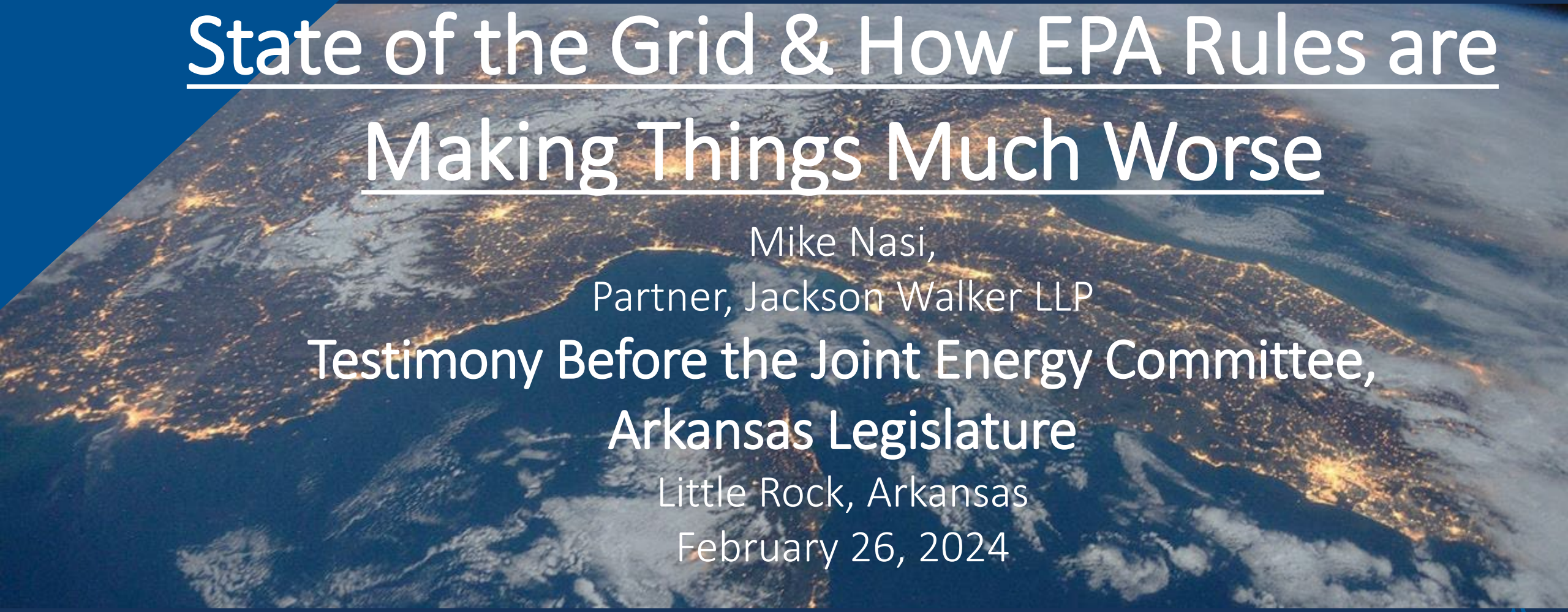
HANDOUT C

State of the Grid & How EPA Rules are Making Things Much Worse

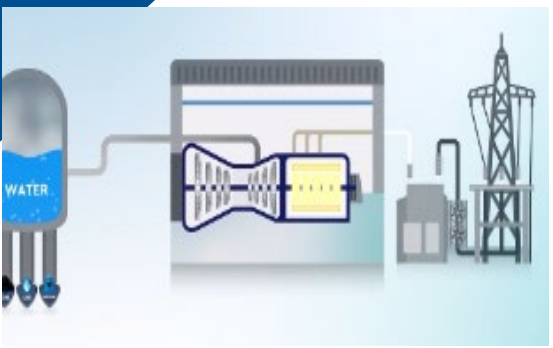


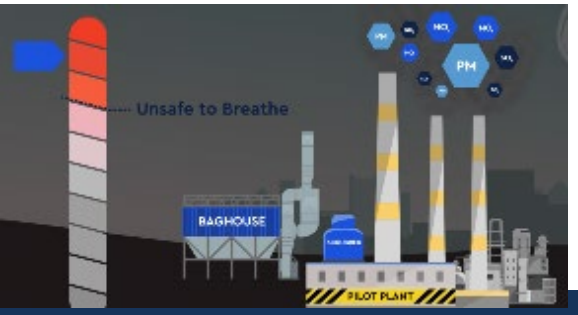
Mike Nasi,
Partner, Jackson Walker LLP

Testimony Before the Joint Energy Committee, Arkansas Legislature

Little Rock, Arkansas
February 26, 2024

PRESENTATION OUTLINE



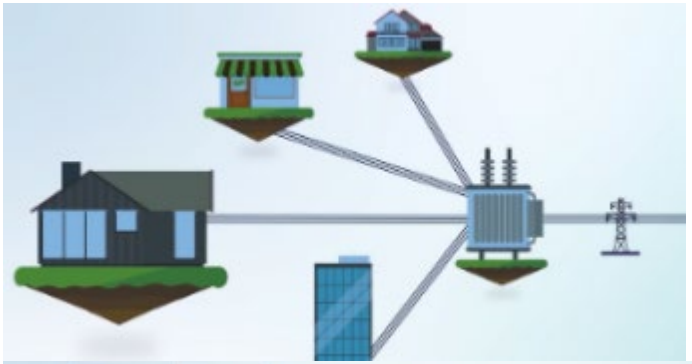


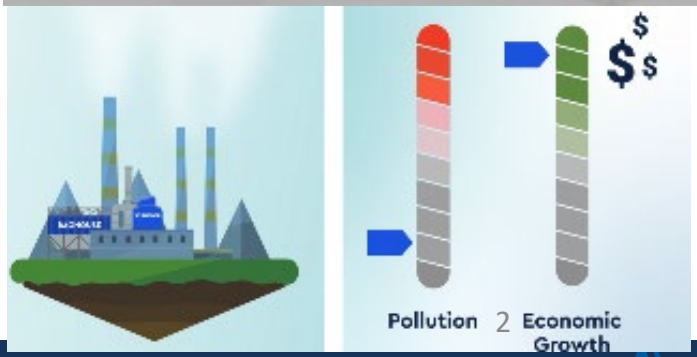
PART I
State of the Grid

PART II
Impact of EPA's Continued Assault

PART III
Stemming the Tide

PART IV
A Geopolitical Reality Check





Jackson Walker LLP

PART ONE:

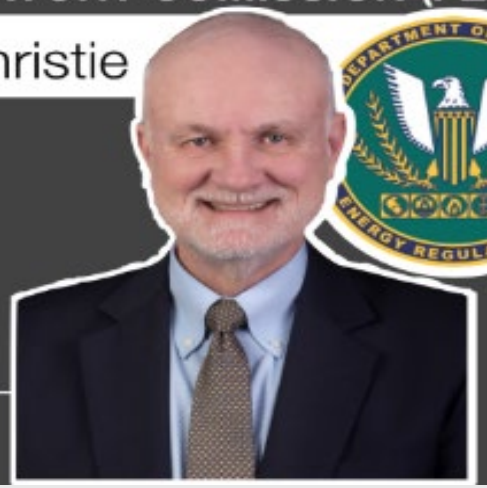
STATE OF THE GRID

Grid Outages, Especially in Winter, at All-Time High

(*shown in unplanned outages (MW) below*)

FEDERAL ENERGY REGULATORY COMISSION (FERC)

Commissioner Mark Christie



"The United States is heading for a reliability crisis. I do not use the term "crisis" for melodrama, but because it is an accurate description of what we are facing. I think anyone would regard an increasing threat of system-wide, extensive power outages as a crisis."

Senate Committee Energy & Natural Resources Oversight Hearing on FERC | May 4, 2023

Winter Energy Market and Electric Reliability Assessment

2023-2024

A Staff Report to the Commission

FEDERAL ENERGY REGULATORY COMMISSION

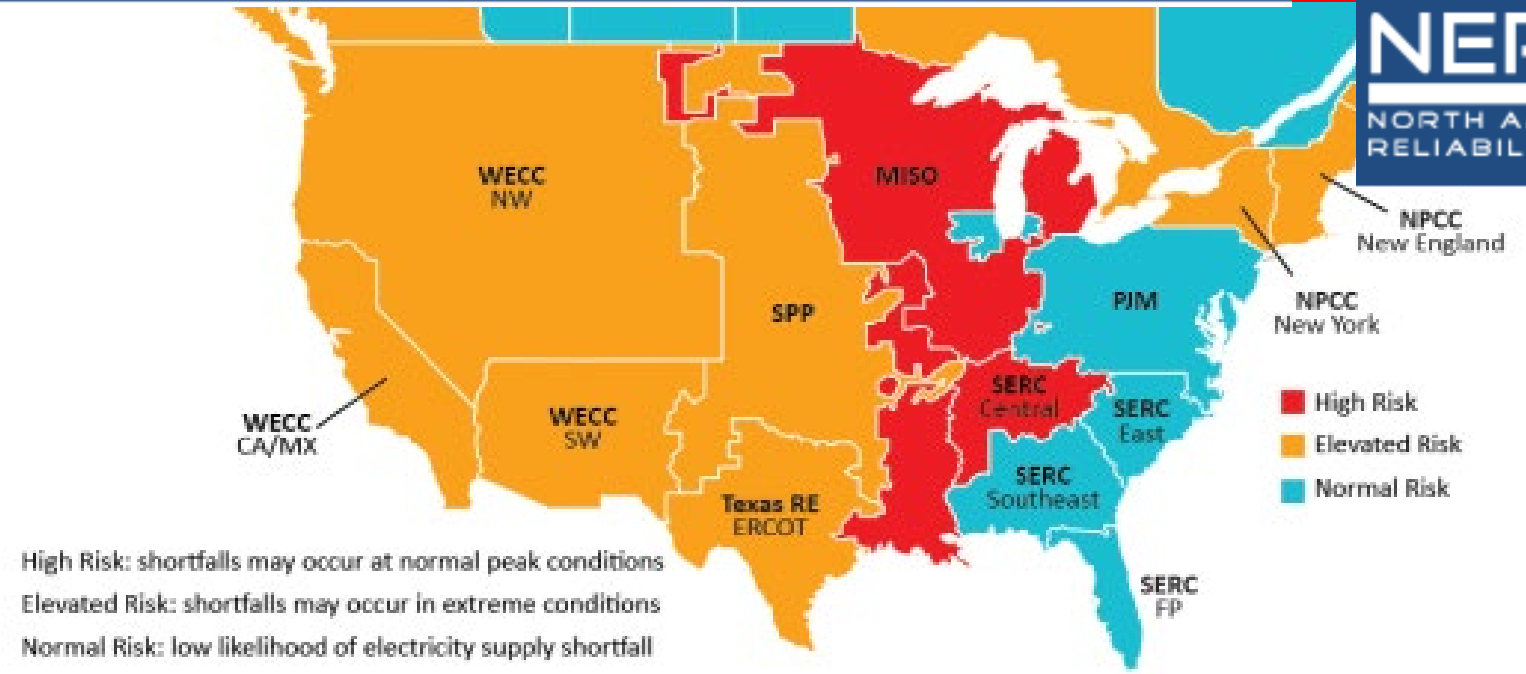
Office of Energy Policy and Innovation

Office of Electric Reliability

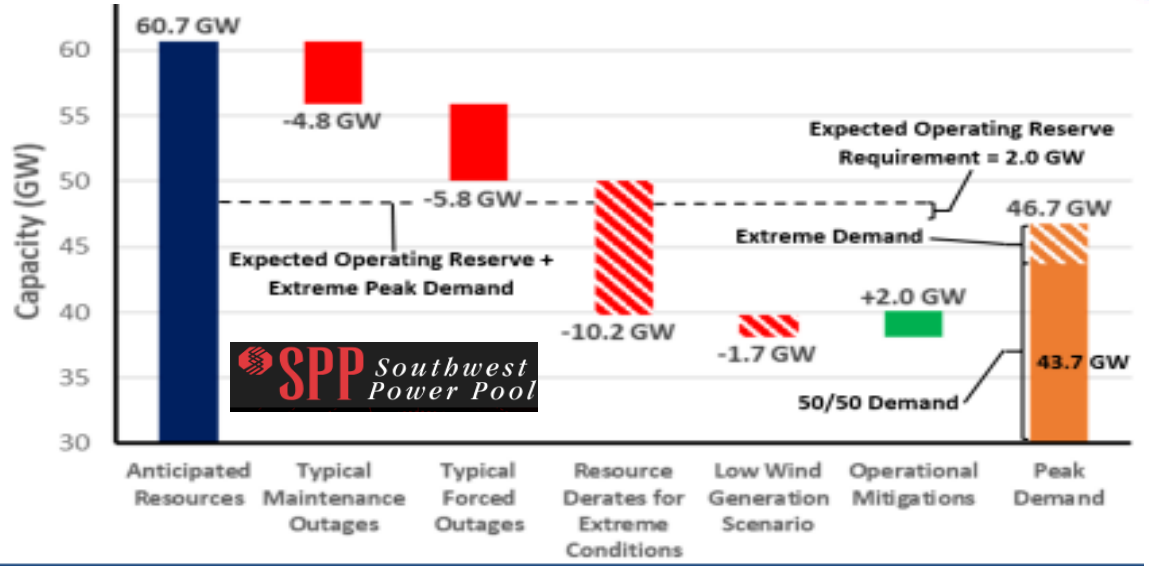
National Grid Warnings

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Long-Term Risk
Summary 2024–2028

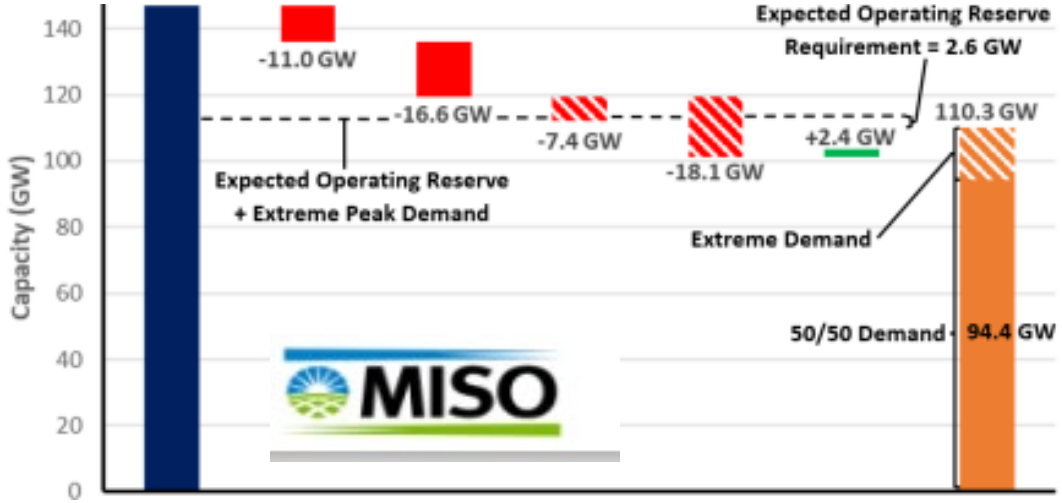


High Risk: shortfalls may occur at normal peak conditions
Elevated Risk: shortfalls may occur in extreme conditions
Normal Risk: low likelihood of electricity supply shortfall



NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

2023 - 2024
Winter Reliability Risk Area Summary



So, What is Going On? A: Self-Imposed Decarbonization

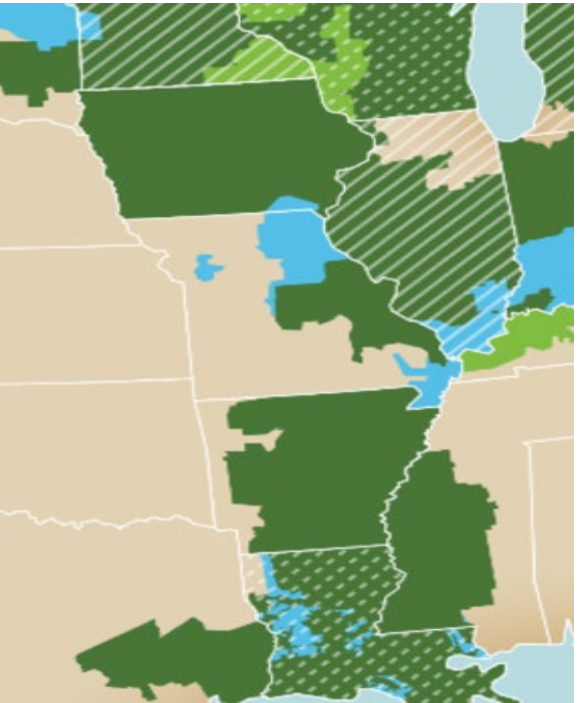
Utility Decarbonization Goals Are Prematurely Retiring Coal (& some gas) Plants

However, the ***transition*** that is underway to ***get to*** a decarbonized end state is posing material, adverse challenges to electric reliability. John Bear, CEO

MISO'S RESPONSE TO THE RELIABILITY IMPERATIVE

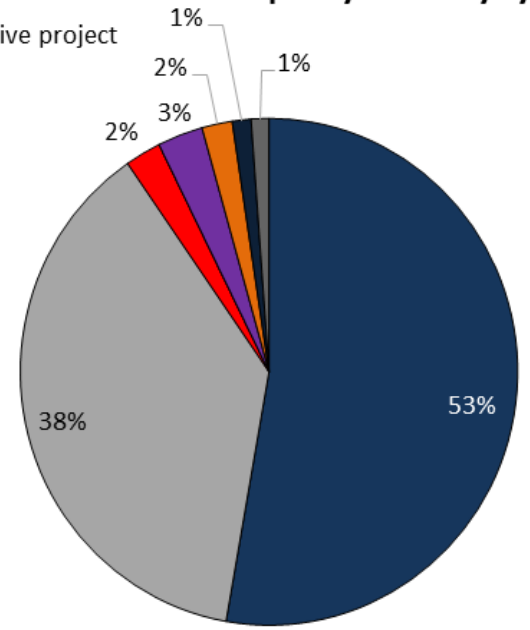
- UPDATED FEBRUARY 2024 -

- MISO Region
- Utilities with 80%+ Targets
- Utilities with 50%+ Targets
- States with Enforceable Decarbonization Goals
- States with Aspirational Decarbonization Goals



SPP interconnection new capacity listed by type by 2030

% of total active project capacity



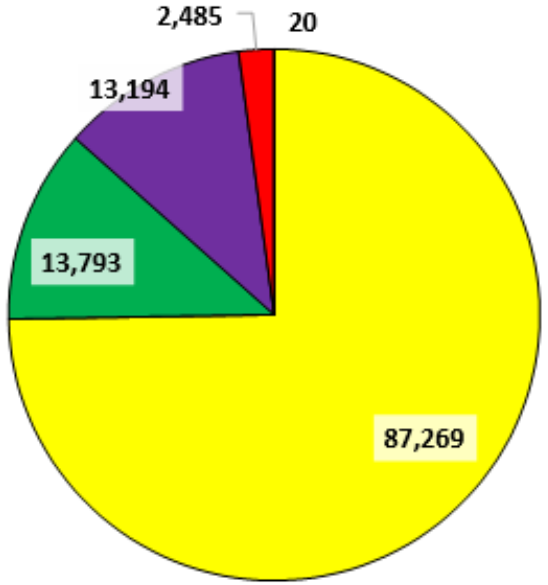
- Wind
- Solar
- Battery and Other Storage
- Steam Turbine
- Combustion Turbine
- Diesel/Gas
- Reciprocating Engine
- Combined Cycle

Source: Energy Ventures Analysis

97% of **new** generation in MISO will be intermittent moving forward

MISO active interconnection requests by type

MW



- Solar
- Onshore Wind
- Offshore Wind
- Battery
- Fossil
- Other Renewables

Source: Energy Ventures Analysis; Fuelcast, *EIA database & MISO*

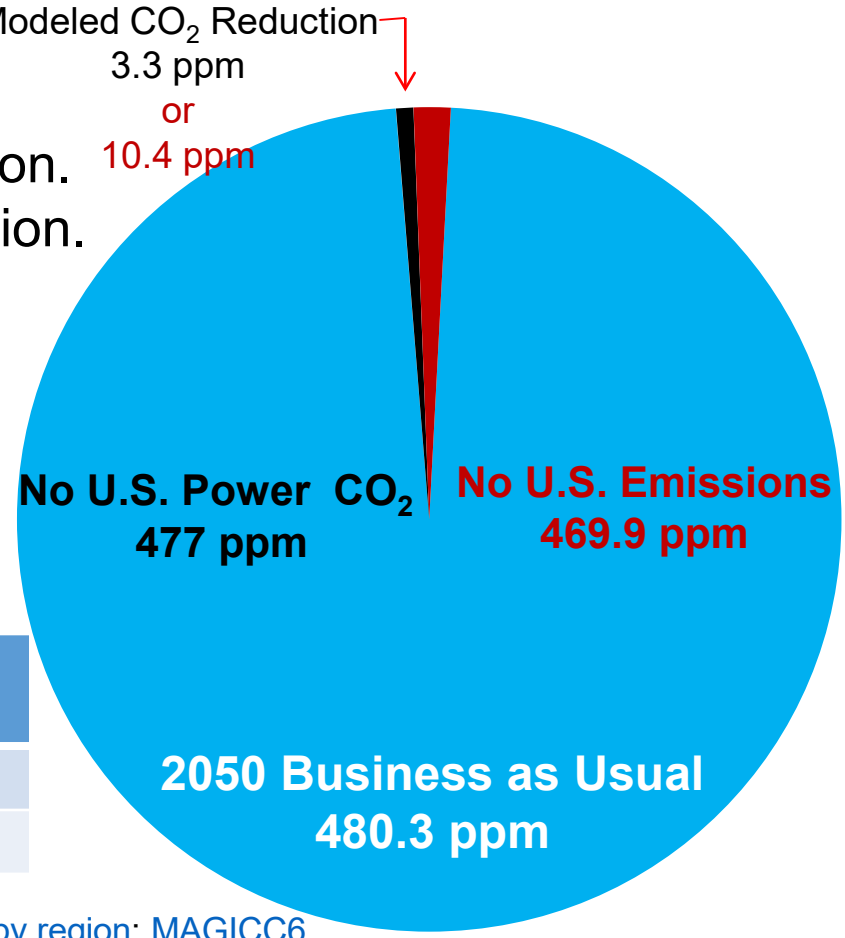
YET, U.S. DECARBONIZATION WON'T MOVE THE NEEDLE IN AN ENERGY-STARVED WORLD

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.:

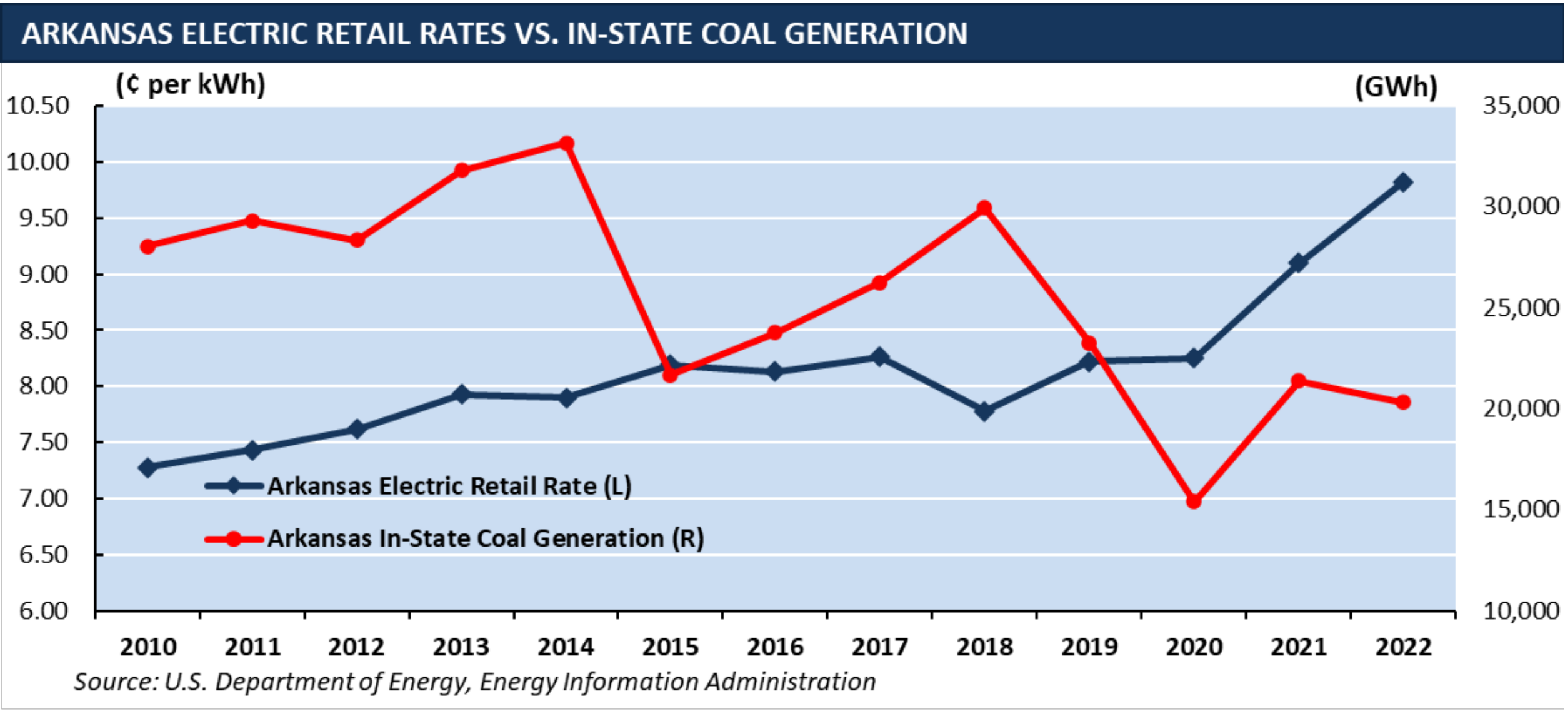
- 10.4 ppm (2.2%) reduction in CO_2 concentration.
- Modeled global temperature reduced by 0.053°C.



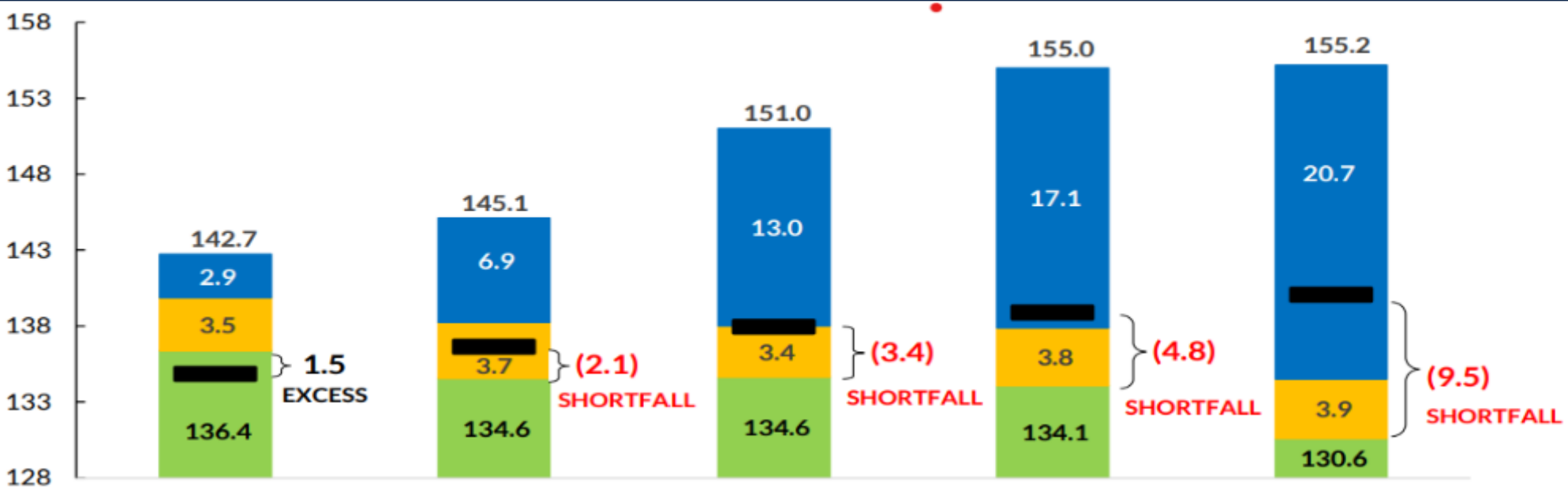
CO2 Emissions	2010	2020	2030	2040	2050	% Change
World	30,834	34,972	36,398	39,317	42,771	+38.7%
U.S.	5,571	5,260	4,839	4,867	5,071	-8.9%

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.

This “Transition” Impacts Ratepayer Pocketbooks



NOW LET'S TALK ABOUT THE "TRANSITION" IMPACTS ON RELIABILITY & RESILIENCE - MISO



	PY 24/25	PY 25/26	PY 26/27	PY 27/28	PY 28/29
Target Planning Reserve Margin	**7.9%**	**8.3%**	**8.8%**	**9.0%**	**9.2%**
Installed Capacity Planning Reserve Margin*	**16.6%**	**17.2%**	**17.9%**	**18.2%**	**18.4%**

Potential New Capacity
Potentially Unavailable Resources
Committed Capacity
Projected PRMR

- **Bracketed values indicate difference between Committed Capacity and projected Planning Reserve Margin Requirement (PRMR)**
- Committed Capacity includes signed GIA projects shown on slide 19 of OMS-MISO workshop presentation
- Capacity accreditation values and PRM projections based on current practices
- Timing/GW of potential New Capacity projected per methodology noted in Oct 2022 RASC
- Regional Directional Transfer (RDT) limit of 1900 MW is reflected in this chart

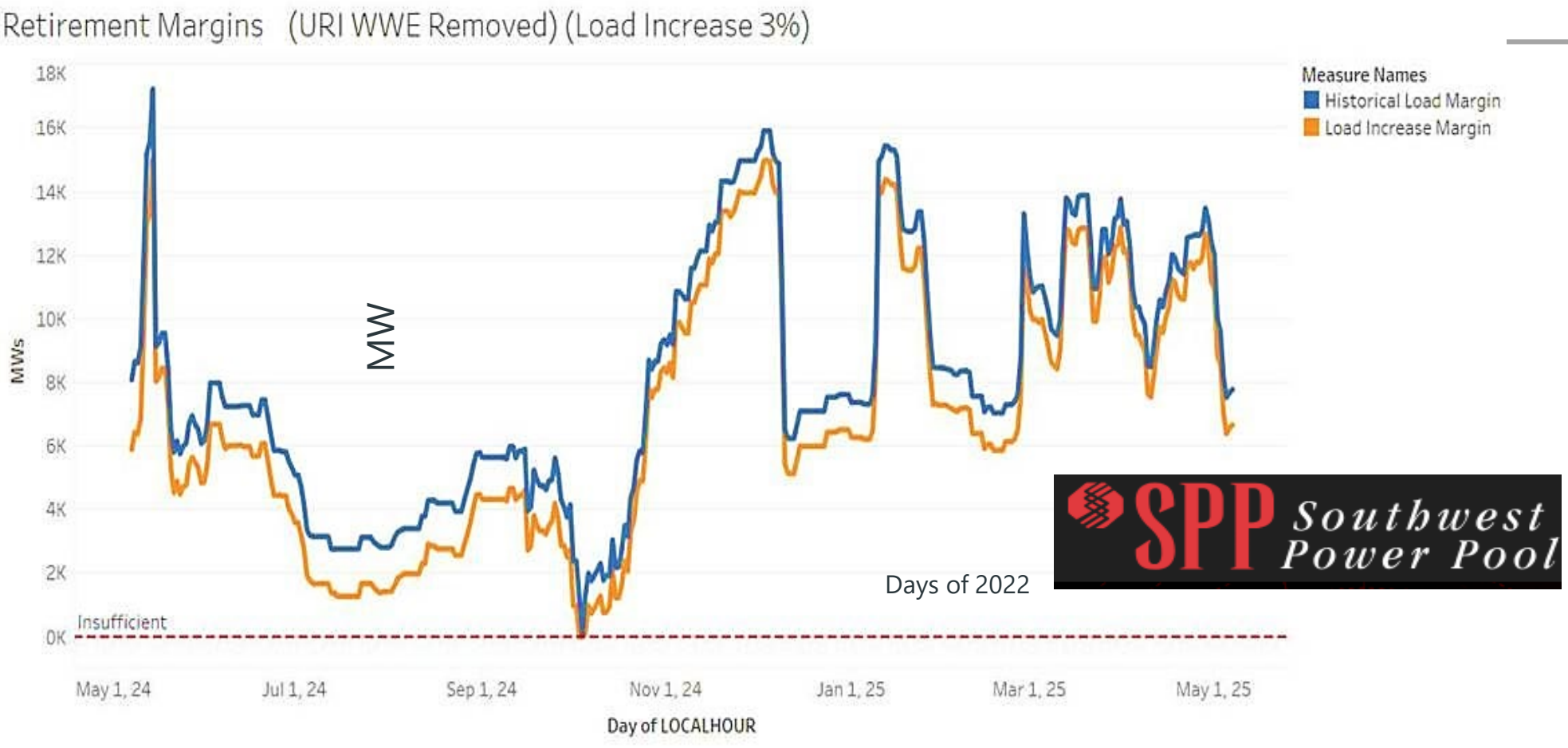
Slide Data Source: OMS-MISO Survey Results
**Planning Year 2023-2024 Loss of Load Expectation Study Report*

SPP Projection: Even Before EPA Rules, Grid Will be in Trouble

*…In my role on the SPP RSC and as the chairman of the Resource & Energy Adequacy Leadership (REAL) Team, I have seen & heard SPP Staff say that the SPP system **cannot afford any more retirements of dispatchable generation**…*

(5/25/23 PUCT Public Meeting)

PUCT Commissioner & REAL Chair, Will McAdams



SPP Southwest Power Pool

LESSON FROM WINTER STORM URI ABOUT WEATHER & FUEL SUPPLY: COAL & NUCLEAR ESSENTIAL TO GRID RESILIENCE

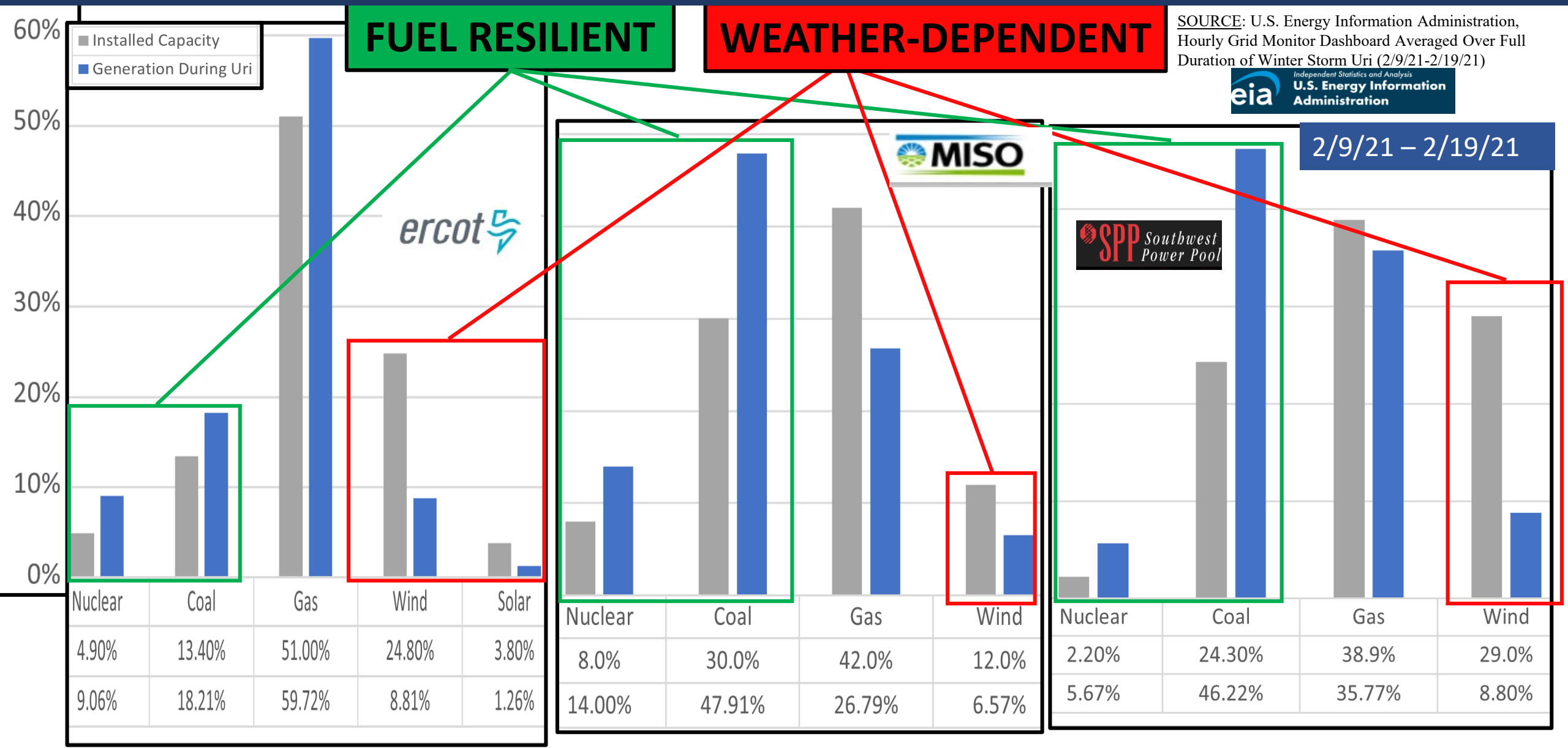
FUEL RESILIENT

WEATHER-DEPENDENT

SOURCE: U.S. Energy Information Administration, Hourly Grid Monitor Dashboard Averaged Over Full Duration of Winter Storm Uri (2/9/21-2/19/21)

eia Independent Statistics and Analysis U.S. Energy Information Administration

2/9/21 – 2/19/21



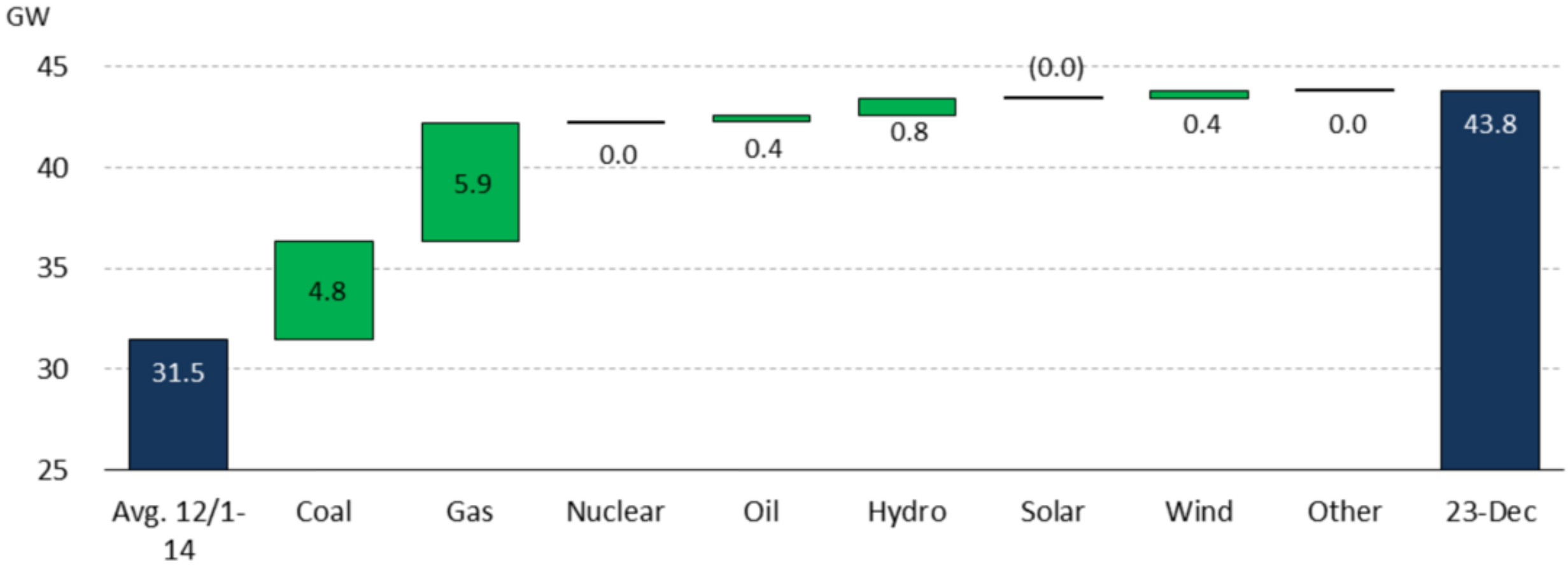
ercot	Nuclear	Coal	Gas	Wind	Solar
Installed Capacity	4.90%	13.40%	51.00%	24.80%	3.80%
Generation During Uri	9.06%	18.21%	59.72%	8.81%	1.26%

MISO	Nuclear	Coal	Gas	Wind
Installed Capacity	8.0%	30.0%	42.0%	12.0%
Generation During Uri	14.00%	47.91%	26.79%	6.57%

SPP Southwest Power Pool	Nuclear	Coal	Gas	Wind
Installed Capacity	2.20%	24.30%	38.9%	29.0%
Generation During Uri	5.67%	46.22%	35.77%	8.80%

Winter Storm Elliot – Another Reality Check

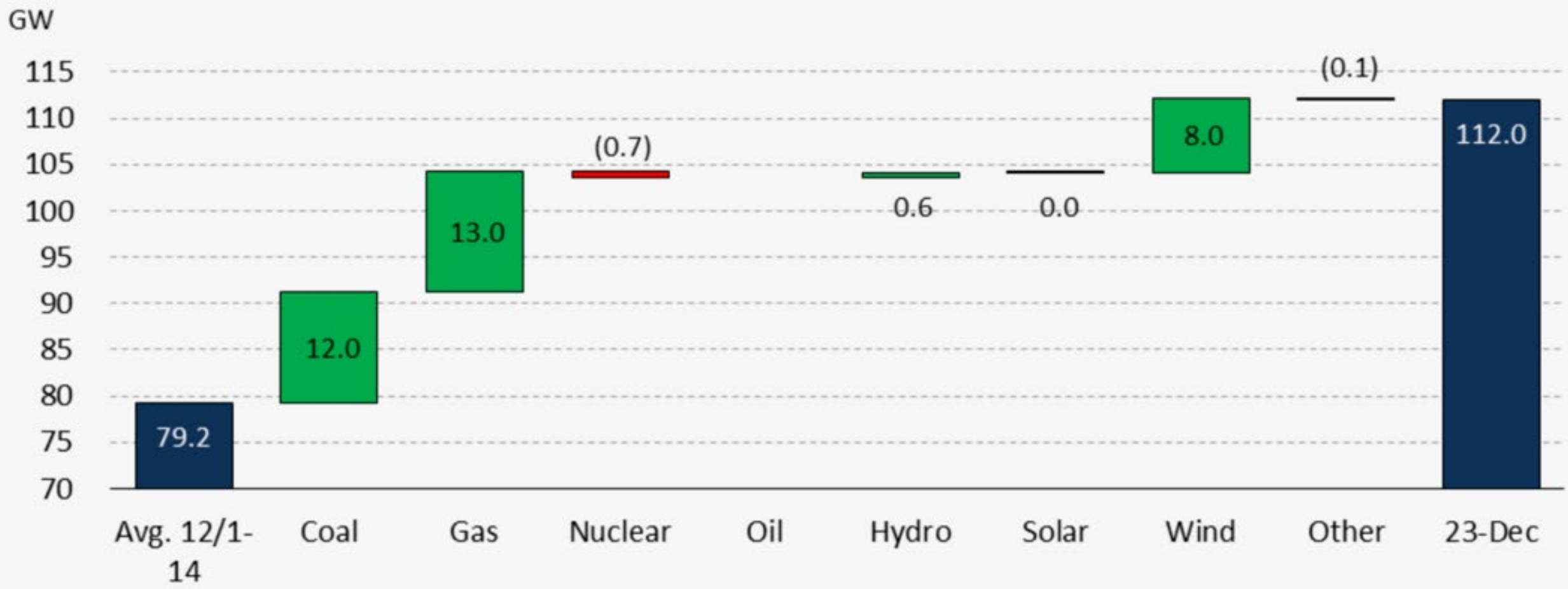
EXHIBIT 38: SPP - CHANGE IN NET GENERATION BY FUEL TYPE DURING WINTER STORM ELLIOTT



Source: EIA Hourly Grid Monitor

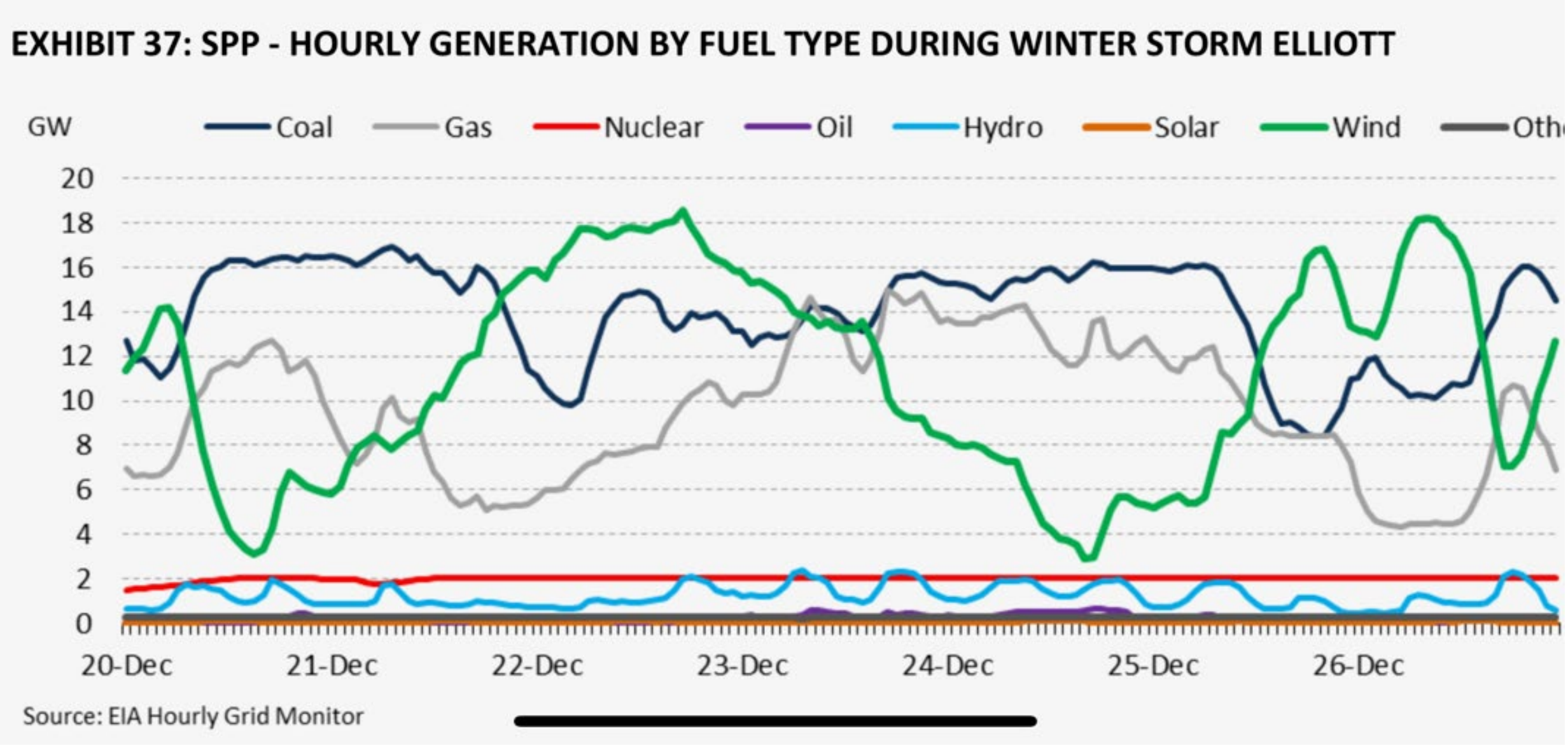
Winter Storm Elliot – Another Reality Check

EXHIBIT 29: MISO - CHANGE IN NET GENERATION BY FUEL TYPE DURING WINTER STORM ELLIOTT



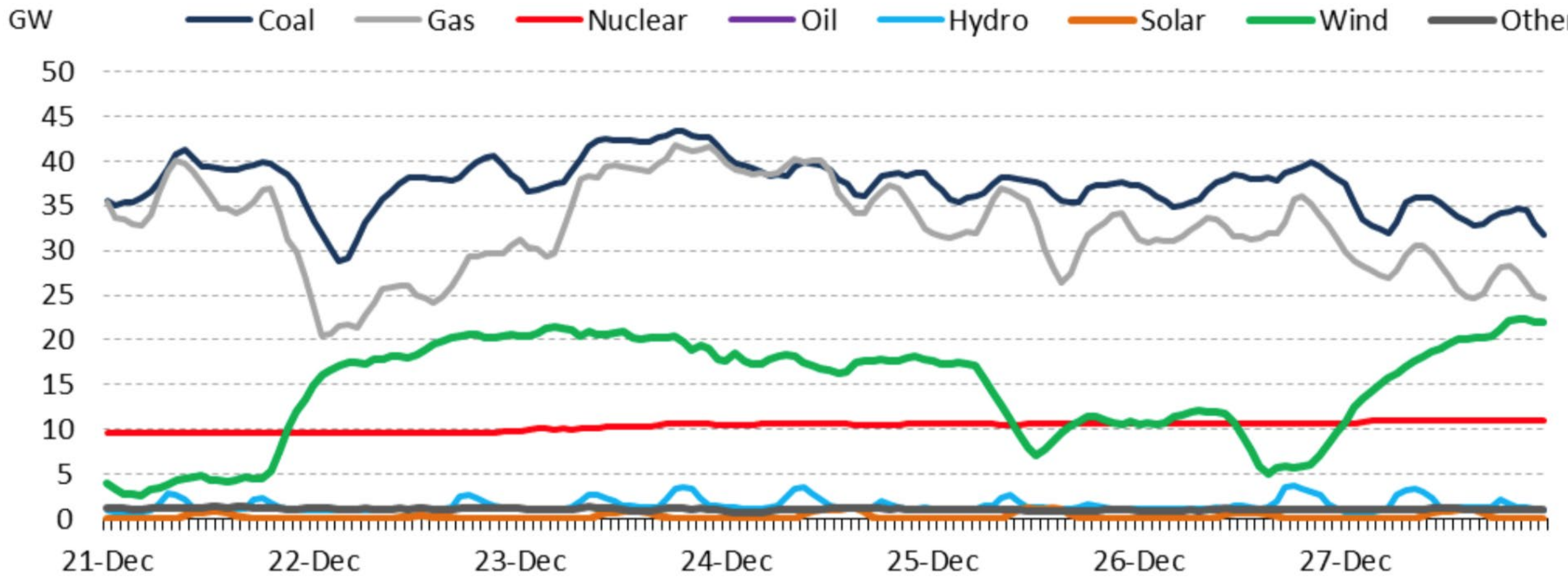
Source: EIA Hourly Grid Monitor

Winter Storm Elliot – Another Reality Check



Winter Storm Elliot – Another Reality Check

EXHIBIT 28: MISO - HOURLY GENERATION BY FUEL TYPE DURING WINTER STORM ELLIOTT



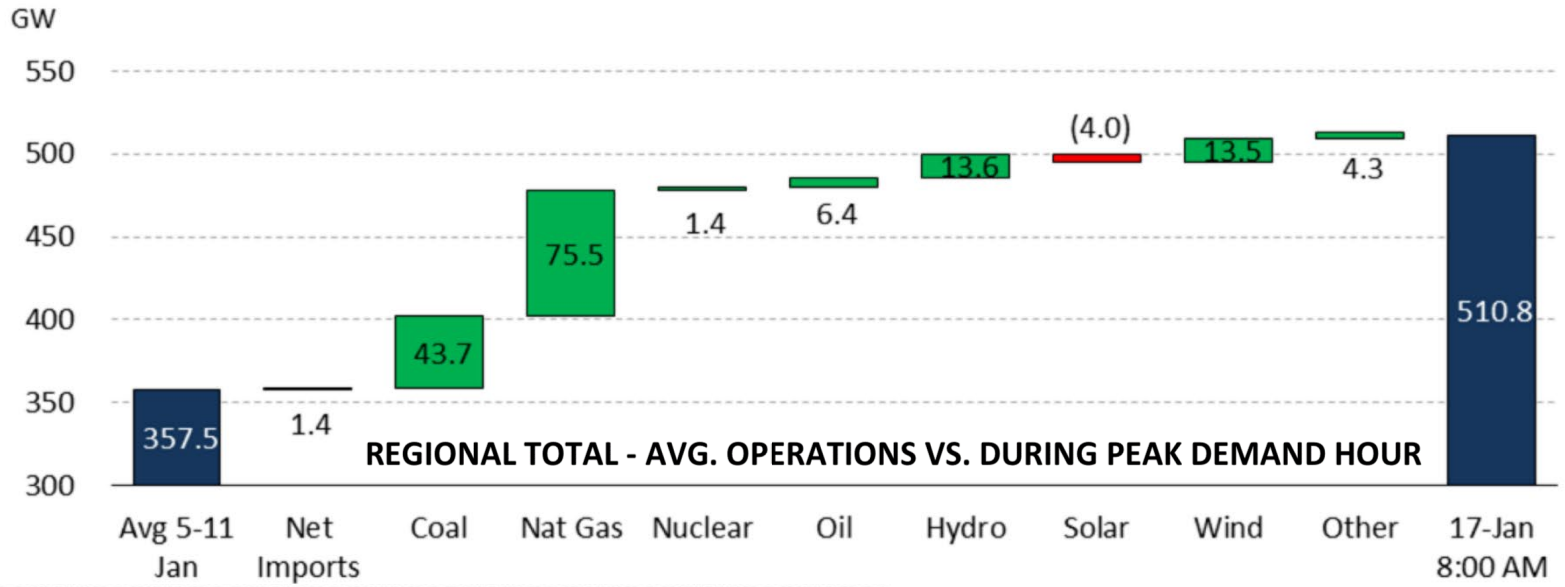
Source: EIA Hourly Grid Monitor

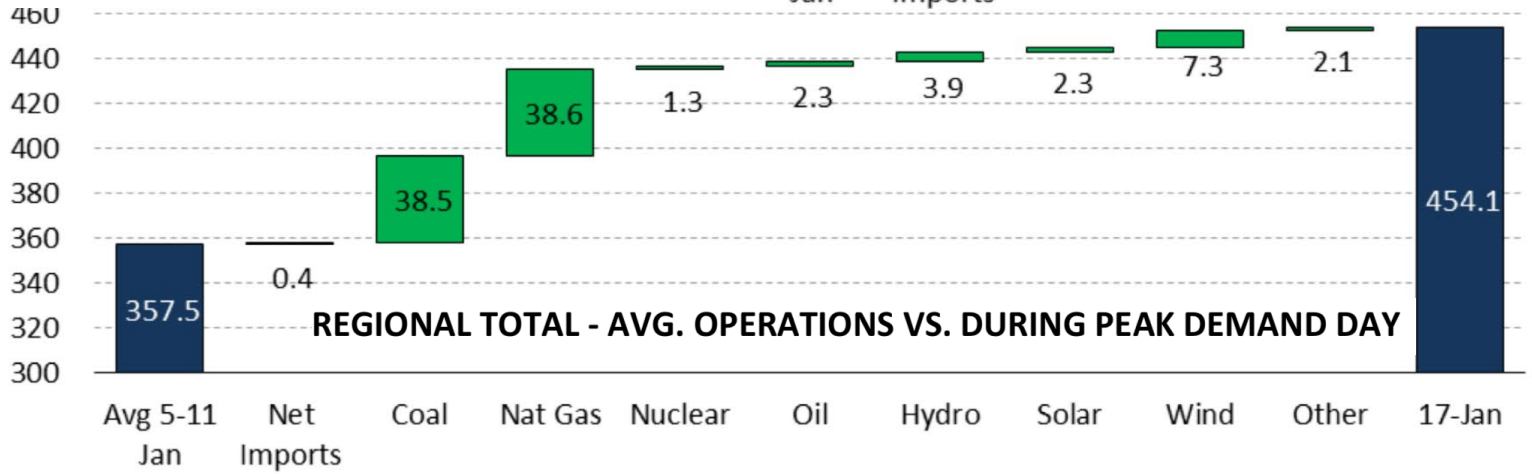
Prepared by:

ENERGY VENTURES ANALYSIS

Operation of the U.S. Power Grid During the January 2024 Storm

2024: Hydrocarbons, Especially Coal, Are Critical to Winter Resiliency . . . Again





Source: EIA Hourly Grid Monitor

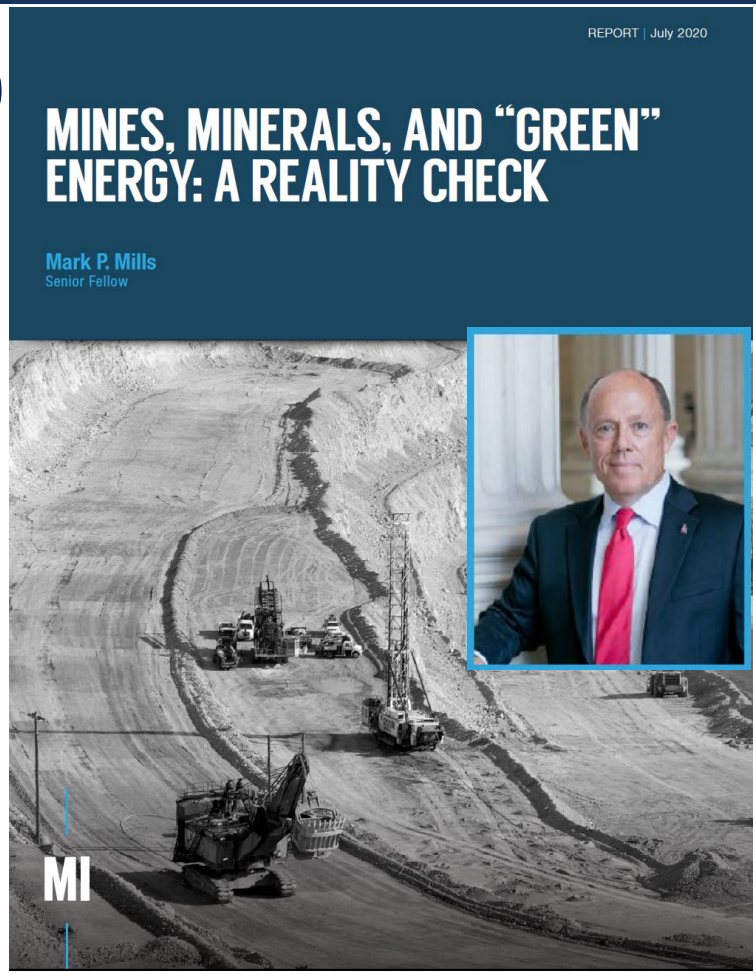
Will Batteries Save the Day? NO! - SCALE MATTERS!

A Month's Battery Backup Equivalent to JUST ONE 1,200 MW Coal Plant Would Require Roughly all the Lithium that is Currently Mined in the ENTIRE WORLD per year.

- 864 GWh of 24/7 electricity capacity would need to be replaced
- 160 metric tons of lithium/GWh of battery storage = 138,000 metric tons of lithium
- This is roughly equal to current global production of 130,000 metric tons/yr

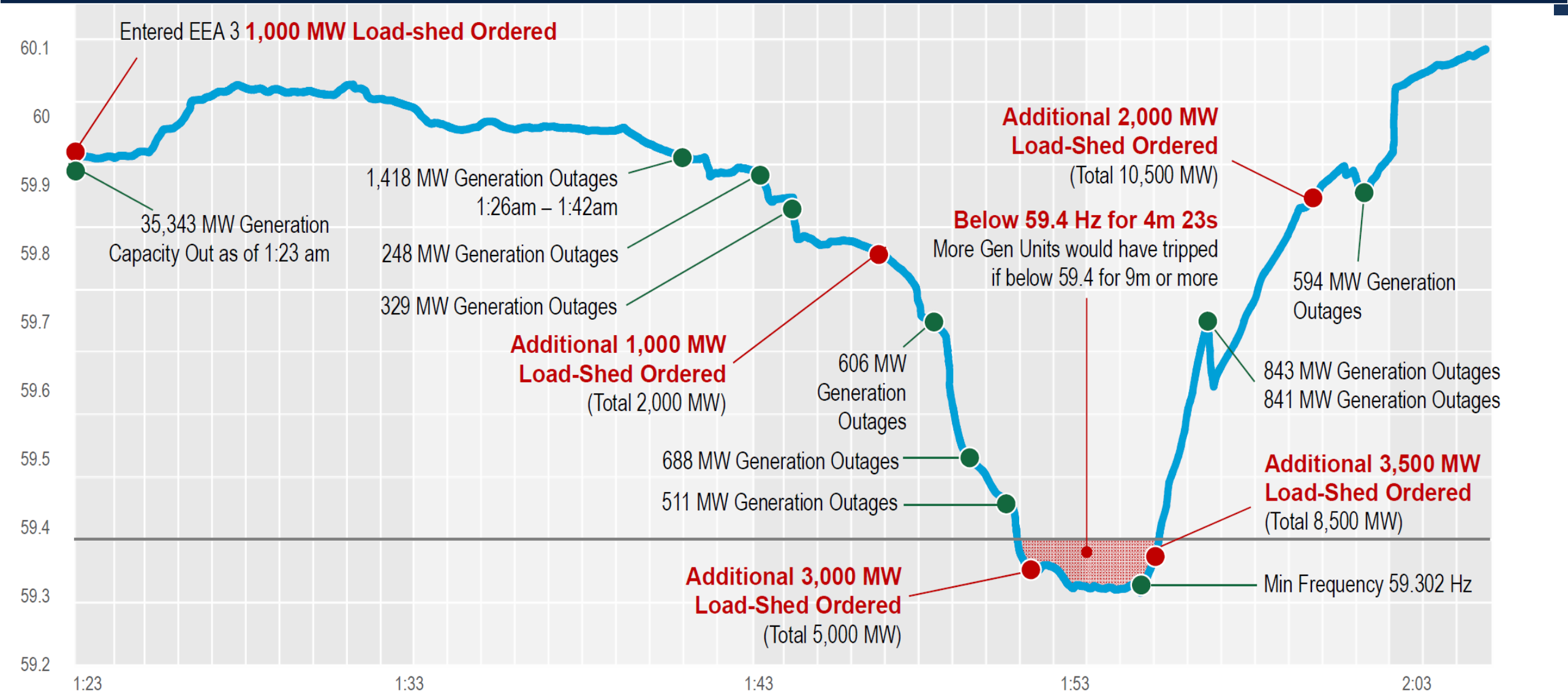
Realizing the "Dream" of 100% Renewable in Just Texas by 2035 Requires at Least One Day of Battery Storage for the Whole System. To Accomplish This, A 100 MW/400 MWh Battery Would Have to be Built EVERY DAY Over the Next 10 Years. This Buildout Would Require 1.5 TIMES CURRENT GLOBAL PRODUCTION/yr.

- 1,300 GWh of electricity to replace (130 GWh/yr per year for 10 years)
- 160 metric tons of lithium needed per GWh of battery storage
- = 208,000 metric tons of lithium (current global production is 130,000 metric tons/yr)

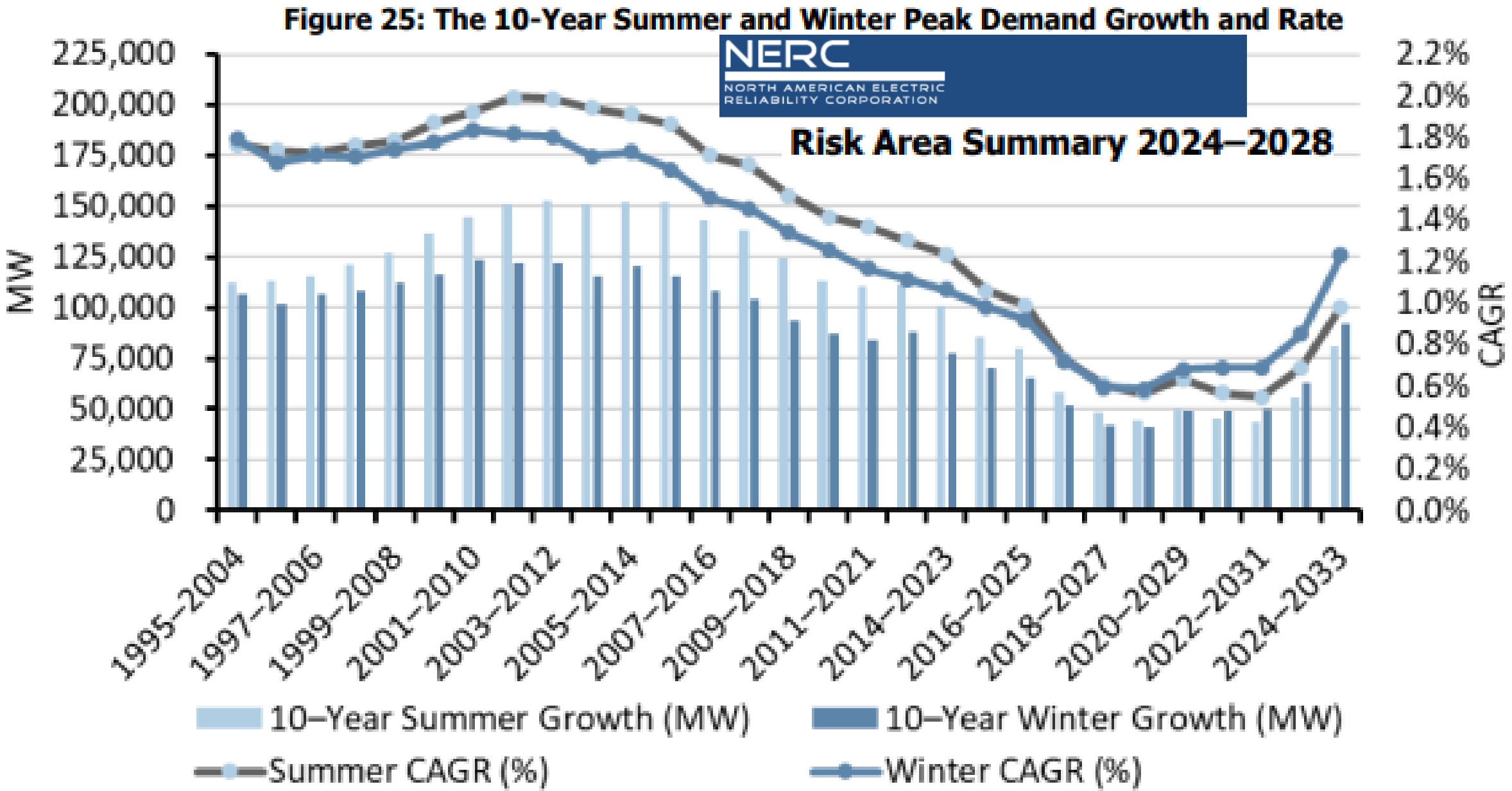


Life:Powered
Raising America's Energy IQ

LEST WE FORGET: The Night the Texas Grid Almost Went Down for a Month – *(Would Have Been Largest Energy Disaster in History)*

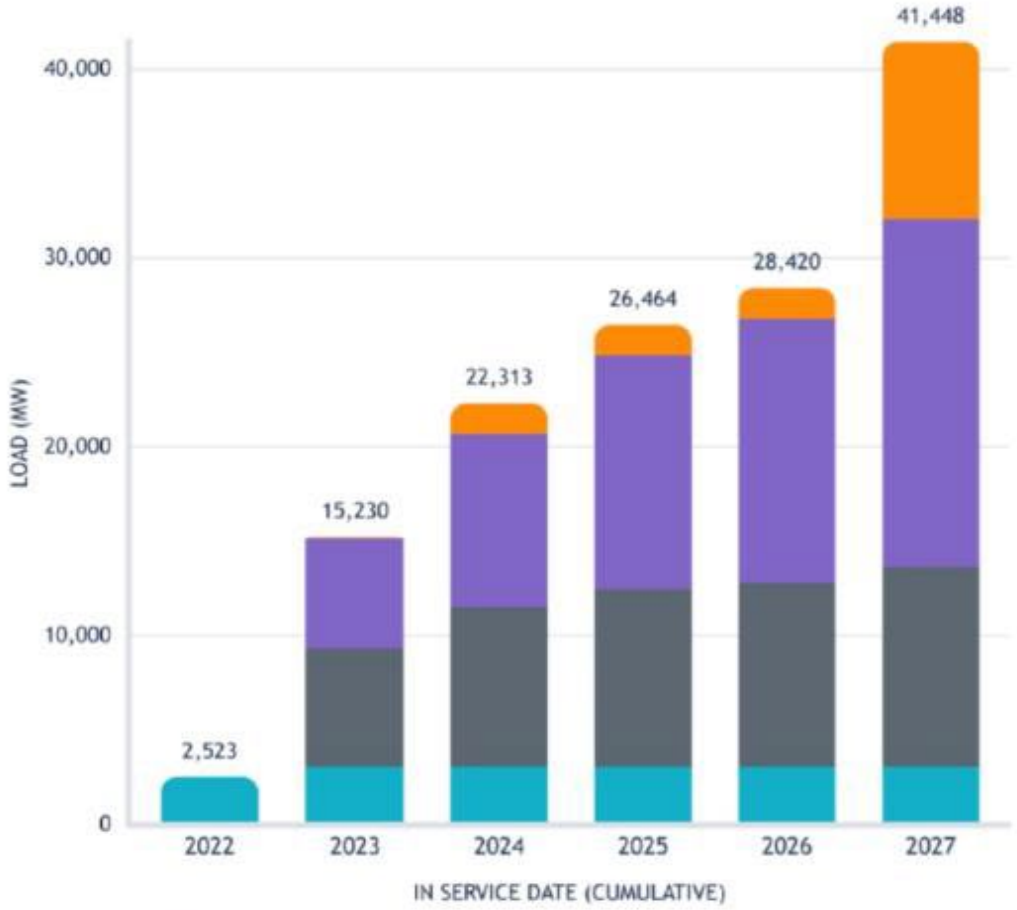


And the Days of Decreasing Demand are Gone!



Case Study: ERCOT - Large Load Growth

Current Large Load Interconnection Queue



Project Status	2022	2023	2024	2025	2026	2027
No Studies Submitted	-	62	1,628	1,628	1,628	9,369
Under ERCOT Review	-	5,834	9,162	12,387	13,987	18,432
Planning Studies Approved	-	6,279	8,468	9,394	9,750	10,592
Approved to Energize	2,523	3,055	3,055	3,055	3,055	3,055
Total (MW)	**2,523**	**15,230**	**22,313**	**26,464**	**28,420**	**41,448**

NOTE: In July 2023, ERCOT identified a database error that had caused some projects to be misclassified in this chart. This error was corrected, resulting in a higher 2022 total of approved load than was previously reported. The overall size of the queue was not impacted by this error.

- **Approved to Energize –** Projects that have received Approval to Energize from ERCOT Operations. NOTE: not all MWs in this category have been observed to be operational (see next slide)
- **Planning Studies Approved –** Projects that have received ERCOT approval of required interconnection studies. Any MWs that were not approved are reclassified as No Studies Submitted.
- **Under ERCOT Review –** Projects that have studies under review by ERCOT
- **No Studies Submitted –** Projects that are tracked by ERCOT but that have not yet provided sufficient information for ERCOT to begin review. Additionally, MWs that were not approved by ERCOT after review of planning studies are included in this category until a path to interconnect these MWs is identified or the customer cancels the interconnection request.

Bloomberg's "Beyond Carbon" Campaign Would Devastate The US Electric Grid

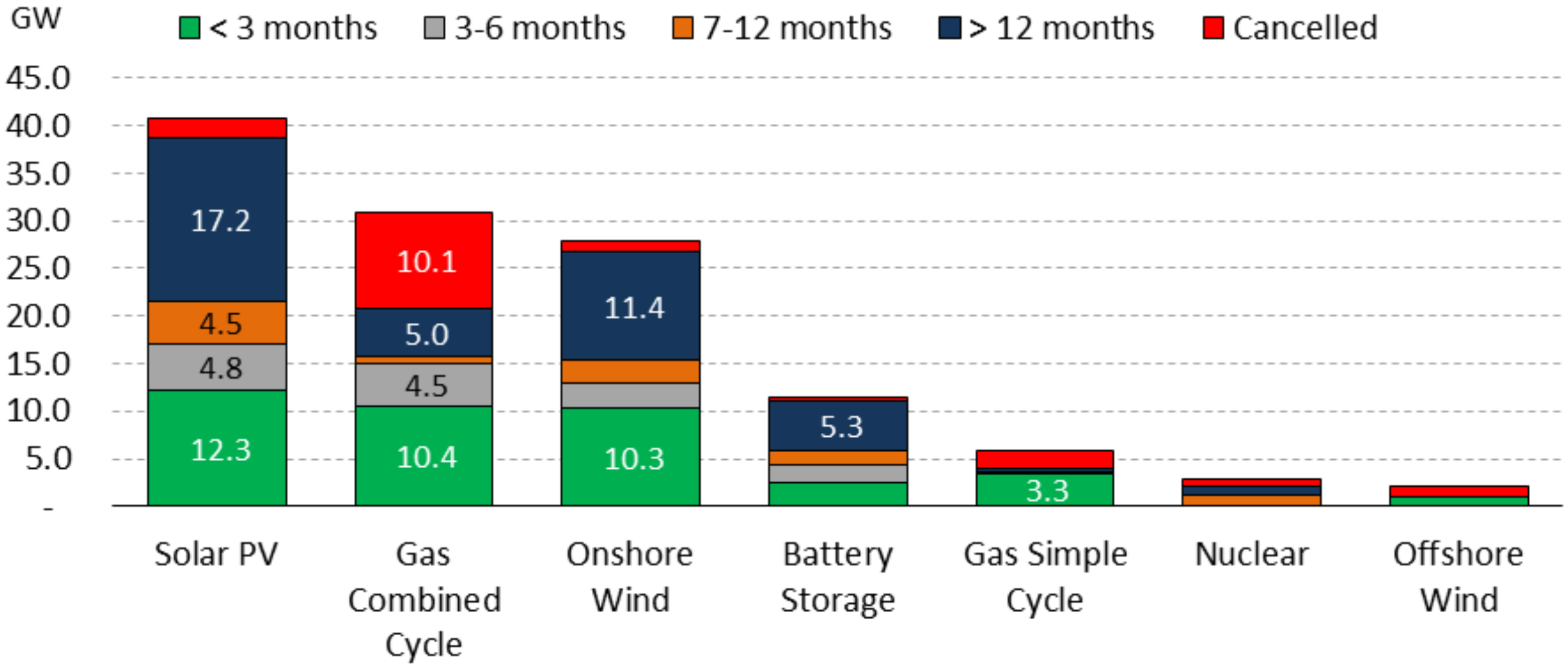
"Shut down every last U.S. coal plant. Slash gas plant capacity in half, and block all new gas plants."

Beyond Carbon aims to eliminate **40% of all U.S. electricity generation by 2030.**

Sources: Statistical Review of World Energy 2023,
https://www.bloomberg.org/press/michael-r-bloomberg-doubles-down-with-additional-500m-to-help-end-fossil-fuels-and-usher-in-a-new-era-of-clean-energy-in-the-united-states/

New Generation Projects Being Cancelled or Delayed

(tracking projects initially announced as of 1/21)



Source: Energy Ventures Analysis Power Plant Tracking Database

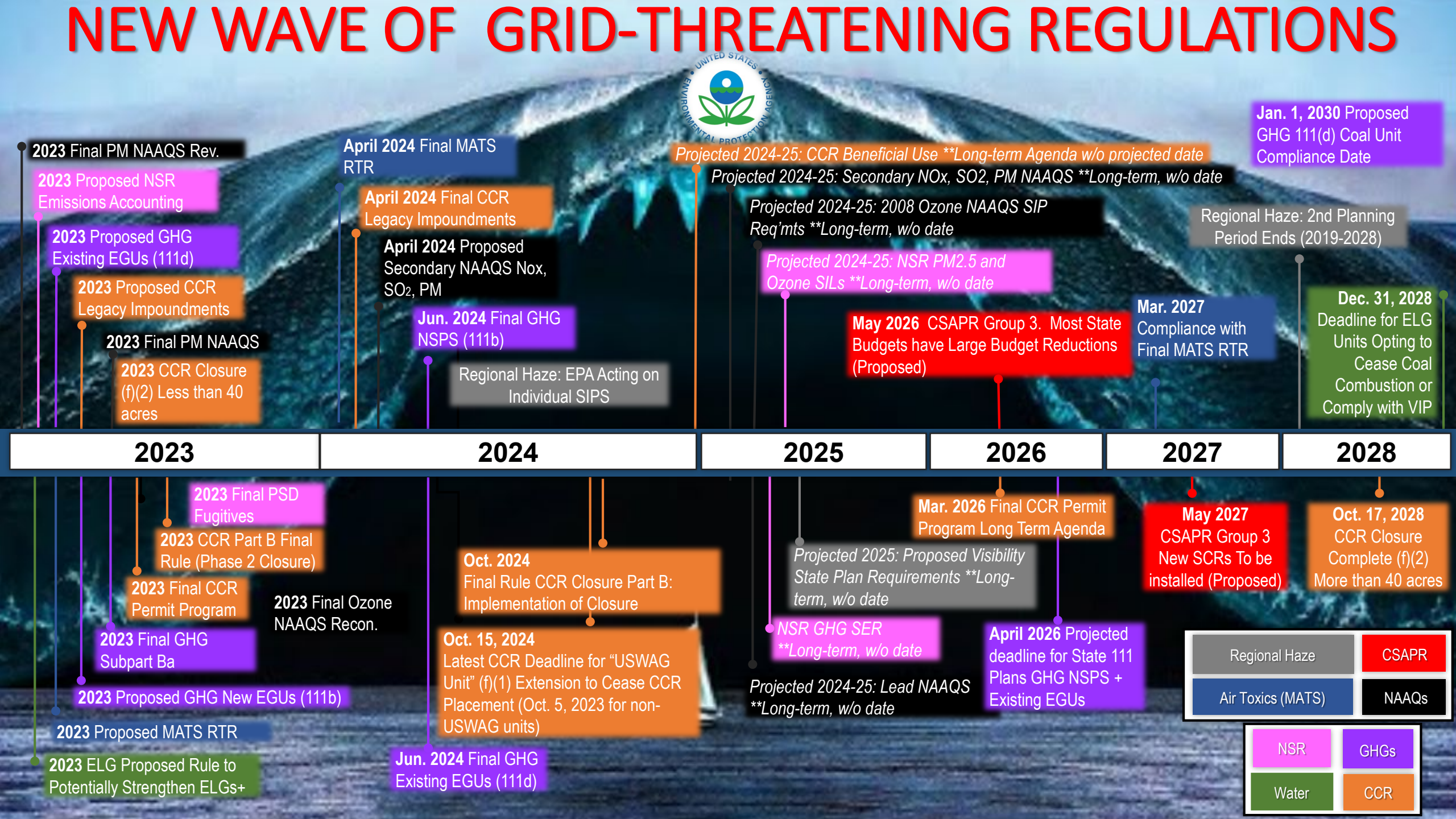
Jackson Walker LLP

PART TWO:

EPA'S CONTINUED ASSAULT

NEW WAVE OF GRID-THREATENING REGULATIONS

NEW WAVE OF GRID-THREATENING REGULATIONS



FINAL DISPOSITION OF KEY RULES ALL COMING AT ONCE

OTR

MATS

CCR

111 Carbon

Haze

ELG

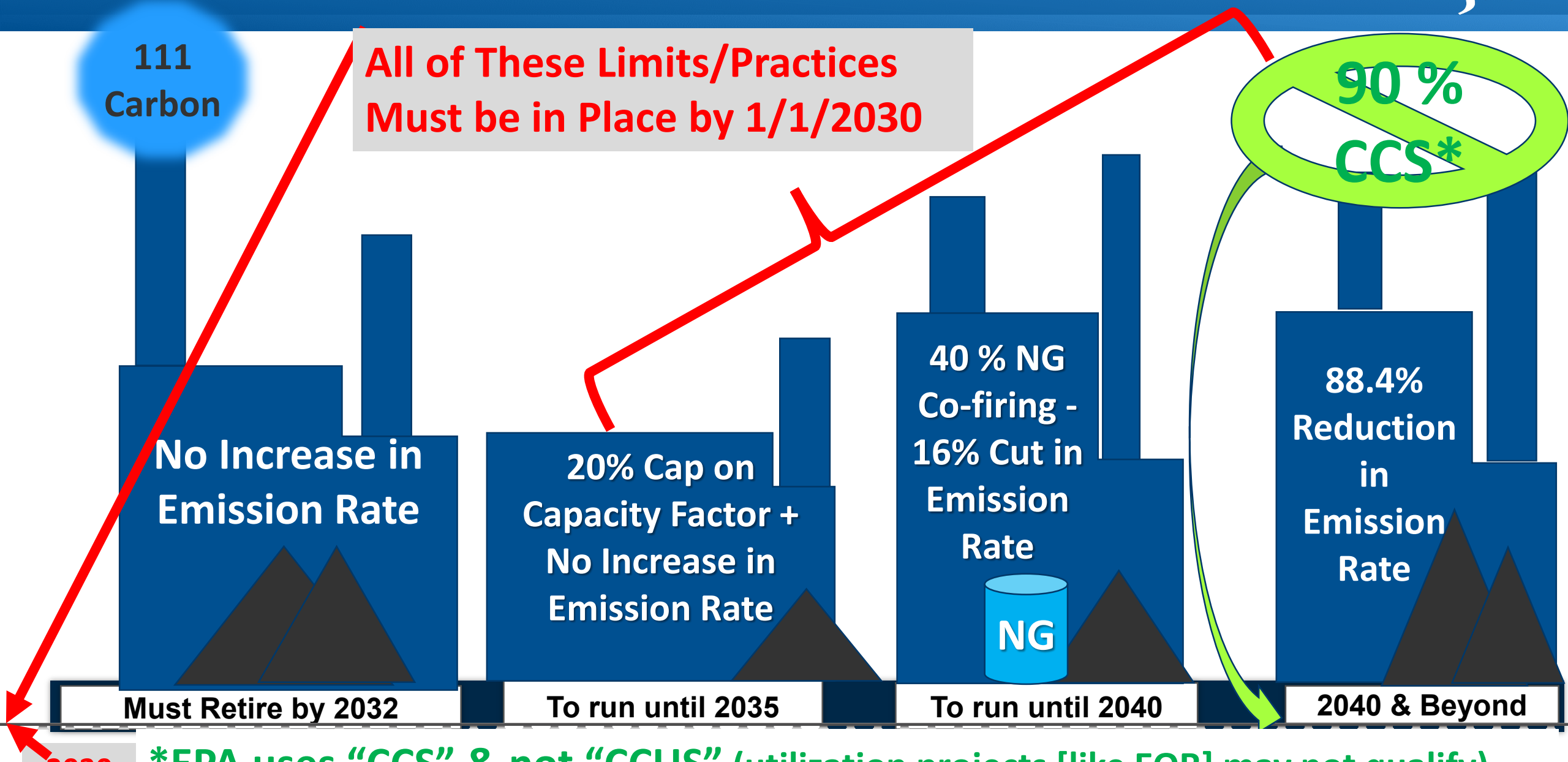
March

April

May

Congressional Review Act (CRA) “Look-Back” Period for Vacating Regulations

EXISTING COAL – Standards Based on Remaining Life



*EPA uses "CCS" & not "CCUS" (utilization projects [like EOR] may not qualify)

New & Existing Gass - Massive uncertainty

New/Existing ≥ 300 MW Combustion Turbines with CF ≥ 33-40% (SC) or 45-55% (CC) face unprecedented mandates for unproven tech:

- MUST Elect Co-firing vs. CCS Path by 1/1/31

- Co-firing Path:
  - Co-firing of 30 percent low-GHG hydrogen by 2032 (680 lb CO_2/MWh-gross)
  - Co-firing 96 percent low-GHG hydrogen by 2038 (90 lb CO_2/MWh-gross)
  - Not clear "low-GHG H2" will be available or affordable
- CCS Path:
  - 90% CCS by 2035 (90 lb CO_2/MWh-gross)
  - Not clear CCS will be eligible if enhanced oil recovery/utilization involved

GRID IMPACTS OF 111 RULE ARE REAL & IMMEDIATE

Comment Period followed by Final 111 Rules (EGUs suspend coal investment & planning new large gas units)

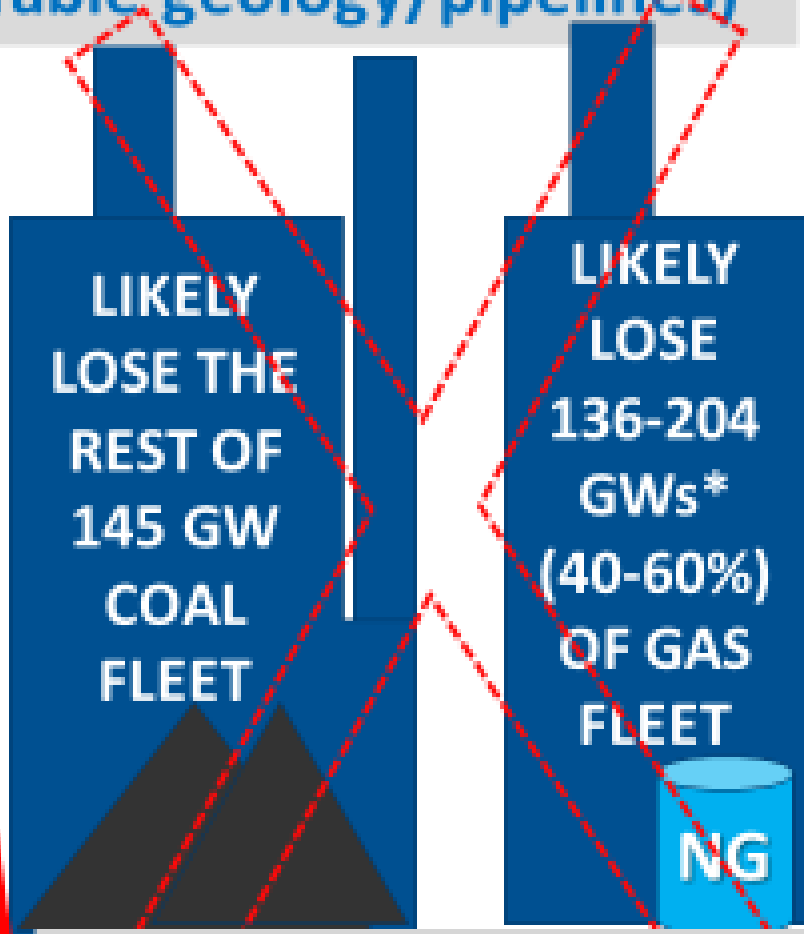
EPA's Mandated BSER Handed Down to States (EGUS/states evaluate if H2/CCS options possible – EGUs increase retirements)

States Plans Developed & Submitted to EPA (EGUs now know their fate & start MASSIVE retirements)

Only 2-3 Years to Construct Massive Infrastructure (retirements continue due to realities of costs/timeline)

2030 CONTROLS IN PLACE

(what is left of coal fleet and over half of gas fleet retires except small gas & a few plants with favorable geology/pipelines)



*The sources for impacted MWs are EIA 860m (for capacity) and the 2021 EIA 923 (for generation).

2023	2024	2025-26	2027-2030	2030	2040

RELIABILITY IMPACTS OF EPA CARBON RULE

(COAL & NATURAL GAS LIKELY TO BE LOST DUE TO EPA'S CAA 111 CARBON RULE)(Source: EIA 860 & EIA 923)

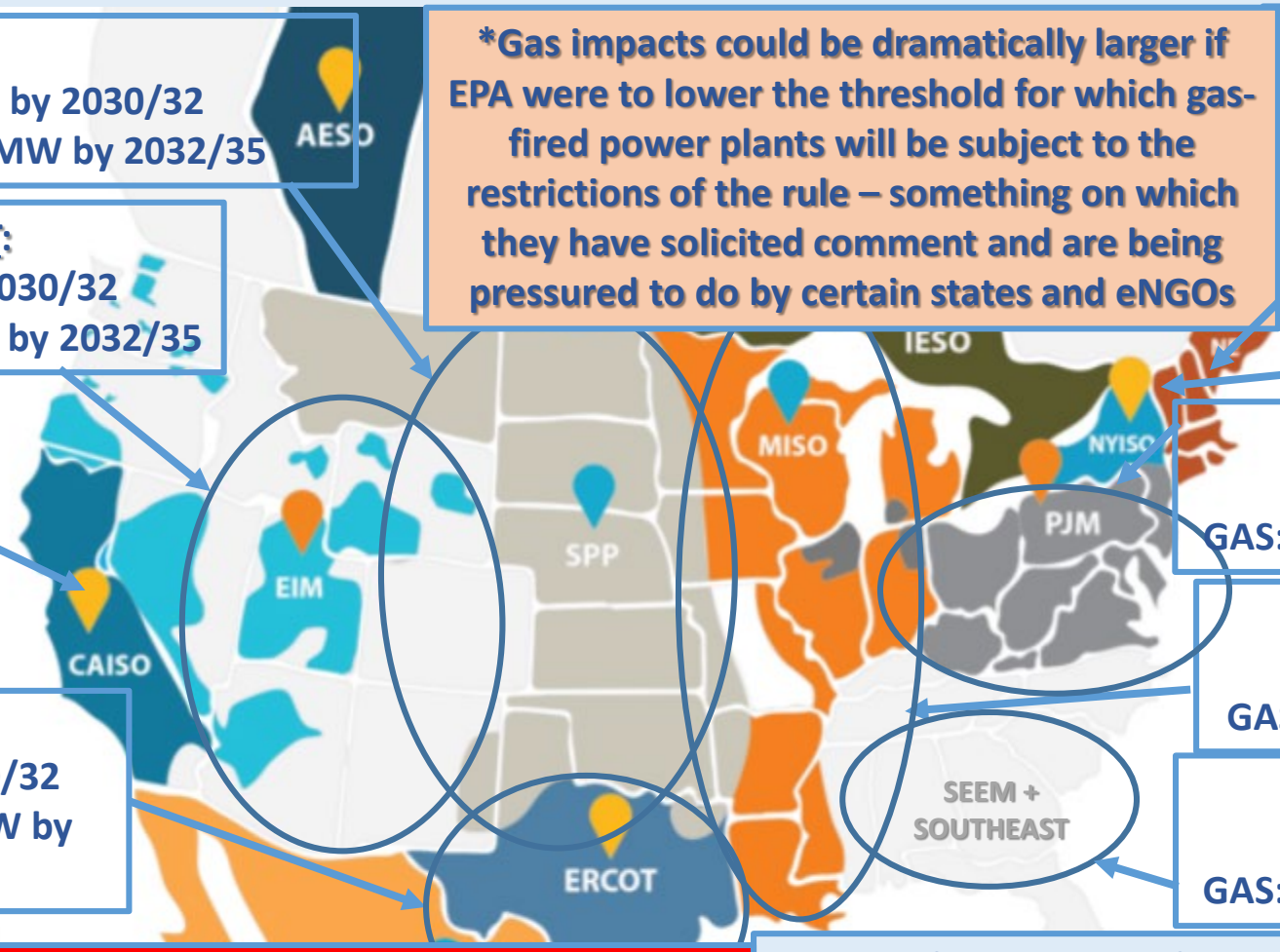
SPP:
COAL: 17,799.5 MW by 2030/32
GAS: 1,519.1 – 3,689.1 MW by 2032/35

MOUNTAIN WEST:
COAL: 8,182.4 MW by 2030/32
GAS: 9.086.1 – 18,694.3 MW by 2032/35

CAISO:
COAL: 62.5 MW by 2030/32
GAS: 5,552.7-9518.6 MW by 2032/35

ERCOT:
COAL: 10,369 MW by 2030/32
GAS: 9,683.3 – 20,017.7 MW by 2032/35

***Gas impacts could be dramatically larger if EPA were to lower the threshold for which gas-fired power plants will be subject to the restrictions of the rule – something on which they have solicited comment and are being pressured to do by certain states and eNGOs**



ISONE:
COAL: 559.2 MW by 2030/32
GAS: 3,937.9 – 7,556 MW by 2032/35

NYISO:
GAS: 5,427.6 – 6,077.6 MW by 2032/35

PJM:
COAL: 41,769.2 MW by 2030/32
GAS: 39.718.7 – 42,206.5 MW by 2032/35

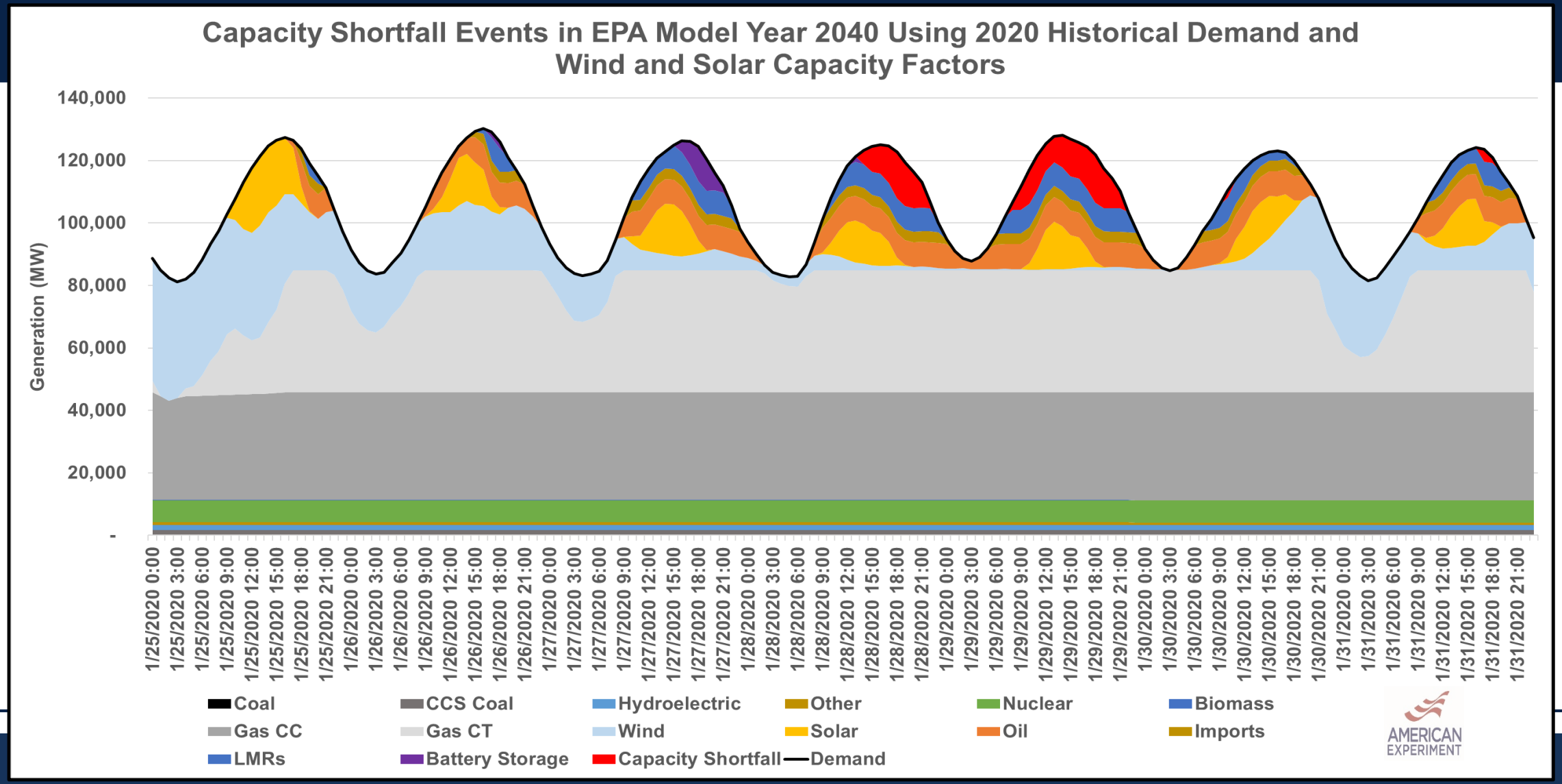
MISO:
COAL: 39,109.5 MW by 2030/32
GAS: 9,467.9 - 19,524.6 MW by 2032/35

SOUTHEAST:
COAL: 27,279.9 MW by 2030/32
GAS: 39,935.3 – 62,254.4 MW by 2032/35

NATIONWIDE IMPACTS *(includes non-RTO EGUs)*:
COAL: 155,110 – 210,944 MW by 2030/32
GAS: 126,000-204,000 MW by 2032/35

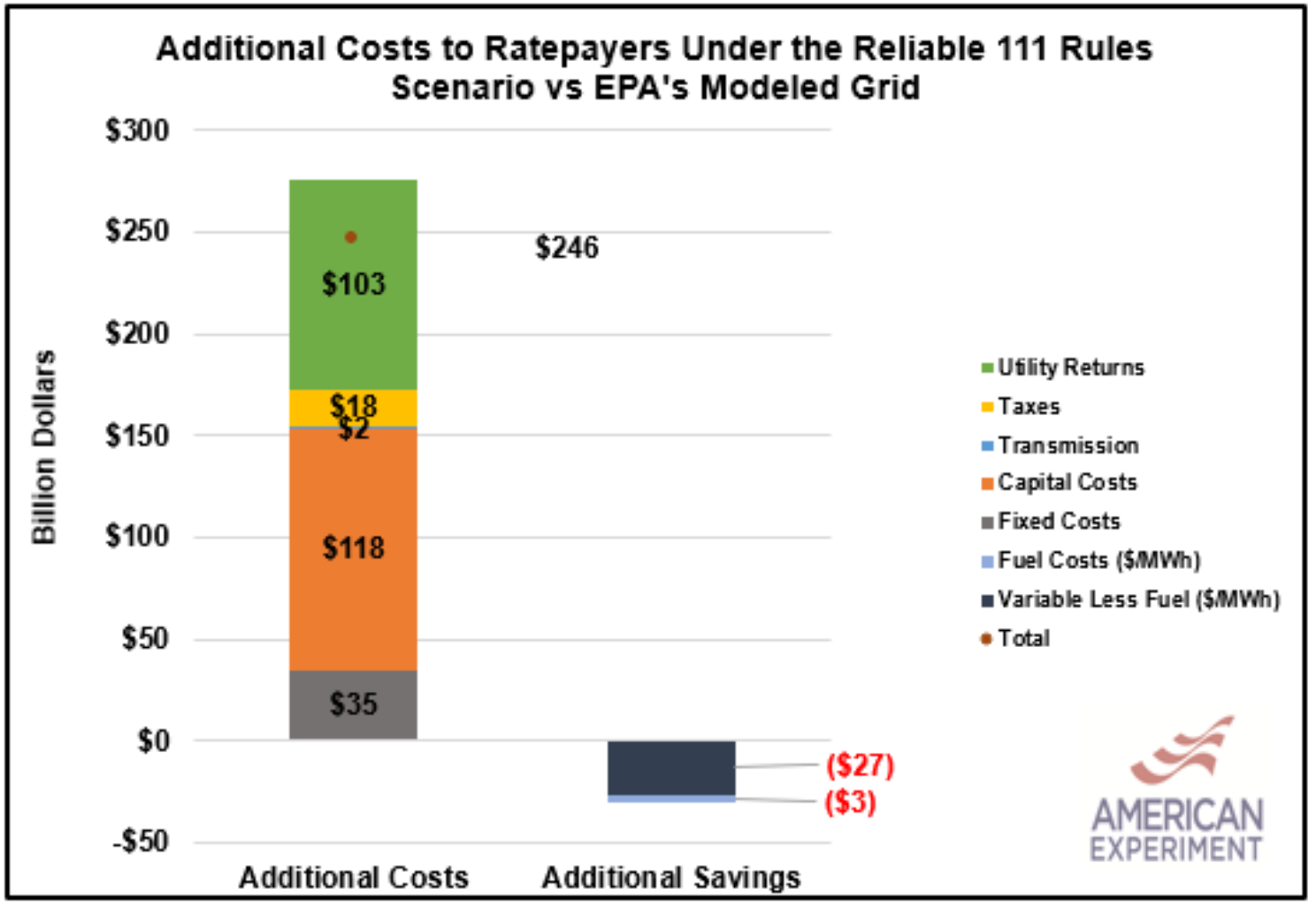
NOTE: These estimates do NOT include retirements that are likely to be driven before 2030 because generators will not be able to justify capital investments required by other EPA regulations because the carbon rule will significantly curtail the remaining useful life and utilization rate of plants – making it financially infeasible to recover additional capital expenditures.

In MISO, with realistic wind/solar performance factors, EPA's own carbon rule modeling can't keep the lights on

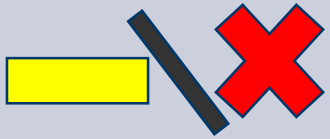


Executive Summary: Shoring Up EPA's Modeled Grid Would Cost $246 Billion

- Preventing capacity shortfalls while still meeting EPAs emission targets would require large capacity additions.
- These additions would increase the cost of compliance by $246 billion through 2055, or $7.7 billion annually, compared to the cost of EPA's modeled MISO grid in the Integrated Proposal with LNG Update.
- **This figure exceeds EPA's annual net benefit estimate of $5.9 billion for the entire country.**



CONTRASTING LEGAL FLAWS OF OLD/NEW CARBON RULES

REG	Abide by *WV v. EPA* Prohibition Against Using Generation Shifting in Deriving BSER under 111(b)?	Comply with 111(d) Requirement that BSER be Applied "For" or "At" the Source (aka "inside fence")?	Is BSER "Adequately Demonstrated" as Required by 111(b)?	Are States Allowed to Lead Implem. of 111(d) Perf. Standards?	Are States Allowed to Lead in RULOF as Required by 111(d)?
CPP					
ACE					
NEW 111 CPS	 EPA appears to have learned this lesson (also true in other rules)	 They start inside the fence, but they did not stay there (dependent on off-site infrastructure)	 Low-GHG H2 & CCS are NOT nationally available or adeq. demonstrated.	 States are given the lead at the source level.	 EPA signals limits on state discretion on RULOF calls.

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PART THREE:
Stemming the Tide


STEMMING THE TIDE
POWER MARKET REFORMS
LITIGATION/REGULATORY FRONT
EDUCATIONAL OUTREACH

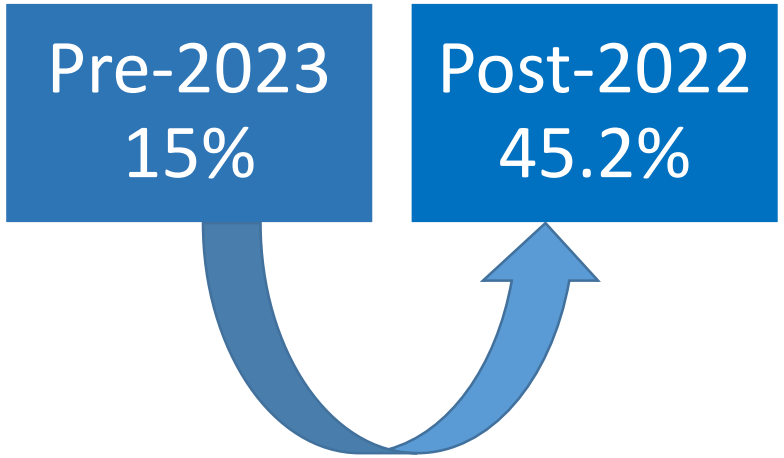
New Accreditation Standards & Increased Reserve Margin Requirements = Winter Reliability & Resilience is in Serious Question in SPP & MISO)

MISO

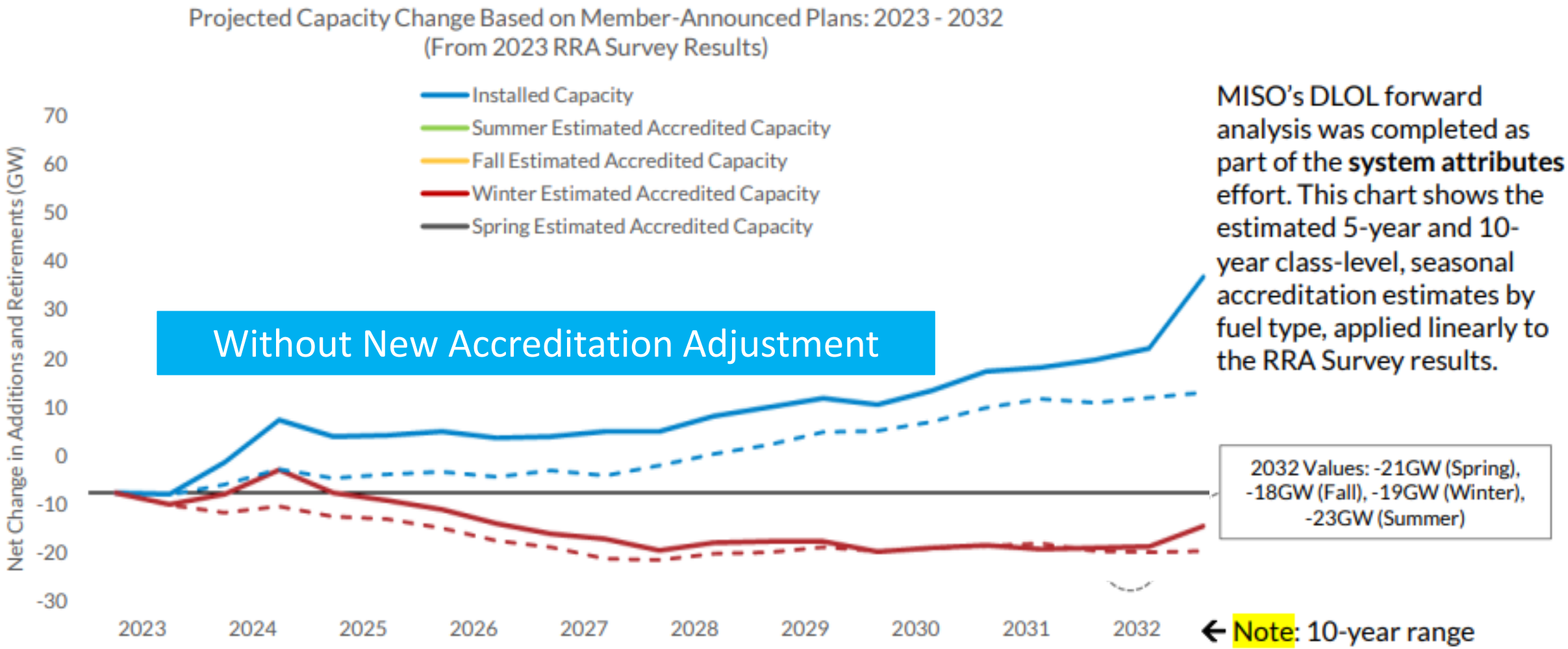
Seasonal Solar Accreditation				
	PY23-24	F1-25	F1-39	Reserve Margin
Winter		1%	1%	25.50%
Spring		35%	2%	24.50%
Summer	45%	43%	3%	7.40%
Fall		6%	5%	14.90%

SPP Southwest Power Pool

Due to Increased Renewable Penetration, Winter Reserve Margin Proposed to be Increased 300%



Alternative view of the installed versus accredited seasonal capacity picture applying the proposed Direct Loss of Load (DLOL) accreditation methodology



MISO's DLOL forward analysis was completed as part of the **system attributes** effort. This chart shows the estimated 5-year and 10-year class-level, seasonal accreditation estimates by fuel type, applied linearly to the RRA Survey results.

DLOL seasonal accreditation assumptions on Slides 16-19 of the System Reliability Attributes Workshop Deck #2

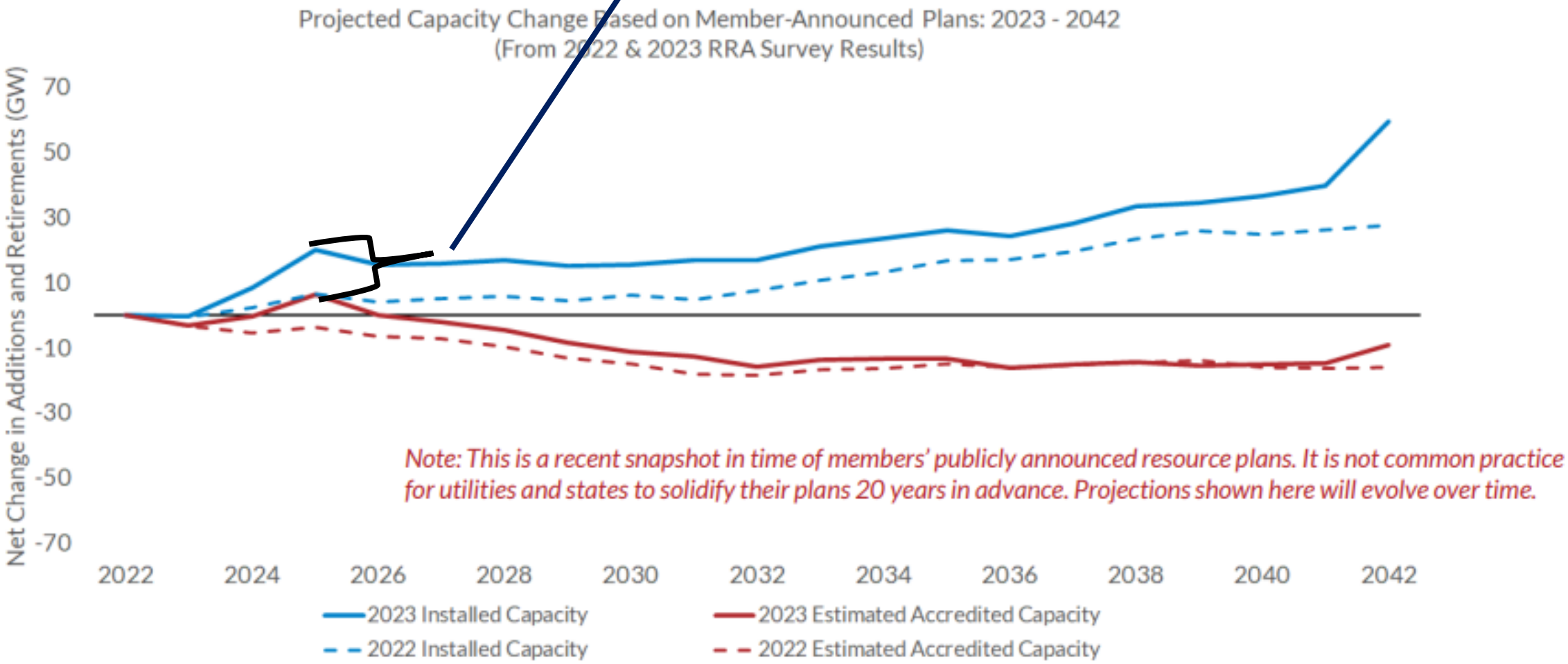
RETIREMENT OF COAL PLANTS BEING DELAYED (**22,202 MW**)

Plant	State	Planned	Revised	Capacity
Indian River (NRG Energy)	DE	2022	2026	410 MW
Bowen 1 & 2 (Georgia Power)	GA	2027	2035	1440 MW
Scherer 3 (Georgia Power)	GA	2027	2035	860 MW
Shafer Power Station (NIPSCO)	IN	2023	2025	1940 MW
Rockport 2 (AEP)	IN	2022	2028	1300 MW
Merom (acquired by Hallador Power Company)	IN	2023	No Set Date	980 MW
Lawrence Unit 4 & 5 (Evergy)	KS	2023	2028	486 MW
Ghent 2 (Louisville Gas & Electric/Kentucky Utilities)	KY	2028	No Set Date	1200 MW
Brown 3 (Louisville Gas & Electric/Kentucky Utilities)	KY	2028	No Set Date	557 MW
White Bluff (Entergy)	AR	2024	2028	1,650 MW
Independence (Entergy)	AR	2025	2030	1,650 MW
Rush Island (Ameren)	MO	2022	2025	1200 MW
GG Allen (Duke)	NC	2023	2024	435 MW
Mayo (Duke)	NC	2028	2031	382 MW
Roxboro Unit 1 &2	NC	2028	2029	1068 MW

Plant	State	Planned	Revised	Capacity
Roxboro Units 3&4	NC	2027	2034	745 MW
North Omaha (OPPD)	NE	2023	2026	645 MW
Coal Creek (acquired by Rainbow Energy)	ND	2021	No Set Date	1150 MW
Newmont (TS Power)	NV	2022	2023	220 MW
Winyah 1 & 2 (Santee Cooper)	SC	2027	2030	570 MW
Fayette 1 (City of Austin)	TX	2022	2028	570 MW
Edgewater (Alliant Energy)	WI	2023	2025	380 MW
Columbia (Alliant Energy)	WI	2024	June 2026	1100 MW
Oak Creek 5 & 6 (WEC Energy Group)	WI	2022	2024	525 MW
Oak Creek 7 & 8 (WEC Energy Group)	WI	2023	2025	310 MW
Pleasants (First Energy)	WV	2018	No Set Date	1288 MW
Jim Bridger 3 & 4 (Rocky Mountain Power/PacifiCorp)	WY	2022	2037	2441 MW

***Analysis does not include units deemed too critical to retire without $1 Billion+ in transmission upgrades (e.g., Rush Island [MISO] & Brandon Shores [PJM]) or deemed imprudently retired)**

KEY INSIGHT 2: The MISO region shows year-over-year growth and acceleration in planned additions which coincides with delays to some planned coal and gas retirements, resulting in a slightly improved near-term capacity picture



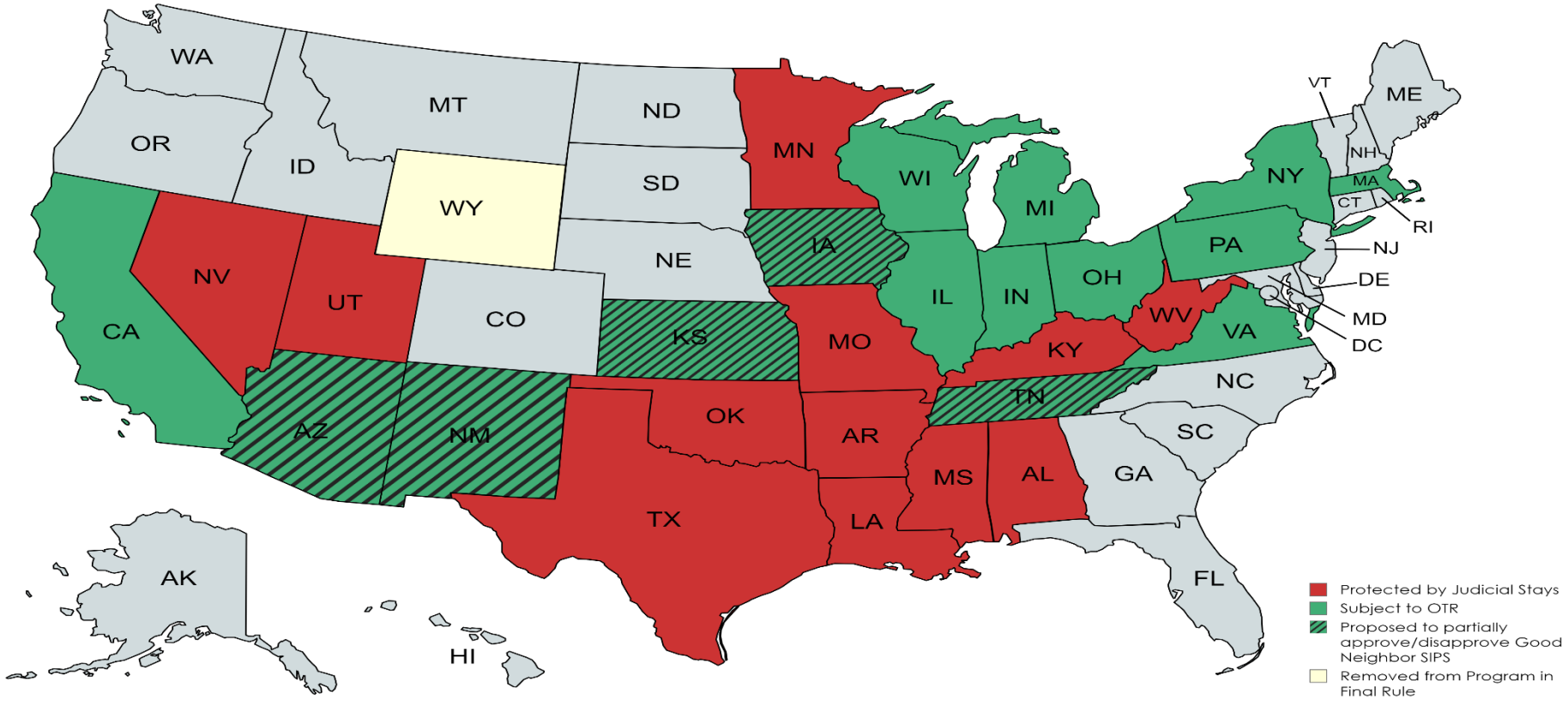
Note: This is a recent snapshot in time of members' publicly announced resource plans. It is not common practice for utilities and states to solidify their plans 20 years in advance. Projections shown here will evolve over time.

This chart depicts summer capacity accreditation estimates. See Slide 24 for yearly accreditation assumptions by fuel type and season.


STEMMING THE TIDE
POWER MARKET REFORMS
LITIGATION/REGULATORY FRONT
EDUCATIONAL OUTREACH

OTR

STATES CURRENTLY PROTECTED BY JUDICIAL STAY



Created with mapchart.net

STATES CURRENTLY SUBJECT TO OTR (SCOTUS Action Critical)

OTR

OTR Precedent: Stays on EPA SIP Denials Now i

Place in the 4th, 5th, 8th, 9th, &10th Circuits

Example - 5th Circuit Order:

. . . This [SIP Denial] would [] transform EPA's statutory role from that of a "ministerial" overseer to one of a ***freewheeling dictatorial regulator****. . . allowing the Final [SIP Denial] to stand pending the appeal would* ***disrupt the system of cooperative federalism*** *enshrined in the Clean Air Act . . . Stay Petitioners will be forced to spend billions of dollars in compliance costs [now] . . . simultaneous change to [] emissions budgets alongside the increased seasonal demand on [] grids will* ***dramatically increase the probability of price spikes and load-shedding***

(emphasis added & citations omitted)

FINAL DISPOSITION OF KEY RULES ALL COMING AT ONCE

OTR

MATS

CCR

111 Carbon

Haze

ELG

March

April

May

Congressional Review Act (CRA) “Look-Back” Period for Vacating Regulations


STEMMING THE TIDE
POWER MARKET REFORMS
LITIGATION/REGULATORY FRONT
EDUCATIONAL OUTREACH

Life:Powered

Raising America's Energy IQ

www.LifePowered.org

Mark P. Mills

Distinguished Senior Fellow

Brent Bennett, Ph.D.

Policy Director

Mike Nasi, JD

Senior Advisor

Andrea Hitt

Communications Manager

Aliyah Formont

Policy Scholar

Carson Clayton

Campaign Director

Jamila Piracci

Senior Fellow

Courtnie Bagley

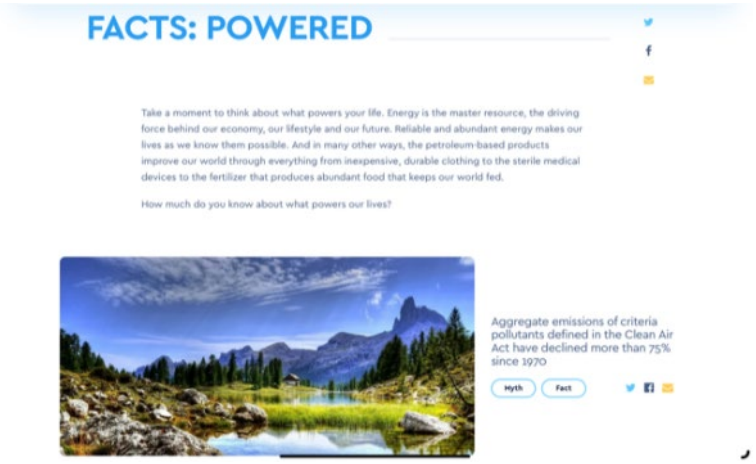
Education Coordinator

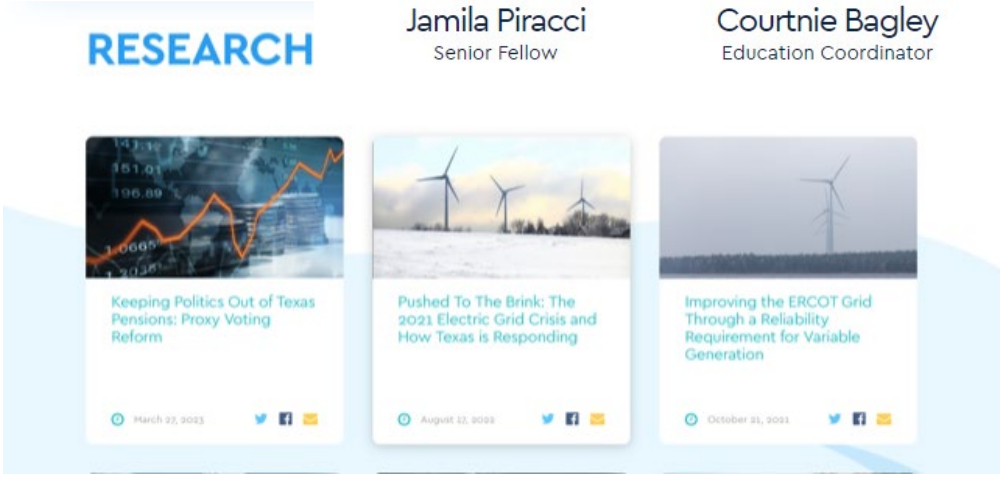
The Honorable Jason Isaac

Senior Fellow

FOUNDATIONS OF ENERGY

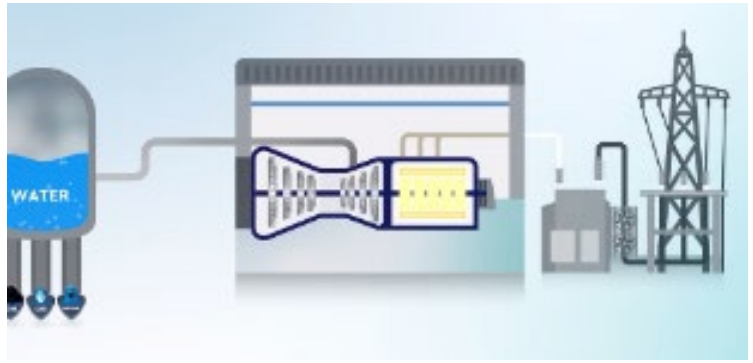
A 3-part curriculum to educate grades 9-12 in the modern application of energy science.

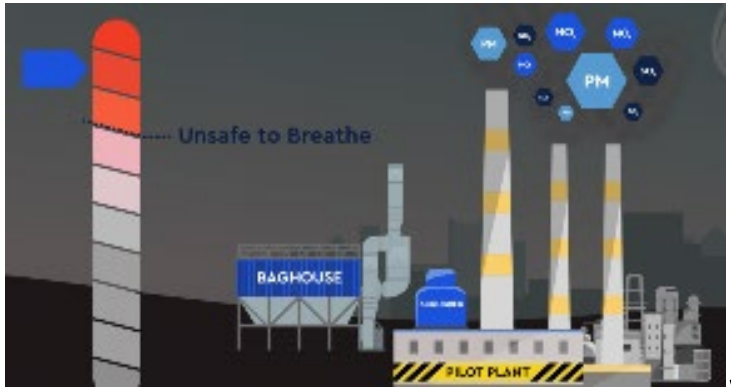


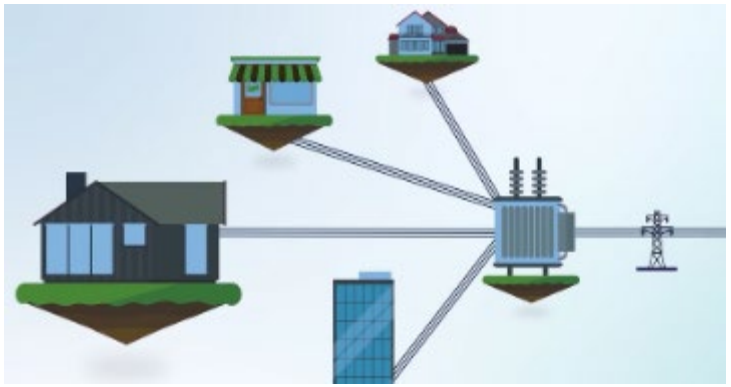


ANIMATED “ENERGY 101” VIDEO SERIES ON ENERGY & ENVIRONMENT

(*www.LifePowered.org*)







VIDEO 1 - Why We Need Electricity

https://youtu.be/ZfrBnddgFAU

VIDEO 2 - The Electric Grid

https://youtu.be/WiMtU6O1SxM

VIDEO 3 - Where Electricity Comes From

https://youtu.be/AKuoIeupGHc

VIDEO 4 - Energy Density

https://youtu.be/6d-HGzZHPG4

VIDEO 5 - Mining and Rare Earths

https://youtu.be/yu3mkFpiGmo

VIDEO 6 - Environmental Technology & Success

https://youtu.be/aodsngzbZqA

VIDEO 7 – Grid Reliability & Resilience

ttps://youtu.be/YLPzgRxm6fA?si=_i-heeK10A

VIDEO 8 –Geopolitical Energy Security

https://youtu.be/cnS3s4Ar-CU

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PART FOUR:

A GEOPOLITICAL ENERGY REALITY CHECK

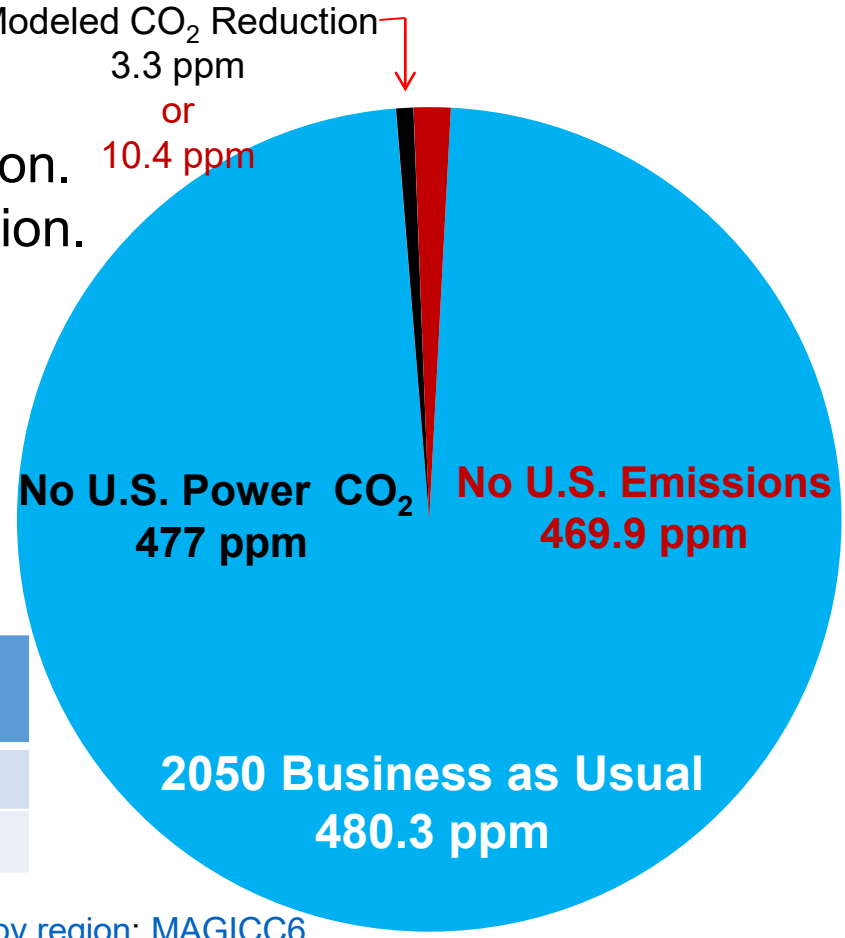
"LEADERSHIP" or Unilateral Disarming Our Global Security?

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.:

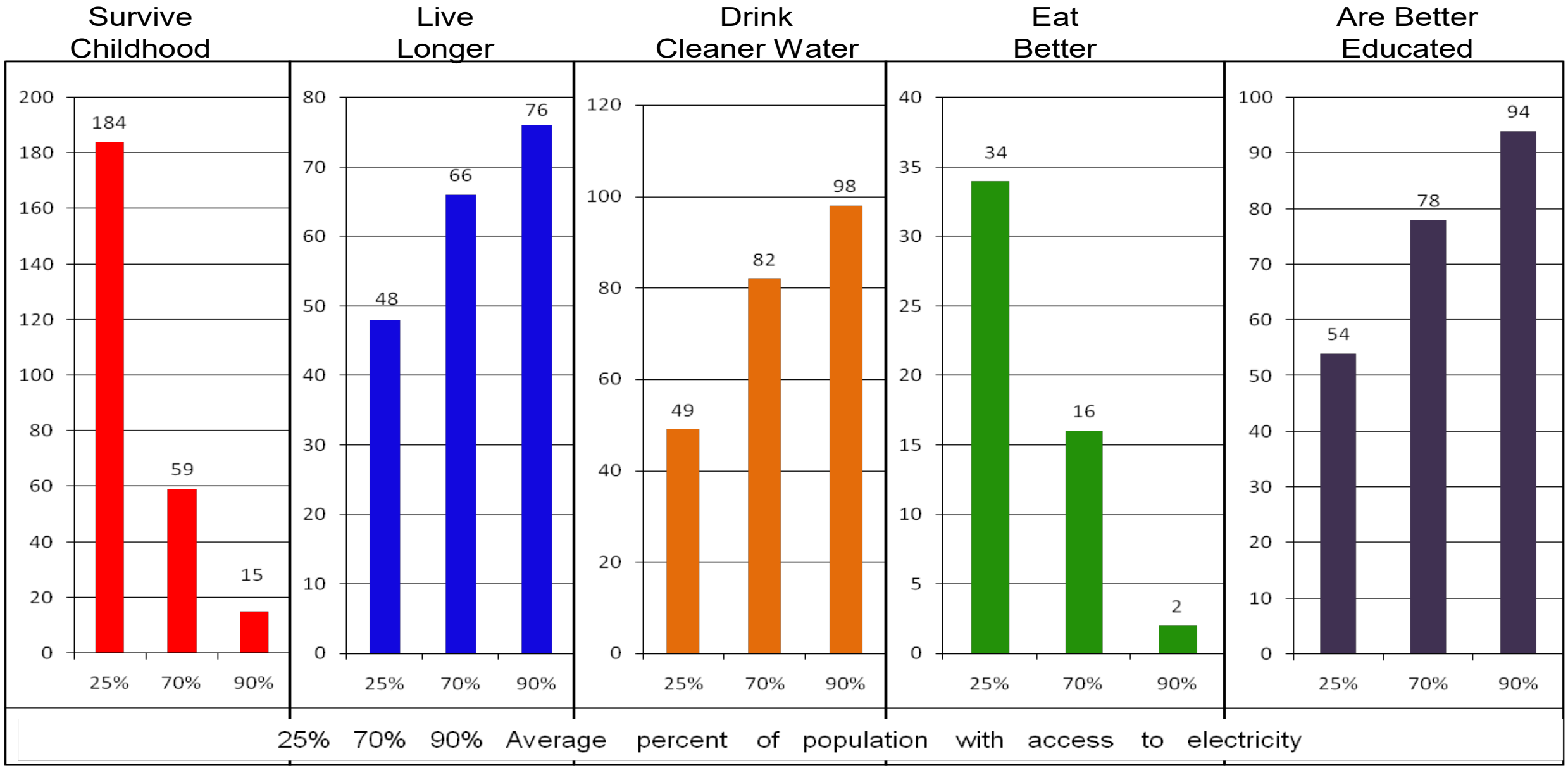
- 10.4 ppm (2.2%) reduction in CO_2 concentration.
- Modeled global temperature reduced by 0.053°C.



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.

People in Societies with Greater Access to Electricity:

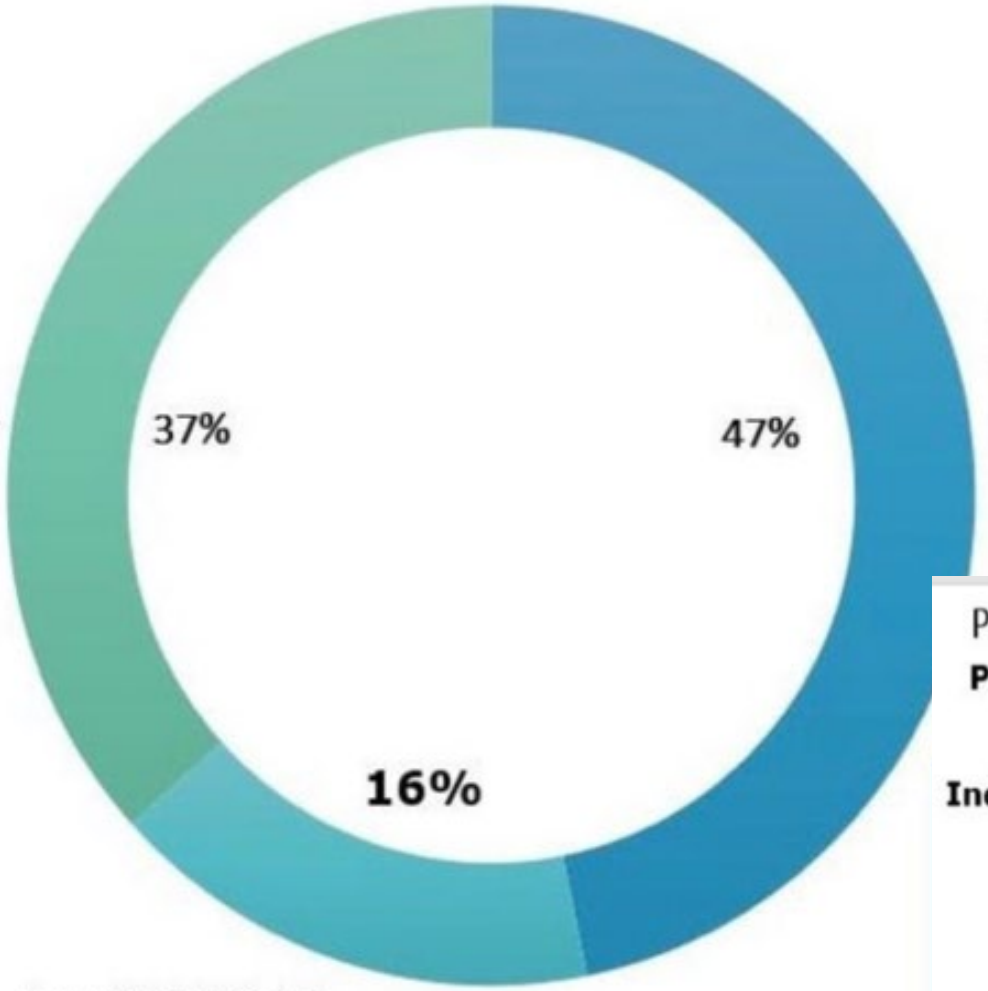


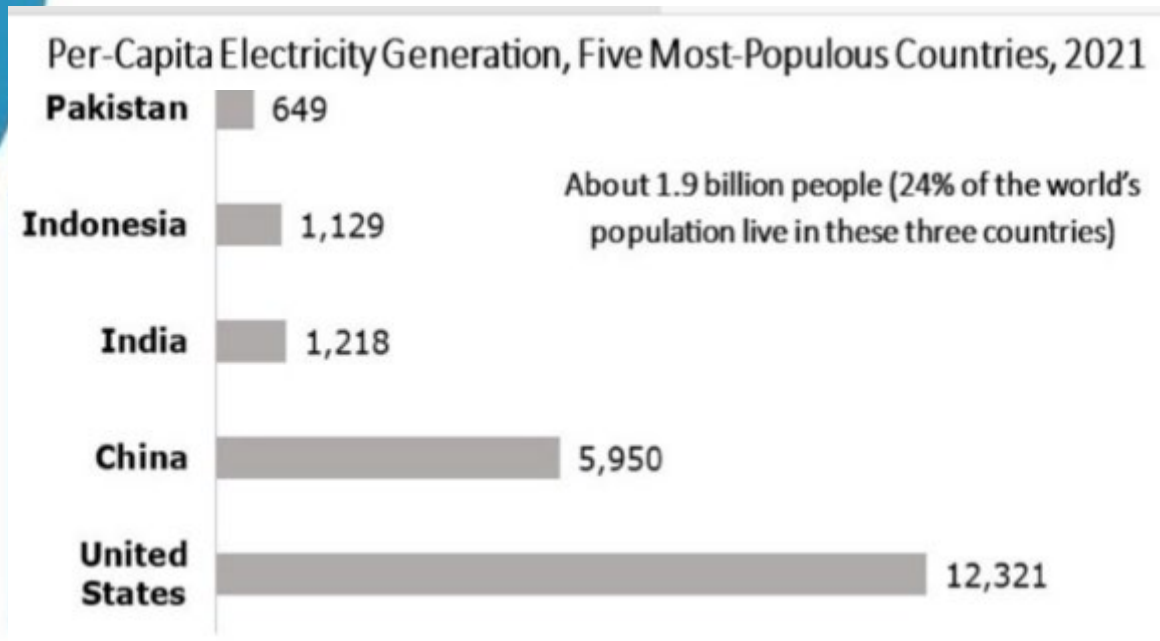
Source: Dr. Frank Clemente
Penn State Univ.

Electricity Use Defines the World

Large U.S. kitchen refrigerator
1,200 kWh/year

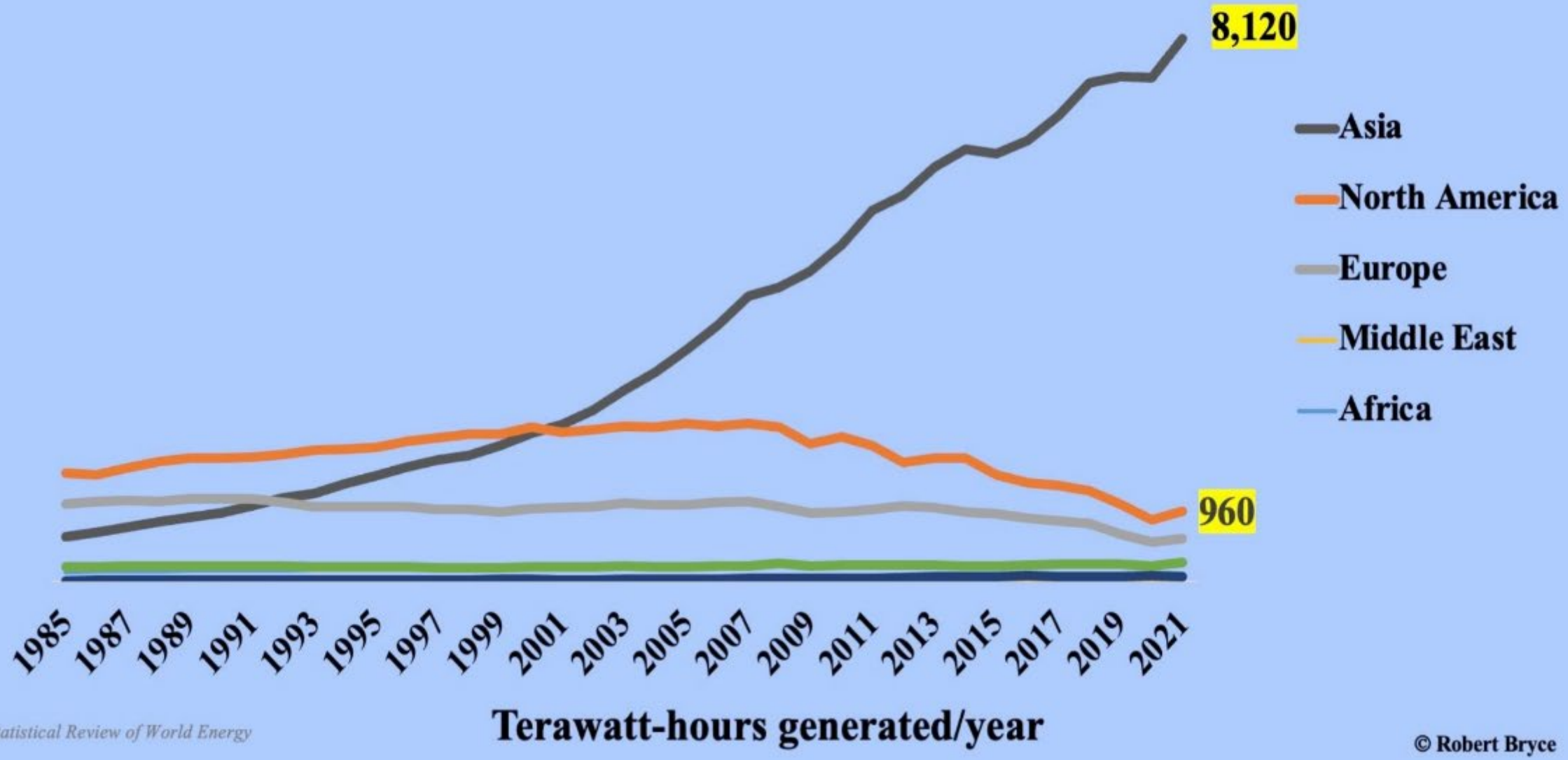
Global average
≈3,500 kWh/capita/year





Sources: Our World in Data, author calculations

What Energy Transition? Global Coal-Fired Generation By Region, 1985 to 2022



Source: Statistical Review of World Energy

AND THEN THERE IS THE UNTOLD STORY OF MASS URBANIZATION

100 Million People Moving to Urban Centers EVERY YEAR FOR 30 YEARS

In all human history we have reached 3.5 billion of urban settlers, and in the next 30 years we are going to have 3 billion more. . . what we have done in all human history, we nearly will do in the next 30 to 40 years. - UN Settlement Program

THIS WILL HAPPEN 120 MORE TIMES IN THE NEXT 3 DECADES!

The Last Time We Added Three Billion People to Cities

(1950-2010)

- Oil demand grew from 10 million b/d to 88 million b/d
- Natural gas use rose from 8 Tcf to 113 Tcf
- Coal demand increased from 2 billion to 7.1 billion tons
- Steel consumption increased from 200 to 1,400 million tons

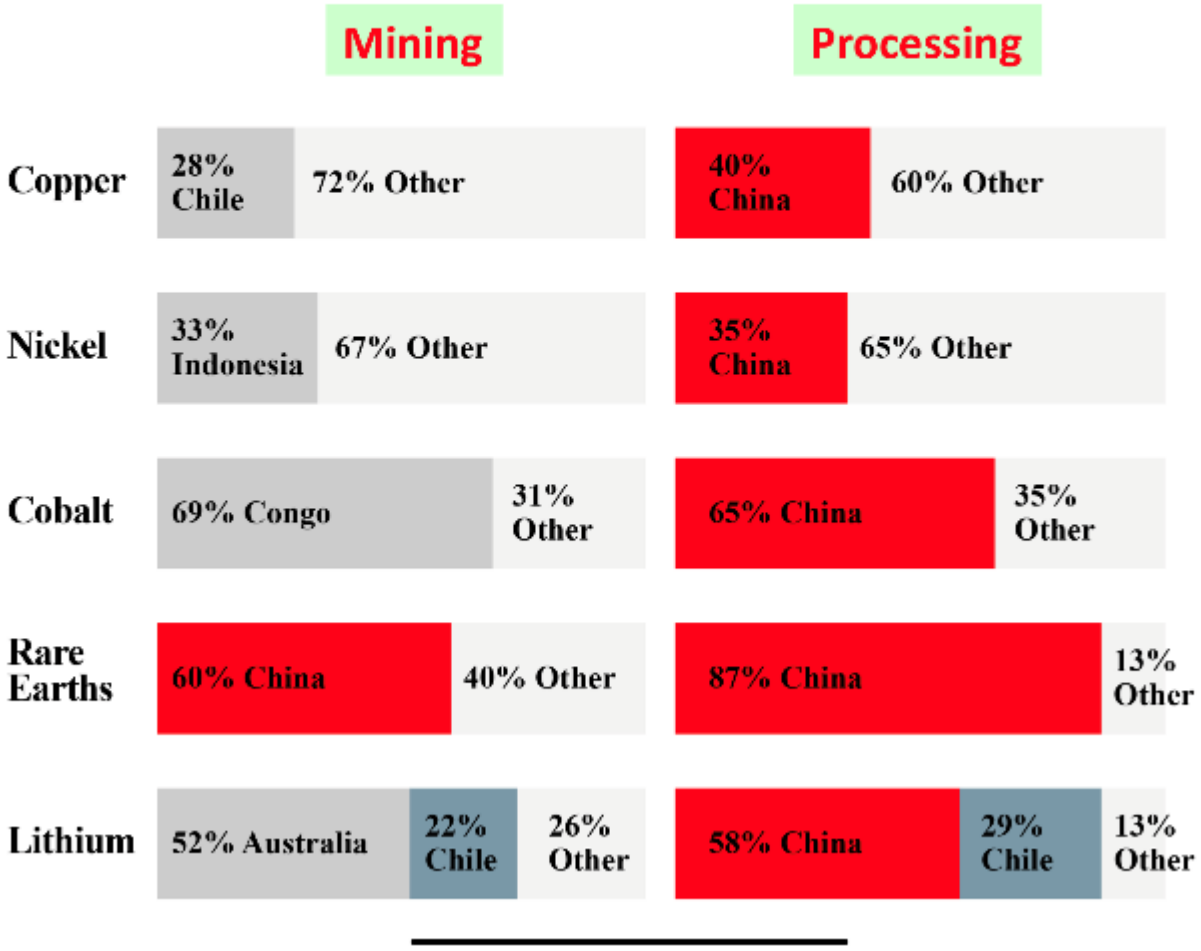
WHO WILL SUPPLY THIS OIL, GAS, COAL, & STEEL?

& this time there will also be a massive expansion in batteries & critrical minerals, all of which are dominated by the Chinese.

Sources: EIA; IEA; Worldwatch Institute; World Steel Association

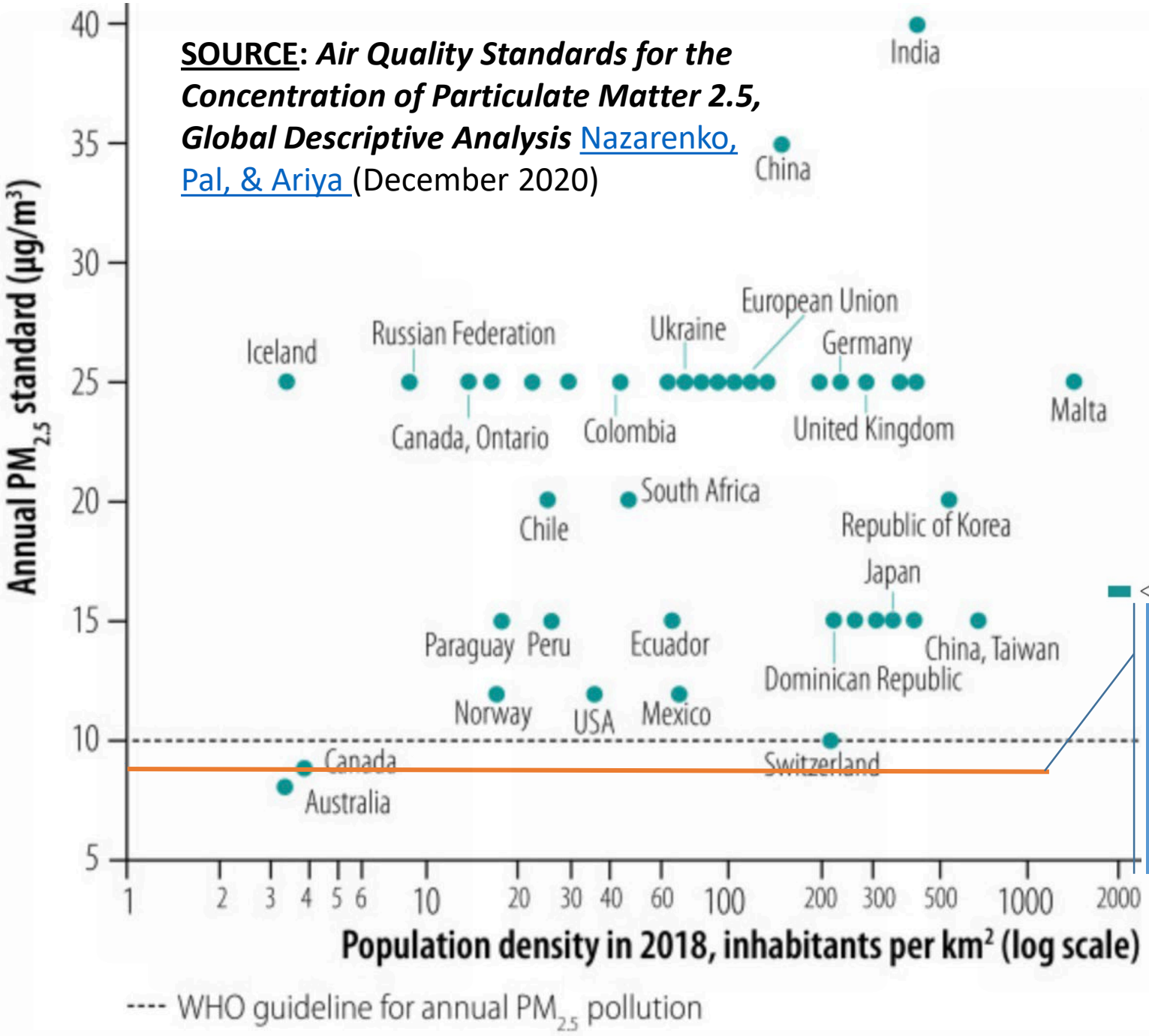
Handing the World's Geopolitical Security to China

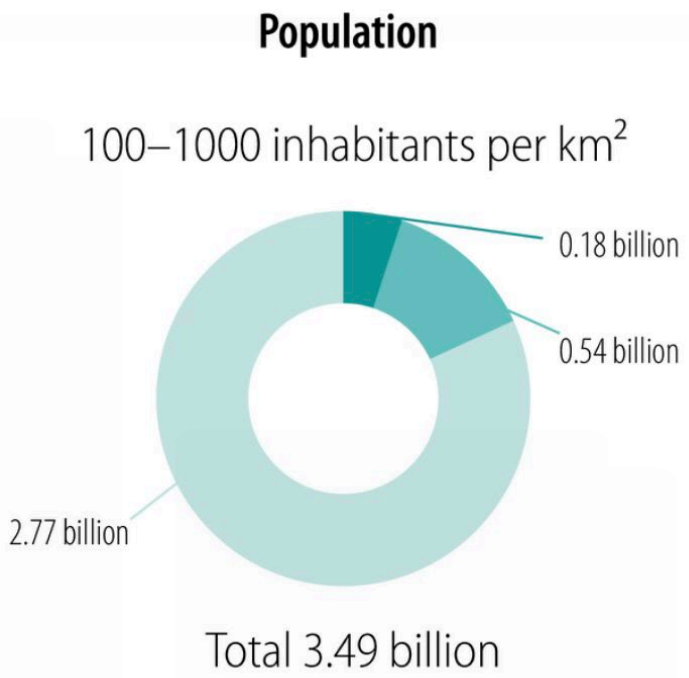
Energy Minerals: New Supplier Dependencies

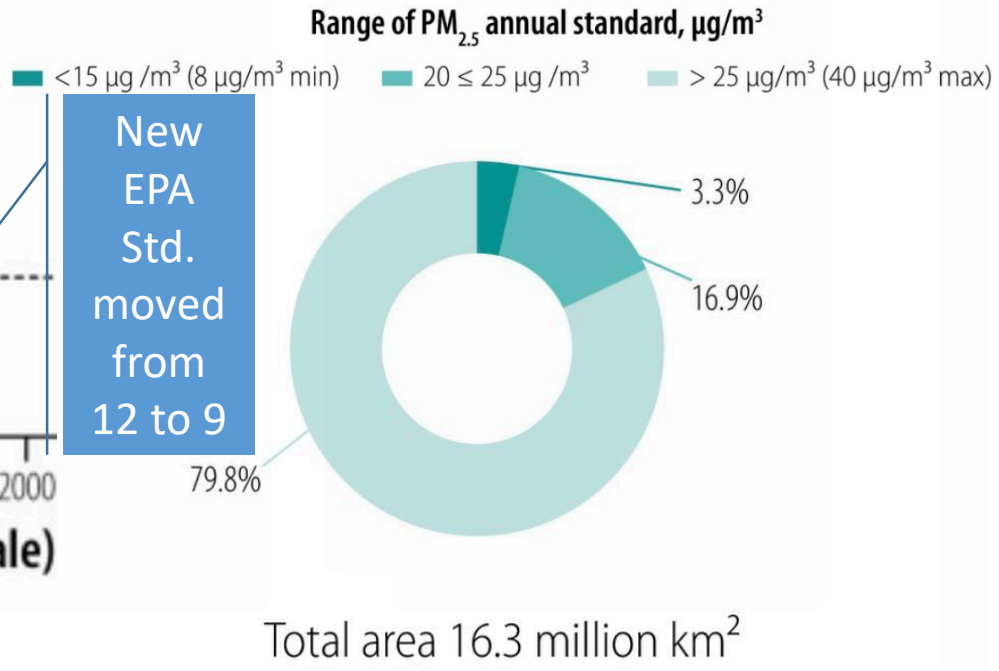


Source: Mark Mills, Manhattan Institute; IEA

SOURCE: ***Air Quality Standards for the Concentration of Particulate Matter 2.5, Global Descriptive Analysis*** Nazarenko, Pal, & Ariya (December 2020)

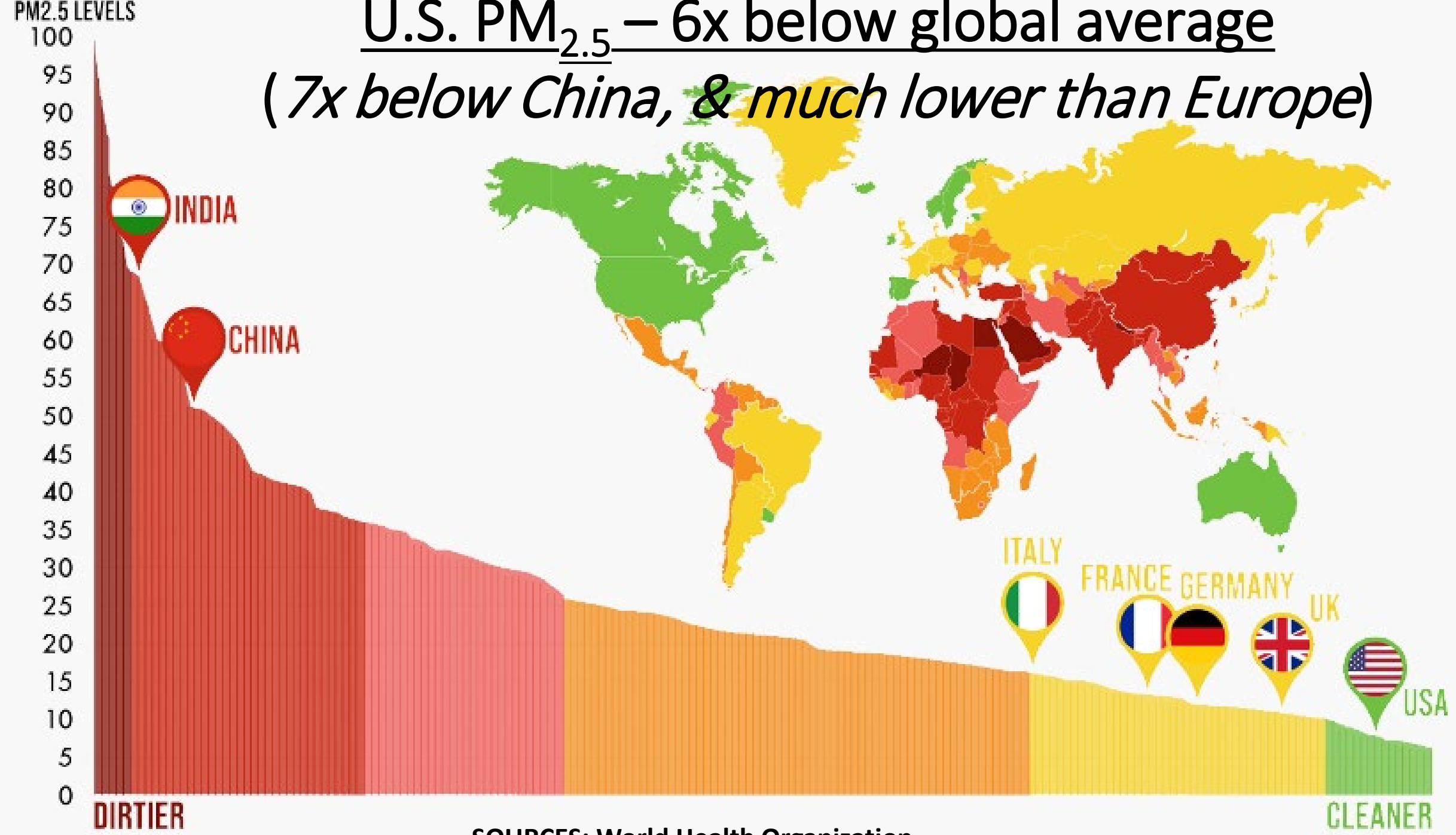






U.S. $PM_{2.5}$ – 6x below global average

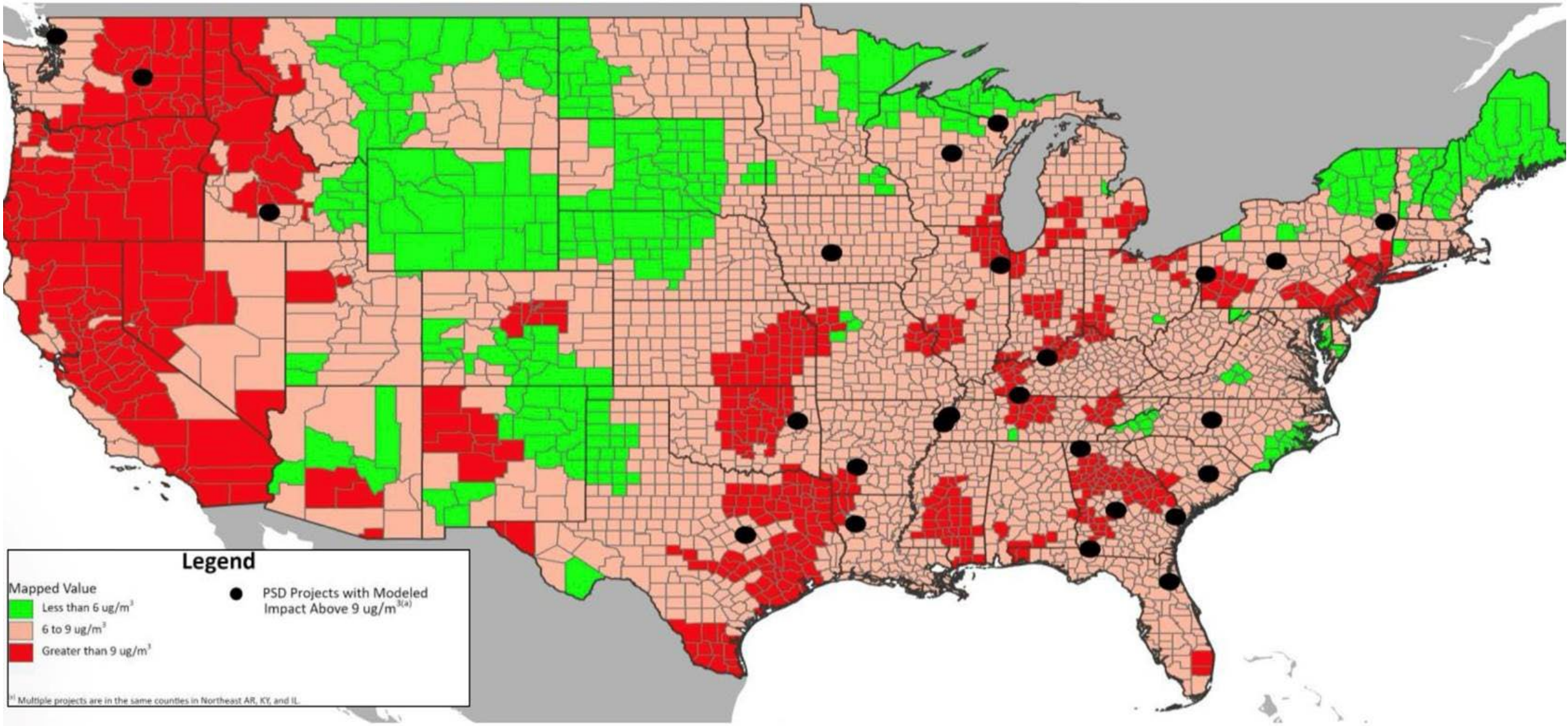
(*7x below China, & much lower than Europe*)



SOURCES: World Health Organization.

Many Future New or Expanded Manufacturing Projects Unachievable in Red and Pink Areas Immediately

Includes Location of 28 Recent PSD Projects That Would Now Fail Under the 9.0 µg/m^3 $PM_{2.5}$ NAAQS



Map shows the interpolated $PM_{2.5}$ annual design values for 2020-2022 by county. Each county with a monitor was included and the counties were designated as above or below the $PM_{2.5}$ NAAQS of 9 ug/m^3. If a design value was not available for a specific county, Alpine Geophysics used a kriging interpolation method to estimat e the $PM_{2.5}$ concentration in a county. Counties with values less than 6 ug/m^3 are highlighted in green because a typical project needs 3 ug/m ^{3} of headroom between the background and the NAAQS to allow for a successful modeling demonstration.

Jackson Walker LLP

QUESTIONS?

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