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POLICY BRIEF



Rep.
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Summary

- The Green New Deal would replace all fossil fuels and nuclear energy with renewables, principally solar and wind, based on dubious fears about global warming.
- The Green New Deal's renewable energy mandates would cause significant harm to the environment.
- Massive solar and wind facilities would disrupt wildlife habitats and kill threatened species.
- Toxic and harmful materials required to power America using renewable energy sources would create an environmental nightmare.

Protecting the Environment from the Green New Deal

By Paul Driessen

Executive Summary

In recent decades, policymakers have forced public utilities to generate increasingly more electricity from fashionable “renewable energy” sources, notably wind and solar. For example, through various measures, they have pushed automakers to manufacture more electric vehicles.

The chief policy goal for many of these policymakers is to eliminate reliable and affordable fossil fuels, despite the fact they continue to generate most of America’s electricity and power most forms of U.S. transportation. Ostensibly, their aim is to avoid an onslaught of devastating global warming and extreme weather events, which they attribute to carbon dioxide (CO₂) emissions resulting from burning coal, oil, and natural gas.¹

The “Green New Deal,” championed by Rep. Alexandria Ocasio-Cortez (D-NY) and other prominent members of Congress, is the latest vehicle for advancing this agenda, which adds nuclear power to the list of energy sources they seek to eliminate. To date, the Green New Deal (GND) has been roundly criticized for the astronomical costs it would impose upon factories, businesses, households, hospitals, and virtually every other sector of the U.S. economy, as well as for the economic devastation it would inflict.

¹ “What is U.S. electricity generation by energy source?,” Independent Statistics and Analysis, U.S. Energy Information Agency, <https://www.eia.gov/tools/faqs/faq.php?id=427&t=3>

* Photo Courtesy: nrkbeta/Flickr.com

However, too little attention has been paid to the fact GND policies would seriously harm the environment—including lands, wildlife habitats, and threatened and endangered species—and thus would undermine the very values environmentalists have espoused for decades. America faces a dilemma: Will it focus on real environmental problems that do measurable harm to human and ecological wellbeing, or will it mandate policies to head off a perceived climate disaster based on fear and highly dubious speculation?

This *Policy Brief* reviews the largely ignored environmental damage that would result from the expanded use of renewable energy mandated under the Green New Deal. It also highlights the current opposition to renewable technologies by many environmental groups and the coming clash those groups could find themselves in with GND advocates. More specifically, this *Policy Brief* will address the following:

1. The Green New Deal's Faulty Premises

The GND is justified primarily by fears that CO2 from fossil fuel use will cause disastrous global warming. The science behind these fears does not stand up to scrutiny, and computer model predictions of such warming have been repeatedly proven wrong by real-world empirical observations.

2. Solar Power's Excessive Land Use

Solar panel farms generate only 1.5 percent of the nation's electricity and would be an inefficient way to generate the more than eight billion Megawatt hours (MWhrs) of power currently provided by fossil fuels and nuclear for industrial, commercial, and residential uses, as well as automotive transportation. If we use the cutting-edge Nellis Air Force Base solar farm as a model of the power such facilities can produce, we find that to generate the more than eight billion MWhrs each year with solar

would require completely blanketing 57,048 square miles of land—an area equivalent to the size of the states of New York and Vermont—with 18.8 billion solar panels. Obviously, this would wreak much havoc on the environment.

“THIS *POLICY BRIEF* REVIEWS THE LARGELY IGNORED ENVIRONMENTAL DAMAGE THAT WOULD RESULT FROM THE EXPANDED USE OF RENEWABLE ENERGY MANDATED UNDER THE GREEN NEW DEAL.”

3. Onshore Wind Power's Excessive Land Use

The Fowler Ridge Wind Farm in Indiana covers 68 square miles, an area larger than Washington, DC. If similar facilities were used to replace all of the country's fossil fuels and nuclear power, it would require 2.12 million turbines on 500,682 square miles of farm, wildlife habitat, and scenic lands. This would require an amount of land as large as the combined total for Arizona, California, Nevada, Oregon, and much of West Virginia.

4. Onshore Wind Power Kills Birds and Bats

Environmental groups have long been concerned with onshore wind turbines killing bats and birds, including many protected and endangered species. These animals fly into wind farms' giant blades, which can rotate at more than 200 miles per hour, with estimates of deaths ranging in the millions. They also note these birds and bats eat insects that would otherwise ravage crops and harm humans. The sheer number of turbines required by the GND would kill millions more birds and bats, putting its advocates in direct conflict with other environmentalists.

5. Damage from Offshore Wind Power

Offshore wind turbines are touted by renewable energy proponents as superior to those on land because ocean winds blow more steadily. Yet because of opposition from environmental groups, only one such facility is operating today, located on Rhode Island's coastline. Such turbines not only negatively impact birds and bats, they also harm sea life. To provide enough power for the country, GND advocates would have to build tens of thousands of these turbines, which are routinely opposed by environmentalists and create significant impacts on shipping and radar.

6. Damage from High-Voltage Transmission Lines

GND-mandated solar and wind facilities

would need to be located further from populated urban areas than natural gas, coal, and nuclear facilities, requiring a major expansion of high-voltage transmission lines. But as recent wildfires in California show, such lines can cause major environmental damage. Environmental groups have opposed such lines and, when they exist, have opposed the clearing of underbrush, fallen trees, and the like as "unnatural," thus making devastating fires more probable.

7. Pollution from Materials and Processes

Manufacturing solar panels requires many materials that are highly toxic. Furthermore, the steel, concrete, rare earth minerals, and other materials necessary to build enough wind turbines to power the nation would require mining and production on a scale most environmentalists strongly oppose.

8. Disposal of Solar Panels, Wind Turbines, and Batteries

Numerous American states and several countries, notably Germany, are experiencing major environmental problems due to the disposal of solar panels, wind turbines, and batteries after they lose their usefulness. Again, this environmental harm is ignored by GND advocates and would multiply substantially under their plan.

1. The Green New Deal's Faulty Premises

The Green New Deal is motivated primarily by fears that CO₂ from fossil fuel use and other human activities will cause disastrous global warming, extreme weather events, sea-level rise, crop failures, and more. However, the science behind these fears is dubious, and most of the frightening predictions made over the past several decades have not occurred.

Global temperatures have varied due to natural processes for the billions of years Earth has had an atmosphere. Before humans started to use fossil fuels, the Medieval Warm Period included temperatures that were higher than they are today, beginning around A.D. 1000. Starting around 1300, temperatures started to plummet in the period commonly called the Little Ice Age, which reached its coldest point around 1650.² Then, as the world recovered from the Little Ice Age, beginning in the mid-1800s, the planet warmed again in response to natural forces.

Predictions in recent decades of catastrophic warming have been way off the mark. The world has warmed at less than half the rate predicted by the U.N. Intergovernmental Panel on Climate Change (IPCC), which used and continues to rely on faulty computer models.^{3,4} In fact, the average of 102 IPCC climate models forecasted temperatures for the present period, beginning in the mid-1970s, nearly one full degree Fahrenheit above what satellites and weather balloons have measured. Clearly, scientists are quite far from understanding the complex nature of climate change.⁵

Many other disasters predicted by global warming alarmists have also failed to materialize. Sea levels are rising at just seven to 10 inches per century, the same rate recorded during the past century or more, after rising nearly 400 feet since the last ice age ended about 12,000 years ago.⁶ Since 1950, tornadoes have not increased in intensity or frequency in the United States.⁷ Moreover, in 2018, for the first time in recorded history, there were no F4 or F5 tornado events—the

² Mauricio Lima, "Climate Change and the Population Collapse During the 'Great Famine' in PreIndustrial Europe," *Ecology and Evolution*, Volume 4, Issue 3, January 2, 2014, <https://onlinelibrary.wiley.com/doi/full/10.1002/ece3.936>

³ U.N. Intergovernmental Panel on Climate Change, *First Assessment Report*, 1990, p. xxii, https://www.ipcc.ch/site/assets/uploads/2018/03/ipcc_far_wg_i_full_report.pdf; U.N. Intergovernmental Panel on Climate Change, *Fifth Assessment Report*, 2014, p. 4, https://www.ipcc.ch/site/assets/uploads/2018/05/SYR_AR5_FINAL_full_wcover.pdf

⁴ Roy Spencer, "Global Warming," [drroyspencer.com](http://www.drroyspencer.com/2019/01/uah-global-temperature-update-for-december-2018-0-25-deg-c), January 2, 2019, <http://www.drroyspencer.com/2019/01/uah-global-temperature-update-for-december-2018-0-25-deg-c>
Anthony Watts, *Is the U.S. Temperature Record Reliable?*, (Arlington Heights, IL: The Heartland Institute, 2009), January 2009, https://www.heartland.org/_template-assets/documents/publications/SurfaceStations.pdf

⁵ John R. Christy, testimony before the U.S. House Committee on Science, Space, and Technology, February 2, 2016, p. 12, <http://docs.house.gov/meetings/SY/SY00/20160202/104399/HHRG-114-SY00-Wstate-ChristyJ20160202.pdf>

⁶ H. Sterling Burnett, "Sea Level Rise Not Accelerating, New Study Shows," *Climate Change Weekly* #325, June 7, 2019, <https://www.heartland.org/news-opinion/news/sea-level-rise-not-accelerating-new-study-shows>

⁷ Roger Pielke, Jr., "A Factual Look At The Relationship Of Climate And Weather," statement before the

most powerful category—anywhere in the United States.⁸

From 1920 to 2005, 52 Category 3, 4, or 5 hurricanes made landfall in the United States. Then, from October 2005 (Wilma) until August 2017 (Harvey), not one Category 3–5 hurricane struck the U.S. mainland. The previous record was nine years, which occurred during the Civil War era (1860–1869).⁹

Despite the lack of evidence showing the climate is warming at a disastrous rate or that adverse effects are harming humanity at unprecedented levels, climate alarmists continue to push radical policies based on their faulty premises. The flagship of the alarmist policies today is the Green New Deal. The most recent iteration of the Green New Deal was first proposed in the United States by Rep. Alexandria Ocasio-Cortez (D-NY) and backed by other prominent politicians and Democratic presidential candidates, including Sens. Bernie Sanders (I-VT), Elizabeth Warren (D-MA), and Kamala Harris (D-CA).¹⁰ Among the goals the GND seeks to accomplish by 2030 are the following:

- The elimination of all electricity generated by coal, natural gas, and nuclear power.

- Replacing existing power generation with more expensive, less reliable renewable energy, especially solar and wind. This would require building huge battery facilities to store electricity for times when solar and wind fail to generate sufficient electricity and lengthy new transmission lines, which would be necessary to bring electricity from distant facilities to homes and businesses.
- The elimination of internal combustion engine vehicles.
- Replacing internal combustion vehicles with those that run on renewable-energy-generated electricity.

In addition to these mandates, the Green New Deal would also impose many other costly—and in some cases, socialist—mandates, including retrofitting all buildings and houses in the United States to make them “green,” replacing air travel with high-speed rail, and enacting a federal jobs guarantee and single-payer health care.

Critics have pointed out that the energy-related components of the GND would on their own cost at least \$13 trillion over a decade, not including the provision mandating “green”

Subcommittee on Environment of the Committee on Science, Space, and Technology, U.S. House of Representatives, December 11, 2013, p. 9, https://sciencepolicy.colorado.edu/admin/publication_files/2013.38.pdf

⁸ Ian Livingston, “2018 will be the first year with no violent tornadoes in the United States,” *The Washington Post*, December 26, 2018, https://www.washingtonpost.com/weather/2018/12/26/will-be-first-year-with-no-violent-tornadoes-united-states/?utm_term=.85f01206a90c

⁹ “Continental United States Hurricane Impacts/Landfalls 1851–2018,” Hurricane Research Division, Atlantic Oceanographic and Meteorological Laboratory, U.S. National Oceanographic and Atmospheric Administration, <https://www.aoml.noaa.gov/hrd/tcfaq/E23.html>

¹⁰ House Resolution 109, 116th Congress, February 7, 2019, <https://www.congress.gov/bill/116th-congress/house-resolution/109/text>

buildings.¹¹ Other critics have highlighted the economic devastation and millions of lost jobs that would result from these policies.¹² However, there have been no systematic studies of the extensive damage that would be inflicted on the environment by GND technologies.

The radical nature of the GND proposal makes it difficult to estimate precisely how damaging these proposals would be to the environment. However, as the remaining sections of this paper demonstrate, even a cursory analysis reveals the enormous destruction that would result from such reforms.

2. Solar Power's Excessive Land Use

Solar power, which currently generates only 1.5 percent of America's electricity, is touted as a primary replacement for fossil fuels.¹³ It receives generous construction and installation subsidies and often is promoted with mandatory

purchase requirements by state and federal governments. Although it has received much support from environmentalists, solar energy is far less efficient at generating electricity than coal, natural gas, and nuclear sources. Solar requires significant land acreage and a large amount of raw materials to properly function, resulting in serious environmental harm.

“SOLAR REQUIRES SIGNIFICANT LAND ACREAGE AND A LARGE AMOUNT OF RAW MATERIALS TO PROPERLY FUNCTION, RESULTING IN SERIOUS ENVIRONMENTAL HARM.”

Solar's Large Footprint

The 14-megawatt photovoltaic solar power facility at Nevada's Nellis Air Force Base consists of 72,000 panels on 140 acres. It generates 32,000 megawatt-hours of elec-

tricity annually, 33 percent of rated capacity.¹⁴ It cannot generate at full capacity because even in Nevada the sun isn't shining 24 hours per day and clouds and other factors reduce output.

By comparison, the Palo Verde nuclear power plant in neighboring Arizona generates 920 times more electricity (29.48 million MWhrs from three 1,250-MW reactors), and it does so

¹¹ James Taylor, “The Green New Deal: A Grave Threat to the American Economy, Environment, and Freedom,” *Policy Brief*, The Heartland Institute, June 2019, https://www.heartland.org/_template-assets/documents/publications/GreenNewDealPB.pdf

¹² Zaichun Zhu *et al.*, “Greening of the Earth and Its Drivers,” *Nature Climate Change* (6), April 25, 2016, pp. 791–795, <https://www.nature.com/articles/nclimate3004#citeas>

¹³ “Frequently Asked Questions: What is U.S. electricity generation by energy source?,” *Independent Statistics and Analysis*, U.S. Energy Information Administration, <https://www.eia.gov/tools/faqs/faq.php?id=427&t=3>

¹⁴ “Nellis Air Force Base solar array provides model for renewable projects,” U.S. Department of Energy, March 24, 2010, <https://www.energy.gov/articles/nellis-air-force-base-solar-array-provides-model-renewable-projects>

on less land, 24 hours a day.¹⁵

Generating Palo Verde’s electricity output using Nellis-type technology would require 920 times more solar panels (66.24 million) on 129,000 acres, about 200 square miles—a land mass 3.3 times larger than the size of Washington, DC.¹⁶ And even if such a facility were built, it would still operate with widely varying, unpredictable output each day and week.

The GND seeks to replace all fossil fuel and nuclear power sources with renewables. This would mean eliminating these sources in three general categories: (1) fossil fuels and nuclear used to generate electricity; (2) natural gas used for purposes other than electricity generation; and (3) petroleum for transportation.

In 2018, fossil fuels and nuclear generated

about 85 percent of 4.2 billion MWhrs of electricity used in the United States, about 3.46 billion MWhrs. Replacing 3.46 billion MWhrs of conventional generation with solar would require 108,125 facilities the size of the one at Nellis Air Force Base. At 140 acres per facility, those solar farms would require 7.8 billion panels covering 15.14 million acres, or 23,652 square miles.¹⁷ That’s almost the size of West Virginia.

But our estimate doesn’t stop there. Only 35 percent of natural gas is used to generate electricity. The other 65 percent of all natural gas production serves

industrial, commercial, and residential needs, including about 62 million homes.¹⁸ Replacing this non-electricity natural gas component is equivalent to producing an additional 2.73 billion MWhrs, which would require an additional 6.1 billion solar panels that would blanket 18,648 square miles of land.¹⁹

“REPLACING 3.46 BILLION MWHRs OF CONVENTIONAL GENERATION WITH SOLAR WOULD REQUIRE 108,125 FACILITIES THE SIZE OF THE ONE AT NELLIS AIR FORCE BASE. AT 140 ACRES PER FACILITY, THOSE SOLAR FARMS WOULD REQUIRE 7.8 BILLION PANELS COVERING 15.14 MILLION ACRES, OR 23,652 SQUARE MILES.”

¹⁵ “Fact Sheet: Arizona and Nuclear Energy,” Nuclear Energy Institute, accessed December 18, 2019, <https://www.nei.org/CorporateSite/media/filefolder/resources/fact-sheets/state-fact-sheets/Arizona-State-Fact-Sheet.pdf>

¹⁶ “Economic Impacts Of Palo Verde Nuclear Generating Station On Arizona,” Applied Economics, 2010, p. 3, <http://large.stanford.edu/courses/2016/ph241/chandler2/docs/ae-2010.pdf>; “The State of Nuclear Power: 2010,” *Independent Statistics and Analysis*, U.S. Energy Information Agency, April 2012, pp. 5–6, <https://www.eia.gov/nuclear/state/pdf/snp2010.pdf>

¹⁷ 3,460,000,000 MWhrs divided by 32,000 MWhrs = 108,125. 140 acres per facility multiplied by 108,125 = 15,137,500 acres, or 23,652 square miles. Further, 108,125 multiplied by 72,000 panels = 7.79 billion panels.

¹⁸ “Natural Gas Explained: Use of Natural Gas,” *Independent Statistics and Analysis*, U.S. Energy Information Agency, accessed December 18, 2019, <https://www.eia.gov/energyexplained/natural-gas/use-of-natural-gas.php>

¹⁹ The 35 percent of natural gas used for electricity generated 1.469 billion MWhrs in 2018. That means the equivalent of electricity that would be generated by the other 65 percent replaced by renewables would be 1.469 billion MWhrs divided by 35 = 0.04197 billion MWhrs times 65 = 2.728 billion MWhrs.

There are also 272 million vehicles powered by gasoline. The GND would replace most of them with electric vehicles. A Tesla-like electric vehicle uses an annual average of 4 MWhrs when charging.²⁰ To meet this demand, solar panels would have to generate an additional 1.1 billion MWhrs per year.²¹ But many light trucks, construction vehicles, heavy-duty trucks, semi-trailers, and buses consume much more fuel, requiring more electricity than a Tesla sedan, easily pushing the total needed to meet these transportation energy demands closer to 2 billion MWhrs annually. This would necessitate another 4.5 billion solar panels, which would cover 13,672 square miles of land.²²

The nation would also need enough solar panels to charge backup batteries so that Americans are not left without electricity when the sun is not shining. A week's worth of backup power would likely require destroying another 1,076 square miles of land to build 354.31 million additional panels.²³

“A WEEK’S WORTH OF BACKUP POWER WOULD LIKELY REQUIRE DESTROYING ANOTHER 1,076 SQUARE MILES OF LAND TO BUILD 354.31 MILLION ADDITIONAL PANELS.”

Thus, to replace all fossil fuel and nuclear power with solar would require some 18.7 billion solar panels, which would cover at least 57,024 square miles, a land mass the size of the states of New York and Vermont.²⁴

Further, Nellis is located in Nevada, a very sunny state. In order to run the entire United States on solar, new facilities would have to be built throughout the country. In many of these locations, sunlight

would be less intense and less frequent than in Nevada, especially in wintertime. This would substantially increase the number of facilities required to generate the requisite power, possibly doubling them.²⁵

Destroyed Habitat

Each habitat in the country is unique, so the damage caused to plants and animals by building thousands of square miles of solar

2.728 billion MWhrs divided by 32,000 MWhrs = 85,250 Nellis-sized facilities. 140 acres times 85,250 = 11,935,000 acres, or 18,648 square miles. 85,250 times 72,000 panels = 6.138 billion panels.

²⁰ “How Much Power Does an Electric Car Use?,” Sibelga, accessed December 18, 2019, <https://www.enrguide.be/en/questions-answers/how-much-power-does-an-electric-car-use/212>

²¹ 272 million vehicles times 4 MWhrs = 1,088,000,000 MWhrs.

²² 2,000,000,000 MWhrs divided by 32,000 MWhrs = 62,500 Nellis-sized facilities. 62,500 times 140 acres = 8,750,000 square miles, or 13,672 square miles. 62,500 times 72,000 panels = 4,500,000,000 panels.

²³ The total MWhrs needed per year is 3.46 billion MWhrs + 2.728 billion MWhrs + 2 billion MWhrs = 8.188 billion MWhrs. With 8.188 billion MWhrs backed up for one week, would be 157,461,538 MWhrs / 32,000 MWh = 4,921 Nellis-sized facilities. 140 acres times 4,921 = 688,940 acres, or 1,076 square miles. 4,921 times 72,000 panels = 354,312,000 panels.

²⁴ 23,652 + 18,648 + 13,672 + 1,076 = 57,048 square miles.

²⁵ This could mean requiring one-third more panels than the estimate above, 50 percent more, or perhaps, as an extreme estimate, doubling the number of panels and land required. That would require 114,000 square miles of land, the size of Arizona, covered with panels.

panels would vary wildly by region. Impacts on desert tortoises and other rare, threatened, or endangered species have already prompted legislators, regulators, and courts to block or ban solar facilities in critical habitat areas, such as parts of California’s Mojave Desert, despite the fact that such sunny areas would be ideal locations for solar energy facilities.²⁶

Oil infrastructure, which needs a fraction of the land required for a typical solar facility, is often delayed for years or halted permanently for environmental reasons.

And these environmental problems do not take into account the toxic materials used in the production of solar panels—materials that will inevitably need to be disposed of—the extensive transmission lines that will be needed to distribute the solar power, or the batteries needed to store power during downtimes. Nor do they consider the land, habitat, and wildlife impacts from mines required to provide the raw materials necessary for solar energy generation. (These matters are examined later in this study.)

Smoke and Mirrors

Photovoltaic panels like the ones used at Nellis are not the only form of solar technology. The \$2.2 billion Solar Two Plant in the Mojave Desert near Ivanpah, California encompasses 3,950 acres—six square miles—of garage-door-sized mirrors (about 350,000 in total) to catch, reflect, and concentrate sunlight that powers electricity-generating turbines in three 40-story towers.²⁷

During peak operating hours, the plant can generate 390 MWhrs of electricity, enough for 140,000 homes. A related demonstration project stored solar energy as heat in tanks of molten salt, to drive the turbines when the sun isn’t shining, as an alternative to massive arrays of large

“AND THESE ENVIRONMENTAL PROBLEMS DO NOT TAKE INTO ACCOUNT THE TOXIC MATERIALS USED IN THE PRODUCTION OF SOLAR PANELS—MATERIALS THAT WILL INEVITABLY NEED TO BE DISPOSED OF—THE EXTENSIVE TRANSMISSION LINES THAT WILL BE NEEDED TO DISTRIBUTE THE SOLAR POWER, OR THE BATTERIES NEEDED TO STORE POWER DURING DOWNTIMES.”

backup batteries.²⁸

This technology uses slightly more land to generate a megawatt of power than do energy-equivalent numbers of photovoltaic panels, though it potentially does not have some of the problems created by storage batteries. However, such facilities draw insects, which

²⁶ David C. Laine, “Effects of Solar Power Farms on the Environment,” *Sciencing*, updated April 24, 2017, <https://sciencing.com/effects-solar-power-farms-environment-13547.html>

²⁷ Mark Strauss, “Take a Look at the World’s Largest Solar Thermal Farm,” *Smithsonian.com*, November, 2012, <https://www.smithsonianmag.com/science-nature/take-a-look-at-the-worlds-largest-solar-thermal-farm-91577483>

²⁸ Robert Dieterich, “24-Hour Solar Energy: Molten Salt Makes It Possible, and Prices Are Falling Fast,” *Inside Climate News*, January 16, 2018, <https://insideclimatenews.org/news/16012018/csp-concentrated-solar-molten-salt-storage-24-hour-renewable-energy-crescent-dunes-nevada>

attract swallows and other birds that fly into the concentrated beams of sunlight, instantly incinerating them. As they plummet to earth, they leave wisps of white smoke, giving them the macabre name “streamers.” A 2016 estimate put the number of birds killed at the Mojave facility at about 6,100. And this could be a low figure, because it is difficult to count birds that have been largely incinerated and because counting is not typically done in a rigorous manner.²⁹

3. Onshore Wind Power’s Excessive Land Use

As is the case with solar energy, state and federal governments mandate and subsidize wind turbines as a preferred alternative to fossil fuels and nuclear. (Today, about 56,000 turbines operate in the United States.) But as they do with solar, many advocates of wind technologies fail to account for the enormous and widespread environmental damage turbines cause.

Modern natural gas turbine combined-cycle

power plants can generate 600 megawatts of electricity every hour of the day, 90 percent of the year, on less than 100 acres. By contrast, Indiana’s Fowler Ridge industrial wind energy facility has a similar capacity, generated by 355 turbines of varying outputs, the equivalent of 330 standard 1.8-MW turbines.³⁰ The turbines sprawl across more than 50,000 acres (78 square miles), for an average of 120 acres per turbine. To put this in perspective, this an

area of land larger than Washington, DC, which encompasses 68 square miles.

In 2018, Fowler Ridge generated 1.3 million MWhrs at a 24.8 percent capacity factor, intermittently and unpredictably.

“BUT AS THEY DO WITH SOLAR, MANY ADVOCATES OF WIND TECHNOLOGIES FAIL TO ACCOUNT FOR THE ENORMOUS AND WIDESPREAD ENVIRONMENTAL DAMAGE TURBINES CAUSE.”

Going All-in on Wind

If all U.S. turbines were capable of generating power at Fowler Ridge’s 2018 output rate, it would take 2,662 Fowler-sized facilities to generate the 3.46 billion MWhrs of electricity needed to replace fossil fuels and nuclear. That

²⁹ Phil Taylor, “Sharp rise in estimated bird deaths at Calif. ‘power tower,’” *E&E News*, July 29, 2016, <https://www.eenews.net/stories/1060040984>

³⁰ Fowler Ridge consists of 133 1.5-MW turbines, 182 1.65-MW models and 40 2.5-MW turbines. 1.8-MW is a convenient and typical average turbine to work with in other calculations. If all Fowler Ridge turbines were 1.8-MW, generating the same power each year would require 330 turbines, each one 400 feet tall. See “Astoria 500MW combined-cycle power plant, US,” <https://www.power-technology.com/projects/500mw/>; “Simple-cycle and combined-cycle natural gas turbines,” Central Arizona Project, October 2013, https://www.cap-az.com/documents/meetings/10-17-2013/1_combined_Natural_Gas.pdf; “Bhikki Combined-Cycle Power Plant, Pakistan,” <https://www.nsenergybusiness.com/projects/bhikki-combined-cycle-power-plant/>; “The Fowler Ridge Wind Farm Project, USA,” <https://www.power-technology.com/projects/fowlerridgewindfarm/>

would require 207,600 square miles of land and 878,308 turbines.^{31,32}

However, wind turbines would also have to replace the natural gas not used to generate electricity. This is equivalent to 2.7 billion MWhrs of power annually to cover natural gas currently used for industrial, commercial, and residential uses. That would necessitate an additional 692,492 turbines on 163,680 square miles of land.³³

Replacing America's gasoline- and diesel-fueled cars, trucks, and buses with electricity-powered versions would demand another 2 billion MWhrs, and thus another 507,692 turbines on 119,964 square miles of land.³⁴

One week of sufficient battery backup for this electricity generation, to cover windless periods, would require an additional 9,438 square miles of land and 39,971 turbines.³⁵

In sum, replacing fossil fuels and nuclear power with wind generation would necessitate 2.12 million turbines and 500,682 square miles of farm, wildlife habitat, and scenic lands—an amount of land as large as the combined total for Arizona, California, Nevada, Oregon, and much of West Virginia.

“THERE IS A 5–10 PERCENT LOSS OF POWER WHEN ELECTRICITY TRAVELS ALONG LONG TRANSMISSION LINES, AND WIND TURBINES LOSE ABOUT 15 PERCENT OF THEIR GENERATING CAPACITY PER DECADE.”

However, the wind does not blow equally in all parts across the country. Wind turbines on the scale imagined by GND advocates would need to be placed in less-than-optimal locations, requiring even more turbines.³⁶

Further, there is a 5–10 percent loss of power when electricity travels along long transmission lines, and wind turbines lose about 15 percent of their generating capacity per decade. This would undoubtedly increase the number of turbines and land areas impacted.

With these factors in mind, the number of

³¹ Replacing 3,460,000,000 MWhs with 1,300,000 MWhs Fowler-sized facilities = 2,662 Fowler facilities. 2,662 facilities times 330 turbines = 878,308 turbines. 2,662 times 78 square miles = 207,600 square miles.

³² This analysis assumes the entirety of GND power generation is done via 1.8-MW wind turbines, which would never happen. Total power generation would not rely solely on wind or solar, and turbines are becoming increasingly larger. But the analysis still offers an appreciation of the magnitude of solar and wind facilities required under the GND.

³³ Replacing 2,728,000,000 MWhs divided by the 1,300,000 MWhs generated each year by Fowler-sized facilities = 2,098.46 Fowlers. 2,098.46 times 330 turbines = 692,492 turbines. 2,098 times 78 square miles = 163,680 square miles.

³⁴ 2,000,000,000 MWhs divided by 1,300,000 MWhrs = 1,538 Fowler-sized facilities. 1,538 Fowlers x 330 = 507,692 turbines. 1,538 x 78 square miles = 119,964 square miles.

³⁵ 8,188,000,000 MWhrs divided by 52 weeks = 157,461,538 MWhs for one week. 157,461,538 MWhs divided by 1,300,000 MWhs = 121 Fowler-sized facilities. That's 121 multiplied by 330 turbines = 39,971 turbines. 121 times 78 square miles = 9,438 square miles.

³⁶ This could mean one-third more turbines, 50 percent more, or an extreme estimate would be twice as many turbines, which could cover one-third of the lower 48 states.

required wind turbines could easily double, to 4.2 million turbines on a land area the size of one-third of the entire lower 48 states.

Some wind energy advocates argue each wind turbine would require “only” 50 or 60 acres, though actual real-world experience suggests this is not the case. If larger turbines are installed, fewer would be needed, but each one could need more acreage for proper operation.

It would be virtually impossible to power the entire United States using only wind power. It is much more likely that in a United States fueled entirely by renewable energy sources, wind would be one part of a larger mix, one that would include solar and hydropower. However, the scale of land disruption caused by wind turbines would nonetheless be significant.

4. Wind Turbines Kill Birds and Bats

In recent years, concern has grown among environmental groups about the massive number of birds and bats killed by wind turbine blades, which often spin at 200 miles per hour.

In 2012, the American Bird Conservancy

(ABC) estimated that as many as 573,000 birds are killed every year by industrial turbines, a conservative estimate. If wind-based electricity reaches 35 percent of total U.S. electricity, which is certainly a reasonable projection under the terms of the Green New Deal, the ABC estimates up to five million birds would be killed annually.³⁷

In many cases, the birds killed by wind turbines are not common species that exist in vast numbers, such as sparrows and pigeons, but rarer species that breed very slowly, such as eagles, hawks and other raptors, herons, cranes, and condors. The slaughter of golden eagles “could easily be over 500” every year in Western states,

says Jim Wiegand, an independent wildlife biologist and vice president of the U.S. chapter of Save the Eagles International.³⁸ Bald eagles are also being killed at alarming rates. Soon, more than 1,000 bald eagles could be killed every year by turbines.

According to Wiegand, in the 86-square-mile area associated with the Altamont Pass wind facility, no eagles have nested for the past 20 years, and golden eagle nest sites have declined by 50 percent across the region, even though it is a preeminent eagle habitat. Wildlife expert Dr. Shawn Smallwood estimates 2,300 golden eagles have been killed by Altamont turbines

“IN 2012, THE AMERICAN BIRD CONSERVANCY (ABC) ESTIMATED THAT AS MANY AS 573,000 BIRDS ARE KILLED EVERY YEAR BY INDUSTRIAL TURBINES, A CONSERVATIVE ESTIMATE.”

³⁷ “Bird-Smart Wind Energy: Protecting Birds From Poorly Sited Wind Turbines,” American Bird Conservancy, accessed December 18, 2019, <https://abcbirds.org/program/wind-energy-and-birds/>

³⁸ “James Wiegand on Fish and Wildlife Service Regulations Change for Bald Eagles,” *The Grant County Beat*, September 1, 2016, <https://www.grantcountybeat.com/editorial/31443-james-wiegand-fws-regulations-bald-eagles>

over the past three decades.^{39,40}

A 2013 study published by the *Wildlife Society Bulletin* concluded wind turbines kill at least 1.4 million birds and bats each year in the United States, including many endangered and protected species.⁴¹ More recent analyses of birds and bats killed by wind turbines in America suggest a death toll that could perhaps be 10–20 times greater than estimates like the one included in the *Wildlife Society Bulletin*. Some researchers suggest more than 10 million birds and bats are likely killed by wind turbines each year, including numerous endangered and protected species.⁴²

Wiegand notes wind industry leaders, regulators, and interest groups deliberately and routinely hide “over 90 percent” of actual bird and bat fatalities. For example, it’s not uncommon for industry-paid researchers and carcass collectors to only conduct searches every few weeks. That means many decaying

bodies are never found. Some wounded birds and bats crawl off and die elsewhere, and coyotes, ravens, and other scavengers remove numerous turbine victims between search periods. In addition, many teams use a 75-meter (275-foot) search radius, even though turbines often catapult birds and bats as far as 655–820 feet.⁴³

“A 2013 STUDY PUBLISHED BY THE *WILDLIFE SOCIETY BULLETIN* CONCLUDED WIND TURBINES KILL AT LEAST 1.4 MILLION BIRDS AND BATS EACH YEAR IN THE UNITED STATES, INCLUDING MANY ENDANGERED AND PROTECTED SPECIES.”

Turbine operators generally do not permit independent investigators on their sites and treat body counts as proprietary data. Legislators, regulators, and the media have largely ignored these improprieties.

Another form of environmental harm that would be caused by the deaths of so many birds and bats would be disrupted ecosystems. For example, a huge decline in the bat population could lead to a vast increase in mosquito populations. According to Save the Eagles, “A conservative estimate ... reveals that the 4 million bats that were killed by wind turbines in 2012-2016 could have eaten as many as 4 billion mosquitoes in the U.S.

³⁹ K. Shawn Smallwood, “Comparing bird and bat fatality-rate estimates among North American wind-energy projects,” *Wildlife Society Bulletin*, March 26, 2013, <https://wildlife.onlinelibrary.wiley.com/doi/abs/10.1002/wsb.260>

⁴⁰ Jim Wiegand, “Golden Eagles Fall Prey to the Wind Industry – 2300 killed in the past 25 years in USA.,” RaptorPolitics.org, August 3, 2011, <http://raptorpolitics.org.uk/2011/08/03/golden-eagles-fall-prey-to-the-wind-industry-2300-killed-in-the-past-25-years-in-usa/>

⁴¹ K. Shawn Smallwood, *supra* note 39.

⁴² “Windfarms kill 10–20 times more than previously thought,” Save the Eagles International, accessed May 27, 2019, <http://savetheeaglesinternational.org/new/us-windfarms-kill-10-20-times-more-than-previously-thought.html>

⁴³ Jim Wiegand, “Hiding avian mortality: Where ‘green’ is red (Part 1: Altamont Pass),” MasterResource.org, September 4, 2013, <https://www.masterresource.org/cuisinarts-of-the-air/hiding-avian-mortality-altamont-pass>

alone last year,” as well as other insects that damage or destroy food crops.^{44,45} And rising populations of crop-destroying insects could require increases in the use of pesticides, which many environmentalists also oppose.

Due to these and many other concerns, numerous environmental groups have waged battles against wind turbines. For example, in November 2019, a coalition of environmental groups strongly opposed the Humboldt Wind Energy Project at Bear River and Monument Ridges in Humboldt County, California, a habitat for marbled murrelets, spotted owls, and bald and golden eagles. Joel Merriman, director of the Bird-Smart Wind Energy Program at the American Bird Conservancy, noted, “It’s hard to conceive of a worse place to put wind turbines.”⁴⁶

Millions of raptor and bat deaths associated with wind turbines might lack the dramatic, visual impact of thousands of animals coated by a sudden oil spill, but the evidence is clear that millions of additional animals would be

killed if the Green New Deal’s mandates were to go into effect.

5. Damage from Offshore Wind Power

Offshore wind farms are attractive to renewable resource advocates because ocean winds tend to blow more steadily and powerfully than onshore winds. Relatively near-shore installations could generate 36 billion MWhrs of planet-wide electricity per year—well above the current global demand of 23 billion MWhrs.⁴⁷ And the U.S. Office of Energy

Efficiency and Renewable Energy reports “U.S. offshore wind has a technical resource potential of more than 2,000 GW of capacity, or 7,200 TWh of generation per year. For context, this is nearly double the nation’s current electricity use.”⁴⁸

Future wind farms could run behemoth 10-MW wind turbines that dwarf the standard

“DUE TO THESE AND MANY OTHER CONCERNS, NUMEROUS ENVIRONMENTAL GROUPS HAVE WAGED BATTLES AGAINST WIND TURBINES.”

⁴⁴ Save the Eagles International, *supra* note 42.

⁴⁵ “Beyond Billions: Threatened Bats are Worth Billions to Agriculture,” U.S. Geological Survey, U.S. Department of the Interior, accessed December 19, 2019, <https://www.usgs.gov/media/audio/beyond-billions-threatened-bats-are-worth-billions-agriculture>

⁴⁶ Jordan Rutter and Joel Merriman, “Conservation Groups Urge Rejection of Controversial California Wind Energy Project,” American Bird Conservancy, November 13, 2019, <https://abcbirds.org/article/conservation-groups-urge-rejection-of-controversial-california-wind-energy-project>

⁴⁷ Anmar Frangoul, “Renewable capacity set for 50% growth over next few years, IEA says,” CNBC, October 21, 2019, <https://www.cnbc.com/2019/10/21/renewable-capacity-set-for-50percent-growth-over-next-few-years-iea-says.html>

⁴⁸ Liz Hartman, “Computing America’s Offshore Wind Energy Potential,” Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy, September 9, 2016, <https://www.energy.gov/eere/articles/computing-america-s-offshore-wind-energy-potential>

1.8-MW turbines commonly used by onshore farms.⁴⁹ It would take more 131,659 10-MW turbines operating 30 percent of the year to generate the 3.46 billion MWhrs of electricity currently produced annually in the United States by fossil fuels and nuclear.⁵⁰

Replacing the 2.73 billion MWhrs of power from natural gas used for purposes other than for producing electricity and the 2 billion MWhrs of power for gasoline motor vehicles would require another 179,909 offshore turbines. That means more than 300,000 massive turbines would be needed to replace conventional energy sources, and that does not take into account the electricity needed to charge backup batteries for windless hours and days.⁵¹

Environmental Concerns

Currently, there is only one American offshore wind facility, Rhode Island's Block Island Wind Farm, which features five 6-MW tur-

bines. If developers have their way, in 2022 a second wind facility would be built about 14 miles south of Martha's Vineyard in Massachusetts. The installation would include 84 9.5-MW wind turbines that would rise 650 feet above the ocean's surface.⁵² Its construction would mark the end of significant environmental battles that have raged since the Vineyard Wind Project was first proposed in 2001. Among the opponents of this project was the late liberal icon Sen. Edward Kennedy. Multiple environmental groups have also opposed the project.⁵³

“THAT MEANS MORE THAN 300,000 MASSIVE TURBINES WOULD BE NEEDED TO REPLACE CONVENTIONAL ENERGY SOURCES, AND THAT DOES NOT TAKE INTO ACCOUNT THE ELECTRICITY NEEDED TO CHARGE BACKUP BATTERIES FOR WINDLESS HOURS AND DAYS.”

The Trump administration has sought expedited approval of this wind project, but Reuters reports “a federal environmental study crucial to its permitting has been repeatedly delayed since April [of 2019],” and “the National Oceanic and Atmospheric Administration's ... National Marine Fisheries Service [NMFS] ... triggered the delays by declining to sign off on the project's design.” The NMFS chose not to sign off on the project because of environmental concerns, principally involving

⁴⁹ “Siemens Gamesa launches 10 MW offshore wind turbine; annual energy production (AEP) increase of 30% vs. predecessor,” Siemens Gamesa, January 16, 2019, <https://www.siemensgamesa.com/en-int/newsroom/2019/01/new-siemens-gamesa-10-mw-offshore-wind-turbine-sg-10-0-193-dd>

⁵⁰ 8,760 hours per year x 10-MW x 0.30 percent = 26,280 MWhrs. 3,460,000,000 MWhrs per year divided by 26,280 MWhrs = 131,659 turbines.

⁵¹ 8,760 hours per year times 10-MW times 0.30 percent = 26,280 MWhrs. 2,728,000,000 MWhrs + 2 billion MWhrs per year = 4,728,000,000 MWhrs divided by 26,280 MWhrs = 179,909 turbines.

⁵² Eric Niiler, “Offshore Wind Farms Are Spinning Up in the US—At Last,” *Wired*, April 17, 2019, <https://www.wired.com/story/offshore-wind-farms-are-spinning-up-in-the-us-at-last>

⁵³ Katharine Q. Seelye, “Big Wind Farm Off Cape Cod Gets Approval,” *The New York Times*, April 28, 2010, <https://www.nytimes.com/2010/04/29/science/earth/29wind.html>

local fisheries.⁵⁴ In July 2019, the project was delayed again because developers are waiting for an environmental impact statement from the Bureau of Ocean Energy Management.⁵⁵

One of the primary reasons some environmentalists oppose offshore wind turbines is that they would cause some of the same problems as their onshore counterparts. Countless seagoing birds would be killed and left to sink uncoun- ted beneath the waves. Bats would also likely be attracted to some of these turbines and killed in large numbers.⁵⁶

Another report noted, “Radar is used every day by the National Oceanic and Atmospheric Administration ... the National Weather Service ... the Federal Aviation Administration

... the United States Department of Defense, the Department of Homeland Security, and many other federal and private organizations to track everything from weather patterns to airplanes to threats to national security.

Concerns that utility-scale wind farms disrupt radar have delayed the construction of new wind facilities.”⁵⁷

The growing jungle of fixed and floating turbines would also interfere with sea life.⁵⁸ Constant vibration noises and infrasound

from the towers and turbines would carry great distances and impair whales’ and other marine mammals’ sonar navigation systems. The soundwaves can travel up to 31 miles.⁵⁹ In 2016, 29 sperm whales were stranded and died on English, German, and Dutch beaches near offshore wind complexes, and many believe

“CONSTANT VIBRATION NOISES AND INFRASOUND FROM THE TOWERS AND TURBINES WOULD CARRY GREAT DISTANCES AND IMPAIR WHALES’ AND OTHER MARINE MAMMALS’ SONAR NAVIGATION SYSTEMS.”

⁵⁴ Nichola Groom, “Exclusive: First big U.S. offshore wind project hits snag due to fishing-industry concerns,” Reuters.com, July 29, 2019, <https://www.reuters.com/article/us-usa-wind-fishing-exclusive/exclusive-first-big-us-offshore-wind-project-hits-snag-due-to-fishing-industry-concerns-idUSKCN1UO0EK>

⁵⁵ Bruce Gellerman, “Delay From Environmental Regulators Blows Vineyard Wind Off Course,” Wbur.org, July 30, 2019, <https://www.wbur.org/earthwhile/2019/07/30/vineyard-wind-environmental-impact-statement-delay>

⁵⁶ Ingemar Ahlen, Hans J. Baagøe, And Lothar Bach, “Behavior Of Scandinavian Bats During Migration and Foraging at Sea,” *Journal of Mammalogy*, Volume 90, Issue 6, 2009, pp. 1318–1323, <http://www.uvm.edu/~bmitchel/temp/Ahlen%20-%20Bat%20migration%20behavior.pdf>

⁵⁷ Eric Nordman, “Wind Farms and Navigation: Potential Impacts of Radar, Air Traffic and Marine Navigation,” West Michigan Wind Assessment, *Issue Brief*, No. 9, 2014, <https://www.michiganseagrant.org/wp-content/uploads/2018/08/Wind-Brief-9-Navigation.pdf>

⁵⁸ “Impacts on Marine Mammals and Sea Birds: Impacts on Marine Mammals,” *Wind Energy: The Facts*, accessed December 18, 2019, <https://www.wind-energy-the-facts.org/impacts-on-marine-mammals-and-sea-birds.html>

⁵⁹ Paul Driessen, “Are Wind Turbines Killing Whales?,” Committee for a Constructive Tomorrow, March 4, 2016, <https://www.cfact.org/2016/03/04/are-wind-turbines-killing-whales>; Martin Robinson, “Dead whales washed up on British beaches attract graffiti, scavengers ... and selfies,” *Daily Mail* (U.K.), January 24, 2016, <https://www.dailymail.co.uk/news/article-3414438/Tragic-pictures-three-dead-sperm-whales-washed-UK-beach-hours-caught-low-tide-died.html>

the wind turbines caused the beachings.⁶⁰

Resistance to offshore wind farms by coastal residents, Greenpeace, Sierra Club, and other groups make it highly unlikely America would be able to rely on offshore wind for power.

6. Damage from High-Voltage Transmission Lines

Coal, gas, and nuclear plants are often located close to cities and industrial facilities. Transmission lines from those plants are typically short, relatively inexpensive, and easy to maintain. They can also be buried underground.

By contrast, wind turbines and solar panels must be constructed in the most ideal locations, which are often hundreds of miles away from where consumers live.

Connecting millions of wind turbines, solar panels, and batteries to cities and other major consumer areas would require thousands of miles of new high-voltage transmission lines built across scenic lands, wildlife habitats, and

people's private property.

Building such an extensive network of transmission infrastructure would be extremely expensive. In Texas, taxpayers recently doled out \$7 billion in subsidies to build just one wind power transmission line.⁶¹ Assuming that this one transmission line would equate to transmitting a full 1 percent of all the nation's electricity, building out enough new transmission lines to transport wind and solar power to customers could add another \$700 billion or more to total U.S. electricity costs under the Green New Deal.

Added transmission lines would also pose environmental dangers. The 2018 and 2019 wildfires in California demonstrate that when power sources serve distant urban and industrial areas, transmission lines must frequently traverse wild grass, brush,

and forest areas that dry up during long summers and pose serious fire threats. If those power lines are not maintained and upgraded on a regular basis, and if grass, brush, and overgrown, diseased, and dead trees are not thinned or removed, catastrophic wildfires can result. These wildfires destroy homes and businesses, burn and kill people, immolate wildlife, and incinerate soil organic matter and

“CONNECTING MILLIONS OF WIND TURBINES, SOLAR PANELS, AND BATTERIES TO CITIES AND OTHER MAJOR CONSUMER AREAS WOULD REQUIRE THOUSANDS OF MILES OF NEW HIGH-VOLTAGE TRANSMISSION LINES BUILT ACROSS SCENIC LANDS, WILDLIFE HABITATS, AND PEOPLE'S PRIVATE PROPERTY.”

⁶⁰ Martin Robinson, *ibid.*

⁶¹ Douglas Holtz-Eakin *et al.*, “The Green New Deal: Scope, Scale, and Implications,” American Action Forum, February 25, 2019, <https://www.americanactionforum.org/research/the-green-new-deal-scope-scale-and-implications>; Robert Bradley, “Texas’s CREZ Transmission Line: Wind Power’s \$7 Billion Subsidy (rate base socialism as ‘infrastructure improvement’),” MasterResource.org, February 16, 2018, <https://www.masterresource.org/cre/texas-crez-transmission-line-wind-powers-7-billion-subsidy>

organisms, leaving vast areas sterile, susceptible to erosion and mudslides, and unable to support wildlife for decades.

For decades, eco-activists have opposed the very maintenance that would reduce such fire risks, arguing that the work would disturb natural forest habitats and harm wildlife. They have even opposed power lines intended to transmit clean, emissions-free hydroelectric power.⁶²

For example, the proposed Cardinal-Hickory Creek transmission line in southern Wisconsin has run into opposition from environmental groups because it “would cut a swath through the state’s scenic and ecologically unique Driftless Area.”⁶³ Dave Clutter, executive director of the Driftless Area Land Conservancy, argued, “We wouldn’t think of putting a power line across the Grand Canyon, so why would we think of putting one through one of the most beautiful and unique landscapes in the

Upper Midwest?”⁶⁴

The GND would require new and dramatically expanded networks of power lines. As such, it is easy to imagine the negative reactions that environmentalists would have if such a proposal were to go into effect, as well as the potential environmental damages these transmission lines would inflict.

“THE GND WOULD REQUIRE NEW AND DRAMATICALLY EXPANDED NETWORKS OF POWER LINES. AS SUCH, IT IS EASY TO IMAGINE THE NEGATIVE REACTIONS THAT ENVIRONMENTALISTS WOULD HAVE IF SUCH A PROPOSAL WERE TO GO INTO EFFECT, AS WELL AS THE POTENTIAL ENVIRONMENTAL DAMAGES THESE TRANSMISSION LINES WOULD INFLICT.”

7. Pollution from Materials and Processes

No major technology is free from risk. The three principal renewable technologies at the core of the GND—solar panels, wind turbines, and batteries

to store energy for the substantial periods those technologies are not in operation—require or contain toxic or polluting substances that pose serious threats to the environment.

⁶² See, for example, Fred Bever, “CMP faces backlash over 145-mile transmission line from environmentalists and power plants alike,” *MainePublic.org*, May 3, 2018, <https://www.mainepublic.org/post/cmp-faces-backlash-over-145-mile-transmission-line-environmentalists-and-power-plants-alike>; Diane Cardwell, “Fight to keep alternative energy local stymies an industry,” *The New York Times*, March 23, 2016, <https://www.nytimes.com/2016/03/24/business/energy-environment/fight-to-keep-alternative-energy-local-stymies-an-industry.html>; DecarbEurope, “How do high voltage overhead transmission lines impact the environment and how can this be evaluated?,” June 10, 2019, <https://help.leonardo-energy.org/hc/en-us/articles/207186749-How-do-High-Voltage-Overhead-Transmission-Lines-impact-the-environment-and-how-can-this-be-evaluated->

⁶³ Chuck Tenneson and Sarah Eddy, “New Environmental Study Of Proposed Cardinal-Hickory Creek Transmission Line Improperly Rejects Alternatives,” *Environmental Law and Policy Center*, December 7, 2018, <http://elpc.org/newsroom/press-releases/new-environmental-study-proposed-cardinal-hickory-creek-transmission-line-improperly-rejects-alternatives>

⁶⁴ *Ibid.*

Solar

Solar power on scales necessary to replace even one-quarter or one-half of America's needed power now generated by fossil fuels and nuclear would require billions of solar panels. Those panels and their manufacturing processes necessitate many toxic chemicals, including lead, cadmium telluride, copper indium selenide, cadmium gallium (di)selenide, copper indium gallium (di)selenide, hexafluoroethane, and polyvinyl fluoride.⁶⁵ All pose environmental dangers and health hazards.

Many environmentalists recognize the potential dangers posed by solar farms. For example, citizen activist Sean Fogarty estimated there would be 100,000 pounds of cadmium in the 1.8 million panels that would be installed on a 6,350-acre planned solar facility in Virginia's Spotsylvania County—if it is ever built. Fogarty has expressed deep concerns about leaching from

broken panels damaged during natural events, such as hailstorms, tornadoes, hurricanes, and earthquakes, as well as when the facility is eventually decommissioned, demolished, and hauled off to landfills or recycling centers.⁶⁶ This is no small concern. In 2015, a tornado damaged 154,843 photovoltaic modules at the Desert Sunlight Solar Farm in the Mojave Desert in California.⁶⁷

“ACCORDING TO A STUDY BY ENVIRONMENTAL PROGRESS, DURING SOLAR PANELS' LIFECYCLES, THEY PRODUCE ABOUT 300 TIMES MORE DANGEROUS WASTE PER UNIT OF ENERGY THAN DO NUCLEAR POWER PLANTS.”

According to a study by Environmental Progress, during solar panels' lifecycles, they produce about 300 times more dangerous waste per unit of energy than do nuclear power plants.⁶⁸ That same study found people living near waste dumps for solar

panels and electronics in developing nations such as China, Ghana, and India often burn the waste to salvage copper wires and other metals for resale. Burning the plastic housings, panels, and circuit boards produces toxic smoke laden with materials that cause cancer and birth defects when inhaled.⁶⁹

⁶⁵ David Nguyen, “Toxic Chemicals in Solar Panels,” *Sciencing*, April 30, 2018, <https://sciencing.com/toxic-chemicals-solar-panels-18393.html>

⁶⁶ Michael Shellenberger, “If Solar Panels Are so Clean, Why Do They Produce so Much Toxic Waste?,” *Forbes*, May 23, 2018, <https://www.forbes.com/sites/michaelshellenberger/2018/05/23/if-solar-panels-are-so-clean-why-do-they-produce-so-much-toxic-waste/#7c92b6bc121c>

⁶⁷ “Tornado impacts to solar project,” First Solar Desert Sunlight Solar Farm, August 28, 2015, <http://www.basinandrangewatch.org/DesertSunlight.html>

⁶⁸ Jemin Desai and Mark Nelson, “Are We Headed for a Solar Waste Crisis?,” *Environmental Progress News*, June 21, 2017, <http://environmentalprogress.org/big-news/2017/6/21/are-we-headed-for-a-solarwaste-crisis>

⁶⁹ *Ibid.*

Wind Turbines

A significant source of environmental harm from wind turbines is the huge amount of materials and energy used to build them. A single Vestas 1.8-MW turbine has 148-foot fiberglass/petroleum-based composite blades that sit atop a 262-foot tower. The tower rests on a 50-foot-diameter concrete and steel rebar base, which weighs as much as 1,000 tons.

A 2.3-MW MidAmerican Energy turbine stands at 554 feet tall and requires nearly 400 cubic yards (835 tons) of concrete reinforced by about 32 tons of steel rebar.⁷⁰

The V-90 2-MW turbine includes more than 200 tons of steel and iron materials.⁷¹ Manufacturing two million of these turbines would thus necessitate some 400 million tons of raw materials. If each turbine is rooted in 1,000 tons of concrete and rebar, these two million turbines would need two billion tons

of concrete and steel for their foundations.

These figures are gargantuan, especially when compared to current production. For context, U.S. manufacturers produced less than 87 million metric tons of steel in 2018,⁷² and the United States imported 35 million metric tons of all steel products.⁷³

“THE V-90 2-MW TURBINE INCLUDES MORE THAN 200 TONS OF STEEL AND IRON MATERIALS. MANUFACTURING TWO MILLION OF THESE TURBINES WOULD THUS NECESSITATE SOME 400 MILLION TONS OF RAW MATERIALS. IF EACH TURBINE IS ROOTED IN 1,000 TONS OF CONCRETE AND REBAR, THESE TWO MILLION TURBINES WOULD NEED TWO BILLION TONS OF CONCRETE AND STEEL FOR THEIR FOUNDATIONS.”

Materials needed to make wind turbines must be mined, processed and smelted, manufactured into finished products, and shipped to wind sites. Getting the metals would require, at minimum, removing hundreds of billions of tons of earth and rock and crushing and processing tens of billions of tons of ore. Every step in this process would also necessitate massive amounts of fossil fuels, because wind turbines cannot operate

earth-moving and mining equipment.

Further, blast furnaces used to make specialty steel strong enough for towers and other

⁷⁰ “The most common sizes of wind turbines,” Arcadia Power, September 19, 2017, <https://blog.arcadiapower.com/common-sizes-wind-turbines>; “How big is a wind turbine?,” National Wind Watch, <https://www.wind-watch.org/publication/nwwpub-size.pdf>

⁷¹ *Material Use: Turbines*, Vestas, Vestas.com, January 2016, <https://www.vestas.com/~media/vestas/about/sustainability/pdfs/material%20use%20brochure%20v2%20jan%202016.pdf>

⁷² “Steel Industry Executive Summary: October 2019,” International Trade Administration, U.S. Department of Commerce, October 2019, p. 7, <https://enforcement.trade.gov/steel/license/documents/execsumm.pdf>

⁷³ “Steel Imports Report: United States,” Global Steel Trade Monitor, International Trade Administration, U.S. Department of Commerce, June 2018, p. 2, <https://www.trade.gov/steel/countries/pdfs/2018/q1/imports-us.pdf>

components that must endure extreme daily and storm-related stresses require hundreds of thousands of BTUs of energy, also necessitating fossil fuels.

Batteries

Crucial to the use of solar and wind is backup batteries that could store power when the sun isn't shining and winds aren't blowing. One week's worth of backup for the more than 8 billion MWhrs of power produced from fossil fuels and nuclear each year would be about 158 million MWhrs. Storing that much electricity would require nearly two billion batteries similar to those used in Tesla electric vehicles.⁷⁴

Tesla's 75-KWhr Model S battery packs use 63 kilograms (139 pounds) of lithium, most of which comes from the Argentina-Bolivia-Chile "lithium triangle." The newer 100-KWhr models use more than 139 pounds of lithium,

plus large amounts of cobalt, mostly from the Democratic Republic of Congo; nickel from Indonesia; and graphite, aluminum, copper, and smaller amounts of manganese and rare earth metals from China and Mongolia. The two billion battery packs of various sizes needed to store renewable energy would

require about 150 million tons of lithium and 1,200 billion tons of all the other previously mentioned metals and materials.⁷⁵

Industry analysts have long worried that material shortfalls and supply disruptions could reduce availability of essential components for many computers, cell phones, electric vehicles, and other products. Even without

the Green New Deal, metals used in batteries are already in short supply, as companies race to build electric vehicles and energy storage systems.⁷⁶ Any major transition to "green" energy would multiply these looming shortfalls dozens or even hundreds of times.

Moreover, increasing global materials and

"EVEN WITHOUT THE GREEN NEW DEAL, METALS USED IN BATTERIES ARE ALREADY IN SHORT SUPPLY, AS COMPANIES RACE TO BUILD ELECTRIC VEHICLES AND ENERGY STORAGE SYSTEMS. ANY MAJOR TRANSITION TO 'GREEN' ENERGY WOULD MULTIPLY THESE LOOMING SHORTFALLS DOZENS OR EVEN HUNDREDS OF TIMES."

⁷⁴ A popular Tesla battery with a full charge can produce 85 KWhrs of power, which translates to 0.085 MWhrs. To store 158 million MWhrs would require 158,000,000 divided by 0.085 = 1.9 billion batteries. For battery statistics, see Fred Lambert, "Tear down of 85 kWh Tesla battery pack shows it could actually only be a 81 kWh pack [Updated]," *Electrek*, February 3, 2016, <https://electrek.co/2016/02/03/tesla-battery-tear-down-85-kwh>

⁷⁵ Fred Lambert, "Breakdown of raw materials in Tesla's batteries and possible bottlenecks," *Electrek*, November 1, 2016, <https://electrek.co/2016/11/01/breakdown-raw-materials-tesla-batteries-possible-bottleneck>

⁷⁶ Ron Struthers, "Battery Production More than a Tesla Nightmare," *Streetwise Reports*, November 28, 2017, <https://www.streetwisereports.com/article/2017/11/28/battery-production-more-than-a-tesla-nightmare.html>

battery production and processing to a scale that would meet GND requirements would be virtually impossible on the timeline that would be mandated by the Green New Deal’s provisions—about one decade—even if the raw materials were available. The mere attempt would have serious, far-reaching, and adverse environmental consequences.

8. Disposal of Solar Panels, Wind Turbines, and Batteries

Renewable energy advocates often hypocritically ignore the environmental harms that are created when dangerous “green” technologies reach the end of their lifecycle and need to be disposed of.

For example, some solar panel production processes release nitrogen trifluoride, which is 17,000 times more potent as a greenhouse gas than CO₂, according to Ray Weiss, professor of geochemistry at the Scripps Institution of Oceanography.⁷⁷ Weiss says efforts are made to contain these gases, but they often leak out anyway. And other renewable-energy-related processes release sulfur hexafluoride, another greenhouse gas that is 22,800 times “more

potent” than CO₂.⁷⁸

Many of the toxic materials contained within the panels are hard to separate. Simply burning the solar panels releases dangerous substances into the air. Putting them in landfills risks potential leaching into nearby soil and groundwater.⁷⁹

Wind turbines are also being decommissioned across the world because of rapid corrosion, high maintenance costs, and general wear and tear that rapidly reduces their electricity output. In Germany, 5,700 of the country’s 29,000 wind turbines are expected to be abandoned in 2020, when their subsidies run out and they become uneconomical to operate. Under German law, the entire turbine, including the massive concrete

“SOME SOLAR PANEL PRODUCTION PROCESSES RELEASE NITROGEN TRIFLUORIDE, WHICH IS 17,000 TIMES MORE POTENT AS A GREENHOUSE GAS THAN CO₂, ACCORDING TO RAY WEISS, PROFESSOR OF GEOCHEMISTRY AT THE SCRIPPS INSTITUTION OF OCEANOGRAPHY.”

base, must be removed when the turbine ceases operating.

Removing 3-MW or larger turbines is a monumental task, because each German wind turbine weighs 3,000 tons or more, including its reinforced concrete base. Removing 200-foot (or longer) blades, breaking down 400-foot towers from turbines, and hauling the sections to landfills or scrap yards is no simple

⁷⁷ Robert Monroe, “Potent Greenhouse Gas More Prevalent in Atmosphere than Previously Assumed,” University of California at San Diego News Center, October 23, 2008, <https://ucsdnews.ucsd.edu/archive/newsrel/science/10-08GreenhouseGas.asp>

⁷⁸ Christopher Boyd, “Learn Which Chemicals Make Solar Power Possible,” Chem Service, February 4, 2015, <https://www.chemservice.com/news/2015/02/learn-which-chemicals-make-solar-power-possible>

⁷⁹ “Are We Headed for a Solar Waste Crisis?” *Environmental Progress News*, June 21, 2017, <http://www.environmentalprogress.org/big-news/2017/6/21/are-weheaded-for-a-solar-waste-crisis>

task. Heavy equipment needs and costs would almost certainly be sky-high.⁸⁰

Recycling various wind turbine components would also be problematic. Blades are made from fiberglass, carbon fibers, and petroleum resins, making them difficult or impossible to recycle. Burning the blades is extremely energy-intensive, releases hazardous dust and toxic gases, and is prohibited in many jurisdictions. Landfills large enough to accommodate hundreds or thousands of turbine blades or blade sections are rare, generally unwanted by local communities, and likely to fill up very quickly.⁸¹

In Iowa, MidAmerican Energy’s plan to refurbish 110 wind turbines highlights the challenge of disposing of blades. Landfill operators had assumed the composite-material blades could be cut in 40-foot or larger sections and then easily crushed and compacted. In reality, the blades were so strong that crushing and compacting were impossible.⁸²

Dismantling even larger towers and blades from offshore turbines—and hauling the sections to onshore landfills or scrap yards—poses even greater engineering, logistical, and ultimate disposal or recycling challenges and costs. In addition, storms or accidents involving offshore wind turbines could lead to floating and sunken debris the size of football fields.

“RECYCLING VARIOUS WIND TURBINE COMPONENTS WOULD ALSO BE PROBLEMATIC. BLADES ARE MADE FROM FIBERGLASS, CARBON FIBERS, AND PETROLEUM RESINS, MAKING THEM DIFFICULT OR IMPOSSIBLE TO RECYCLE. BURNING THE BLADES IS EXTREMELY ENERGY-INTENSIVE, RELEASES HAZARDOUS DUST AND TOXIC GASES, AND IS PROHIBITED IN MANY JURISDICTIONS.”

However, allowing wind energy companies to simply leave dozens, hundreds, or even thousands of dilapidated turbines behind, as they have done with smaller turbines in California and Hawaii, would be an especially unattractive option, especially given the massive number of new turbines envisioned by GND supporters.

Backup batteries also have relatively short lifespans and are composed of multiple toxic materials that pose additional difficult disposal problems.

⁸⁰ Pierre Gosselin, “Germany’s wind energy mess – as subsidies expire, thousands of turbines to close,” *Climate Change Dispatch*, April 24, 2018, <https://climatechangedispatch.com/germanys-wind-energy-mess-as-subsidies-expire-thousands-of-turbines-to-close>

⁸¹ Jason Hopkins, “Environmentalists sound alarm on coming wave of toxic solar panel waste,” *The Daily Caller*, May 24, 2018, <https://dailycaller.com/2018/05/24/michael-shellenberger-solar-panel-toxic-waste>

⁸² “Iowa wind farm sending many giant blades to landfills,” Associated Press in the *Star Advertiser*, November 16, 2019, <https://www.staradvertiser.com/2019/11/16/breaking-news/iowa-wind-farm-sending-many-giant-blades-to-landfills/?fbclid=IwAR3YBik-KeUoObyBydQyWcVa6zzLkbxFP4pbornrvvz1t0YvqmjE4Xt9DCY>

Conclusion

The most important issue concerning so-called “renewable” energy sources is very simple, but often ignored: Wind and sunshine are renewable, sustainable, and eco-friendly, but the lands, habitats, raw materials, and mines required to build the wind turbines, solar panels, batteries, and transmission lines needed to harness these widely dispersed, intermittent, weather-dependent energy sources are not renewable.

Advocates of the Green New Deal cannot credibly claim the renewable technologies they promote will result in little or no environmental harm. Indeed, the relatively modest number of solar and wind installations in the United States today are already causing serious environmental damage. Technologies on the scales mandated by the GND would have incalculable environmental impacts, reversing much of the environmental progress made over the past several decades.

Solar facilities and wind turbines would cover tens or even hundreds of thousands of square miles of land, disrupting eco-systems and habitats.

Onshore or offshore wind turbines would kill millions of birds, including threatened species, and wind facilities would also pose numerous other environmental problems.

Transmission lines for energy produced by remote solar or wind installations would increase the threat of wildfires, like those that recently ravaged California.

Further complicating matters, GND advocates have no plans for disposing of large and often hazardous solar panel and wind turbine components when they are no longer useful.

In addition, estimates of the GND’s environmental damage presented in this paper do not include “upgrading” all houses and buildings to make them green-energy compliant. That would carry a price tag of \$4.2 trillion, or \$30,000 per household, and would require still more raw materials, mining, land, and wildlife habitat disturbances.⁸³

With all these factors in mind, it’s clear the Green New Deal would not only be an economic catastrophe, it would also be an environmental disaster—one that all policymakers should firmly reject.

“WITH ALL THESE FACTORS IN MIND, IT’S CLEAR THE GREEN NEW DEAL WOULD NOT ONLY BE AN ECONOMIC CATASTROPHE, IT WOULD ALSO BE AN ENVIRONMENTAL DISASTER—ONE THAT ALL POLICYMAKERS SHOULD FIRMLY REJECT.”

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⁸³ Douglas Holtz-Eakin *et al.*, *supra* note 61.

About the Author

Paul Driessen is senior policy advisor to the Committee for a Constructive Tomorrow and a senior policy advisor to The Heartland Institute. He is the author of *Eco-Imperialism: Green Power - Black Death* (Merril Press, 2004), *The Three Faces of Sustainability* (Heartland Institute, 2014), and many other books, reports, and articles on energy, environmental, climate change, and human rights issues.

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