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Green New Deal Will Put Texans in the Red

Effects on Texas Electricity Costs and Energy Production up to 2030

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Key Points

- Transitioning Texas to 50 percent wind and solar electricity generation by 2030 would cause annual generation and transmission costs to rise by 250 percent compared to 2018 costs. Reaching 100 percent wind and solar would increase these costs by nearly 10 times.
- Under the Green New Deal, the average Texas family's annual electricity bill would rise more than $3,200 by 2030.
- The total cost to implement the renewable electricity generation mandates of the Green New Deal in Texas would reach $120 billion per year in 2030—about equivalent to the state of Texas' entire annual budget.
- If those renewable mandates were fully implemented by 2030 across the U.S., climate models suggest the global average temperature would decrease by less than a tenth of a degree: 0.097° Fahrenheit by 2050.

Part 1: Electricity Generation

Much has been written about the costs and feasibility of many of the proposals in the Green New Deal (H Res. 109) from organizations such as the American Action Forum (Holtz Eakin et al.), American Enterprise Institute (Zycher), and Wood Mackenzie (Shreve and Schauer). In particular, the resolution's call to meet "100 percent of the power demand in the United States through clean, renewable, and zero-emission energy sources" has attracted much of the attention. Though the resolution does not call specifically for the U.S. to transition to 100 percent wind and solar electricity generation, the wording of the resolution and the messaging used by the movement supporting it appear to make that the goal, especially given the geographic limitations of hydro- and geothermal power generation.

The question of how to achieve levels of renewable energy above 50 percent has been debated in academic and industry circles for many years (Denholm and Hand, Frew et al., Kroposki et al.). The Green New Deal and legislation in a few states, notably New Mexico (SB 489) and California (SB 100), mandating 100 percent zero-carbon electricity generation within the next 30 years have recently shined a greater spotlight on this question and whether or not the technology and scale needed can be achieved. With these state and local policies becoming reality even as the Green New Deal itself fails to gain traction in Congress, policymakers and the public need to learn more about the costs, impacts, and feasibility of a rapid switch to electricity generation from wind and solar resources.

Texas offers a unique case study for this question because of its relatively large supply of wind and solar resources, its large economy, and the fact that 90 percent of its electric grid operates under a single market with a single market operator, the Electric Reliability Council of Texas (ERCOT). The ERCOT market also has an abundance of publicly available market data and wind and solar production data from which to draw upon. Therefore, this study seeks to apply the thought experiment outlined above to the ERCOT market and frame the discussion in a context that is relevant to policymakers.

Figure 1 outlines the capacity requirements for achieving three high renewable scenarios—50 percent, 80 percent, and 100 percent—in the ERCOT market by 2030, per the goal of the Green New Deal (H Res. 109). Those scenarios are compared to a "current policies" scenario, which is used as the 2030 base case, and the mix of electricity generation in 2018. The current policies scenario reflects ERCOT forecasts (ERCOT 2019) with additional wind, solar, and gas to maintain required reserve levels and no coal or nuclear retirements prior to 2030. The

continued

Figure 1. 2030 capacity requirements of 50 percent, 80 percent, and 100 percent wind and solar generation for ERCOT compared to 2030 base case and 2018 generation mix.

	2018	Current Policies	50 Percent Renewables	80 Percent Renewables	100 Percent Renewables
Wind Capacity (MW)	22,066	37,596	49,877	102,928	107,737
Solar Capacity (MW)	1,861	11,019	25,372	86,091	91,597
Battery Capacity (MW)	87	527	10,626	23,260	533,833
Nuclear Capacity (MW)	4,960	4,960	4,960	4,960	-
Gas capacity (MW)	45,449	51,997	54,700	42,000	-
Coal Capacity (MW)	14,225	14,225	-	-	-

Calculations *by author. Methodology and data sources are available at the Foundation website.*

50 percent scenario assumes that current coal capacity is phased out but that natural gas is not required to use carbon capture. Therefore, it is a reduced-carbon scenario and not a zero-carbon scenario. The 80 percent scenario requires natural gas to use carbon capture and is designed to illustrate the added cost of using wind and solar instead of firm capacity to achieve the last 20 percent of zero-emission generation. These scenarios were not run through an optimization routine but are consistent with ERCOT projections (ERCOT 2018) and with studies that find a roughly 50/50 wind/solar capacity mix is optimal for the southwestern United States, within the constraint of evolving from Texas' current wind- and gas-heavy generation mix (Ziegler et al.).

A necessary assumption in the high renewable scenarios is that Texas adopts a regulated "cost of service" model,* wherein state regulators would dictate how much capacity is derived from each resource and pass the costs of building that capacity directly to consumers.** The model also assumes a 10 percent reserve margin is maintained through 2030 in order to provide a consistent basis for quantifying capacity needs. In practice, the reserve margin is likely to fluctuate based on prices, demand growth, reliability constraints, and policy changes.

Another important assumption across all the scenarios is that annual electricity demand growth will continue to follow the recent historical average of 1.4 percent per year. The tremendous cost increases associated with the high renewable scenarios dictate that electricity consumption will likely go down in conjunction with increasing renewable energy use. This is, in fact, a stated goal of the Green New Deal and many other plans to transform our energy system, and the economic consequences of that energy deprivation would be severe. However, in order to maintain a level comparison with the base case, the study assumes constant electricity demand growth.

Figure 2 outlines how much the cost of electricity generation and transmission is projected to increase under these different scenarios. While the current policies scenario sees an increase in total annual costs of 46 percent, the 50 percent renewable scenario sees an increase of 2.5 times due to the addition of wind and solar capacity, a sharp increase in battery capacity needs, and the need to maintain a large amount of natural gas generation to provide backup

Figure 2: 2020-2030 average annual cost of 50 percent, 80 percent, and 100 percent scenarios for ERCOT compared to 2030 base case and 2018 (values not adjusted for inflation).

	2018	Current Policies	50 Percent Renewables	80 Percent Renewables	100 Percent Renewables
Annual Cost ($ Billion)	13	19	33	61	120
Annual Cost ($/MWh)	36	44	73	138	270

Calculations by author. Methodology and data sources are available at the Foundation website.

* The current policies scenario assumes that the current model of competitive generation and regulated transmission is carried forward, and it can therefore use forward prices to make a more accurate forecast. It also assumes the current production tax credit and investment tax credit policies are carried forward.

** There are limits to forecasting how these changes could be achieved in practice, and the assumptions and data sources are described in a separate methodology document.

power for the wind and solar. The 80 percent scenario incurs another doubling of cost primarily due to the need for significantly more wind and solar capacity and the added cost of installing and operating carbon capture units on the natural gas power plants. Finally, the cost of the 100 percent scenario is again double due to the more than twentyfold increase in battery capacity needed, compared to the 80 percent scenario. The 7.5 times cost-increase per MWh in that scenario over today's costs, under the simplistic assumption that it is applied evenly to all electricity consumers, would cause the average annual residential electricity bill in Texas to rise more than $3,200 by 2030.

Figure 3: 2030 incremental land use of 50 percent, 80 percent, and 100 percent scenarios for ERCOT.

	50 Percent Renewables	80 Percent Renewables	100 Percent Renewables
Miles Transmission	6,450	29,700	32,500
Land for Transmission (acres)	234,545	1,080,000	1,181,818
Land for Solar (acres)	114,824	600,576	644,624
Land for Wind (acres)	736,860	3,919,920	4,208,460

Calculations by author. Methodology and data sources are available at the Foundation website.

A key point to remember in this discussion is that renewable does not mean unlimited. The land needed for siting wind turbines and solar panels and the materials needed to build them are finite, a problem that is exacerbated by the low energy density of these resources. The land requirements for wind and solar facilities in the 100 percent scenario are nearly five million acres, more than 10 times the amount of land used for the current generation assets. The miles of transmission lines are conservatively estimated to increase 70 percent from today and require another 1.2 million acres, bringing the total land use to more than six million acres, more than five times the size of Harris County. The environmental impact of this buildout cannot be overstated. Using less dense energy sources will necessarily increase our footprint on the land, requiring appropriations of private property through eminent domain and likely affecting sensitive wildlife habitat.

The material needs of this buildout are also substantial. It would require nearly 36,000 wind turbines, at 3 MW each, using over 10 million metric tons of steel (Mone et al.) and nearly that much coal to make the steel (WCA). The batteries in this scenario are assumed to meet their power rating for four hours, which means Texas will need more than 2,000 gigawatt-hours of storage capacity—more than 250 times what was installed worldwide in 2018 (Munuera). Given that Texas produces 11 percent of the United States' total electricity (EIA 2019a), the scale of the nationwide buildout called for in the Green New Deal is difficult to fathom.

Ultimately, despite the limitations of forecasting what a high-renewable electric grid would look like, this analysis makes clear that even topping 50 percent wind and solar will be difficult in practice and likely politically impossible given consumers' sharp opposition to rapid increases in electricity costs. Achieving 80 or 100 percent is not just a problem of technology but also of scale and physics. The challenges faced by European countries such as Denmark and Germany, which are approaching that 50 percent mark, are also instructive. Households in those countries are paying close to three times the rate for electricity that U.S. households are paying (Eurostat), and they are increasingly having to rely on fossil fuel generation in neighboring countries to absorb the intermittency of their renewable generation.

If policymakers and environmental advocates were truly concerned about reducing carbon emissions, they would turn to nuclear and other zero-carbon resources that have the dispatchability, and scale to power the majority of the electric grid, while using wind and solar on the margins where they are economical. Unfortunately, the push for 100 percent wind and solar electricity generation will not achieve its stated goals of low-cost, zero-emission electricity generation, but it will achieve another outcome: forcing greater government involvement in the energy sector in order to ensure enough capacity gets built and to manage the reliability problems created by intermittency. These actions will only serve to slow and stifle the innovation needed to create our energy systems of the future by draining our resources and locking us into inefficient methods of electricity generation.

Part 2: Replacing Current Energy Production

In addition to the question of overhauling our electricity generation, it is important to ask what would be needed to transform the rest of our energy system. The analysis above does not consider a large-scale rollout of electric vehicles, which would have significant effects on electricity demand that are even more difficult to forecast than the effect of adding a substantial amount of wind and solar. One straightforward way to consider the problem would be to consider the current size of our energy economy and what would be needed to replace it.

Texas again offers an excellent case study as it is the largest energy-producing state in the United States and one of the largest energy-producing regions in the world. Every day, Texas produces nearly five million barrels of crude oil (nearly half the country's output), 24 billion cubic feet of natural gas, more than 100 thousand short tons of coal, and a variety of other fuels that emit greenhouse gases (EIA 2019c). From 2007 to 2017, Texas' energy production from oil and gas increased by 6.8 quadrillion BTUs, more than 11 times the increase in the state's energy production from wind and solar over that time despite a massive influx of wind production (EIA 2019b). CO_2-emitting fuels still provide more than 80 percent of our total energy, but the Green New Deal would require Texas to replace this efficient, dense, and scalable energy system with a system of wind and solar energy that is many times less efficient, less dense, and more expensive.

The prosperity brought about by Texas' energy production is also staggering. Throughout recorded history, as access to energy has improved, so has nearly every metric of human health and quality of life, from life expectancy to education to economic freedom. And this tremendous energy system was brought about by the power of competitive energy markets and the millions of people working in those markets.

The energy industry employs more than 380,000 people in Texas. The loss of these direct energy jobs, which are among the highest paying, would easily result in the total loss of well over one million jobs throughout the statewide economy, and in fact when all is said and done the damage is likely to be much worse. One-fifth of Texas' economy is directly comprised of petroleum-based energy activity, and these industry companies are engaged with a broad range of suppliers in other sectors, from manufacturing to transportation to wholesale and retail. A conservative multiplier of 2.5 suggests that fully 50 percent of the statewide economy would be severely affected by the significant or total loss of economic activity generated by oil and gas companies.***

The final piece of this question involves taxes and the level of government involvement needed to achieve the Green New Deal's "energy transformation." Consumers, especially the millions of households paying 30 percent or more of their income on utilities (Boyce and Wirfs-Brock), will not be able to pay twice as much for electricity, much less 10 times. The 100 percent renewable scenario would require the state of Texas—which has a budget of $115 billion this year (HB 1)—to spend $120 billion per year on electricity. The state would also need to replace the more than $3 billion in taxes it receives from oil and gas production annually (Hegar). There is no plan for determining what government services would be eliminated or who would be taxed to raise that amount of money. Again, the only predictable result of these policies will be a tremendous growth in the size and power of government.

We cannot forget that prosperity and technological innovations, made possible by affordable and reliable energy, have allowed us the free time and energy to think about the effects of our carbon dioxide emissions 50 to 100 years from now—a luxury many poor and developing nations who need to focus on feeding their people don't have. Forcing the transition to a zero-carbon economy by government fiat will lead to a massive economic disruption and deprive us of the resources that we need to keep moving forward. And even if we can achieve a total overhaul of our energy system by 2030, as the Green New Deal calls for, climate models suggest that we would cut the increase in global temperatures by just 0.05° Celsius in 2050 and less than 0.2° in 2100. Developing nations will contribute an ever-increasing majority of the world's emissions for the rest of the 21st century as our petrochemical and manufacturing jobs move overseas where environmental protections pale in comparison to those of the United States. The unintended consequences of the Green New Deal would be a step backward for them in environmental protections. And any potential damage from climate change 50 years from now is paltry compared to the suffering their people face right now due to a lack of affordable and reliable energy.

Throughout human history, the best solutions have come from private citizens rolling up their sleeves and creating their own innovative approaches to the challenges facing them. Few of the world's great achievements have come from top-down, one-size-fits-all government mandates. The power of the free market, not the power of government, will continue to grow prosperity and reduce poverty worldwide through the power of reliable, affordable, dense, and abundant energy. Environmental policy should serve mankind, not the other way around.

*** Data courtesy of Karr Ingham.

Erratum: The first version of this paper stated incorrectly that the cost per household of 100 percent wind and solar generation in Texas in 2030 would be nearly $14,000 annually. Table 2 shows the annual cost of generation and transmission rising from $13 billion to $120 billion, and this 9.2 times multiplier was applied to the annual estimated residential electricity bill of $1,500 to get nearly $14,000. However, generation and transmission costs only make up 30 to 40 percent of a typical electricity bill. The correct method to calculate the cost per household is to multiply the cost per MWh from Table 2, $270/MWh, by the average electricity usage per household, roughly 14 MWh per year, which comes to $3,780 per year. The annual cost of generation and transmission today is $504 per household, so the increase is $3,276.

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