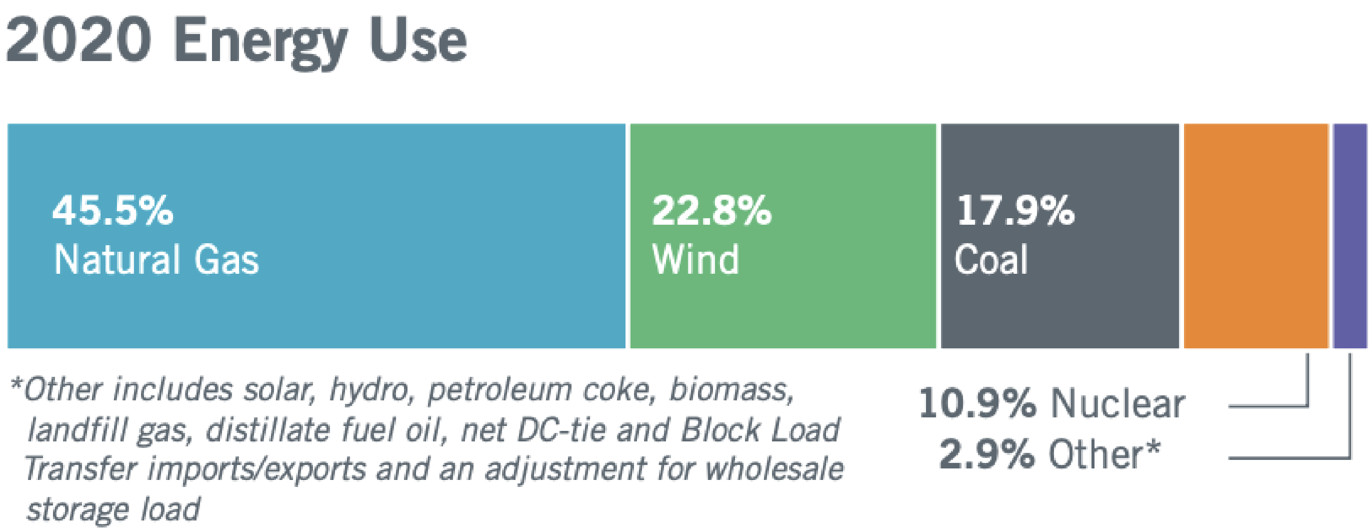
Twitter Thread by Daniel Cohan

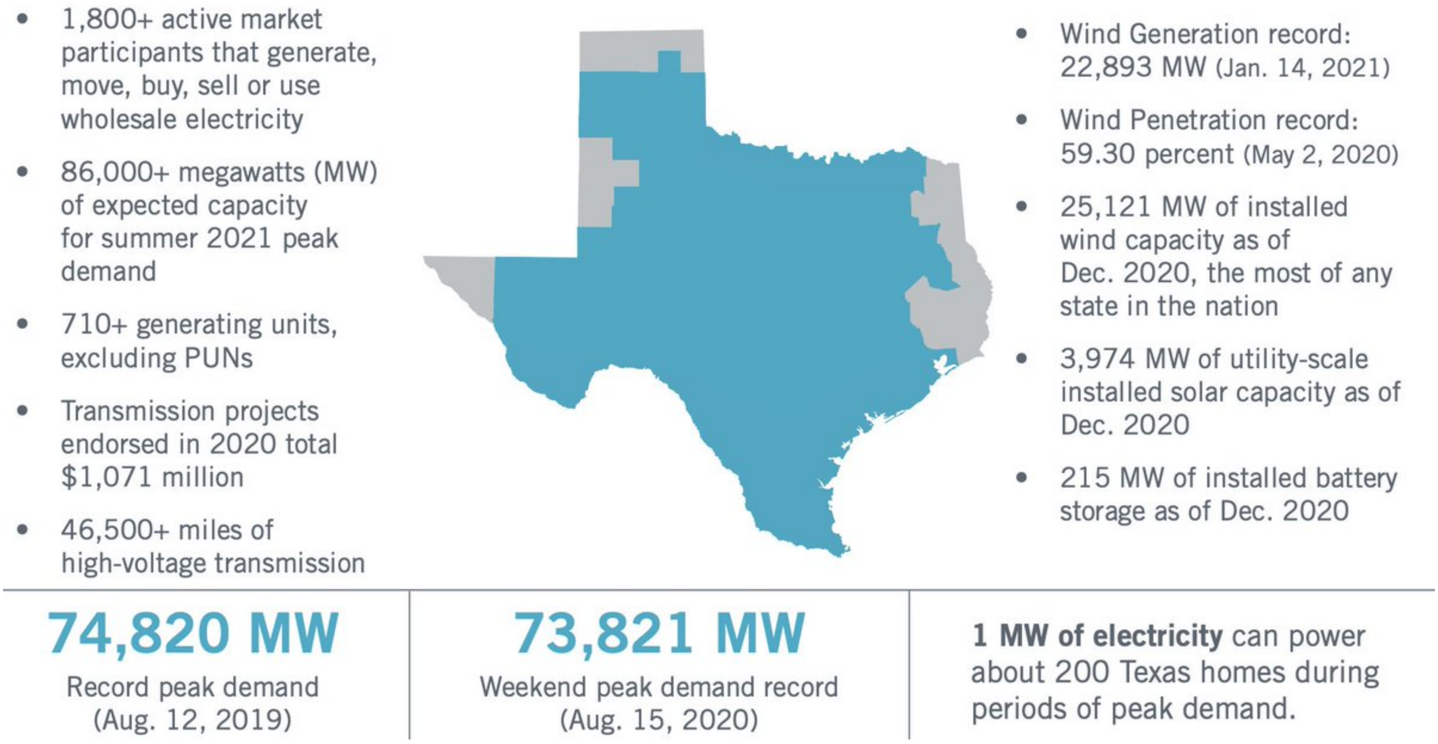
Daniel Cohan
@cohan_ds

So many of the misleading narratives about the #TexasBlackout are missing a fundamental understanding of our electric power supply, and its mutual vulnerabilities with our gas systems. We're facing an _energy systems_ crisis, not just an electricity crisis.

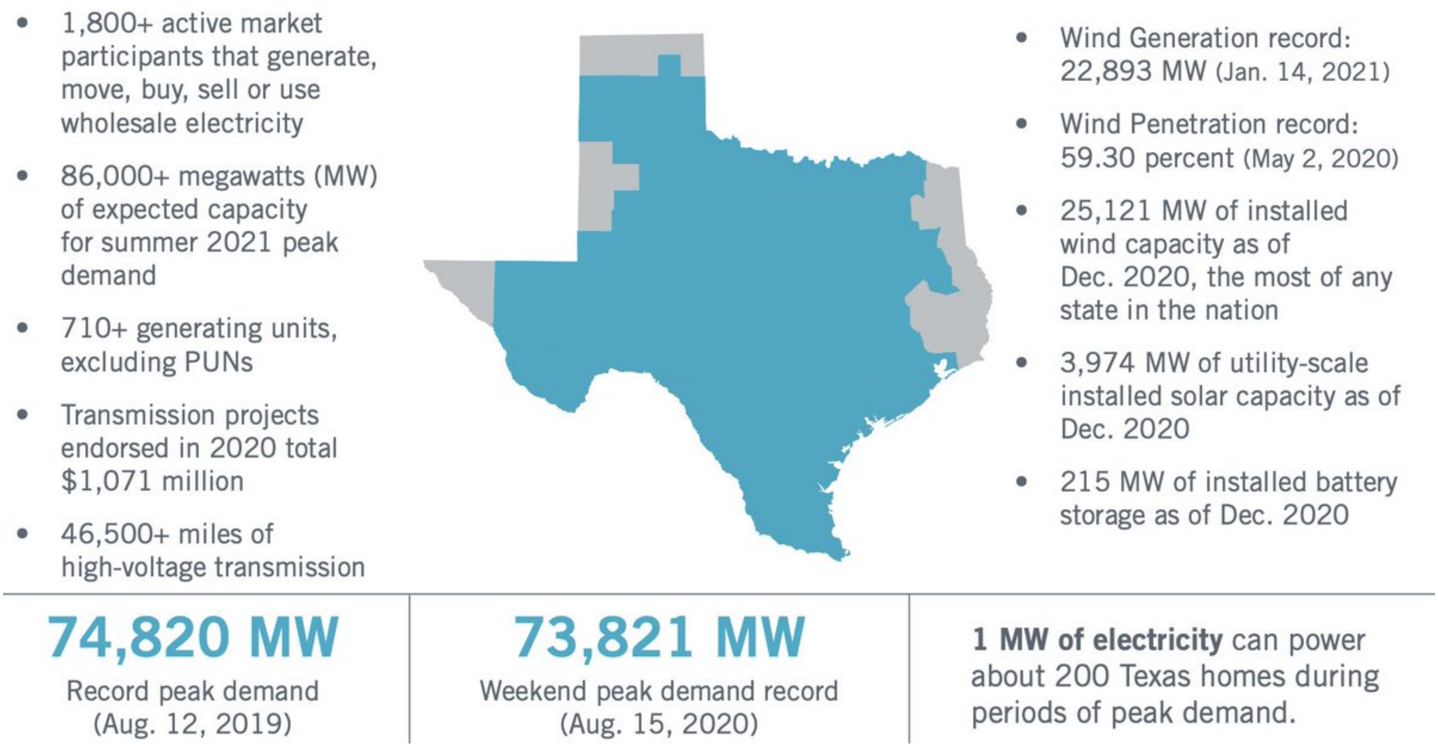
To understand why, we can begin by seeing how ERCOT generates power on average. Nearly half is from gas. Wind topped coal last year for the first time. We have just 4 nuclear units, little hydro, and solar soaring from a small base.



That supply provides power for most but not all of the state. And the grid is contained within Texas, with very little transmission linking to the rest of the country or Mexico. So what happens in Texas, stays in Texas.



You'll also notice that the grid can operate just fine with very high levels of wind -- over 50% at times -- at that our peaks typically come in summer. We also have a minuscule but growing amount of battery storage (0.2 GW vs. 74 GW peak demand).



Before each season, ERCOT issues a Seasonal Assessment of Resource Adequacy. It's meant to plan for the peak demand expected that season.

Seasonal Assessment of Resource Adequacy for the ERCOT Region
Winter 2020/21 - Final
Release Date: Novermber 5, 2020

Forecasted Capacity and Demand

Operational Resources (thermal and hydro), MW	67,529	Based on current Seasonal Maximum Sustainable Limits reported through the unit registration process
Switchable Capacity Total, MW	3,710	Installed capacity of units that can interconnect with other Regions and are available to ERCOT
Less Switchable Capacity Unavailable to ERCOT, MW	-568	Based on survey responses of Switchable Resource owners
Available Mothballed Capacity, MW	0	Based on seasonal Mothball units plus Probability of Return responses of Mothball Resource owners
Capacity from Private Use Networks, MW	3,631	Average grid injection during the top 20 winter peak load hours over the last three years, plus the forecasted net change in generation capacity available to the ERCOT grid pursuant to Nodal Protocol Section 10.3.2.4.
Coastal Wind, Peak Average Capacity Contribution, MW	1,480	Based on 43% of installed capacity for coastal wind resources (winter season) per ERCOT Nodal Protocols Section 3.2.6.2.2
Panhandle Wind, Peak Average Capacity Contribution, MW	1,411	Based on 32% of installed capacity for panhandle wind resources (winter season) per ERCOT Nodal Protocols Section 3.2.6.2.2
Other Wind, Peak Average Capacity Contribution, MW	3,251	Based on 19% of installed capacity for other wind resources (winter season) per ERCOT Nodal Protocols Section 3.2.6.2.2
Solar Utility-Scale, Peak Average Capacity Contribution, MW	269	Based on 7% of rated capacity for solar resources (winter season) per Nodal Protocols Section 3.2.6.2.2
Storage, Peak Average Capacity Contribution, MW	0	Based on 0% of rated capacity (winter) season); resources assumed to provide regulation reserves rather than sustained capacity available to meet peak loads
RMR Capacity to be under Contract	0	
Capacity Pending Retirement, MW	0	Announced retired capacity that is undergoing ERCOT grid reliability reviews pursuant to Nodal Protocol Section 3.14.1.2
Non-Synchronous Ties, Capacity Contribution, MW	838	Based on net imports during winter 2013/2014 Energy Emergency Alert (EEA) intervals
Planned Thermal Resources with Signed IA, Air Permits and Water Rights, MW	0	Based on in-service dates provided by developers
Planned Coastal Wind with Signed IA, Peak Average Capacity Contribution, MW	371	Based on in-service dates provided by developers and 43% winter capacity contribution for coastal wind resources
Planned Panhandle Wind with Signed IA, Peak Average Capacity Contribution, MW	0	Based on in-service dates provided by developers and 32% winter capacity contribution for panhandle wind resources
Planned Other Wind with Signed IA, Peak Average Capacity Contribution, MW	557	Based on in-service dates provided by developers and 19% winter capacity contribution for other wind resources
Planned Solar Utility-Scale, Peak Average Capacity Contribution, MW	35	Based on in-service dates provided by developers and 7% winter capacity contribution for solar resources
Planned Storage, Peak Average Capacity Contribution, MW	0	Based on in-service dates provided by developers and 0% winter capacity contribution for storage resources
[a] Total Resources, MW	82,513	
[b] Peak Demand, MW	57,699	Based on average weather conditions at the time of the winter peak demand from 2004 – 2018, and updated to reflect a revised economic growth forecast prepared in April 2020
[c] Reserve Capacity [a - b], MW	24,814	

Looking more closely at ERCOT's winter peak plan, we see they expected "operational resources" (mostly gas, plus coal, nuclear, and hydro) to provide 67 GW of power. They know it's not always windy or sunny, so they guesstimated 6 GW wind, and <1GW solar.

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In a "normal" winter, those "operational resources" would have been enough to supply peak demand, even if there was zero wind and solar. Wind and solar operating at other times reduce emissions and costs and conserve fuels like gas and coal for when we'll need them most.

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ERCOT realized not every winter is typical, so it planned for several what-if scenarios and associated potential risks. Again, all of their estimates are publicly available. https://t.co/y6ueMSsmCm

Range of Potential Risks

	Forecasted Season Peak Load	Extreme Peak Load / Typical Generation Outages During Extreme Peak Load	Forecasted Season Peak Load / Extreme Low Wind Output	Extreme Peak Load / Extreme Generation Outages During Extreme Peak Load	
Seasonal Load Adjustment	-	9,509	-	9,509	Based on the 2011 winter and a revised economic growth forecast prepared in April 2020 ; the extreme winter forecast is 67,208 MW
Typical Maintenance Outages, Thermal	4,074	4,074	4,074	4,074	Based on the historical average of planned outages for December through February weekdays, hours ending 7 am - 10 am, for the last three winter seasons (2017/18, 2018/19, and 2019/20)
Typical Forced Outages, Thermal	4,542	5,339	4,542	5,339	Based on historical average of forced outages for December through February weekdays, hours ending 7 am - 10 am, for the last three winter seasons (2017/18, 2018/19, and 2019/20); both Extreme Load scenarios include typical fuel limitation-related derates/outages at units in north Texas during extreme peak load hours
95th Percentile Forced Outages, Thermal	-	-	-	4,540	Based on the 95th percentile historical average of forced outages for December through February weekdays, hours ending 7 am - 10 am, for the last three winter seasons (2017/18, 2018/19, and 2019/20) plus additional fuel limitation-related derates/outages at units in north Texas during the peak load hours for the January 17, 2018 cold weather event
Low Wind Output Adjustment	-	-	5,279	-	Based on the 5th percentile of hourly wind capacity factors (output as a percentage of installed capacity) associated with the 100 highest Net Load hours (Load minus wind output) for the 2015/16-2019/20 winter Peak Load seasons; this low wind output level is 1,791 MW
[d] Total Uses of Reserve Capacity	8,616	18,922	13,895	23,462	
[e] Capacity Available for Operating Reserves, Normal Operating Conditions (c-d), MW	16,198	5,892	10,919	1,352	See the Background tab for additional details

In those risk scenarios, we see the typical temptation to refight the last battle. So the planning considered a repeat of the 2011 freeze that last caused rolling blackouts (though for hours, not days). They did have a worse scenario in the last column.
https://t.co/uAOzaSTLFQ

> ERCOT realized not every winter is typical, so it planned for several what-if scenarios and associated potential risks. Again, all of their estimates are publicly available. https://t.co/y6ueMSsmCm pic.twitter.com/BxexLTN1r1
>
> — Daniel Cohan (@cohan_ds) February 17, 2021

Even with that imperfect foresight, ERCOT didn't do too badly predicting peak _demand_, with 67 GW in extreme scenario. We don't know what actual peak would have been without these rolling blackouts, but perhaps in the low 70s GW. So maybe a 10%, 7 GW underestimate.

ERCOT also got things about right predicting scheduled maintenance, as plants tune up for summer peak. Why those were allowed to continue, given forecasts of an Arctic blast over a week ahead, deserves investigation. https://t.co/uAOzaSTLFQ

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Where ERCOT totally missed the situation was in forecasting outages. Actual outages of "firm" resources -- mostly gas, plus a bit of coal and 1 of 4 nuclear reactors that went down -- topped 30 GW, more than double its worst case scenario. https://t.co/uAOzaSTLFQ

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If Rep. Crenshaw is right, in his otherwise deeply misleading thread, individual power plants didn’t have equipment failures. What failed was the natural gas system in consistently supplying gas at adequate pressure to those power plants. https://t.co/D4x1jEqEJI

> In an otherwise misleading thread, the congressman makes a crucial point. Natural gas faces uniquely systemic vulnerabilities no matter how well individual power plants are maintained, by relying upon continuous supply of a fuel that\u2019s also needed for heat. https://t.co/MIa3elh6jH
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Politicians aren’t just misleading us in blaming renewables as the leading cause of the Texas blackouts. They’re pretending this is just a power system problem, that ERCOT alone could fix. We’re in an __energy systems __ crisis.

That means that as investigations occur -- as they must, for the worst winter blackouts in Texas history, not just uncomfortable but deadly for too many of my fellow Texans -- we need to look at systemic failures across energy systems, supply & demand, & energy/water nexus too.

Every one of our sources of power supply underperformed. Every one of them is vulnerable to extreme weather and climate events in different ways. None of them were adequately weatherized or prepared for a full realm of weather and conditions.

We also need to realize that this particular event, an Arctic blast stronger than any in 3+ decades, is rare. Climate science is uncertain on the future of extreme freeze events, but on average our winters are getting warmer. Houston gets 5x fewer freezing nights than in 1970s.

So whatever we do to improve our energy systems to prepare for the next freeze, we should prioritize measures that add resilience, as well as affordability, reliability, and environmental sustainability, across the spectrum of typical and extreme conditions.

Those extreme conditions in Texas are more likely to come in the form of heat waves, droughts (our last severe one was 2011, coincidentally the year of the last big freeze), hurricanes, and fires. All of those are being made worse by climate change.

Our power system isn't just failing us in the moment. They're too costly year-round to our $, air, climate, and health. In this paper, we estimated the air pollution, haze, and many 100s of deaths from Texas coal power plants, which emit more CO2, SO2 & NOx than any other state.

JOURNAL OF THE AIR & WASTE MANAGEMENT ASSOCIATION
https://doi.org/10.1080/10962247.2018.1537984

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TECHNICAL PAPER

Check for updates

Air quality and health benefits from potential coal power plant closures in Texas

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ABSTRACT

As power production from renewable energy and natural gas grows, closures of some coal-fired power plants in Texas become increasingly likely. In this study, the potential effects of such closures on air quality and human health were analyzed by linking a regional photochemical model with a health impacts assessment tool. The impacts varied significantly across 13 of the state's largest coal-fired power plants, sometimes by more than an order of magnitude, even after normalizing by generation. While some power plants had negligible impacts on concentrations at important monitors, average impacts up to 0.5 parts per billion (ppb) and 0.2 μg/m^3 and maximum impacts up to 3.3 ppb and 0.9 μg/m^3 were seen for ozone and fine particulate matter ($PM_{2.5}$), respectively. Individual power plants impacted average visibility by up to 0.25 deciviews in Class I Areas. Health impacts arose mostly from $PM_{2.5}$ and were an order of magnitude higher for plants that lack scrubbers for SO_2. Rankings of health impacts were largely consistent across the base model results and two reduced form models. Carbon dioxide emissions were relatively uniform, ranging from 1.00 to 1.26 short tons/MWh, and can be monetized based on a social cost of carbon. Despite all of these unpaid externalities, estimated direct costs of each power plant exceeded wholesale power prices in 2016.

Implications: While their CO_2 emission rates are fairly similar, sharply different NO_x and SO_2 emission rates and spatial factors cause coal-fired power plants to vary by an order of magnitude in their impacts on ozone, particulate matter, and associated health and visibility outcomes. On a monetized basis, the air pollution health impacts often exceed the value of the electricity generated and are of similar magnitude to climate impacts. This suggests that both air pollution and climate should be considered if externalities are used to inform decision making about power-plant dispatch and retirement.

PAPER HISTORY
Received May 30, 2018
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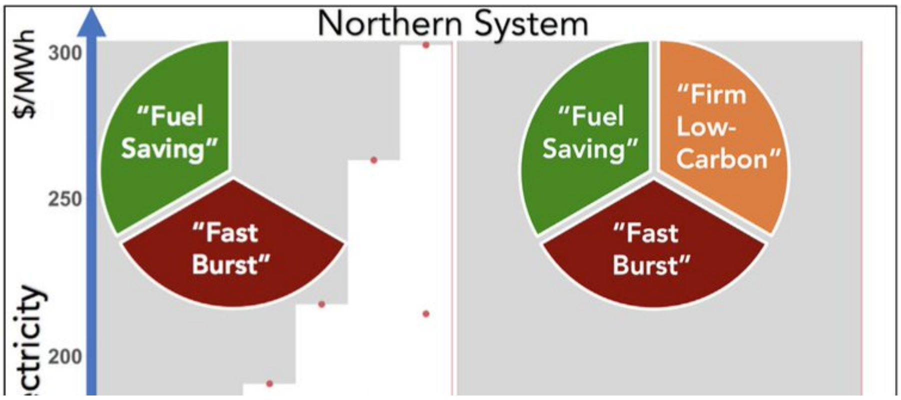
We should be thinking of our electricity supply as a team, and a portfolio of resources. Sepulveda and @JesseJenkins provided a nice framing for it here.

Joule

CellPress

Article

The Role of Firm Low-Carbon Electricity Resources in Deep Decarbonization of Power Generation



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HIGHLIGHTS

Firm low-carbon resources consistently lower decarbonized electricity system costs

We need that team to meet all of our priorities for electricity: affordable, reliable, resilient, and clean. No single player can do it alone. We don't necessarily need all players -- we can phase out coal with time. But we do need a balanced mix.

Joule

CellPress

Article

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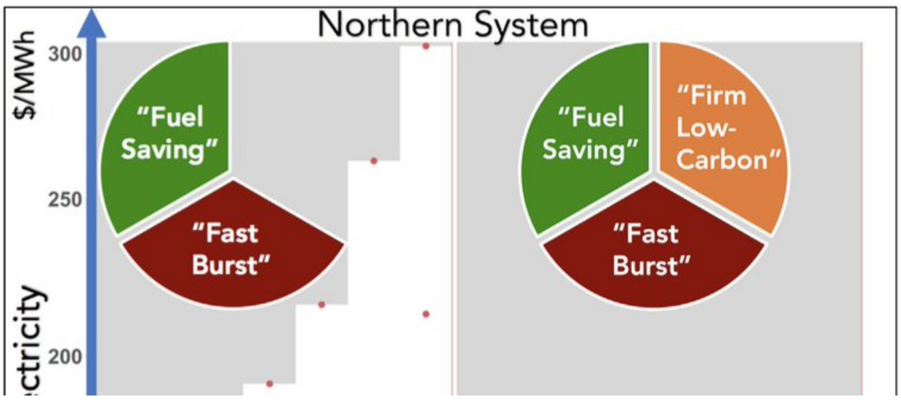

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HIGHLIGHTS

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So how does that framing apply to our Texas power sources? Wind, solar, and hydro are our fuel saving renewables. They operate as much as they can, very affordably, holding down costs & emissions and saving fuel overall. We need more, not less, of them.
https://t.co/FepgE074i0

> To understand why, we can begin by seeing how ERCOT generates power on average. Nearly half is from gas. Wind topped coal last year for the first time. We have just 4 nuclear units, little hydro, and solar soaring from a small base. pic.twitter.com/1Wba2O3Bfd
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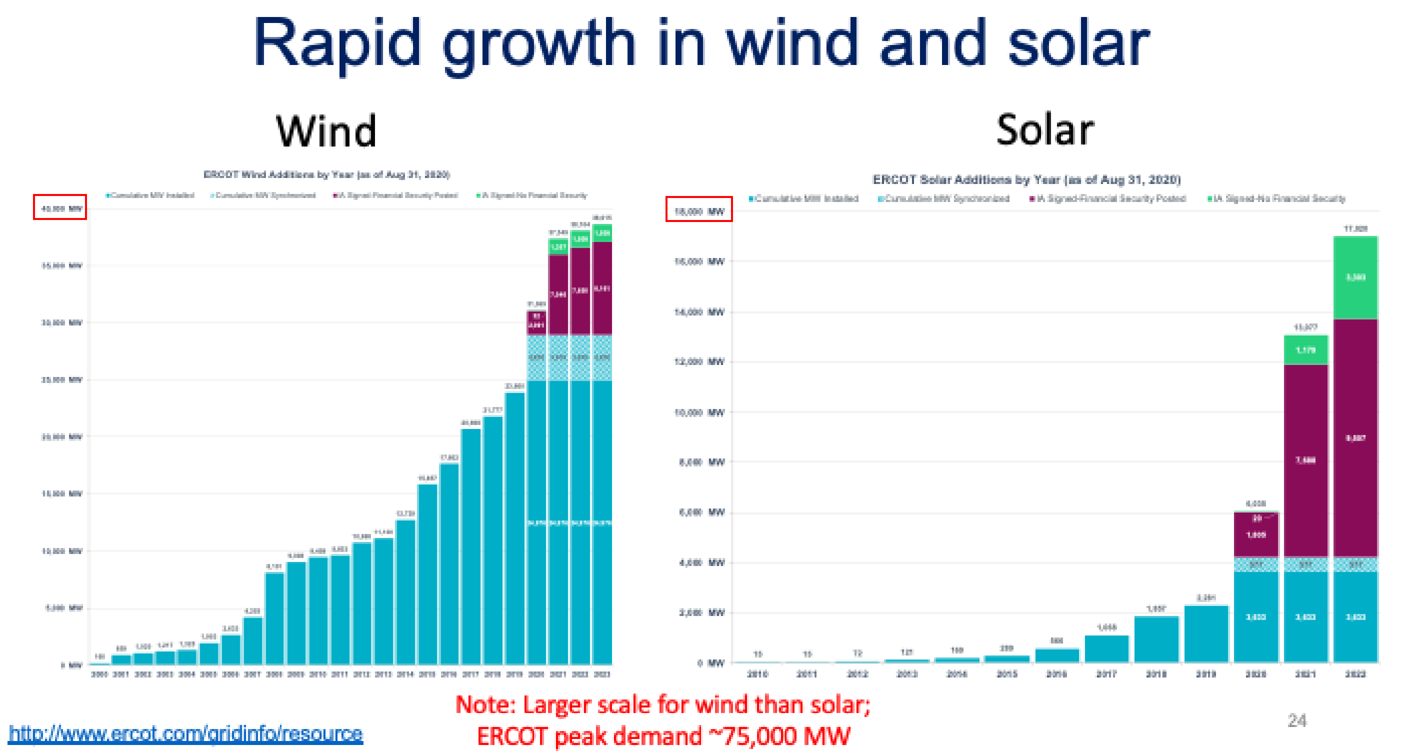
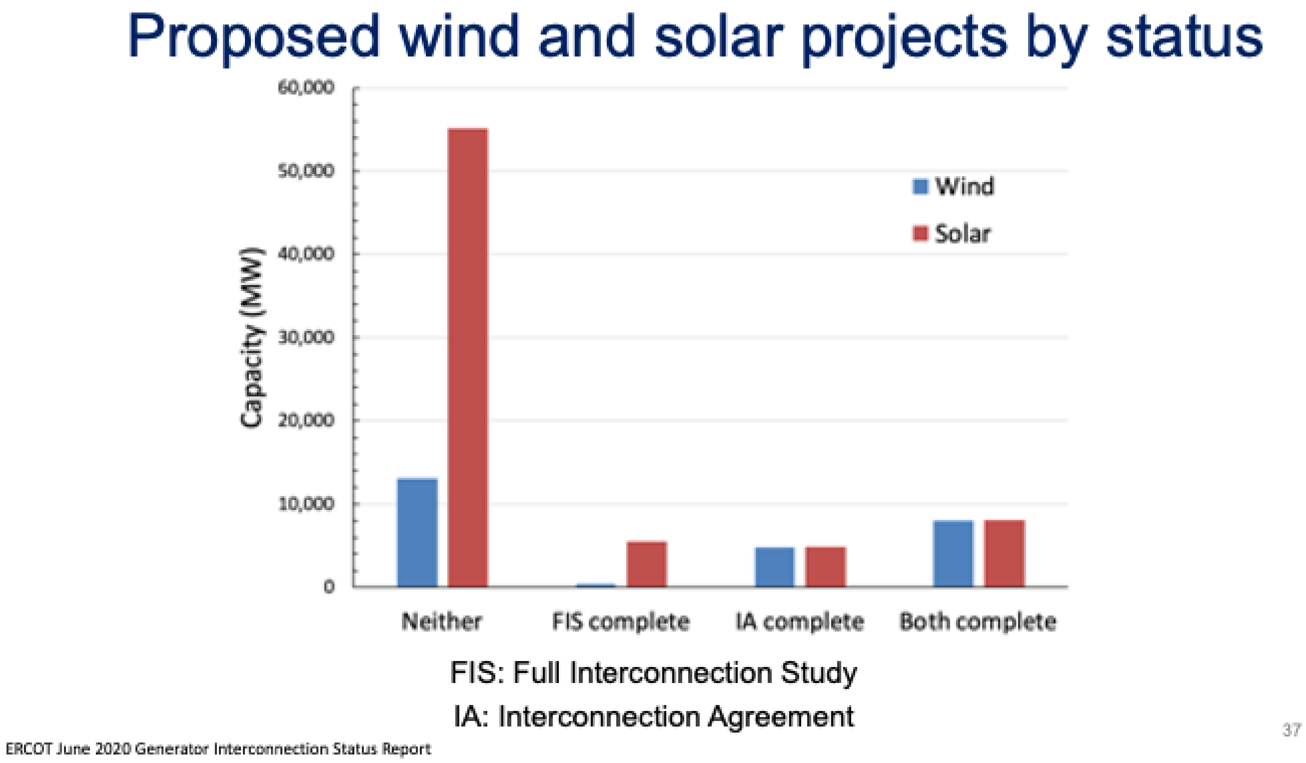
Wind and solar are growing fast. Texas leads the nation in wind MW, though not % of supply. We didn't even crack the top 10 states in solar until recently, yet but are doubling it each year.



We can be adding wind and solar a lot faster. Here's what was in the ERCOT interconnection queue as of June. That would dwarf the solar on the grid today. If we buy into the false narratives of this crisis, many of those projects won't get built.



Again, wind and solar are clean, affordable, fuel saving resources. It's not windy and sunny all the time. They're not meant to be our sole source of power during peak hours. But they save a lot of fuel to be available as so-called "firm" sources when we need them most.

Returning to that overall mix, coal provides 18% of power, falling below wind for last year. It's keeping the lights on for many of us now, while so much gas power is offline. It's also polluting and deadly, as our research has shown. https://t.co/FepgE074i0

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TCEQ has allowed some of those coal plants avoid installing SO2 scrubbers, which have been required at all new plants since early 1980s. Its Regional Haze Plan proposes to do zero about it. See criticisms here: herehttps://www.tceq.texas.gov/airquality/sip/bart/haze_sip.html