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UNRELIABLE ARGUMENTS AGAINST RENEWABLES

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INTRODUCTION

Renewable energy has grown rapidly over the last decade. Non-hydro renewable energy accounted for 10 percent of total electric generation in the United States in 2018, and is expected to increase to 13 percent by 2020. In part, this growth has been spurred by a rapid decline in the cost of renewable electricity.[1] Since 2010, the benchmark price for solar electricity has fallen by 84 percent, while the price of wind energy has dropped by half.[2]

The increased competitiveness of wind and solar in particular has led to an increase in criticism of those energy sources. That may seem paradoxical, but makes sense from a political economy point of view. As long as wind and solar remained a marginal player in the electric system, there was little reason for ideological and economic opponents of wind to spend time and effort attacking it. Once they became real players in the market, however, that calculus changed.

While a variety of anti-wind and anti-solar arguments have been made, ranging from the use of government subsidies to aesthetic considerations, the most sustained arguments against renewables have involved electric reliability. Renewable energy, it is claimed, threatens to destabilize the electric grid, leading to blackouts and other harms to consumers. Some have even suggested that the electric market must be protected from wind and solar power via special taxes or other restrictions inconsistent with a free-market electric system.

In light of this, the present brief provides a high-level overview, aimed at the non-technical reader, of some of the arguments put forward to show that renewable energy harms electric reliability. Speaking generally about the topic is complicated by the fact that different regions of the country have vastly different electric regulatory systems. While some states use market competition to determine generation mix, other states operate according to a vertically integrated utility model, where such decisions are made more centrally.[3] States where competition is practiced may also use different mechanisms such as capacity markets or scarcity prices to deal with reliability risk. Despite this, it is possible to make some general comments on the issues with renewables and reliability that may help quiet some concerns and provide a framework for further study.

It is important not to dismiss the real challenges that can come from integrating renewable energy into the electric grid. Nevertheless, many of the arguments on this score are overblown and often involve misunderstandings of how the grid operates. In addition, they risk leaving the false

1. U.S. Energy Information Administration, "EIA forecasts renewables will be fastest growing source of electricity generation," *Today in Energy*, Jan. 18, 2019. https://www.eia.gov/todayinenergy/detail.php?id=38053.

2. Douglas Broom, "The cost of generating renewables has fallen—a lot," World Economic Forum, May 7, 2019. https://www.weforum.org/agenda/2019/05/this-is-how-much-renewable-energy-prices-have-fallen.

3. "Types of Organized Electricity Markets," R Street's Electricity 101 Series, No. 5, August 2016. https://www.rstreet.org/wp-content/uploads/2016/08/electricity5.pdf.

impression that markets are unable to provide reliable and affordable electric power. Electric markets rely on a variety of resources to deliver cheap, reliable power to consumers, including renewables and demand-side resources like demand response. Proper market design is perfectly capable of achieving these goals. In light of this, instead of scapegoating individual energy sources, we should simply let markets work as intended.

INTERMITTENCY

On the simplest level, critics of wind power will sometimes note that wind and solar are intermittent or variable resources (the wind does not blow all the time; the sun does not always shine), and conclude from this that it must be bad for electric reliability. President Donald Trump offered a summation of this argument at a speech at the Conservative Political Action Conference in March 2019: "When the wind stops blowing, that's the end of your electric."[4]

However, such an argument involves what philosophers call the fallacy of composition. Just because something is a feature of a whole system does not mean that it has to be a feature of each of the system's parts. It is important for electric reliability that the grid as a whole can provide enough generation to meet demand at all times. It is not important, however, whether any individual plant or group of plants are able to do so. Indeed, no power plant is capable of providing electricity with 100 percent reliability. Even plants that are designed to run 24/7 may not be able to generate during critical periods due to maintenance or other issues. For example, during periods of extreme cold, coal stockpiles may freeze, rendering them unusable. Such events can happen even during peak demand periods. In Texas, for example, during periods of high demand, more than 5 gigawatts of generation from traditional plants had to go offline for maintenance on two separate occasions in August 2019.[5]

Despite the fact that no individual plant is completely reliable, the electric grid as a whole is capable of providing high levels of electric reliability through proper market design. In fact, to the extent that reliability problems do occur, they are far more likely to involve issues with the transmission and distribution system than with generation fuel type. According to one recent report, over 90 percent of service outages are due to problems with the distribution system.[6] Electric markets have already integrated large amounts of renewable energy into the grid without sacrificing reliability, and technical analysis suggests that even more renewables could safely be added to the grid.[7]

Aside from providing sufficient electric supply to continuously meet demand, generators also provide other "ancillary services," such as grid balancing. Some regions operate separate markets or use price adders to compensate for these ancillary services. In addition, many grid-balancing services have been procured historically in ample supply indirectly as a byproduct of procuring enough conventional bulk energy and capacity. As markets change, there is a possibility that there could be shortfalls in some of these moving forward. Various proposals have been put forward for further "essential reliability services" (such as ramping and voltage support) to be included in these processes.[8] The increase of intermittent energy sources such as wind and solar may increase the need for some of these services on the grid.[9] At the same time, the cost increases from additional ancillary services for renewables may be small and offset by the lower prices they provide.[10] While this is an area of ongoing discussion and research, there is no indication that a properly designed market cannot deal with these issues just as it can ensure adequate generation supply.

BACK-UP POWER

A more complicated line of criticism recognizes that reliability is a feature of the electric system as a whole, but argues that renewable energy's intermittent nature increases costs for the grid overall because it requires "back-up" generation to be on standby to step in when renewables are not available. For example, one popular video by the Clean Energy Alliance analogizes the intermittency of solar power to "a privileged part-time [employee] who arrives late, does work others could easily do and then leaves while everyone else is working full tilt," and suggests that "because full-time workers are needed at peak workload, they all have to be kept on staff."[11]

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4. John Kruzel, "Fact-checking Donald Trump's take on wind energy," *Politifact*, April 3, 2019. https://www.politifact.com/truth-o-meter/statements/2019/apr/03/donald-trump/fact-checking-donald-trumps-take-wind-energy.

5. Bernard L. Weinstein, "The straining Texas power grid needs some pricing help from regulators," *TribTalk*, Sept. 3, 2019. https://www.tribtalk.org/2019/09/03/the-straining-texas-power-grid-needs-some-pricing-help-from-regulators.

6. Allison Silverstein et al., "A Customer Focused Framework for Electric System Resilience," Grid Strategies, LLC, May 2018. https://gridprogress.files.wordpress.com/2018/05/customer-focused-resilience-final-050118.pdf.

7. See, e.g., National Renewable Energy Laboratory, *Renewable Electricity Futures Study*, U.S. Dept. of Energy, 2012. https://www.nrel.gov/docs/fy12osti/52409-1.pdf.

8. See, e.g., "Essential Reliability Services: Whitepaper on Sufficiency Guidelines," North American Electric Reliability Corporation, December 2016. https://www.nerc.com/comm/Other/essntlrlbltysrvcstskfrcDL/ERSWG_Sufficiency_Guideline_Report.pdf.

9. Devin Hartman, "Comment on FERC's Notice of Proposed Rulemaking on Primary Frequency Response," R Street Institute, Feb. 2, 2017. https://www.rstreet.org/2017/02/02/comment-on-fercs-notice-of-proposed-rulemaking-on-primary-frequency-response.

10. See, e.g., Thomas A. Deetjen et al., "Solar PV integration cost variation due to array orientation and geographic location in the Electric Reliability Council of Texas," *Applied Energy* 180 (October 2016), pp. 607-16. https://www.sciencedirect.com/science/article/pii/S0306261916310984.

11. "Solar Value Eclipse," Clean Energy Alliance, June 26, 2018. https://www.youtube.com/watch?time_continue=1&v=shq06IW2wwg.

It is true that to ensure the reliability of the electric grid does require plenty of back-up generation. But the reasons for this have little to nothing to do with renewable energy. Instead, they are the result of two features of how the electric grid operates. First, electricity has to be produced when it is needed. As noted above, currently the ability to store electricity on a large scale commercially is fairly limited and this means that electricity demand must be met by supply more or less instantaneously.

Second, the amount of electricity demand varies widely but predictably depending upon the time of day and year. In Texas, for example, electric demand tends to be higher during the late afternoon and summer (when temperatures are highest), and lower during the nighttime and winter months. During winter months, average electricity demand in Texas' ERCOT region can range between 30,000 and 40,000 megawatts. By contrast, between 4:00pm and 5:00pm on Aug. 12, 2019, peak demand in the ERCOT region was 74,531 megawatts—double what is typical during the winter.[12]

The lack of large-scale storage on the grid means that the market must maintain enough capacity to meet the yearly peak demand year round. This means that for the bulk of the year, a substantial amount of generation capacity must remain idle. However, this mostly idle back-up generation is not the result of wind or solar power being on the grid. The need for large amounts of back-up predate the entry of renewables onto the grid and would continue even if all renewable energy ceased production. It is variability of electricity demand, not of wind and solar, that necessitates this spare capacity. In fact, the extent to which the addition of more wind and solar onto the grid raises the amount of spare capacity needed depends upon market design and other factors like how well renewable production matches electric demand.

INVESTMENT

Renewable energy has very low marginal costs. A wind turbine or a solar farm costs money to build, but once built, when the wind is blowing, it costs very little to produce electricity. This means that when they are able to generate, wind farms are typically able to bid into the market at a lower price than other sources.

Lower prices are not typically something that we should complain about. And, lower electricity prices in particular translate into savings for electricity consumers. It may not seem as good from the point of view of other generators who have to compete with those low prices, but what is bad for an individual business can often be good for the market as a whole. When a company introduces a cheaper version of a product or service, its competitors may lose business, but this is a net benefit for society.

Some critics, however, have offered a complicated line of argument that the lower electricity prices from renewable energy threaten electric reliability by undermining long-term investment in new capacity. However, as noted in the prior section, the variable nature of electricity demand plus the lack of widespread storage means that most of the time, there will be a substantial amount of potential generation capacity that remains idle.

And, the bottom line is that this spare capacity must be paid for one way or another. Some states maintain a "capacity market," which effectively pays generators to be ready to provide power during peak periods. Since the purpose of a capacity market is to make sure there is adequate capacity ready to meet demand, a properly structured capacity market should ensure desired reliability.

Uncertainty about supply availability, however, can cause problems here. Although no type of plant is 100 percent dependable, it is the case that wind and solar are more subject to intermittency than other power types. And this issue can become more serious as renewable penetration increases, since the ability of renewables to generate is highly correlated (i.e. if one wind farm cannot generate because the wind is not blowing, likely a neighboring wind farm will not be able to generate either).

To some extent, this factor can be offset by the use of multiple different types of renewable generation (in Texas, for example, onshore wind tends to blow at different times from offshore wind, and peak solar generation follows its own separate schedule). Nevertheless, to deal with the lack of firm capacity, market operators de-rate wind and solar capacity by an estimate of their "effective load carrying capability." If these estimates prove inaccurate, they can result either in cost overruns or in reliability problems. If renewables are given too much capacity credit, regions may under-procure resources and have reliability problems. If renewables receive too little, they will under-procure the optimal level of capacity. It is worth noting, however, that these are ultimately problems with market rules, rather than with deficiencies in particular energy sources per se.

Most parts of the country pay for spare capacity via capacity markets and/or central planning through vertically owned utilities. By contrast, Texas' ERCOT region uses scarcity pricing to achieve this objective. That is, Texas allows prices to rise in times of higher demand, which encourages investment in needed electric capacity. While electric prices for much of the year may average $36 a megawatt hour, dur-

12. Jen Price, "Texas breaks record for peak electricity demand," *Houston Public Media*, Aug. 13, 2019. https://www.houstonpublicmedia.org/articles/news/energy-environment/2019/08/13/342706/texas-breaks-records-for-peak-electricity-demand.

ing the periods of highest demand, prices could spike up to $9,000 a megawatt hour for a few hours. These high prices send a signal to the market to bring additional supply online.

However, critics allege that renewable energy distorts these price signals, thus making it less profitable to build the spare capacity that is needed to keep the lights on.[13] One commentator has described Texas' energy-only market as being "designed to play chicken with blackouts."[14]

To make sense of this, it helps to distinguish between different strategies that traditional power plants use to try to turn a profit. Some power plants are designed to put out a more-or-less constant amount of power over the course of the day and year. These plants aim to meet part of the minimum demand level (sometimes called "baseload" generation). Often, such plants cannot easily ramp up or down the amount of power they produce, and so they generate a relatively constant level of electricity regardless of whether prices are high or low.

At the other end of the spectrum are "peaker" plants, which have high marginal costs and are relatively inefficient compared to other resources. As a result, these plants typically operate only a few times a year when prices rise to cover their marginal costs, as operating them at prices below their marginal cost would result in significant losses to the owner. In Texas, some of these plants may be able to turn a profit for the entire year from these few hours of operation. Between these two models are the aptly named "intermediate" plants, which may try to produce some power constantly, but also can more easily ramp up or down to match changes in demand throughout the day.[15]

The lower prices driven by renewables affect these models in different ways. In the case of peaker plants, for example, one common criticism of renewable energy is that it is not there when it is most needed during periods of peak demand. To the extent this is true, renewable energy cannot undercut the profitability of peaker plants that make their money exclusively during those same periods. Now suppose that renewable energy (for example, solar power) is able to provide generation during peak periods. This will tend to lower prices, which could make it less attractive for companies to invest in new peaker plants. But, this would only be because renewable energy itself is providing the needed generation capacity. If and when renewables are not able to provide low-price power, traditional generators will have the opportunity to step in and reap the gains from higher prices. Assuming that prices are able to respond to supply and demand, there is no reason to think that wind or solar would prevent the market from producing enough spare capacity to meet the public's reliability needs.

On the other hand, "baseload" plants try to produce a constant amount of electricity irrespective of what the price of electricity is at any particular moment. If renewables reduce prices during periods of low demand, this could eat into the profitability of these plants and some might even become uneconomical. Indeed, this is always a danger when a business faces a lower-cost competitor. But, by definition, these plants are not meeting the extra demand needed during peak periods. To the extent that one of them cannot compete, the generation they provide should be able to be easily replaced either by renewables themselves or by more flexible intermediate plants. If not, the owner of that plant has the option to make investments to increase its efficiency.

On the demand side, scarcity pricing can also have an impact. Price spikes tend to be of short duration, perhaps lasting as little as 15 minutes. This has incentivized the development of fast-start generation. A growing number of business models also allow individual businesses to access wholesale electric rates. This is cheaper throughout most of the year, and when prices are high, those consumers can either reduce demand or switch to on-site generation.[16] For example, H-E-B, a popular Texas grocery store chain, contracted to provide on-site backup generation at 50 locations in Houston, with plans to go statewide.[17] This demonstrates that if market forces are allowed to operate, they are perfectly capable of incentivizing the necessary capacity and behavior changes to meet desired electric reliability.

SUBSIDIES

Renewable energy is the recipient of considerable government subsidies. Chief among those currently given to renewable energy producers are the Production Tax Credit (PTC) and the Investment Tax Credit (ITC). The ITC provides a tax credit for up to 30 percent of the cost of a solar-energy system, while the PTC provides a credit of 2.2 cents for each kilowatt hour of electricity that is produced from qualifying types of renewable energy.[18] After being in place for several decades, both the ITC and PTC are set to phase out, but have

13. For an example of this argument, see Bernard L. Weinstein, "The straining Texas power grid needs some pricing help from regulators, *Tribtalk*, Sept. 3, 2019. https://www.tribtalk.org/2019/09/03/the-straining-texas-power-grid-needs-some-pricing-help-from-regulators.

14. Daprato. https://www.greentechmedia.com/articles/read/texas-power-price-spike-and-designing-markets-for-a-carbon-free-grid#gs.8qakzs.

15. See Devin Hartmann, "Embracing Baseload Power Retirements," *R Street Policy Study* No. 97, May 2017. https://www.rstreet.org/2017/05/30/embracing-baseload-power-retirements.

16. Devin Hartman, "An Electric Summer Update in Texas," *R Street Shorts* No. 62, September 2018. https://www.rstreet.org/wp-content/uploads/2018/09/Short-No.-62.pdf.

17. Chris Tomlinson, "Houston company helps H-E-B keep the lights on," *Houston Chronicle*, July 20, 2017. https://www.houstonchronicle.com/business/columnists/tomlinson/article/Small-player-in-power-helps-H-E-B-with-low-cost-11304218.php.

18. *The Renewable Electricity Production Tax Credit*, Congressional Research Service, Nov. 27, 2018. https://fas.org/sgp/crs/misc/R43453.pdf.

been extended in the past. In addition to these federal subsidies, many states and local governments also provide their own incentives for renewable energy use through tax abatements, credits and other devices.[19]

Renewable energy is, of course, not the only type of energy to receive government subsidies. However, it is true that, at least for the time being, renewable subsidies per kilowatt hour of energy produced are higher than for traditional sources.[20] Government subsidies for renewable energy distort the electricity market in that they make renewable energy relatively cheaper than it would be without the subsidies. This means that more renewable energy (at least in the short term) is deployed on the grid.

There are many strong arguments against subsidizing renewable energy that involve issues of fairness, economic efficiency and other factors. Nevertheless, it must be asked why a subsidy for renewable energy would pose a specific reliability problem for the grid. After all, the primary effect of the subsidy is to make renewable energy become cheaper. Yet renewable energy can and has also become cheaper through technological improvements. The most recent estimate of the levelized cost of electricity by Lazard indicates that even without subsidies, the price of onshore wind has fallen to the level of coal ($56 to $29 a megawatt hour for wind versus $45 to $27 a megawatt hour for coal), while the unsubsidized cost for solar ($44 to $36 a megawatt hour) is also comparable.[21]

If, as has been suggested above, declining wind or solar prices themselves do not cause reliability problems in general, then it is hard to see why matters would be different when the decline is due to subsidization. However, to say this is not to defend the subsidies themselves, but merely to suggest that, if the existence of subsidies in a market were enough to destabilize the entire market, then few markets would be able to survive.

There are two caveats to make here. The first involves so-called "negative pricing," where a generator bids onto the grid at a negative price, effectively paying others to take their electricity. Because the PTC provides 2.2 cents per kilowatt hour generated, it can be profitable for a wind farm to sell at negative prices. Admittedly, wind power is not the only type of electricity that sometimes offers negative prices. Nuclear plants, for example, cannot easily curtain their generation, and therefore may find it less costly to bid their generation even at a negative price. In 2019, Texas also began to see negative prices for natural gas due to issues of congestion and oversupply.[22] Still, negative prices are generally an economic signal that the good in question is being oversupplied, and renewable subsidies like the PTC undoubtedly make this problem worse. However, for now, negative pricing remains a rare occurrence. For example, in Texas, where wind is plentiful, system-wide electricity prices were negative for only 64 hours in 2017 (less than one percent of total hours).[23]

The situation is also somewhat different if we consider not renewable subsidies per se, but rather renewable energy mandates. Unlike a subsidy, which for all its faults, still allows markets to respond, a mandate requires the grid to act in a particular way. Some states are currently experimenting with Renewable Portfolio Standards (RPSs) that require a large percentage of electricity to be supplied from renewable sources. These mandates not only have the potential to be very costly to consumers, but if set high enough may preclude the market responses necessary to ensure reliability. On the other hand, a low or moderate RPS likely would not pose a specific reliability challenge, and given the growth in renewable energy from other factors, may not even increase the amount of renewable energy on the grid by much.[24]

CONCLUSION

Properly designed, markets are perfectly capable of delivering electricity that is both affordable and reliable—and there is nothing in the nature of renewable energy that would make them unable to do so. Moreover, no matter how unjustified they are on their face, subsidies for renewable energy do not alter this equation. Where high renewable penetration does raise valid stability concerns, this is because markets do not fully reflect all reliability elements. Thus, the appropriate response is to make market design improvements to ensure market incentives align with the efficient and reliable operation of the system. But, it is important not to exaggerate these concerns or to use them to demonize particular energy sources. To do so is not only unfair, it is dangerous from a free-market perspective, because it ultimately destroys confidence in the ability of the market to respond to supply and demand. Accordingly, it is not surprising that many of those who claim that renewables endanger electric reliability end up calling for more government interference in the market

19. See, e.g., Benjamin W. Griffiths et al., "State Level Financial Support for Electricity Generation Technologies: An Analysis of California and Texas," Energy Institute, April 2018. https://energy.utexas.edu/sites/default/files/UTAustin_FCe_State-Subsidy_Paper_2018.pdf.

20. Recent subsidies for coal and nuclear plants, such as HB 6 in Ohio, rival the level of subsidy for renewable generation.

21. "Lazard's Levelized Cost of Electricity Analysis, Version 12.0," Lazard, Nov. 8, 2018. https://www.lazard.com/perspective/levelized-cost-of-energy-and-levelized-cost-of-storage-2018.

22. Mose Buchele, "Oil companies will pay you to take natural gas from west Texas," KUT 90.5, April 12, 2019. https://www.kut.org/post/oil-companies-will-pay-you-take-natural-gas-west-texas.

23. "Impact of increased wind resources in the ERCOT region," ERCOT, August 2018. http://www.ercot.com/content/wcm/lists/144927/Wind_One_Pager_FINAL.pdf.

24. See, e.g., Josiah Neeley, "Why environmentalists should support repealing Texas' RPS," *R Street Blog*, July 25, 2018. https://www.rstreet.org/2018/07/25/why-environmentalists-should-support-repealing-texas-rps.

as a "corrective."[25] Conservatives should therefore continue to oppose renewable energy subsidies and mandates, but should not let this opposition bleed over into a general opposition to particular technologies.

ABOUT THE AUTHOR

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25. See, e.g., Ed Hirs, "How to fix Texas' Soviet-style electricity market," *Houston Chronicle*, Aug. 20, 2019. https://www.houstonchronicle.com/opinion/outlook/article/How-to-fix-Texas-Soviet-style-electricity-14363388.php.