," 5.
[142] Rolling, "Limited Lifespans of Wind Turbines."

the province of Alberta even instituted a temporary moratorium on renewable energy projects due to concerns about financial feasibility of decommissioning and site restoration.[143]

As a result of these reduced timelines, an important lesson has been learned: correct planning for end of life is essential during the *development phase* of a project.[144] DNV, a risk management company specializing in the maritime industry, went as far as to say that it is best practice to have a financial plan "from construction to decommissioning," assuring that all costs are accounted for.[145]

Still, renewable energy financers and regulators may be setting themselves up to be caught flat footed. A Capital Monitor report found "Several bankers [said] that decommissioning of renewable energy assets has not been a focus of financing arrangements or corporate relationships, with the issue typically seen as someone else's problem."[146] These companies are focused on their overall Environmental, Social and Governance ("ESG") credentials to meet their decarbonization portfolio pledges than the cradle-to-grave costs of the products in which they invest.[147] Accordingly, the "decommissioning piece very often sits outside the financing arrangement," including even the financing documents.[148]

Federal regulators seem similarly deficient in their preparedness for decommissioning. As stated above, at least one estimate says that wind could cost

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[143] Tovar, "Begin at the End."
[144] Ibid.
[145] Ibid.
[146] Furness, "Decommissioning: The Dark Heart of Renewable Energy Finance."
[147] Ibid.
[148] Ibid.

as much as $532,000 per turbine to decommission. Solar plants could take as much as $278,000 per acre. Both of these estimates are speculative and could be even more. Yet federal regulations only require $10,000 per turbine or per acre of land to decommission renewable energy plants. Should a company default on its obligations, the assurances given are drastically deficient to cover the potential costs of decommissioning—placing decommissioning costs on the backs of taxpayers, who already subsidized the original development of renewable energy projects.

As it stands, off-shore renewable projects are in their infancy. But the Biden-Harris administration has set things in motion with a goal of 16 off-shore wind projects to be permitted[149] and as many as 3,411 turbines with 9,874 miles of cables to be laid by 2030.[150] This is a break-neck pace.

According to Pat Parenteau, professor at Vermont Law School, "We are in a period where we are testing, in a larger context, how environmental laws are going to be interpreted with regards to renewable projects, wind and solar in particular."[151] With this in mind, all eyes are on Vineyard Wind, a 62-turbine offshore wind plant off the coast of Massachusetts, which has been dubbed a "legal test case for US clean energy."[152]

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[149] Storrow, Benjamin, "Why Vineyard Wind is a Legal Test Case for US Clean Energy," E&E News, January 19, 2024, https://www.eenews.net/articles/why-vineyard-wind-is-a-legal-test-case-for-us-clean-energy/.
[150] Department of the Interior Bureau of Ocean Energy Management, "BOEM and NOAA Fisheries North Atlantic Right Whale and Offshore Wind Strategy, October 2022, 3, https://www.boem.gov/sites/default/files/documents/environment/BOEM_NMFS_DRAFT_NARW_OSW_Strategy.pdf.
[151] Storrow, "Why Vineyard Wind is a Legal Test Case."
[152] Ibid.

Despite all these concerns, in the case of Vineyard Wind, BOEM waived the requirement that lessees provide financial assurance for decommissioning costs before the installation of facilities.[153] In fact, Vineyard Wind requested delay of providing any financial assurances until year 15 of the project, which BOEM approved.[154] There were conditions in the lease that Vineyard Wind have insurance, but only for "damages to the Project," not decommissioning.[155] The lease also requires Vineyard Wind to use "proven wind turbine technology," and long term purchase agreements,[156] but in what scenario would a company not use "proven" technology? And, all three conditions already apply to all wind projects.[157] BOEM's explanation is that it would enable Vineyard Wind to have capital to plan and build the project.[158] But if Vineyard Wind, the poster child for federal offshore wind energy, did not have that capital without the government's waiver of its financial assurance regulations is Vineyard Wind or other wind projects financially viable?

Waiving the financial assurance requirements for a project that is part of an entirely new industry and at risk of having a shorter lifespan than predicted is questionable. Given that applicable federal regulations do not even provide for such waivers, this waiver sets a new precedent. And a dangerous one. What happens if the lifespan of the project is shorter than 15 years? What if the financial model

[153] James F. Bennett to Rachel Pachter, accessed November 29, 2024, https://budsoffshoreenergy.com/wp-content/uploads/2024/01/vineyard-wind-financial-assurance-deferral.pdf.
[154] Ibid.
[155] Ibid.
[156] Ibid.
[157] James F. Bennett to Rachel Pachter.
[158] Ibid.

proves unsustainable? What if Vineyard Wind walks away or declares bankruptcy? These are all very reasonable concerns. BOEM is exposing the taxpayer to the risk of footing the bill for decommissioning costs, which it has repeatedly said is an unacceptable risk[159] — but only for oil projects, apparently.

VII. Renewable Energy Gets Special Treatment

The United States government appears to have a bias toward renewable energy. The IRA even gives credits to renewable energy that is developed to replace traditional energy sectors.[160] As described above, BOEM and BSEE promulgated rules during the Biden-Harris administration that will require significant increased financial assurances that will fall disproportionately on smaller and independent oil companies for the stated purpose of reducing the risk of orphaned wells. However, decades of experience with off-shore oil leasing conclusively show that this nearly never happens, and certainly does not justify the potential destruction an entire segment of an industry.[161]

Concurrently, while tightening the screws on off-shore oil, BOEM waives financial assurance and bonding requirements for the nascent renewable energy industry that is full of unknowns and holds the much higher potential to created orphaned facilities. It is hard to understand why BOEM would do this, absent bias. While the federal government often justifies its subsidization of clean energy development on environmental grounds, in doing so, the government

[159] OCS Rule.
[160] "Renewable Electricity Production Tax Credit Information."
[161] Schube, "BOEM and BSEE's Proposed Financial Assurance Regulations," 11-12.

ignores that wind and solar development itself is often at odds with environmental goals as documented above.

This is not the only time the United States government has looked the other way in enforcing its own laws with Vineyard Wind. ACK for Whales, a non-profit, sued BOEM and the National Marine Fisheries Service for allegedly "shortcutting…the environmental review process" and ignoring the Endangered Species Act (ESA) in approving the project.[162] The organization claims that the decision conflicts with the ESA by failing to use the best available science to evaluate the impacts of federal actions on an endangered species—in this case the North Atlantic Wright Whale.[163] So far, however, this, and other legal efforts to stop Vineyard Wind under the Endangered Species Act, the Marine Mammal Protection Act, and the National Environmental Policy Act (NEPA) have been unsuccessful in the lower courts , but are on appeal.[164]

Additionally, as mentioned above, for renewable energy projects to be financially viable, tax credits are given to producers of renewable energy. But these tax credits are subject to abuse, and have turned into a windfall for so-called green companies. For example, First Solar, who donated $1.5 million to Joe Biden's presidential campaign and spent $2.8 million lobbying the Biden-Harris

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[162] Petition for Writ of Certiorari at 3, *Nantucket Residents Against Turbines v. United States,* (Sept. 23, 2024), https://nantucket-current.nyc3.cdn.digitaloceanspaces.com/assets/No.-24-Petition_2024-09-24-201936_csjk.pdf.
[163] Ibid. 8.
[164] These dismissals are either based upon standing (a technical ruling that bars the party from bringing the lawsuit but has no bearing on the merits of their claim) or relied upon deference to the executive agency under Chevron U.S.A. Inc. v. Natural Resources Defense Council, which has since been overruled and may bring a different result after appeals. Storrow, " Why Vineyard Wind is a Legal Test Case."

administration (and Congress), benefitted greatly.[165] It received $1 trillion in benefits under the Inflation Reduction Act.[166] The company's executives and lobbyists candidly acknowledged that "none of this would have been possible without the dedication and collaboration of a group of Congressional staffers…."[167]

Perhaps the current administration has pure motives. But it is hard to explain why renewable energy continues to get favorable treatment while traditional forms of energy are being crippled by regulation. An even playing field, fully accounting for the risks and costs imposed by renewable energy, must be created.

VIII. Conclusion

Government has played a significant role in subsidizing the creation of the renewable energy industry. It should do its part to also protect the environment. Can wind and solar plant technology be made to improve so as to reduce the harm to wildlife and ecosystems? Can solutions be created for the considerable waste that will go into our landfills that may not even have room, much less be able to safely take on materials that are toxic? And, with these structures likely coming down much quicker than originally expected, steps need to be taken, now, to ensure that companies are financially prepared to take on decommissioning of these sites.

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[165] Slodysko, Brian, "A Signature Biden Law Aimed to Boost Renewable Energy. It also helped a Solar Company Reap Billions," AP News, https://apnews.com/article/biden-solar-inflation-reduction-act-dca914675cd0855004214d82aab5b10c.
[166] Ibid.
[167] Ibid.

Additionally, as of now, government has created an artificial profit model for renewable energy companies by subsidizing them and waiving bonding requirements. Government should set time limitations to these subsidies to ensure that industries are sustainable without this help. The taxpayer should not have to foot the bill indefinitely.

Government must regulate the renewable energy industry with the same vigor that other industries are regulated, which includes the obligation to provide non-waivable financial assurances—of a sufficient amount—and environmentally sound plans for decommissioning. These wind and solar companies must find ways to be economically viable—and reliable—on their own while also ensuring that the energy created truly is "clean."