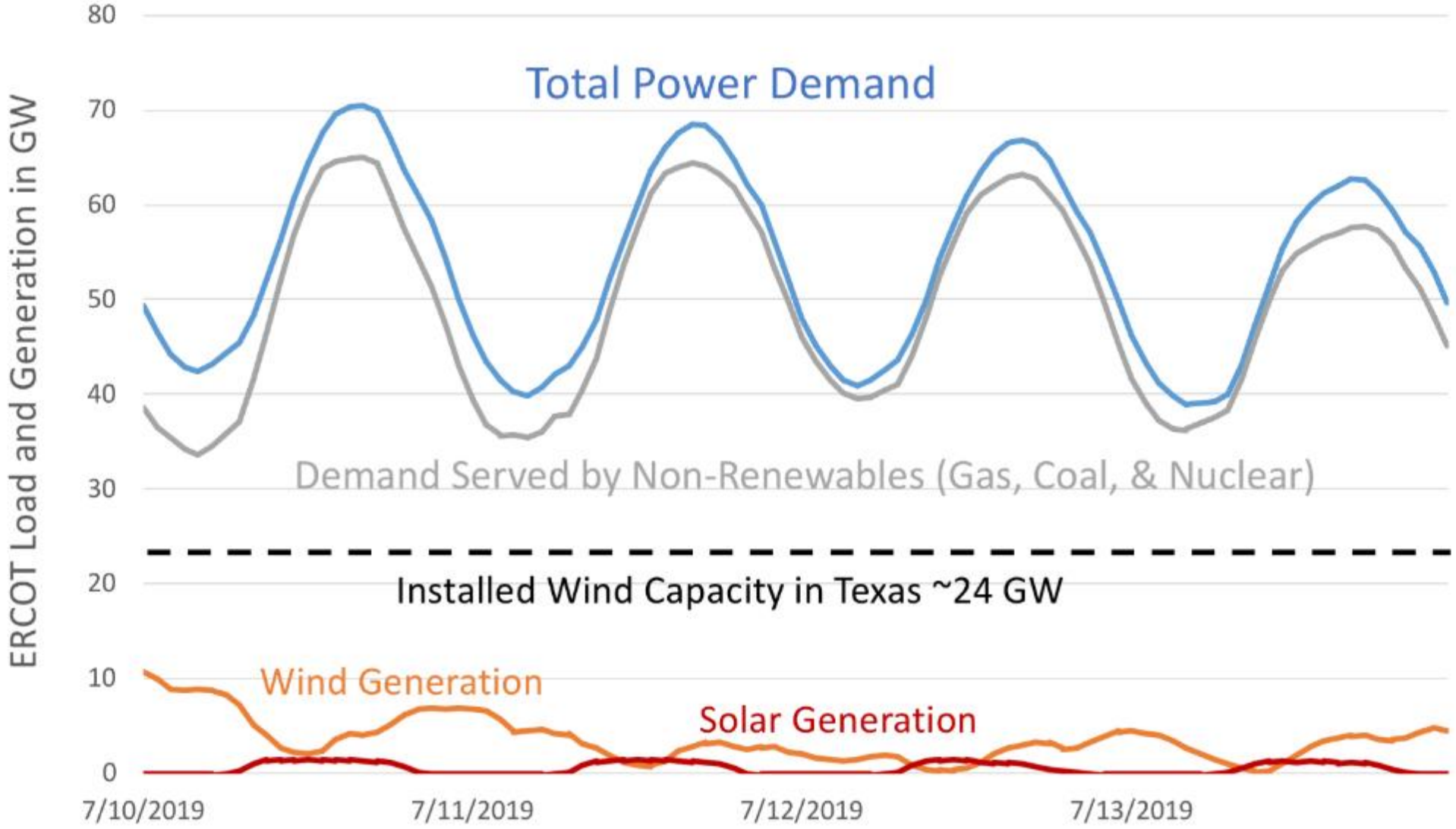
THE IMPORTANCE OF ELECTRIC RELIABILITY & RESILIENCE –

Houston, We Have a Problem. . .

Mike Nasi
Senior Advisor, *Life:Powered*

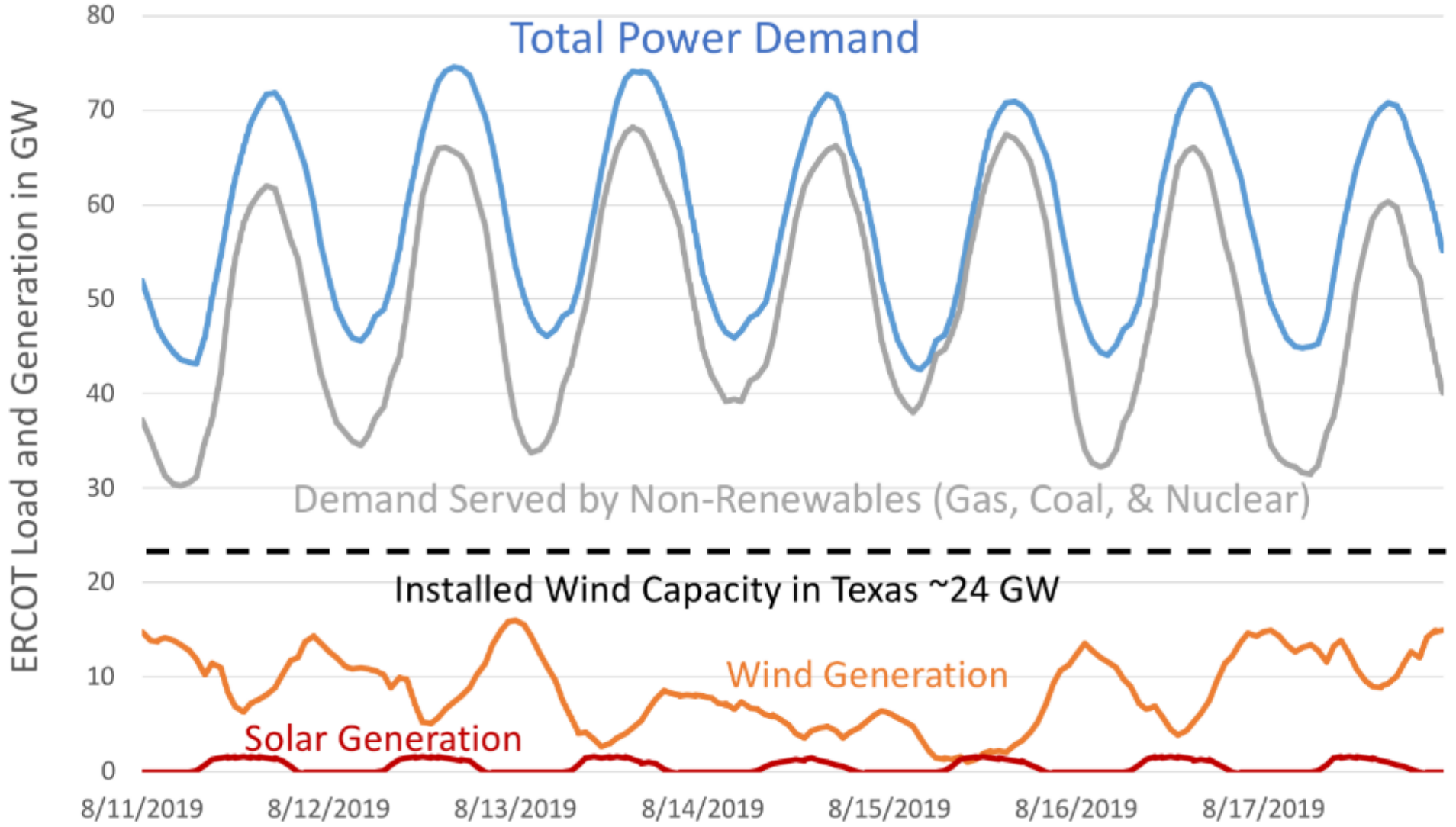
Testimony Before the North Dakota
February 18, 2021

Off-Peak Exuberance vs. Peak Reality – TX (7/19)



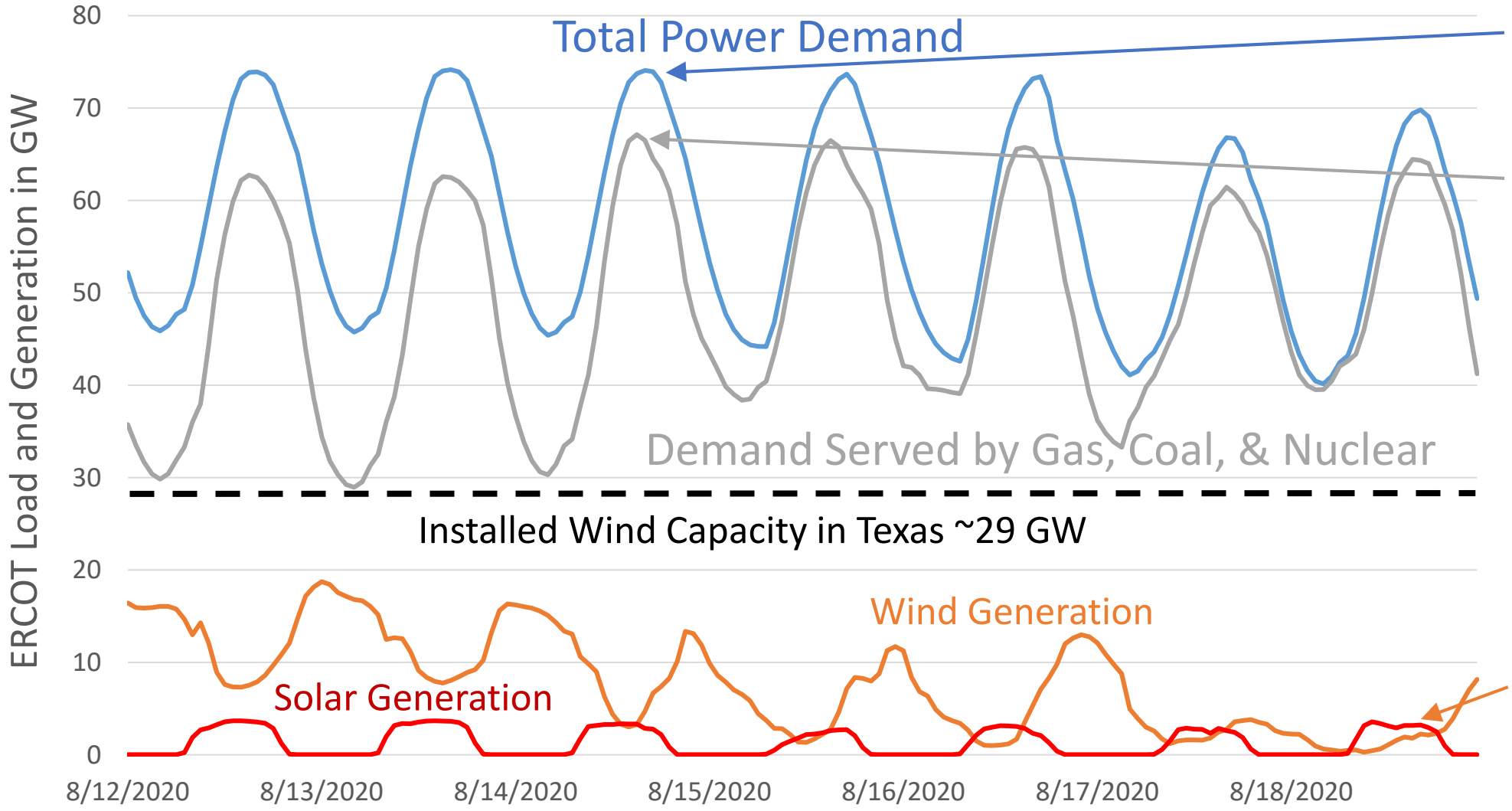
Source: Life:Powered (based on ERCOT market data)(2019)

Off-Peak Exuberance vs. Peak Reality – TX (8/19)



Source: Life:Powered (based on ERCOT market data)(2019)

Dodging a Bullet Last Summer: August 12 – 18, 2020



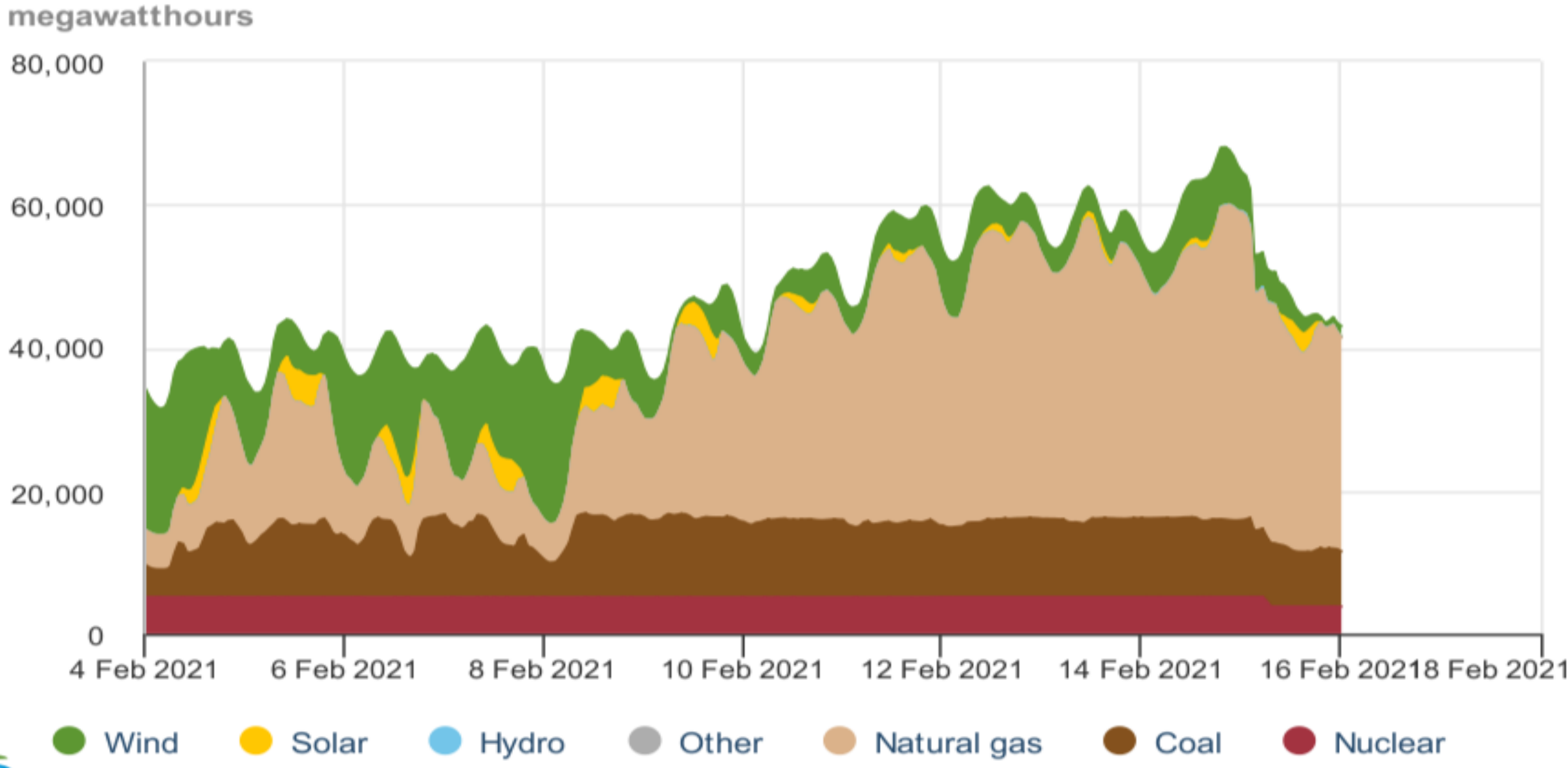
Aug. 14: Total demand = 73,740 MW at 4 PM

Demand served by gas, coal, and nuclear = 67,129 MW at 4 PM

Compare to Aug. 13, 2019 emergency, where gas, coal, and nuclear served 68,268 MW

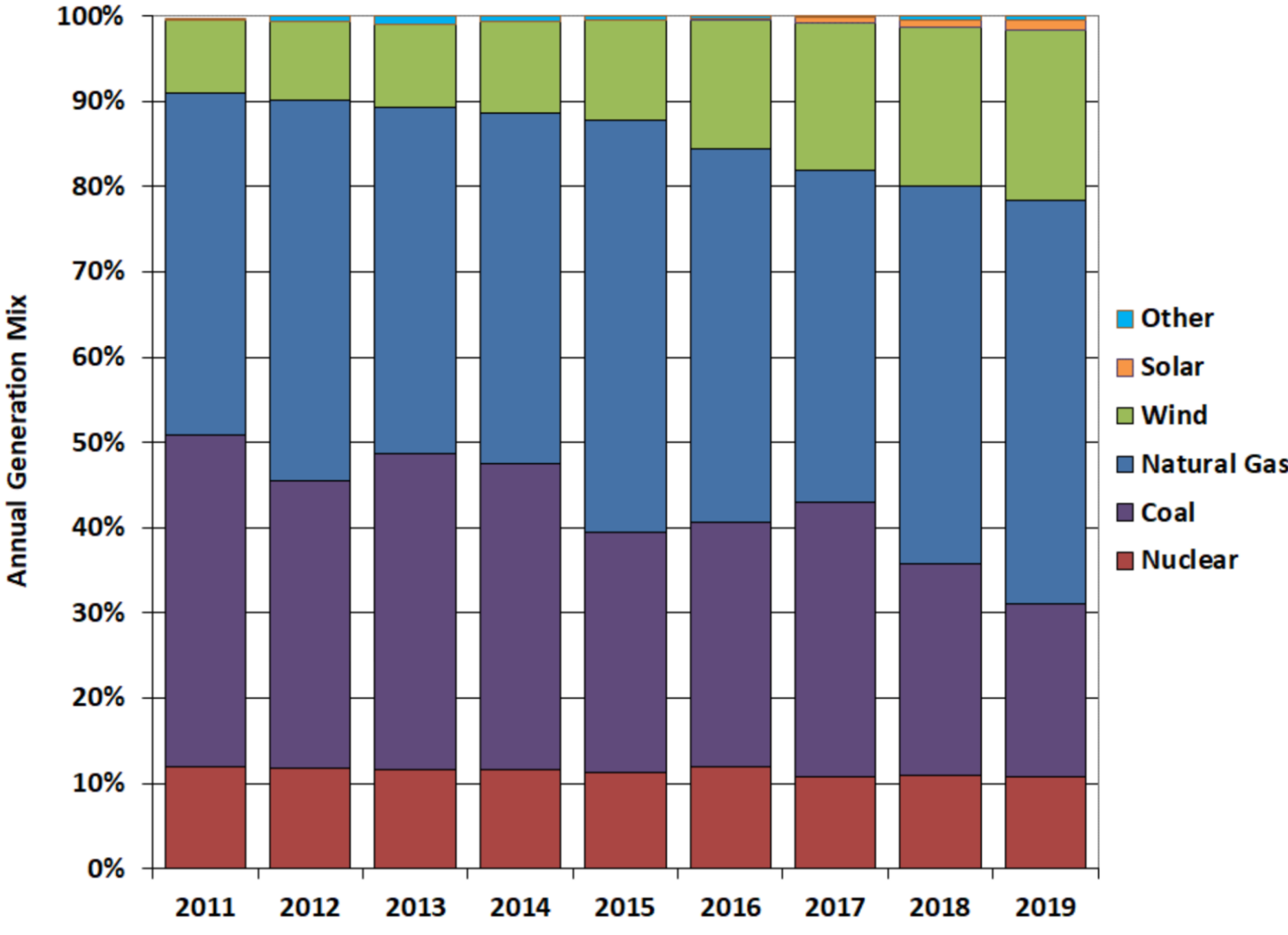
Add 2,500 MW of demand (pre-COVID forecast) or 1,500 MW less wind (as on Aug. 18), and TX would have had a major emergency.

The Bullet Hit This Time: February 15 – 17, 2022

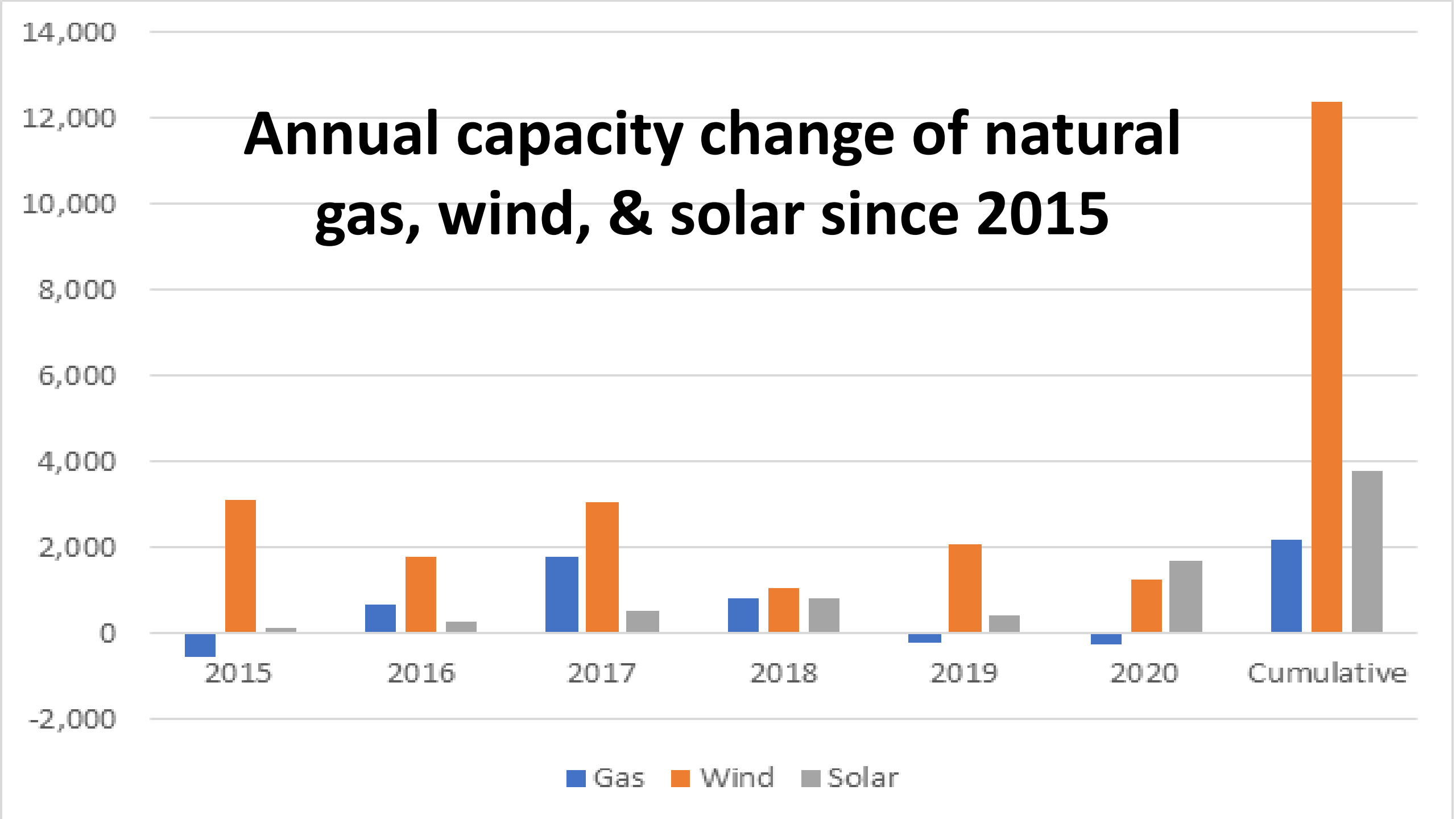


eia Source: U.S. Energy Information Administration

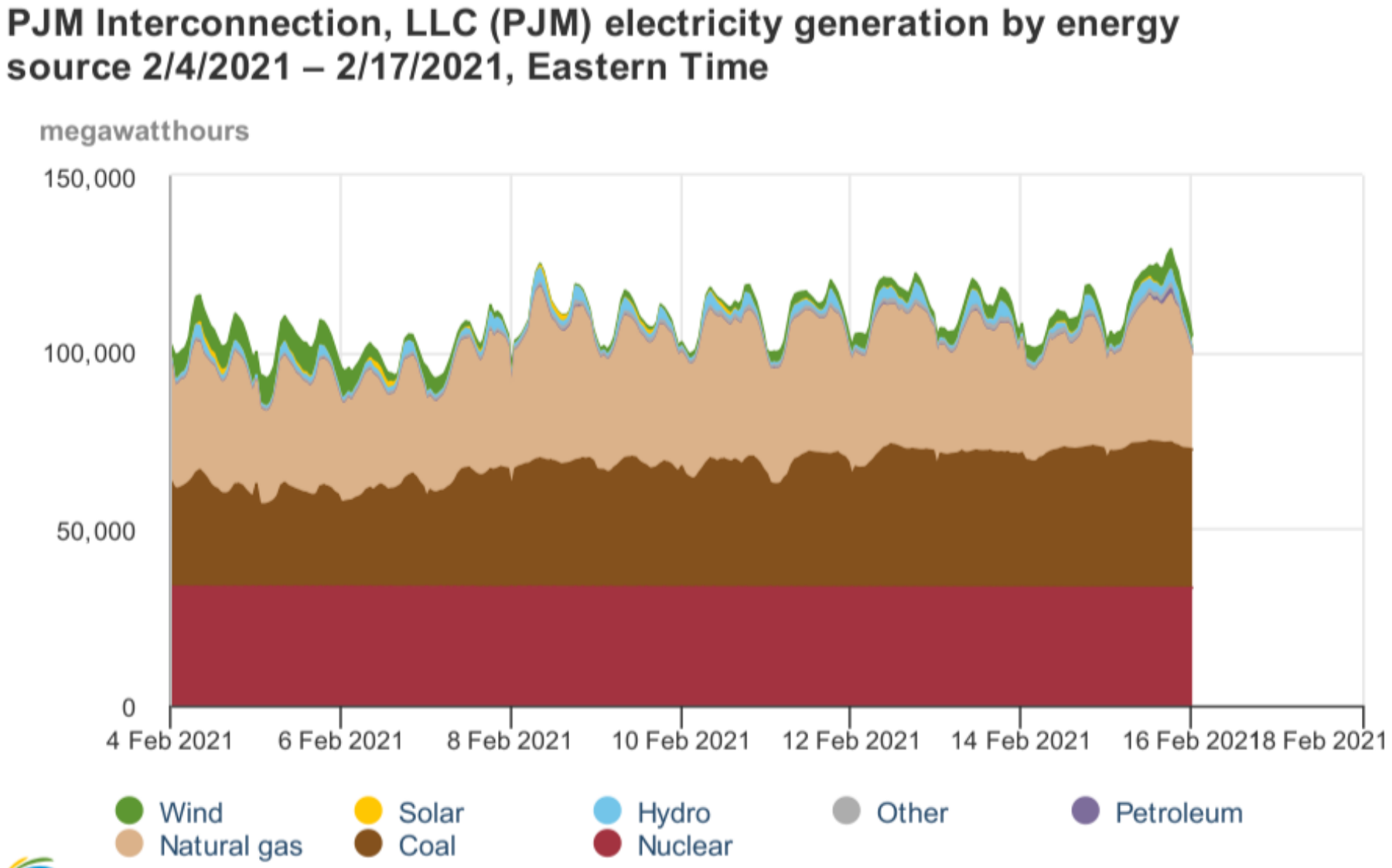
How Did the Texas Market Go From The Envy of the World to This Cautionary Tale?



SOURCE: Texas Independent Market Monitor


Annual capacity change of natural gas, wind, & solar since 2015
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
-2,000
2015
2016
2017
2018
2019
2020
Cumulative
Gas
Wind
Solar

THE CAUTIONARY TALE IS EVERYWHERE



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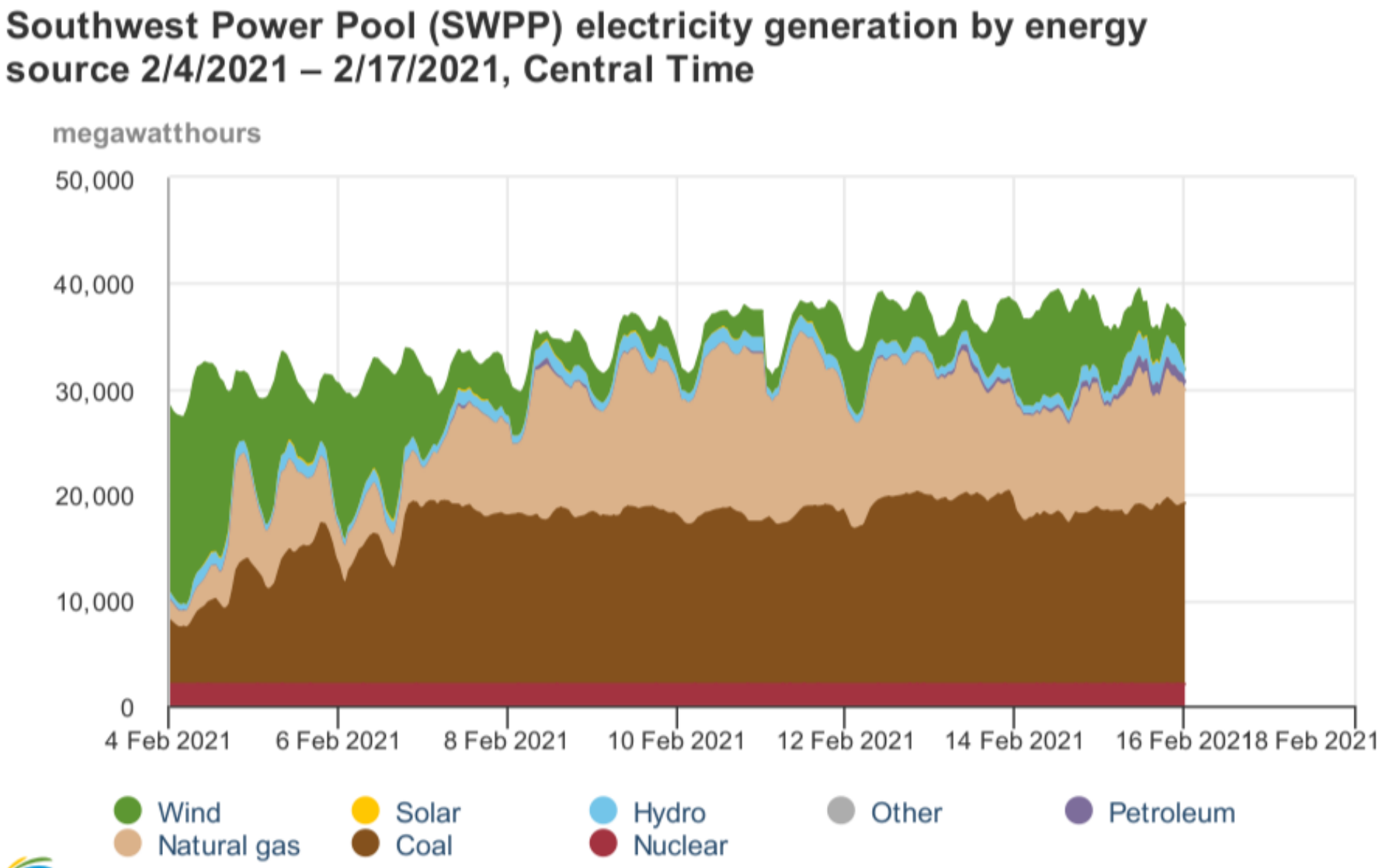

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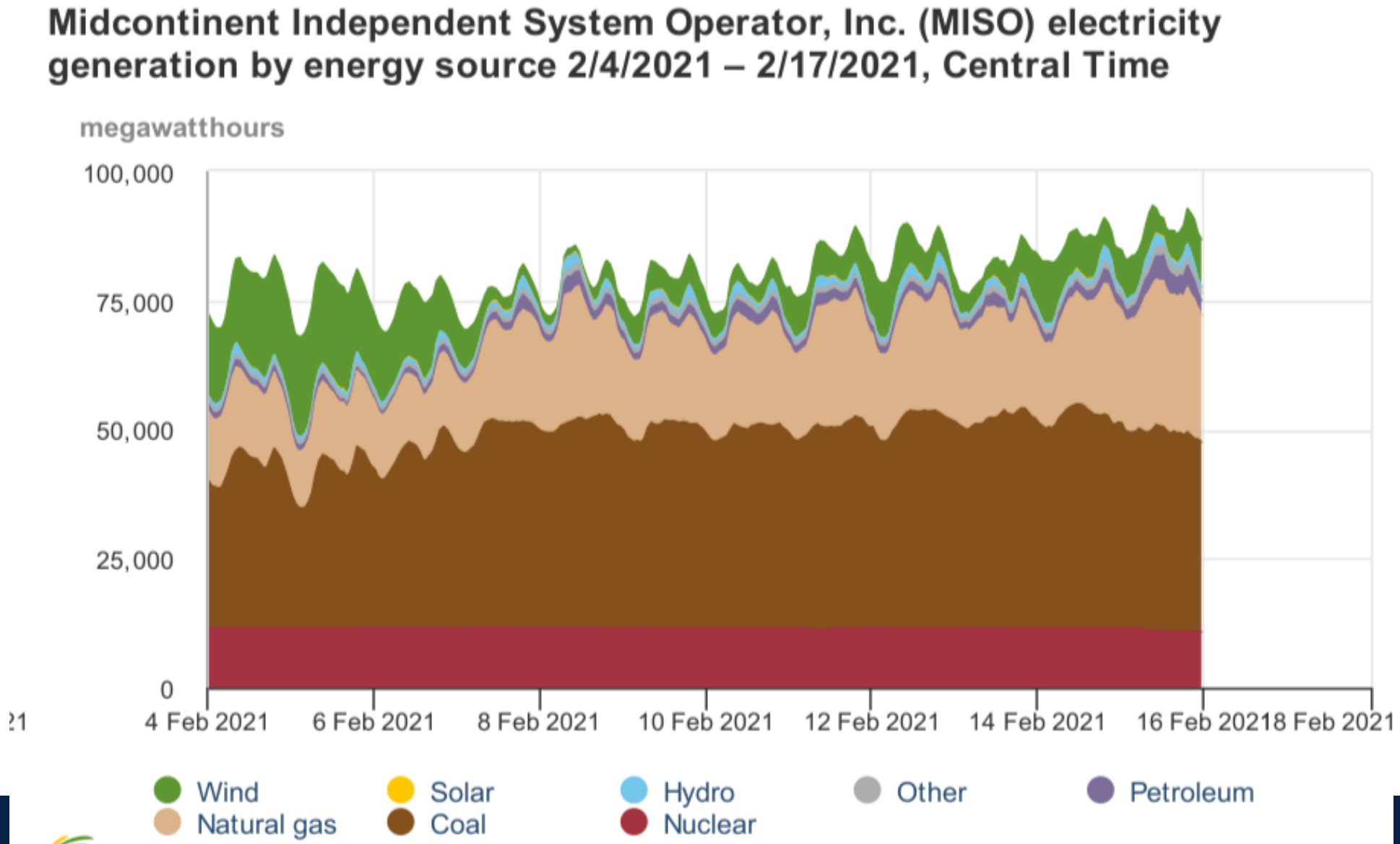
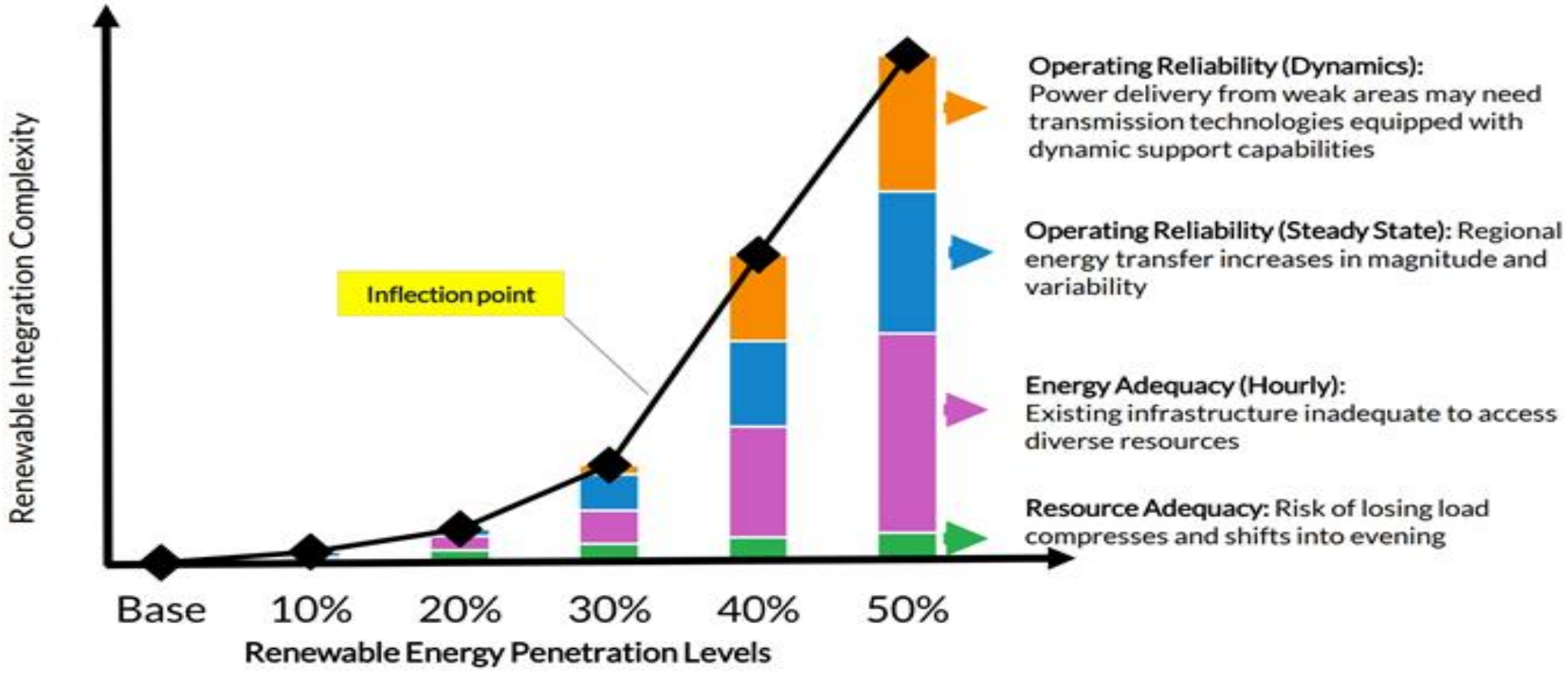


MISO Warning of System Stability Issues

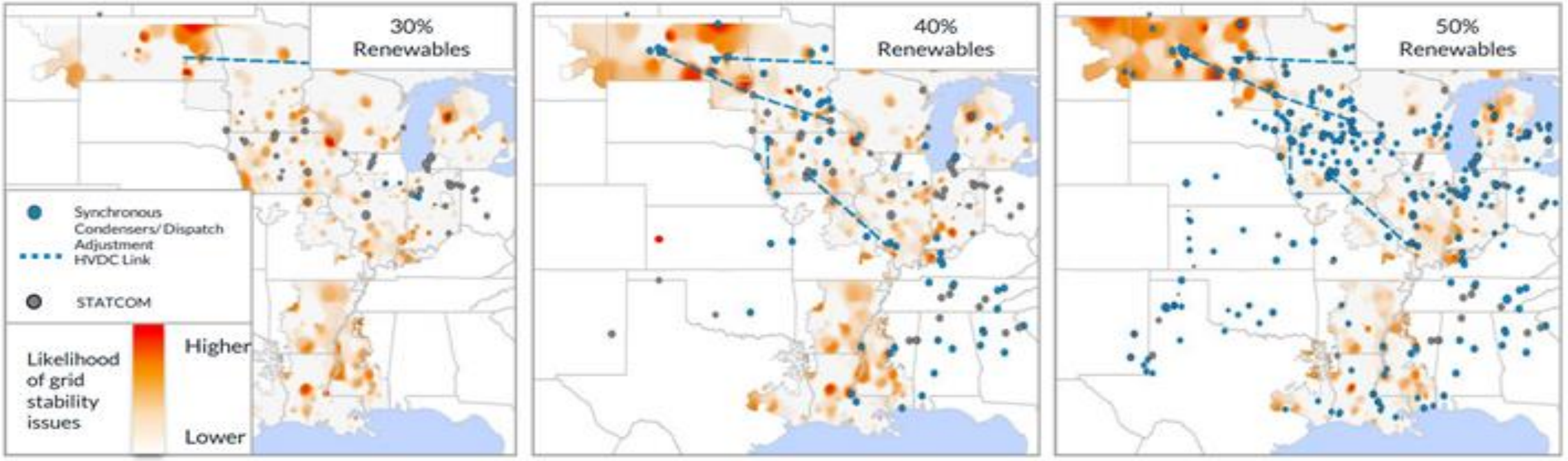
These resource changes will significantly impact grid performance with complexity increasing sharply after 30% penetration levels



MISO

MISO Warning of System Stability Issues

Beyond 30%, system-wide voltage stability is the main driver of dynamic complexity and requires transmission technologies equipped with dynamic-support capabilities



* Maps reflect cumulative issues/solutions across milestones

Okay, Lesson Learned, Now What Do We Do?

State-Established Reliability (and/or "Firming" Requirements)

- Like renewable portfolio standards, but focused on grid reliability and resilience – must be uplifted to RTOs
  - *(MISO recently confirming that they are "policy takers, not makers")*
- Non-dispatchable resources could be made to procure dispatchable power to mitigate against the reliability/resilience penalties they impose on the grid
- In states with aggressive low carbon goals, CCUS, nuclear, and batteries can compete on level playing field.

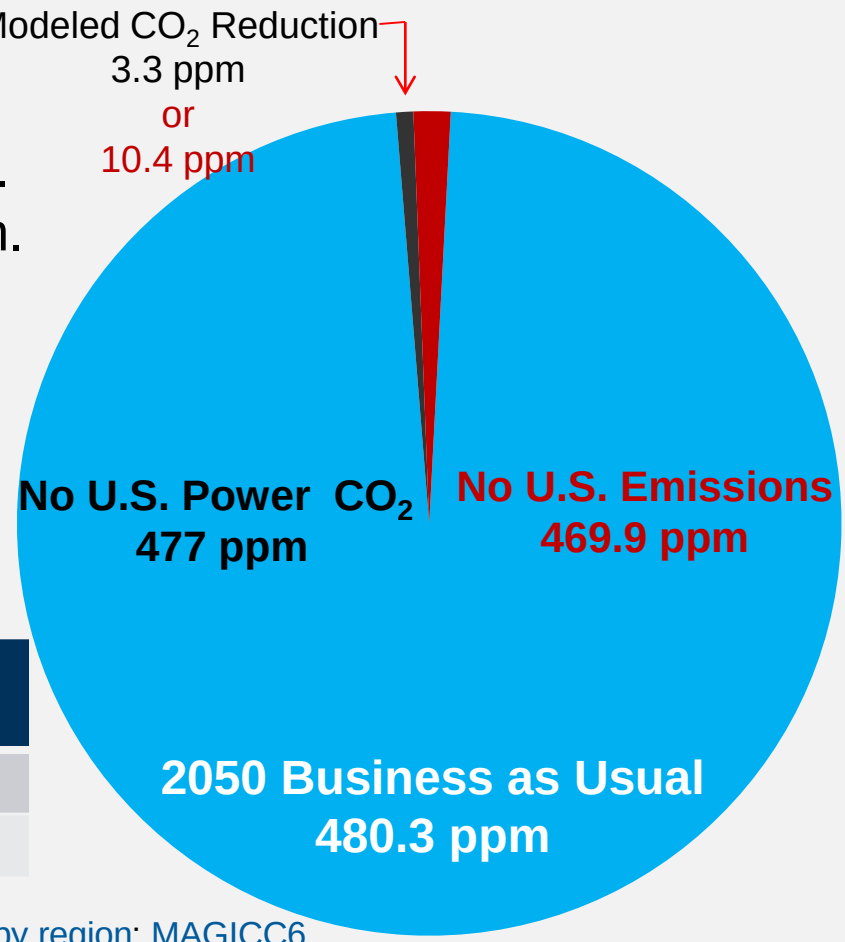
REMEMBER TO ASK: WHY WOULD WE ENDANGER LIVES & ENERGY SECURITY
When Domestic Power Sector Carbon Reductions Don't Move the Needle

2050 IMPACT OF DECARBONIZING ELECTRICITY:

- NO COAL FLEET = 2.06 ppm (0.4%) reduction in CO_2 concentration.
- NO FOSSIL FLEET = 3.3 ppm (0.7%) reduction in CO_2 concentration.
- Modeled global temperature reduced by a mere 0.016°C.

2050 IMPACT OF DECARBONIZING ENTIRE U.S.:

- 10.4 ppm (2.2%) reduction in CO_2 concentration.
- Modeled global temperature reduced by 0.053°C.



CO2 Emissions	2010	2020	2030	2040	2050	% Change
World	30,834	34,972	36,398	39,317	42,771	+38.7%
U.S.	5,571	5,260	4,839	4,867	5,071	-8.9%

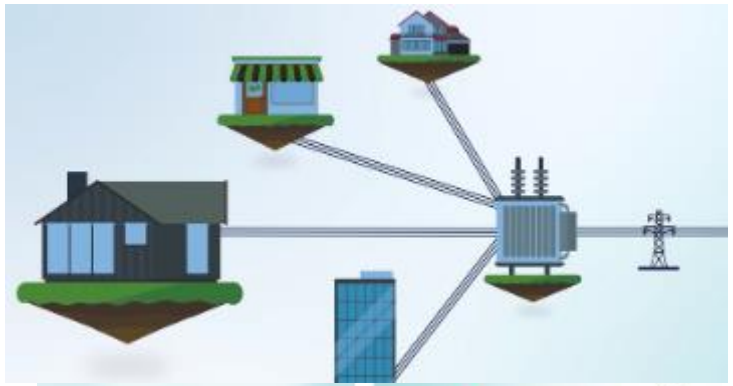
Sources: Energy Information Administration, International Energy Outlook 2017, World carbon dioxide emissions by region; MAGICC6 Model; Intergovernmental Panel on Climate Change Fifth Assessment Report Working Group I, Summary for Policymakers; National Oceanic and Atmospheric Administration Global Land and Temperature Anomalies.

NEW ANIMATED EDUCATIONAL VIDEO SERIES ON ELECTRICITY & ENVIRONMENTAL TECHNOLOGY (*www.LifePowered.org*)

VIDEO 1 - Energy 101: Why We Need Electricity
https://youtu.be/ZfrBnddgFAU

VIDEO 2 - Energy 101: The Electric Grid
https://youtu.be/WiMtU6O1SxM

VIDEO 3 - Energy 101: Where Electricity Comes From
https://youtu.be/AKuoIeupGHc



VIDEO 4 - Energy 101: Energy Density
https://youtu.be/6d-HGzZHPG4

VIDEO 5 - Energy 101: Mining and Rare Earths
https://youtu.be/yu3mkFpiGmo

VIDEO 6 - Energy 101: Environmental Technology
https://youtu.be/aodsngzbZqA

QUESTIONS / FOLLOW-UP?

Mike Nasi

Senior Advisor, *Life:Powered*

mnasi@jw.com

512-736-9200