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GRID SECURITY: EVALUATING THE EFFECTS OF RELIANCE ON WIND AND SOLAR-BASED RENEWABLE ENERGY

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TOPLINE POINTS

- The effort to make renewable technology the primary source of electricity generation is challenged by the inherent intermittence of these sources.
- States such as Minnesota, California, and New Jersey are already suffering the consequences of a renewable-based electricity transition.
- A transition to renewable energy for our electricity needs forces the United States to be reliant on China for critical minerals that solar and wind cannot function without.

Introduction

The United States' electric system is composed of about 11,000 power plants, 160,000 miles of high-voltage power lines, and millions of miles of low-voltage power lines (Energy Information Administration, 2016, Government Accountability Office, 2023). Divided primarily into three major geographic regions, the United States electric grid supplies electricity to consumers that is generated by several energy sources, including natural gas, coal, nuclear, wind, and solar energy (Environmental Protection Agency, 2023).

However, the United States electric grid's strength and stability will face substantial challenges in the coming years. The Biden administration's declaration that it aims to shift the electric grid to run entirely on carbon-free energy by 2030 has presented key challenges for the United States grid, which is not configured to nor is capable of meeting the Biden administration's demands (White House, 2021). Moreover, the Biden administration's strategic vision of a "carbon-free" electric grid myopically focuses on prioritizing solar and wind energy for electricity generation, rather than dispatching nuclear power, an energy source that is carbon-free and can produce three times the amount of maximum energy of wind and solar (Office of Nuclear Energy, 2021). Unless the Biden administration pivots from its current course, the United States will remain stymied by grid insecurity and reliance on malign foreign powers as it attempts to meet the nation's electricity needs.

Wind and solar intermittency

The effort to make renewable technology the primary source of electricity generation is challenged by the inherent intermittence of these sources. Despite a significant increase in solar panel installations over the past decade, electricity from solar is often generated when demand is notably low, typically during daylight hours (SGE Solar, 2021). When demand rises—typically toward sunset—solar generation declines substantially, leaving a critical gap between electricity supply and demand (Clean Technica, 2023). This phenomenon, known as the "Duck Curve" (Venditti & Wallach, 2022) of solar power, has only worsened in states such as California which have rapidly expanded their reliance on solar generation, demonstrating that it alone is not a stable or viable option to reliably power the grid (EIA, 2023). Moreover, according to the Government Accountability Office, manufacturing large-scale energy storage prototype technologies—which is an essential component in addressing the challenges of intermittence found in renewable electricity generation—would take more than 10 years to be commercially viable (GAO, 2023).

Similarly, electricity generated from wind power also faces significant headwinds. Despite the Biden administration's contention that it intends for the country to have enough offshore wind energy to power 10 million homes by 2030, the United States has only seven turbines in United States waters. Historically, the United States has invested substantial resources in wind energy. The Production Tax Credit (PTC) (EIA, 2021), a federal tax incentive under Section 45 (EPA, 2023) of the United States tax code that is provided per kilowatt-hour (kWh) of electricity generated, has been extended 14 times for wind energy (Stevens, 2023). The Biden administration also earmarked $270 billion in federal subsidies for clean energy technology in the Inflation Reduction Act (IRA), which is intended to spur further investment in and expansion of wind programs (Department of Treasury, 2022). Despite investment through PTCs and hundreds of

billions of promised federal funds, few benefits from completed installations of wind power have been realized (Plumer, 2023).

State-based renewable energy transitions

Studies have shown that states such as Minnesota, California, and New Jersey are already suffering the consequences of a renewable-based electricity transition. Between 1990 and 2009, following the implementation of aggressive renewable and green energy policies, Minnesota went from having 0% of its share of electricity come from wind energy to having 17.7% from wind energy (Hayward & Nelson, 2017a). During that same period, the state's coal- and nuclear-generated electricity declined by 26.4% and 5.2%, respectively. As a result, Minnesota (Hayward & Nelson, 2017b) lost its advantage on electricity pricing—from a rate 18.2% below the national average in 1990 to 0.97% *above* the national average in 2009 (EIA, 2023). Minnesota's reductions in emissions also fell below the national average, and the supply of power through wind energy dropped during the summer, the time when electricity demand was at its highest point. Moreover, the Energy Information Administration's data shows that Minnesota has only increased its electricity generated from wind by 4% in 12 years, increasing from 17.7% in 2009 to 21.7% in 2021 (Minnesota Department of Commerce, 2022). Additionally, as wind capacity increases, Xcel—Minnesota's largest wind power provider—has proposed to increase the cost of residential electricity in Minnesota by 21.2% over the next three years (Hughlett, 2021). Despite its ambitious goals, Minnesota's renewable and clean energy policies failed by nearly every relevant metric.

Similarly, California implemented green energy mandates, starting in 2008 with a requirement that one-third of all electricity come from renewable sources (California Energy Commission, 2020a). Since then, the mandated share of electricity to be produced from renewables has increased to 60 percent by 2030, intending to be completely carbon-free by 2045. With these mandates in effect, renewable energy now represents about 33.6% of California's total power mix, according to the California Energy Commission (California Energy Commission, 2020b). Testimony from the Foundation for Research on Equal Opportunity (FREOPP, 2020) indicated that because of these mandates, electricity costs rose remarkably. Between 2011 and 2019, according to the testimony, "the average price of electricity in California for all users—industrial, commercial, and residential—jumped by nearly 30 percent, or more than seven times the rate of increase seen in the rest of the United States."

New Jersey, which is seeking to add additional capacity for wind energy, is also facing significant challenges in the development and building of offshore wind farms, ironically despite funding from the Inflation Reduction Act (Wade, 2023a). Two citizen groups, Protect Our Coast NJ and Defend Brigantine Beach, filed a lawsuit against the state of New Jersey in the Superior Court of New Jersey, arguing that Ørsted Wind, a Danish

energy company, was unconstitutionally provided $1 billion in tax breaks by the state for their offshore wind project (Wade, 2023b). According to New Jersey lawmakers, the unconstitutional tax breaks place the $1 billion financial burden on New Jersey taxpayers. The lawsuit underscores a key issue with the funding provided to Ørsted: In addition to subsidies from the Inflation Reduction Act, New Jersey has provided Offshore Renewable Energy Certificates (ORECs) as a means to offset the cost of rising inflation for energy companies (New Jersey Board of Public Utilities, 2023). ORECS are certificate programs that provide federal funds for electricity produced from offshore wind energy. ORECs artificially keep the price of offshore wind energy electricity consistent with the average cost of electricity generated through other fuel sources, such as coal, natural gas, or nuclear energy. Because of federal funds from ORECs and the IRA, Ørsted Wind essentially receives a "double credit" that price-fixes the cost to generate offshore wind electricity, while the true cost to generate the electricity is directly passed on to New Jersey taxpayers (New Jersey Division of Rate Council, 2023a).

While the cost-prohibitive nature of offshore renewable energy has led organizations across the United States and Great Britain to cancel wind projects, citing high costs and interest rates driven by inflation, New Jersey's wind projects are maintained by taxpayer revenues (Pope, 2023).

In essence, companies have received a tax break as part of an agreement to produce offshore wind energy, and now they are receiving energy certificates to artificially offset increased costs from higher prices and interest rates. The State of New Jersey Division of Rate Council, the agency tasked with keeping electricity prices low throughout the state, filed comments that documented that if the government continues to subsidize companies with ORECs beyond the original amount stipulated, ratepayers could see an increased cost of $4.9 billion over the next 20 years (New Jersey Division of Rate Council, 2023b).

Energy efficiency of traditional energy vs. renewable energy

Overall, a leading challenge to a shift to renewable energy is the rate of efficiency that renewable energy provides. Coal, natural gas, and nuclear energy, for example, produce 49%, 54%, and 93%, respectively, on average of their total listed energy capacity (EIA, 2022, Greenstone and Nath, 2019). By contrast, solar produces only 25% (sometimes as low as 10%) of its listed capacity, and wind produces only 34%. Listed capacity is a key benchmark in understanding electricity because it is used to calculate supply and demand. If solar energy, for example, can only provide 10% of its listed capacity instead of the 25% needed to meet electricity needs in the market, then producers must do one of the following: raise the price of electricity for the consumer and ration the limited electricity they have, raise prices and not ration electricity (and risk energy blackouts), or fall back on other forms of energy to generate electricity (such as nuclear, natural gas, or coal). In total, wind and solar energy currently provide only 15% of United States electricity, an

amount that is both intermittent and heavily contingent upon weather conditions (EIA, 2023).

A primary concern for consumers relying on solar panels to generate electricity is the inability of solar panels to lower the cost of electricity, even as installations that are intended to lower costs increase. Even though California possesses one-third of all United States (EIA, 2020a) solar photovoltaic (PV) capacity and has more solar PV installations than any other state, the wholesale dollar per megawatt-hour (MWh) cost for electricity in California is $100, compared to an average of $63 in other states (Texas, Oklahoma, and Kansas) (EIA, 2020b). However, the intermittence of solar means that even states with lower average costs for solar per megawatt hour cannot rely on solar energy as a reliable electricity source.

Relying on such intermittent sources of electricity places the United States at additional risk of blackouts across the country. Blackouts pose a threat to the country's well-being and economic security. The risks associated with blackouts highlight the need to maintain the integrity of electric grids in times of crisis. In Texas, the blackouts caused by Winter Storm Uri resulted in the tragic loss of 210 lives across the state, with 69% of all Texans having lost power during the storm (Donald, 2021). The potential threats that blackouts cause can present a detriment to a nation's economy as well. Energy blackouts in developing nations such as South Africa, for example, cost the country $24 billion in 2022 (Morisset and Salto, 2022) and are projected to cost $192 billion (3.3 trillion rand) by 2030 (Hartley and Mills, 2023).

Put simply, because solar cannot provide power when the sun does not shine, and wind cannot provide power when the wind does not blow, both options are innately unreliable to power an energy transition. Coal, natural gas, and nuclear energy, by contrast, are each far more reliable and capable of delivering electricity at any time (McPherson-Smith, 2023).

An additional concern with wind and solar is the amount of land required to build wind and solar farms. Analysis from the Nuclear Energy Institute found that wind and solar farms required 360 and 75 times as much land area, respectively, to produce the same amount of electricity as a nuclear energy facility (Nuclear Energy Institute, 2015). Further analysis from NEI highlighted that "to build the amount of wind and solar needed to support the grid, the United States energy footprint would quadruple in size, and wind farms would occupy areas equivalent to Arkansas, Iowa, Kansas, Missouri, Nebraska, and Oklahoma" (NEI, 2022).

The demand for critical minerals

A further considerable issue with the renewable transition is the United States' limited access to critical minerals. Critical minerals are essential components in renewable energy technology, particularly in solar and wind. Wind energy requires 13 times the mineral resources as a gas-fired plant of similar size (International Energy Agency, 2023). In total, each megawatt (MW) of additional offshore wind capacity requires roughly 15.5 tonnes of critical minerals, while solar requires roughly 7 tonnes for an additional MW of capacity (World Nuclear Association, 2021). Additionally, of the 35 minerals identified by the Department of Interior to be critical, 14 are not extracted or refined in the continental United States (Cohen and Grant, 2021a). Several determining factors limit the expanding production and refinement of these critical minerals. Cobalt production, for example, is limited in the United States because domestic producers cannot be profitable selling cobalt at international rates.

The United States' lack of mineral production is made more grave by the Nation's import reliance on the People's Republic of China (PRC). The PRC is currently home to 70% of rare earth mining and 85% of rare earth refining (McPherson-Smith and Savit, 2023). In contrast, the United States produces only 12.2% of rare earth elements (Cohen and Grant, 2021b). Similarly, the United States' only cobalt mine—located in Idaho and owned by Australian corporation Jervois Global Limited—has had to suspend mining operations before producing a single pound of cobalt (Uberti and Hoyle, 2023a). Due to the high rate of cobalt production from China, the market cost of cobalt has fallen to roughly $15 per pound. For Jervois to operate at a profit, the price per pound of cobalt would need to rise to $25 (Uberti and Hoyle, 2023b).

The reliance on the PRC to produce and refine most of the global share of critical minerals is a challenge to the Biden administration's goals. It not only is a serious impediment to United States energy security but also threatens the United States' airline, cell phone, computer, and advanced technology industries, each of which is vital to national security (Federal Register, 2020). Reliance on China presents a key challenge to the expanded use of solar and wind to power a clean energy transition, not to mention the geo-economic and geopolitical challenges and implications of such an expansion (United States Department of Commerce, 2018).

Another challenge for consumers is a proposal from the Biden administration through the United States Consumer Product Safety Commission (CPSC) (Climate Depot, 2023). A CPSC proposed ruling would implement a nationwide ban on the sale of most portable gas generators by restricting the amount of carbon monoxide that generators can emit (50% for small generators and 95% for large ones). If the proposal were implemented, manufacturers would have six months to comply with the ruling and would be forced to implement a carbon monoxide detector that would cause their generators to automatically shut off when they reach a certain level of emissions. This ruling would directly affect

nearly 5 million Americans who use generators, particularly during blackouts (Athrappully, 2023).

With this proposal, consumers would have no alternative to generate power should the energy grid fail. Generators are an independent backstop for when rolling blackouts and other bouts of grid fragility occur. Whether because of natural disasters or a lack of stable energy supply, this rule would leave Americans even more vulnerable to grid insecurity, demonstrating the regressive and backward nature of the Biden administration's proposal that would innately eliminate and limit, not strengthen and grow, our electricity supply.

Additional proposals by the Biden administration also present challenges to navigating grid insecurity. The EPA's latest proposed rule, the Clean Power Plan 2.0, would impose on utility-scale plants a new requirement to capture 90 percent of their emissions by 2035 (Fisher, 2023). For nearly all coal-fired power plants—which provide 20% of electricity and reliable capacity on the United States electric grid—this rule would effectively render them incapable of operation (EIA, 2023).

Conclusion

Rather than forcing an unhealthy reliance on malign foreign nations and dismantling the reliable energy sources that keep our grid functional, the Biden administration should bolster America's energy grid by using reliable and proven energy sources to generate electricity. America possesses the cleanest sources of energy across the board and can produce the most affordable energy at home and abroad. The Energy Information Administration (EIA) has reported that between 2005 and 2019, the shift to natural gas reduced carbon emissions by 532 million tons of carbon, more than double the reduction in CO2 from renewable sources of electricity (EIA, 2021). The United States has an overabundance of clean and reliable energy options. The America First approach to unleashing American energy is essential to promoting American prosperity, and the best way to safeguard America's security and prosperity comes through an all-of-the-above approach to energy (America First Policy Institute, 2023). If the United States is to resolve grid insecurity, unleashing America's clean and affordable energy sources is the key.

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