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NFiP Nasjonal forskerskole i petroleumsfag
Petroleum Research School of Norway

NorTex Petroleum Cluster

The Research Council of Norway

COLORADO SCHOOL OF MINES

The Payne Institute for Public Policy
COLORADO SCHOOL OF MINES
EARTH • ENERGY • ENVIRONMENT

North American Projects and Policy Landscape

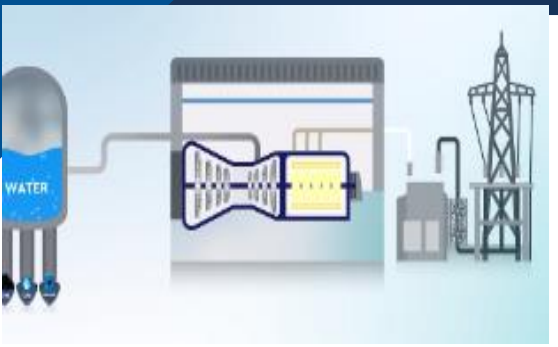
vs.

Energy Needs in Undeveloped Countries

Mike Nasi
Partner, Jackson Walker LLP

Whole Value Chain CCUS Conference
November 14, 2022

PRESENTATION OUTLINE



PART I
Imperative of Addressing Energy Poverty

PART II
Domestic Grid Reliability Reality Check

PART III
Financial & Regulatory Incentives

PART IV
Geopolitical Reality Check

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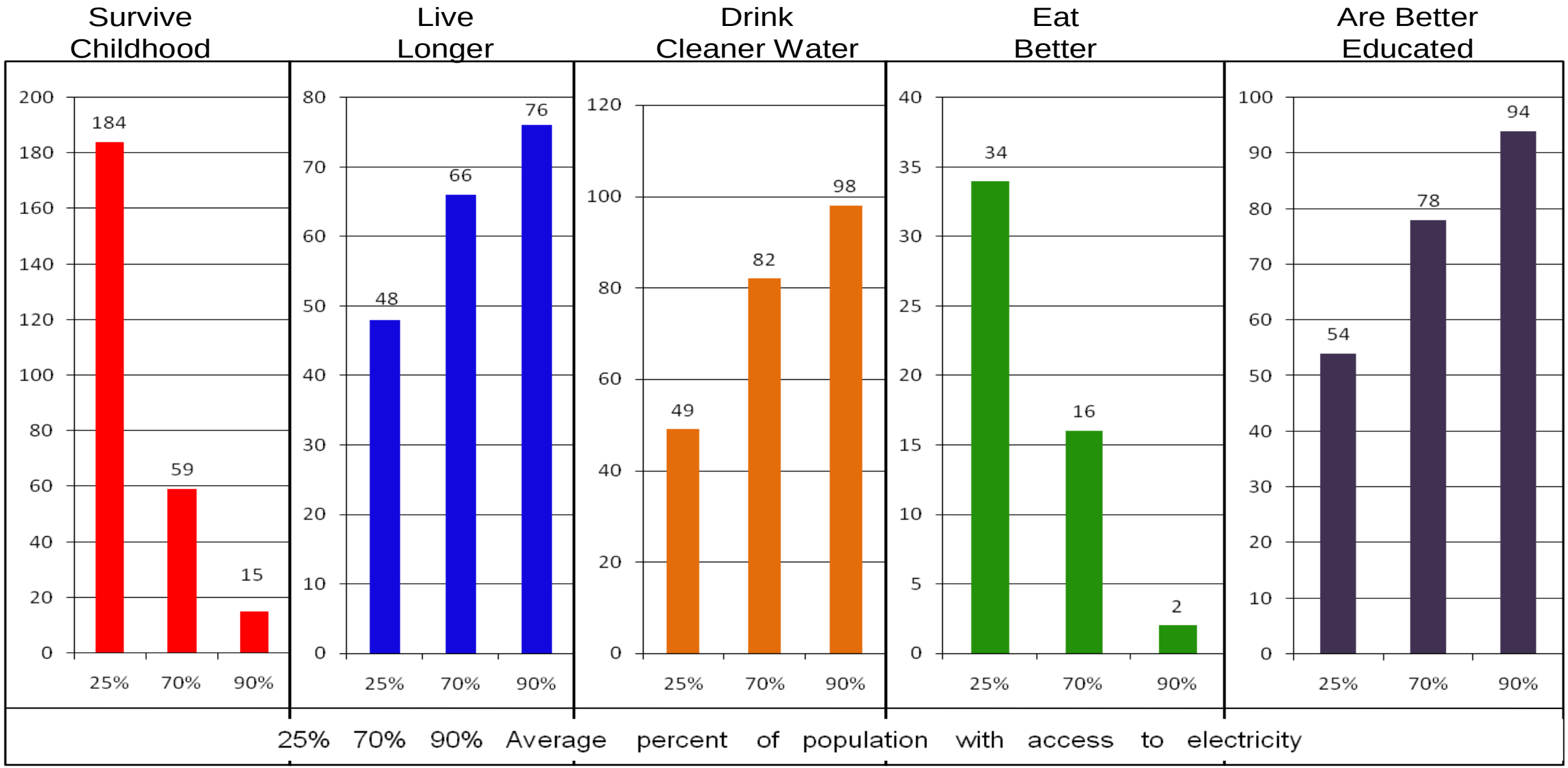
PART I

Why Global Funding & Deployment of CCUS in the Developing World is Essential to any Moral (or Practical) Carbon Mitigation Strategy

People in Societies with Greater Access to Electricity:



Under Five Death Rate/1000

Life Expectancy (years)

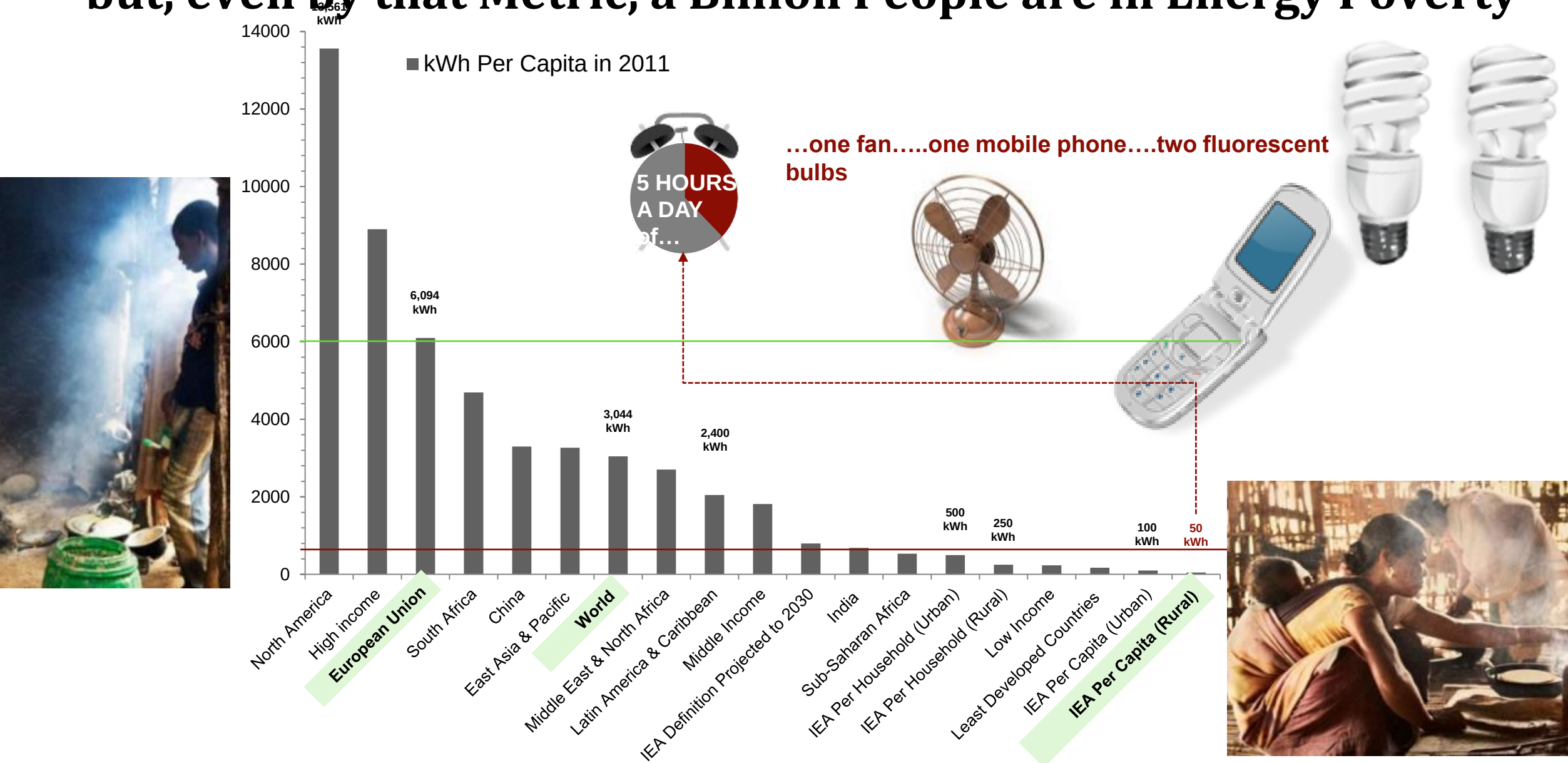
Access to Improved Sources (%)

Under Nourished (%)

Literacy Rate (%)

Source: Dr. Frank Clemente
Penn State Univ.

IEA Defines Adequate Access Well Below a Level You Would Accept, but, even by that Metric, a Billion People are in Energy Poverty



(a) Women and young children receive the highest exposure because they spend the most time in or near the

The World We Don't Want

IEA Projects Electricity Poverty Will Prevail with Billions still Suffering for Decades

Country/Region	No Access to Electricity in 2030 (millions)	No Access to Clean Cooking Facilities in 2030 (millions)
Africa	645	879
India	147	730
China	----	241
Other Developing Asia	177	611
Rest of World	----	63
Total	969	2,524

"This is an alarming picture of what the future might look like, and one which the global community must work together to counter" (International Energy Agency)

Advocates Arguing for a "Perfect World" Should Start Caring About the People Who Live In This One

1.3 Billion people have no electricity

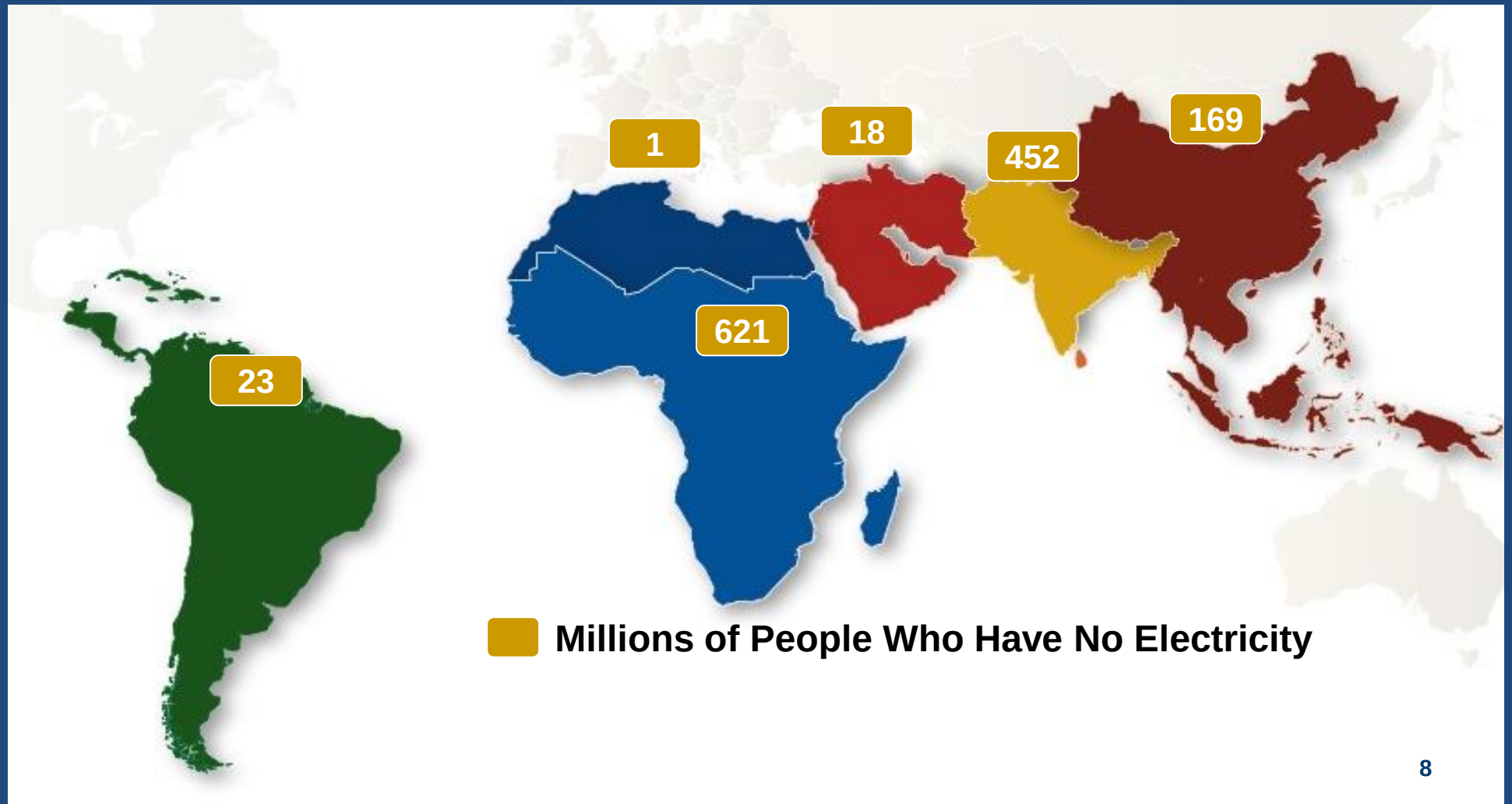
2.4 Billion live on less than $2 a day

3.8 Million die annually from household air pollution

Land degradation, erosion from gathering fuel wood

WHAT WE HAVE DONE & WHAT WE STILL MUST DO

- Over Last 20 Years, 830 Million Get their First Electricity
- 1 Billion Still Living with **no** Access to Affordable or Reliable Electricity



Energy Deprivation is an Immoral Climate Policy

- It is immoral for the developed world to withhold funding due to anti-fossil fuel ideology when doing so deprives hundreds of millions of our fellow global citizens access to affordable & reliable energy.
- According to the IPCC, carbon capture utilization & storage (CCUS) technology is essential to every decarbonization scenario that does not deprive the developing world the opportunity to energize.
- The world needs CCUS technology, not anti-fossil fuel ideology.

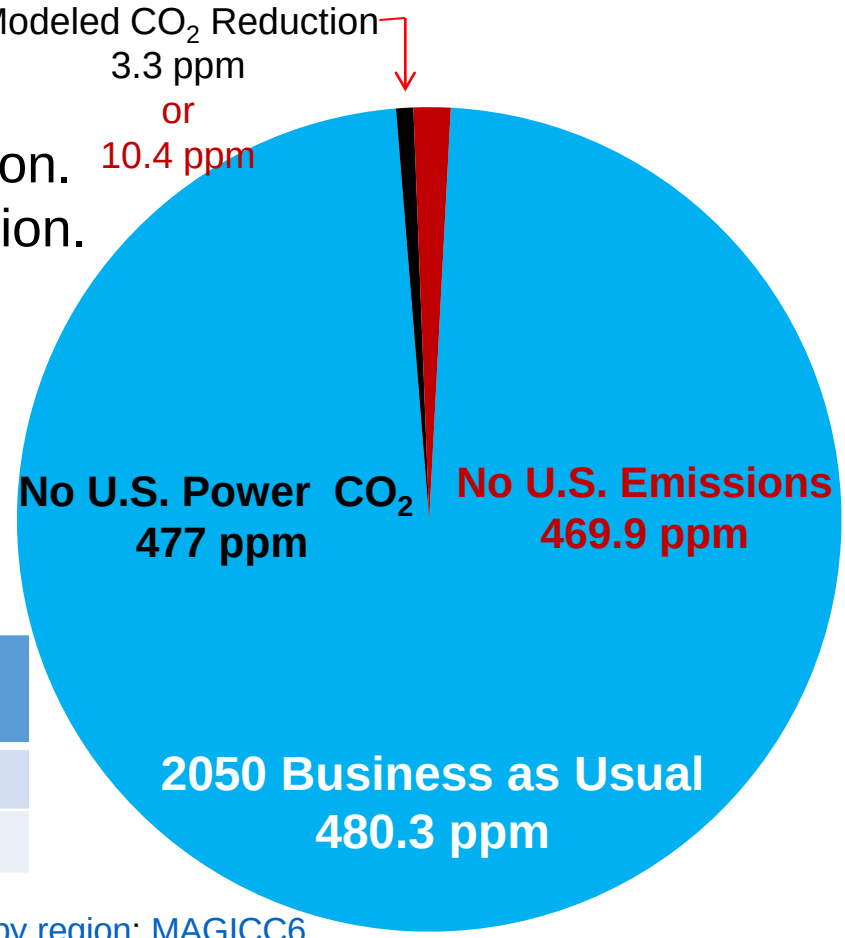
US DECARBONIZATION WON'T SAVE THE WORLD - DRIVING DOWN CCUS COST FOR GLOBAL DEPLOYMENT WILL MATTER MUCH MORE

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.

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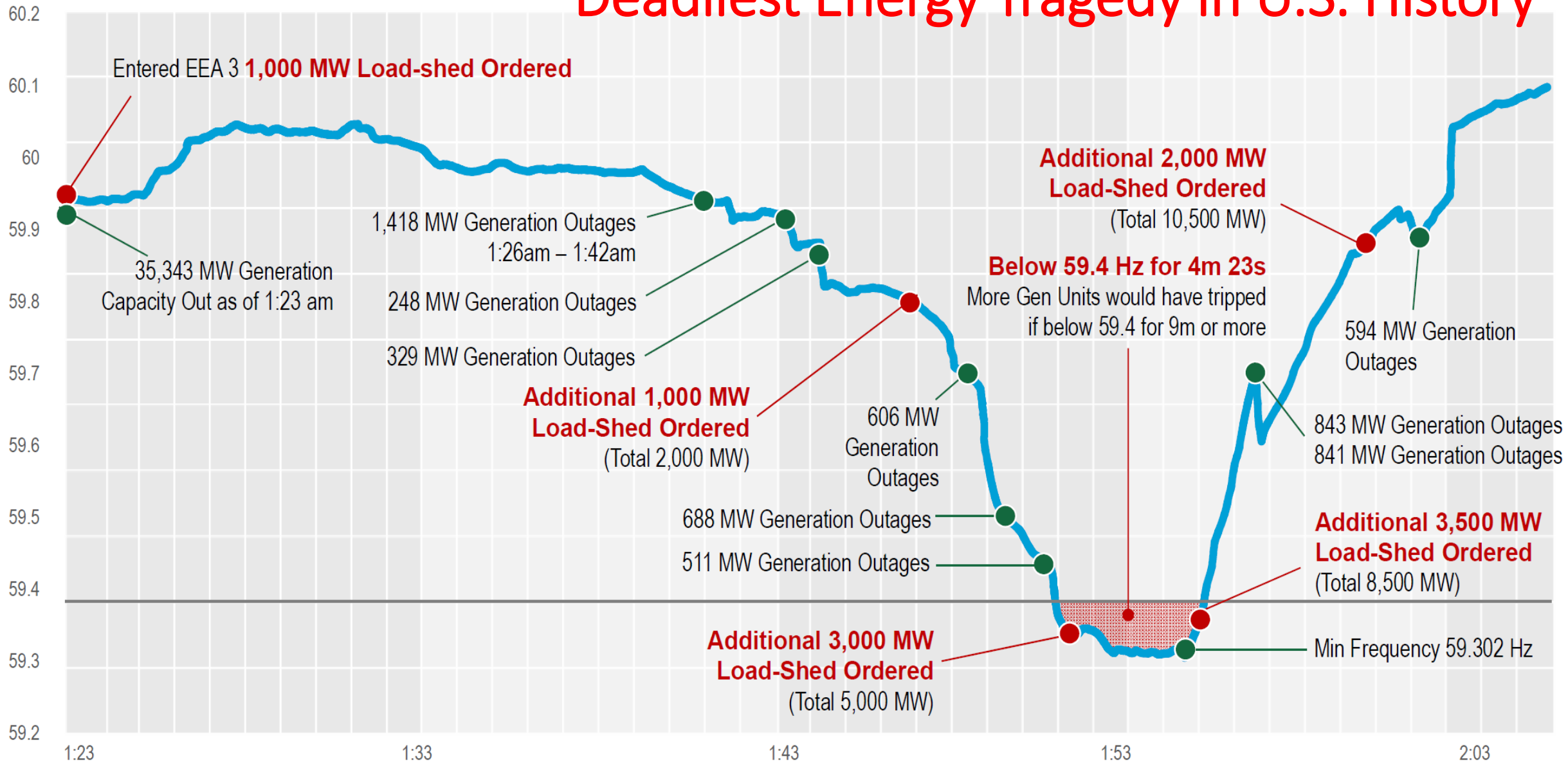
PART II

Domestic Grid Reliability & Resilience Reality Check

LEST WE FORGET: Texas was 4.5 minutes away from the Deadliest Energy Tragedy in U.S. History

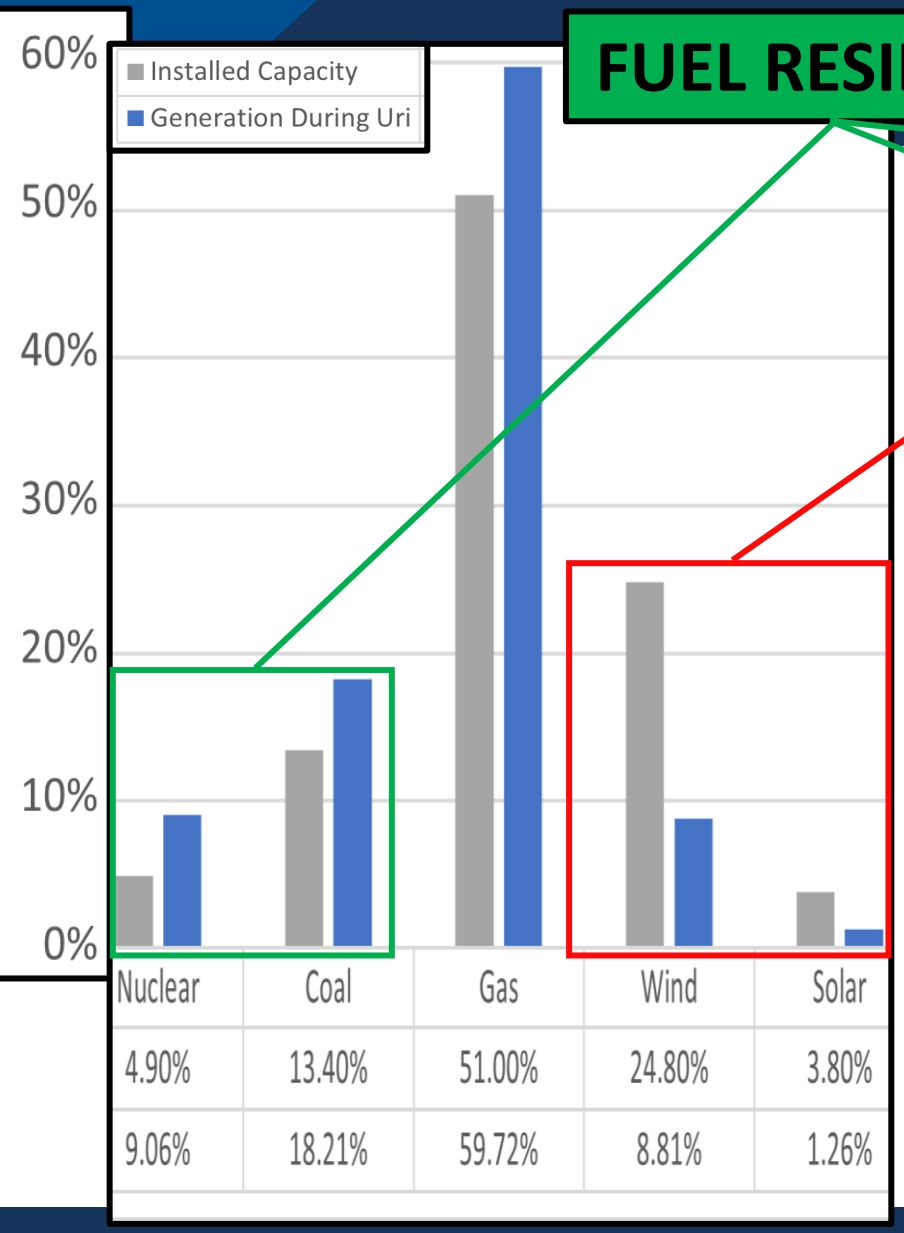


COAL IS ESSENTIAL TO GRID RESILIENCE

CASE STUDY: *STORM URI*

FUEL RESILIENT

WEATHER-DEPENDENT



	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%

ERCOT

	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%

MISO

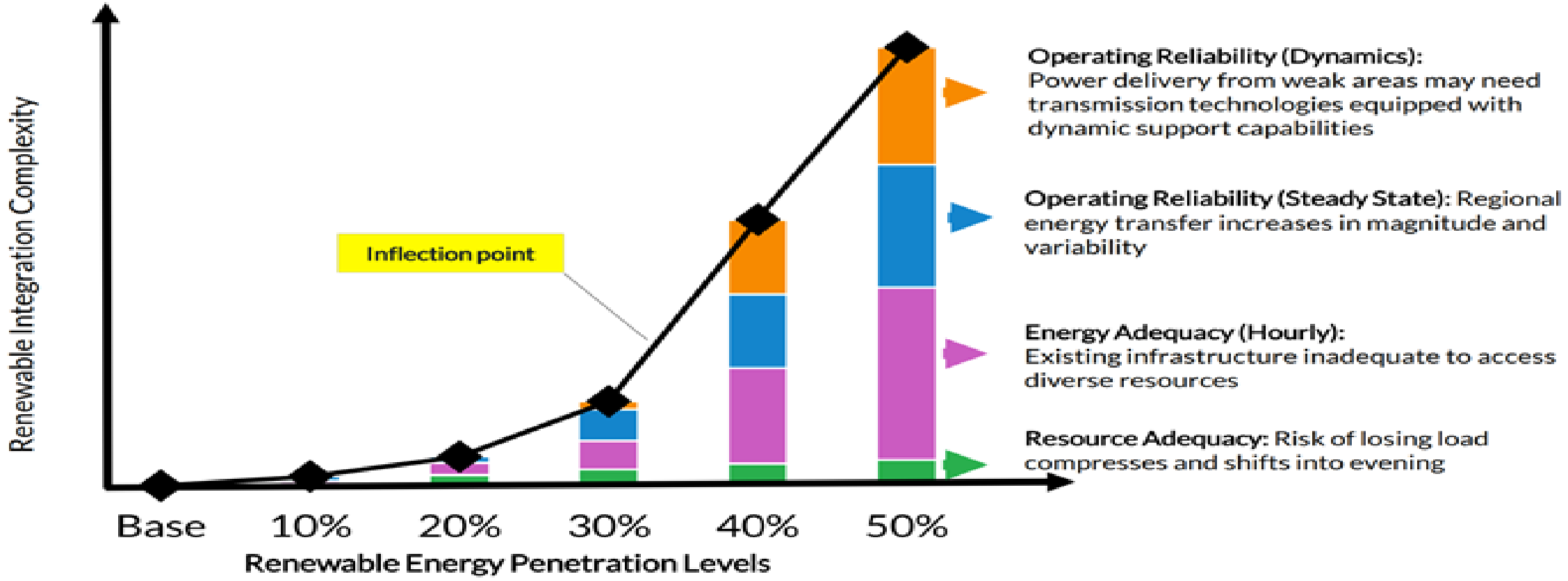
	Nuclear	Coal	Gas	Wind
Installed Capacity	2.20%	24.30%	38.9%	29.0%
Generation During Uri	5.67%	46.22%	35.77%	8.80%

SPP

MISO Concerns = ERCOT Harsh Reality

-Renewable Penetration > 33% Causes Problems

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



Plains CO_2 Reduction (PCOR) Partnership

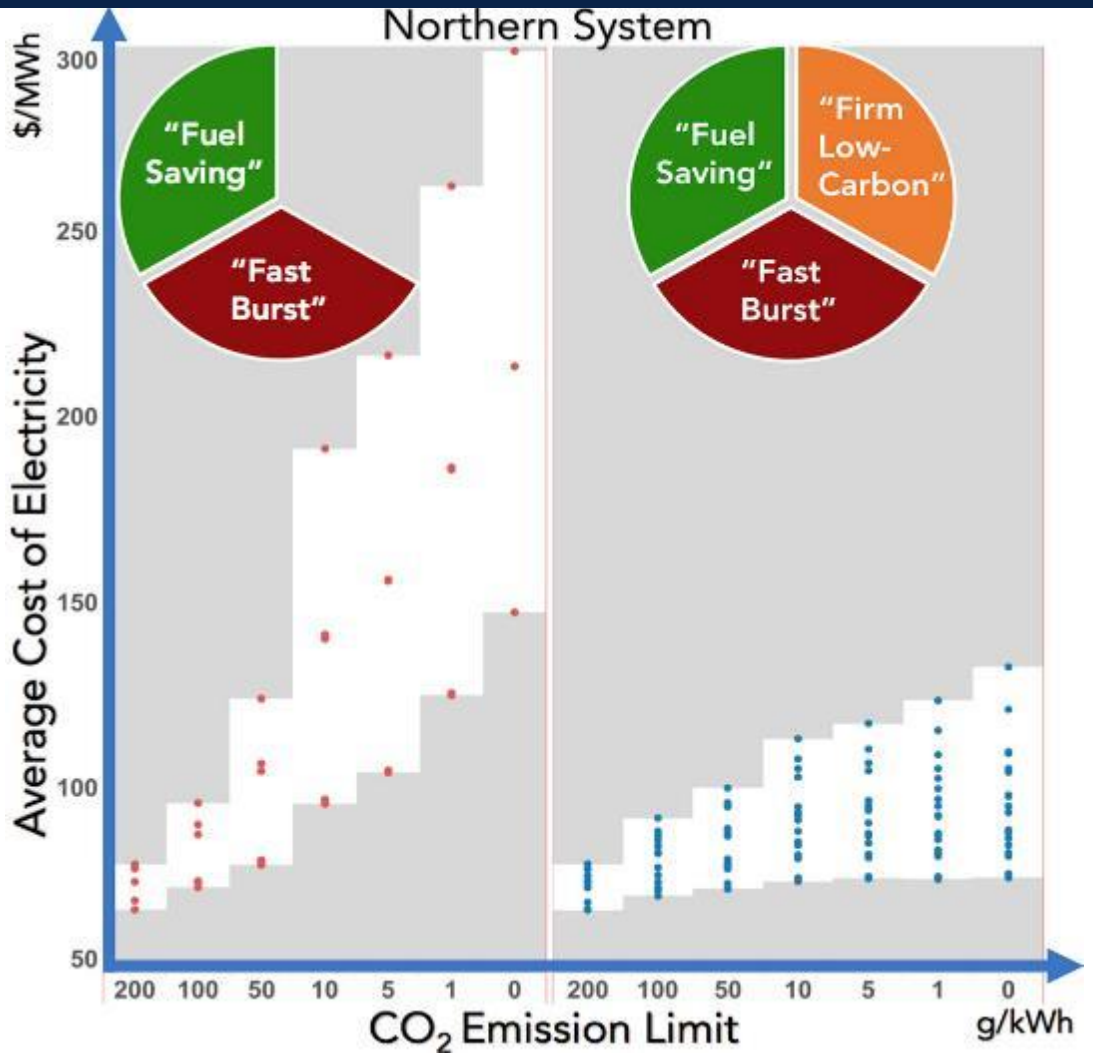
Energy & Environmental Research Center (EERC)

NEW COMPREHENSIVE FORENSIC ANALYSIS OF GRID IMPACTS FROM WINTER STORM URI

NATIONAL ENERGY TECHNOLOGY LABORATORY

MIT Study Shows Exponential Cost-Escalation if We Attempt Carbon Mitigation Without Large-Scale Carbon Capture on Fossil Fleet

Without these [firm] resources, electricity costs rise rapidly as CO2 limits approach zero. Batteries and demand flexibility do not substitute for firm resources – Sepulveda et al.



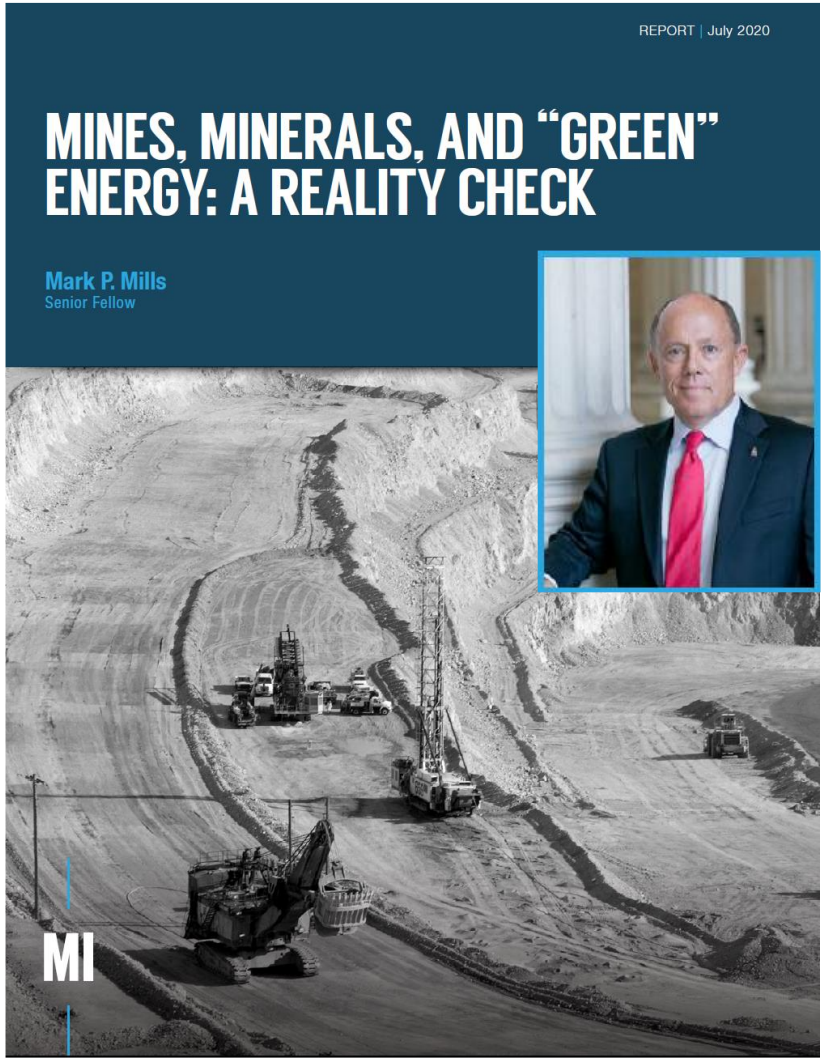
Source: Sepulveda et al, *Joule* 2(11), 2018, 2403-2420
https://doi.org/10.1016/j.joule.2018.08.006

Critical Material Realities

ESSENTIAL READING

1. **To Provide a Month's Battery Backup for JUST ONE Coal Plant Would Require Roughly all the Lithium that is Currently Mined in the ENTIRE WORLD per year.**
   - ✓ *512.5 GWh of electricity to replace*
   - ✓ *160 metric tons of lithium/GWh of battery storage*
   - ✓ *= 82,000 metric tons of lithium, which is equivalent to current global production/yr*

2. **To Realize the "Dream" of 100% Renewable in ERCOT by 2035, to Build Enough Battery Storage to Backup Wind & Solar for Just One Day, a 100 MW/400 MWh Battery Would Have to be Built EVERY TWO DAYS Between Now and 2035 (which would take OVER TWICE THE CURRENT GLOBAL ANNUAL LITHIUM PRODUCTION).**
   - ✓ *1,000 GWh of electricity to replace (83 GWh/yr per year for 12 years)*
   - ✓ *160 metric tons of lithium needed per GWh of battery storage*
   - ✓ *= 160,000 metric tons of lithium (2x current global production/yr [82,000 tons])*



Factors That Regulators Should Address When Comparing CCUS & Renewable Energy

WIND/SOLAR/STORAGE	KEY CONSIDERATIONS	CCUS RETROFIT
• Low Capacity Factors • Transmission Additions • Reliability & Resilience Penalty	**LCOE is an Academic Discussion - Focus Should be on "Levelized Cost of Dispatchable & Delivered Energy (LCODDE)"**	• High Capacity Factors • No New Transmission • High Reliability & Resilience • Flexibility of carbon capture machine slip stream management - capable of demand response.
• Bird Strikes • Habitat Destruction • Lithium/Cobalt Mining for Batteries • Rare Earths for Turbines & Solar	**Non-GHG Externalities**	• Air Quality Not Impacted < Known "Safe" Levels (NAAQS) • Successful & Established Coal Reclamation Programs
• Backup Power Emissions • Life-Cycle GHGs From Construction & Land Use • Missed R&D opportunity	**GHG Externalities**	• No Backup Power Required – (24/7 carbon-free resource) • R&D Drives Down Future Costs (global game changer)
• Dependence on Minerals & Products Not Mined/Made in US	**Economic Impact & Geopolitical**	• Domestic fuels (coal & gas) + export commodity (oil & tech)

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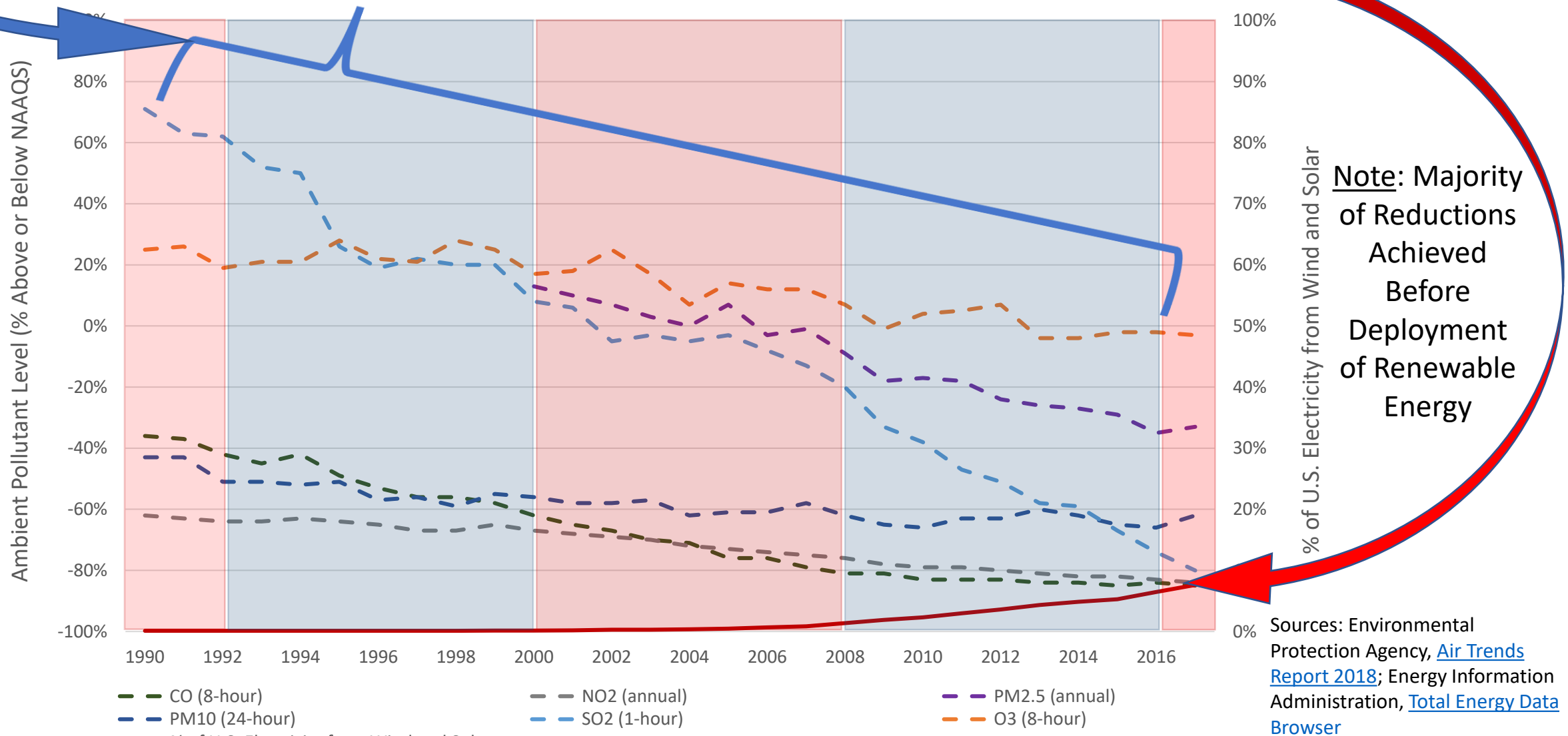
PART III

Financial & Regulatory Incentives & Project Perspectives

CASE IN POINT: The U.S. Made its Air Safe with Technology, Not Anti-Fossil Fuel Ideology



Note: Majority of Reductions Achieved Before Deployment of Renewable Energy

THESE ARE THE POLLUTANTS WE KNOW CAN HURT PEOPLE

Sources: Environmental Protection Agency, Air Trends Report 2018; Energy Information Administration, Total Energy Data Browser

STATE OF PLAY ON FEDERAL TAX CREDITS

The IRA increased 45Q credit values:

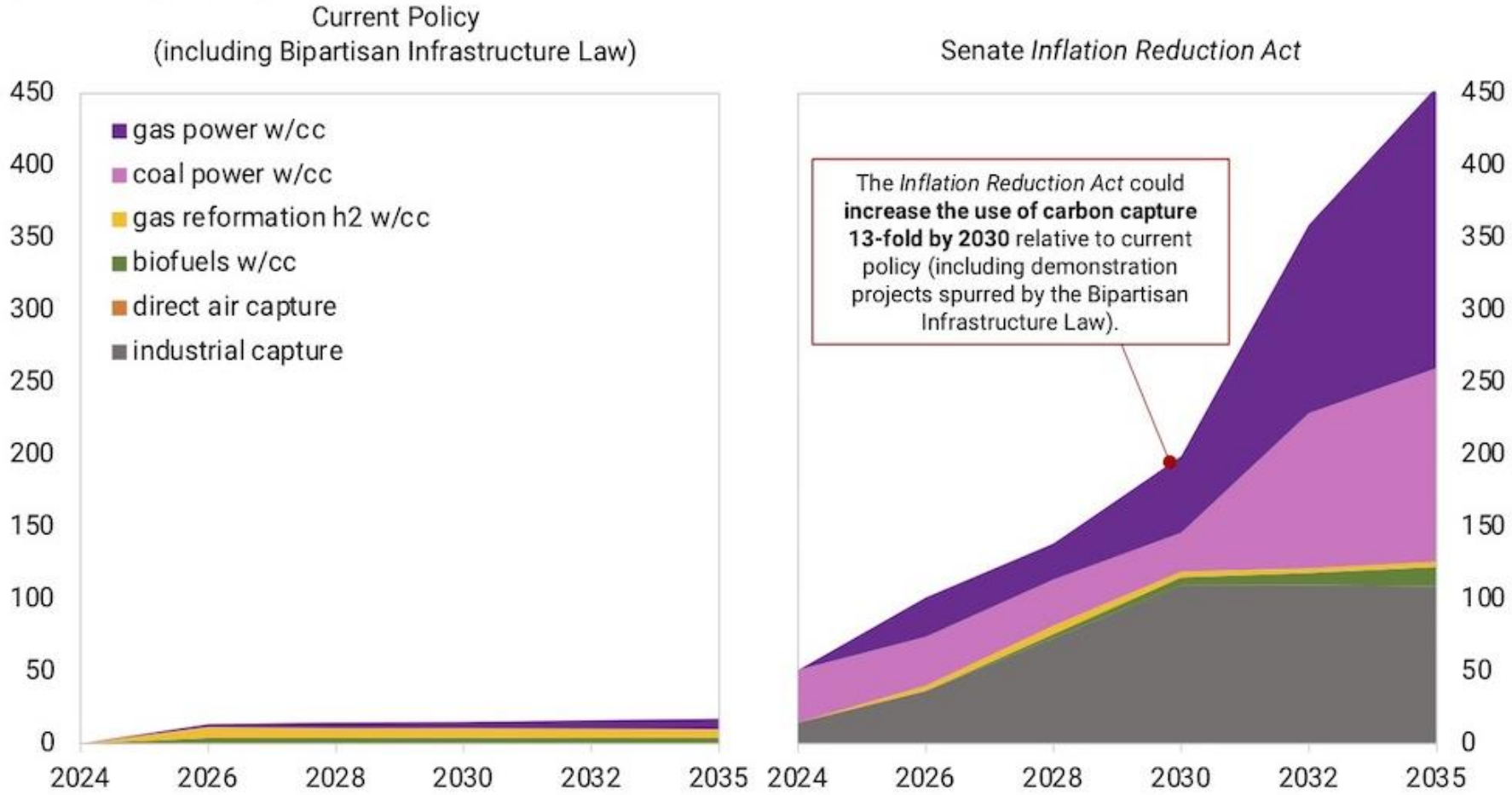
- Saline Storage –
  - Increase from $50 to $85/tonne for CCS on industrial & power sectors.
  - Increase from $50 to $180/tonne for Direct Air capture (DAC).
- Utilization / EOR –
  - Increase from $35 to $60/tonne for CCUS on industrial & power sectors
  - Increase from $50 to $130/tonne for CCUS from DAC.
- Realization: 12 years after the CC equipment is placed in service and will be inflation-adjusted beginning in 2027 and indexed to base year 2025.

Full value realized only if prevailing wage & apprenticeship requirements are met

PROJECTING OUTCOMES RESULTING FROM NEWLY-EXPANDED 45Q TAX CREDIT FOR CCUS

Annual Carbon Dioxide Captured for Transport and Geologic Storage

million tons per year (Mt/y)



Incentives for carbon capture, storage, and use in the *Inflation Reduction Act* would build on demonstration funding in the Bipartisan Infrastructure Law to **make carbon capture a viable economic option** for the most heavily emitting industries, such as steel, cement, and refineries, as well as power generation from coal and natural gas.

The total volume of CO_2 captured for transport and geologic storage across energy and industry could reach **200 million tons per year** by 2030, if sufficient investment in transport networks and storage basins can be deployed.[1]

That includes roughly 110 million tons across industries and 90 million tons in power generation.[2] Modeled results include 6 gigawatts of carbon capture retrofits at existing coal-fired power plants and 18 gigawatts of gas power plants with carbon capture installed by 2030.

1 – Growth in annual CO2 injection capacity in storage basins is likely to constrain the pace of carbon capture deployment. This modeling assume maximum annual CO2 injections increase to 200 Mt CO2/y by 2030 based on expert input and Princeton *Net-Zero America* study.

2 – Industrial CO_2 capture volumes are fixed exogenously based on analysis in Larson et al., 2021, "Capturing the Moment: Carbon Capture in the American Jobs Plan," Rhodium Group, April 2021. Carbon capture in fuels conversion (biofuels, hydrogen, ammonia) and power generation are optimized in RIO modeling, constrained by remaining available annual injection volume limit.

History of Texas CCUS Policy Development

Clean Carbon Technology
FOUNDATION OF TEXAS

2003-04 – Creation of the Clean Coal *(now "Carbon")* Technology Foundation

2005-2006 – First Major CCUS Legislation Passed

- HB 149 (Chisum/Averitt) & – State ownership of FutureGen-injected CO2
- HB 2201 (Hughes/Estes) – Established Texas FutureGen incentives

2007 – Market-Wide CCUS Legislation

- HB 3732 (Hardcastle/Averitt) – initial ACEP incentive package
- SB 1461 (Seliger/Cook) – Additional FutureGen Incentives
- HB 2608 (Hughes/Eltife) – Research funding for CCT using lignite
- HB 2994 (Bonnen/Hegar) – Tax abatement eligibility for IGCC
- HB 1967 (Farabee/Averitt) - eminent domain authority for pipelines

2009 – Significant Expansion/Improvement of Financial Incentives & Carbon Storage Options

- HB 469 (King/Seliger) – expanded ACEP incentives + CEP franchise tax credit
- HB 1796 (Chisum/Watson) – grant program and creation of the Texas Offshore Carbon Repository

2013 – Improved Monetization of Credits & Extension to Natural Gas Power Plant Carbon Capture

- HB 2446 (Crownover/Estes) – made franchise tax credit more valuable (can be monetized) & extended incentives to Natural Gas CCUS projects

2021 – Class VI Primacy

- HB 1284 (Paddie/Hancock): Class VI Primacy to Facilitate Carbon Capture & Storage - Consolidates the jurisdiction over Class VI underground injection control (UIC) wells solely under the Railroad Commission (RRC) & clarifies that the RRC may not issue a Class VI well permit for a previously authorized Class I well and requires Class VI well permit applicants to obtain a letter of determination from TCEQ that the Class VI well will not interfere with existing Class I wells.

“Converting Carbon into a Commodity”

Video

Petra Nova:

(9/23/22 JW White Paper)

Carbon Capture:

- Post-combustion amine solvent
- 92.4% capture of 240 MWe slip stream
- 3-Year Total: 3,904,978 short tons of CO^2

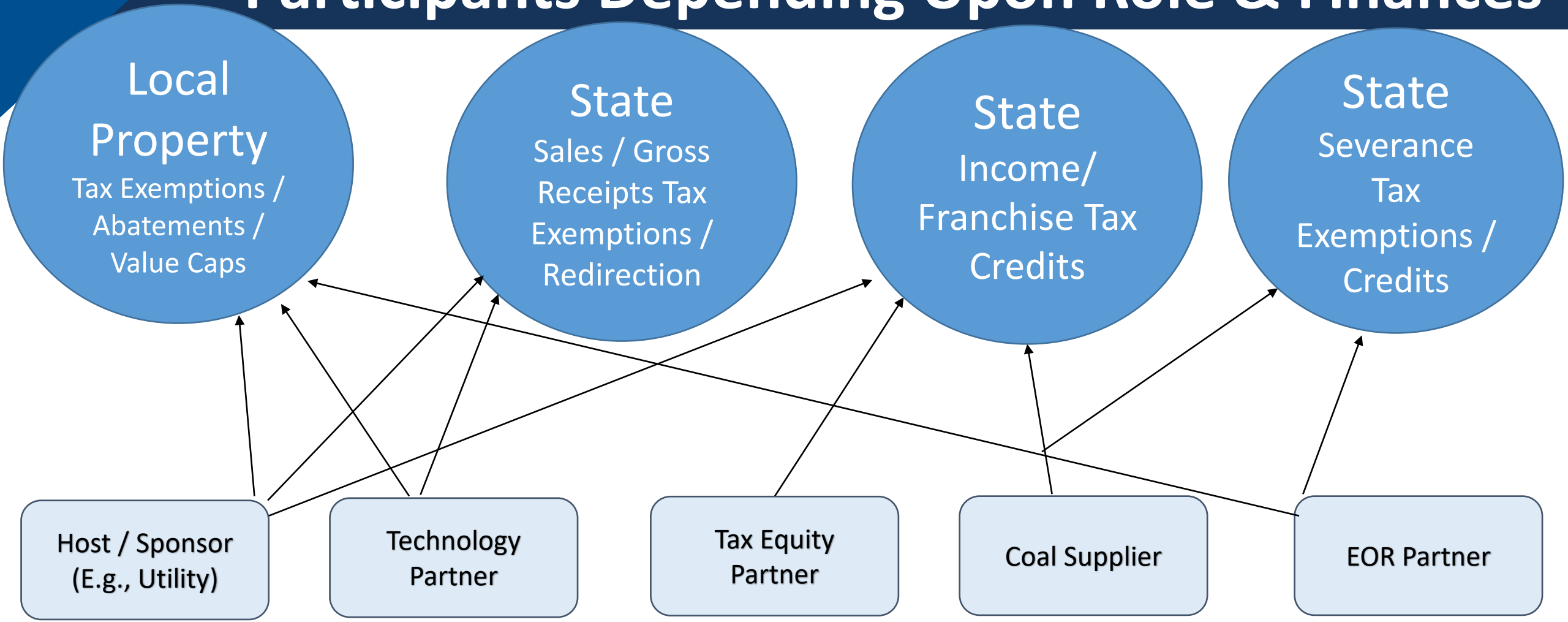
Product Delivery and Utilization:

- CO^2 EOR via 80-mile pipeline
- Successful MVA program documenting permanent storage of CO^2

Reasons for Common Myths About Project

- Dependence on EOR revenue
- Lack of 45Q drove many issues
- Capacity factor confused:
  - Slip stream performance is key
  - Drive costs down through ERS

Value Proposition of Incentives Varies Across Participants Depending Upon Role & Finances



Categories of State Incentives

A. TAX INCENTIVES *(as applicable based on state tax structures)*
   1. Business tax credits
   2. Personal income tax credits
   3. Local property tax abatements
   4. Sales & gross receipts tax exemptions
   5. Severance tax exemption for oil produced using manmade CO2

B. REGULATORY & LIABILITY MANAGEMENT INCENTIVES
   A. Environmental Permitting & Liability (Air, Water, and UIC Wells)
   B. Utility Certainty (Prudence Reviews, Portfolio Standards, & IRP Reforms)
   C. Oil & Gas (Class 2 UIC Permitting & Unitization)
   D. Pore space and stored CO2 ownership
      - *English Rule, American Rule, or State/Federal Ownership*

Local Property Tax Exemptions/Abatements/Value Caps

- Significant economic value here ($80-200MM+ per plant)
- Clarify that CCUS-EOR network qualifies as tax-exempt under existing programs (“pollution control property”)
- If non-exempt, facilitate abatements of, value caps on, and/or increment financing of local property taxes
- Locally-controlled and relatively state budget-proof

State Sales & Gross Receipts Tax Exemptions

Sales Tax Exemption

- Clarify sales tax-exempt status of carbon capture, transportation & injection equipment relating to anthropogenic “emission” source

Gross Receipts Tax Exemption/Redirection

- Permanent exemption from *(or redirection of)* gross receipts & similar taxes

State Sales & Gross Receipts Tax Exemptions

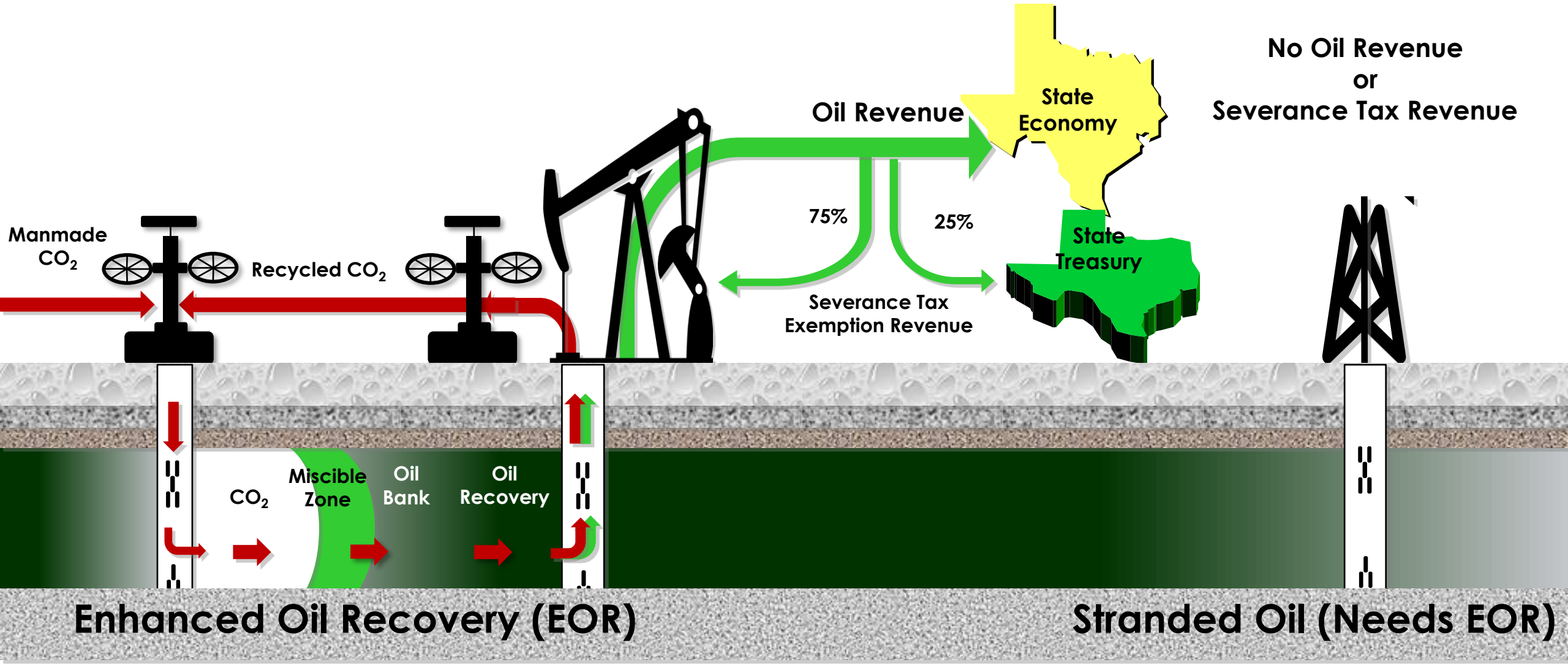
Corporate Income / Franchise Tax Credit Programs

- New & retrofit projects meeting defined “gatekeeper” emission criteria (% CO2, PM, SO2, Nox, etc…)
- Ensure it can be monetized *(multi-year & assignable)*
- Fuel & technology neutral so natural gas and pre and post-combustion carbon capture projects are covered

Severance Tax Exemptions *(or redirection/credits)*

- Coal
- Oil & Gas

SEVERANCE TAX EXEMPTIONS EXPLAINED (TX)



Regulatory Incentives -Environmental

Time-Certain Air & Water/Water Quality Permitting

- Cap/refine time for processing of state & delegated federal permits

Underground Injection and Control (UIC) -

- Class VI Primacy is key (and Class II-to-VI transition for EOR)

Regulatory treatment of CO_2 in the EOR Context-

- NOT a “waste” or “pollutant” (sold and used as a product)
- Relevance to air, water, & waste programs

Utility Regulatory Incentives – Regulated Market Examples

WY HF 159 (Stick)

- "Good faith offer for sale" as prerequisite to retirement

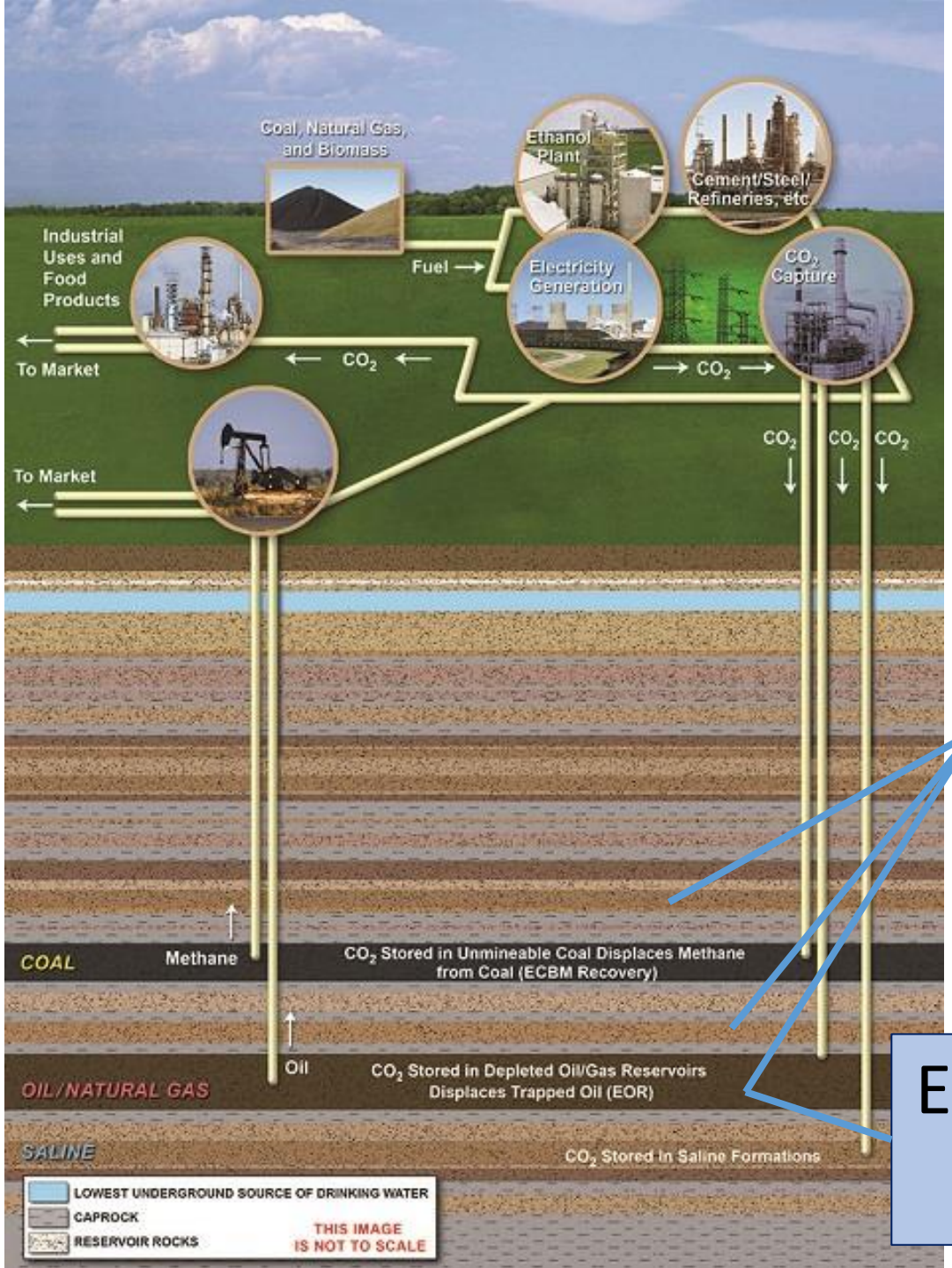
WY HF 200 (Carrots and Sticks)

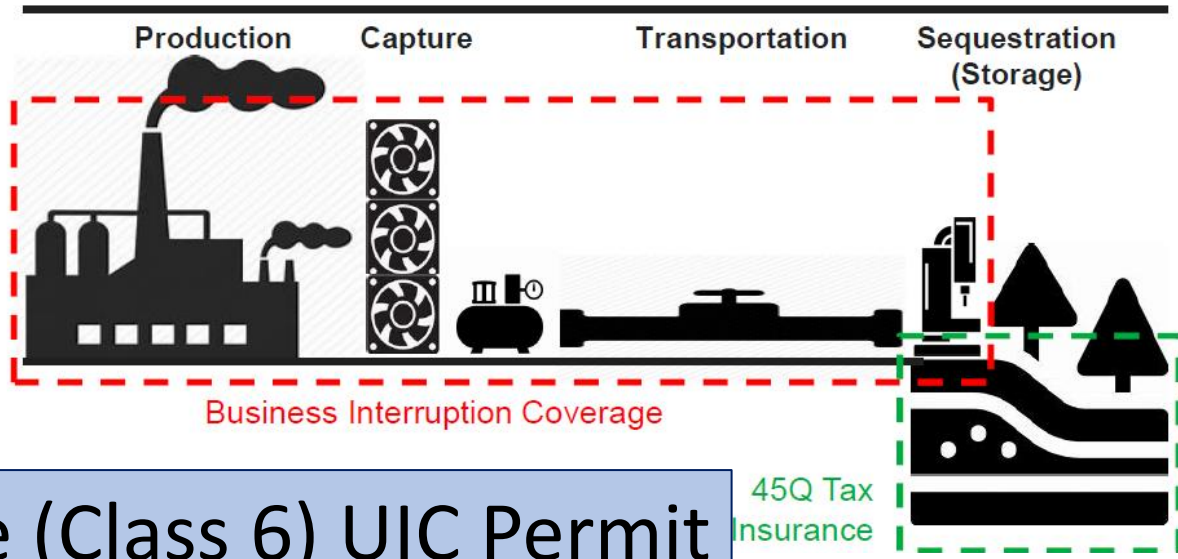
- Mandatory CCUS evaluation in IRPs
- CCUS Portfolio Standard - compliance as prerequisite to accelerated depreciation for coal plant retirement and/or cost recovery for replacement power
- Innovative Ratemaking to (1) enable IOUs to "earn" outside of rate-base and (2) allow large loads to aggregate behind the meter

Utility Regulatory Incentives – Deregulated Market Ideas

- Capacity payments (or other resilience/reliability product payment)
- Winter firm fuel/storage product
- CCUS as part of “clean energy” portfolio standards (if already existing)
- Renewable partial firming/balancing power to cover intermittence (short-duration storage + long duration CCUS)
- Categorize carbon capture machine similar to industrial load capable of providing demand response service (partial vs. full slipstream flex)

Given that most rural cooperatives are not “regulated” in either market structure, carrots need to value cooperative investment in carbon-free resilience without imposing regulation





Storage (Class 6) UIC Permit

- Requires a demonstration of financial responsibility during multiple phases.
- Accepted financial assurance include:
  - Trust Funds
  - Surety Bonds
  - Letter of Credit
  - Insurance
  - Other

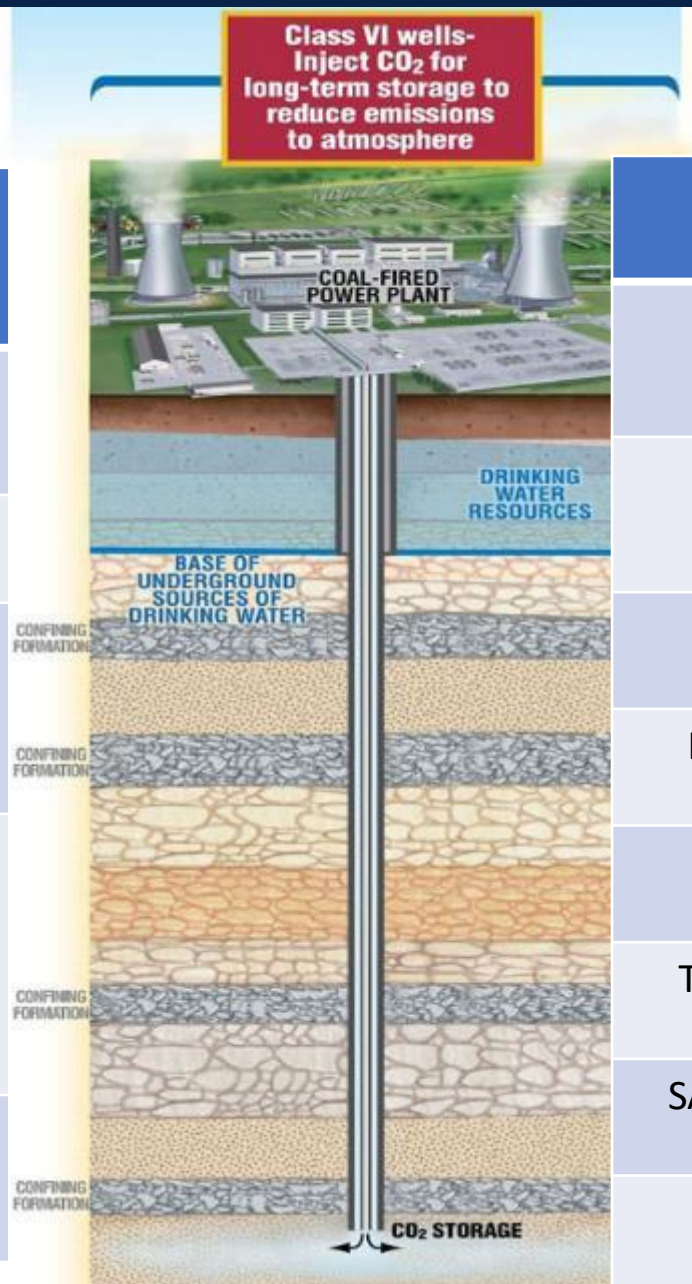
Enhanced Oil Recovery (Class 2) UIC Permit

(involves a “useful product” and begins with Class II Permit)

STATE OF PLAY FOR CLASS VI UIC PERMIT PROGRAMS

CLASS VI PRIMACY

STATE	STATUS
North Dakota	Primacy
Wyoming	Primacy
Louisiana	Application Complete – Under Review
Texas	Application Completeness Determination Pending
Arizona	Pre-Application

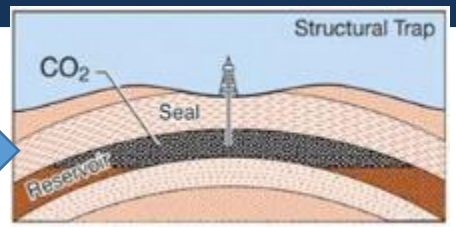


CLASS VI PERMITS

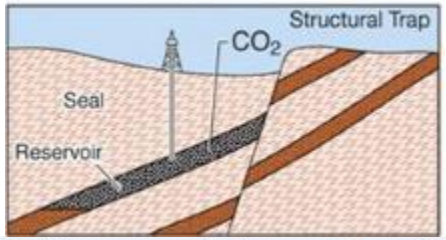
SITE	STATUS	PHASE
ADM (IL)	Issued (1/.3 MMtpy)	Injection & Post-Injection
WABASH (IN)	Admin Complete	Injection
LORAIN (OH)	Admin Complete	Pre-Construction
HACKBERRY (LA)	Admin Complete	Pre-Construction
MENDOTA (CA)	Admin Complete	Pre-Construction
TERRAVAULT (CA)	Admin Complete	Pre-Construction
SAN JOAQUIN (CA)	Admin Complete	Pre-Construction
TUNDRA (ND)	Pending	Pre-Construction

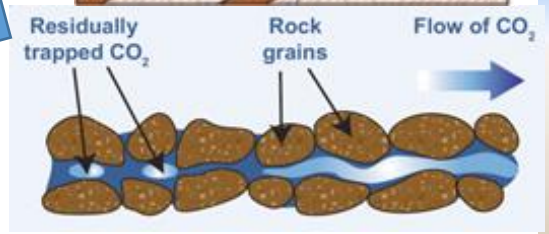
LIABILITY MANAGEMENT - Trapping Mechanisms & Difference Between Surface Gas Volume & Subsurface Supercritical FluidMechanisms

1. Structural

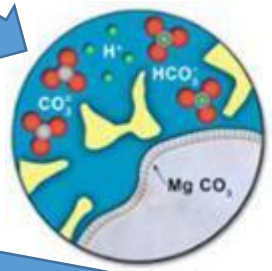


2. Residual

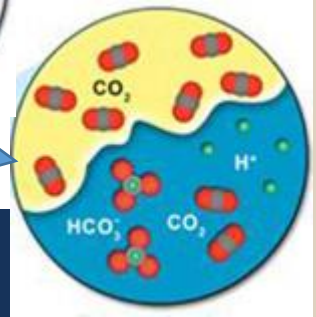


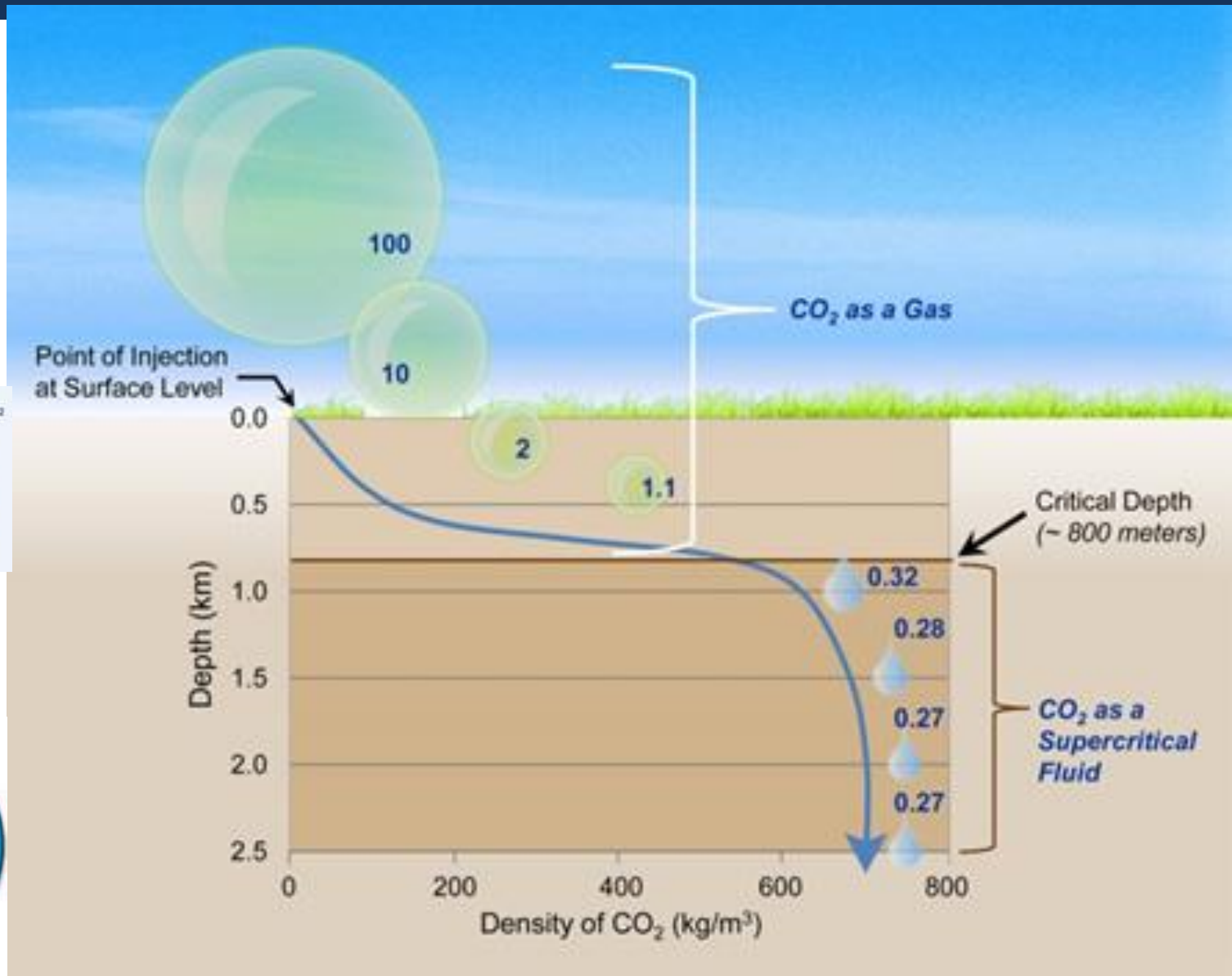


3. Solubility



4. Mineral





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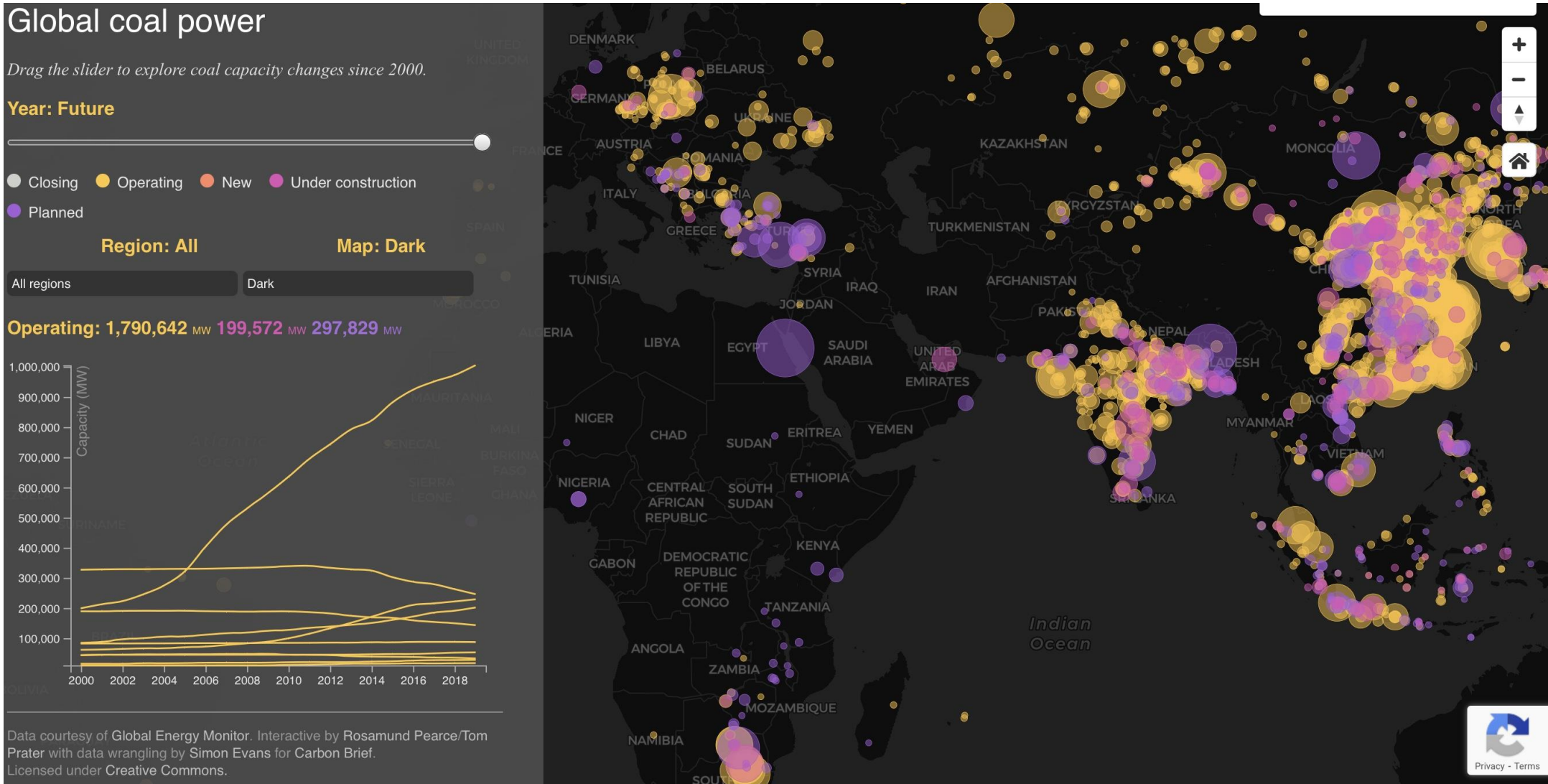
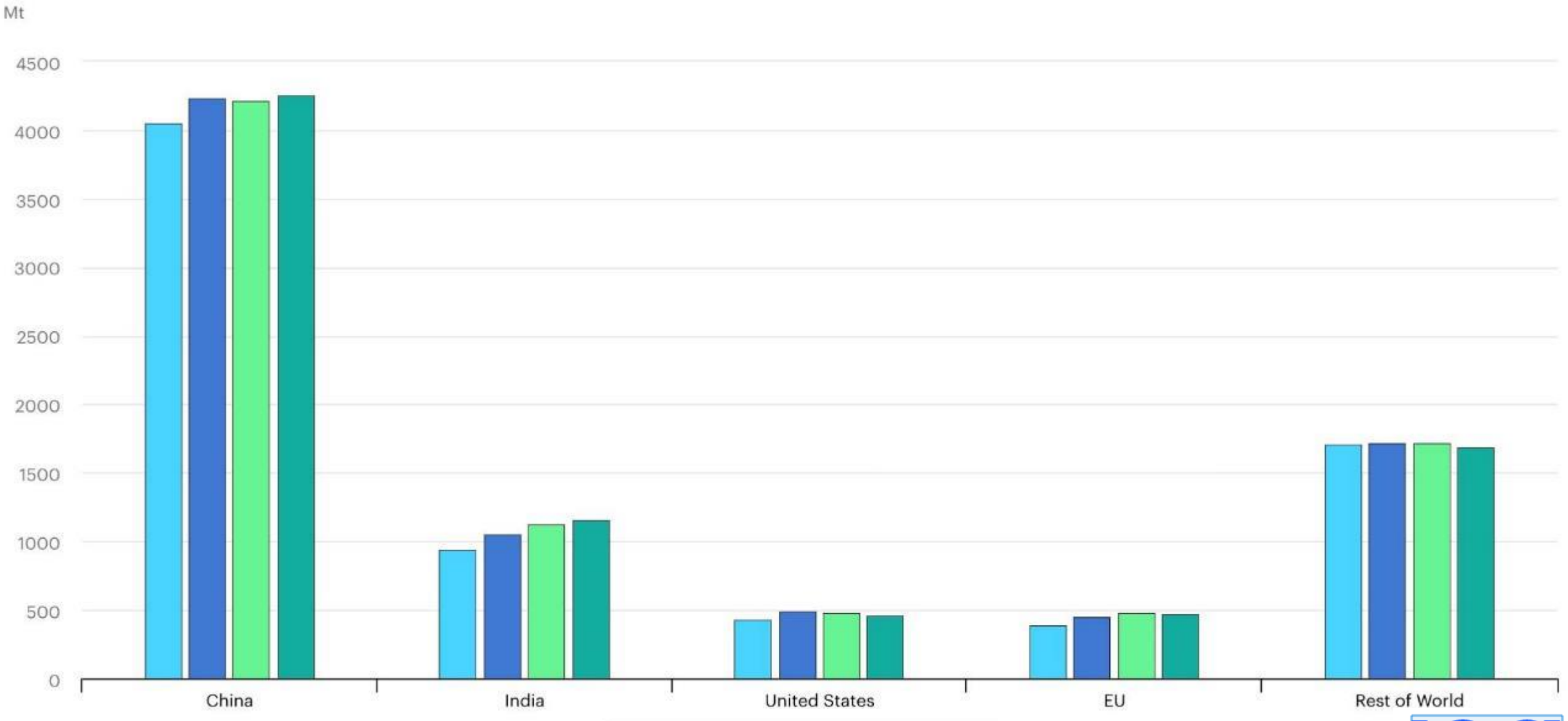
PART IV
Geopolitical Reality Check

Good Internet Tool to Show How the World Continues to Expand Coal Use Despite No Matter What We Do

LINK:
[Mapped: The world's coal power plants in 2020 (carbonbrief.org)]



GLOBAL COAL CONSUMPTION DWARFS THAT OF THE U.S.



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.

Geopolitical Control of Critical Mineral Mining/Processing

	Mining	Processing
Copper	28% Chile; 72% Other	40% China; 60% Other
Nickel	33% Indonesia; 67% Other	35% China; 65% Other
Cobalt	69% Congo; 31% Other	65% China; 35% Other
Rare Earths	60% China; 40% Other	87% China; 13% Other
Lithium	52% Australia; 22% Chile; 26% Other	58% China; 29% Chile; 13% Other

Source: Mark Mills, Manhattan Institute; IEA

Jackson Walker LLP

QUESTIONS?

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