



# **The Low Carbon Role for Coal**

## *Why Carbon Capture Utilization & Storage (CCUS) Must be a Part of Resource Planning*

*NARUC Summer Meeting  
Indianapolis, Indiana  
July 22, 2019*





# The Low Carbon Role for Coal DISCUSSION OUTLINE



- The Difference Between “Safe” and “Clean”
- Carbon Reductions are Not all Created Equal
- Status of and Business Case for CCUS
- CCUS in Resource Planning





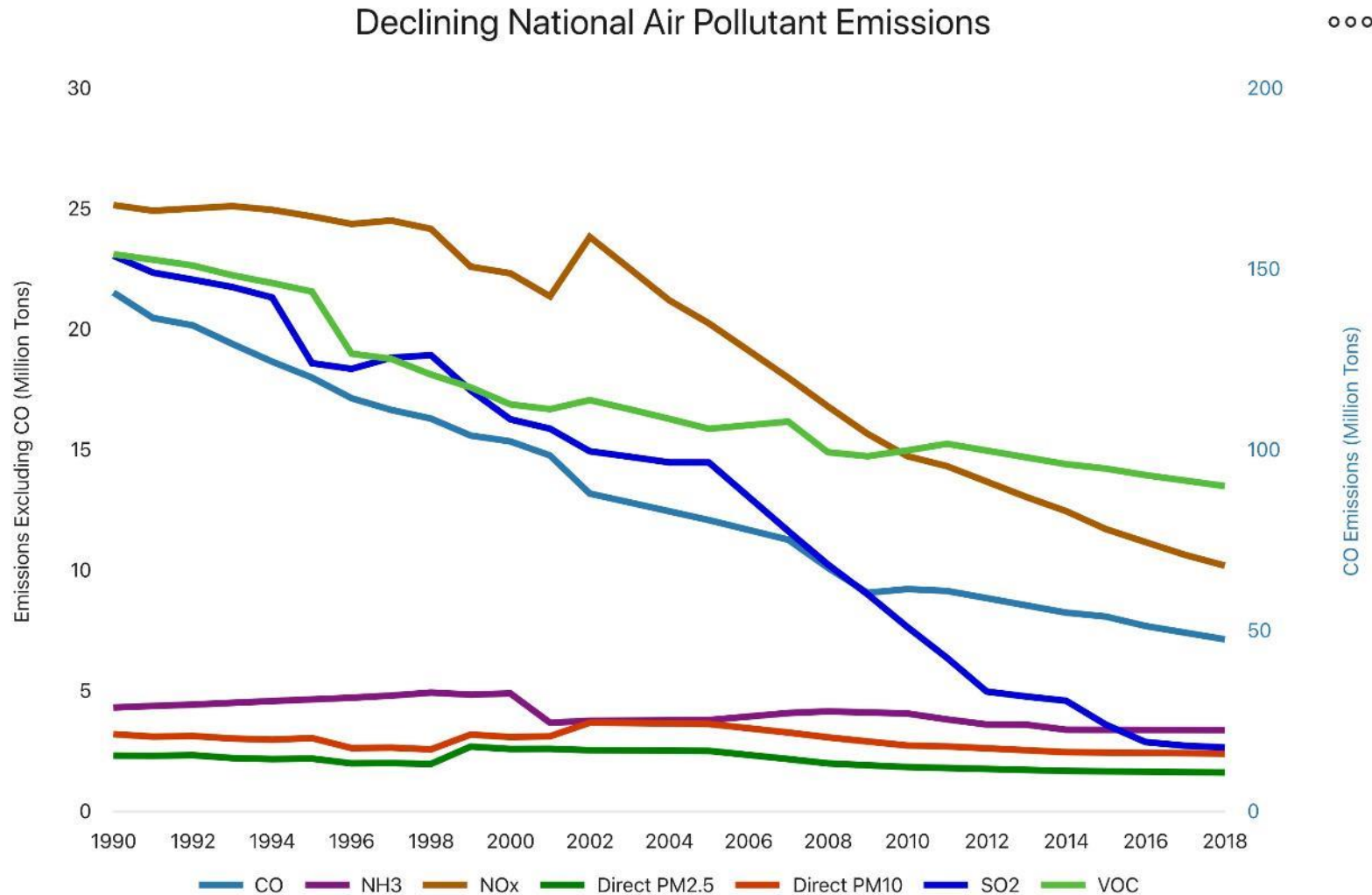
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# Then and Now: 50 Years of Success - *We Internalized the Externalities of Pollution*



Source: U.S. EPA National Emissions Inventory 2014 ver. 2



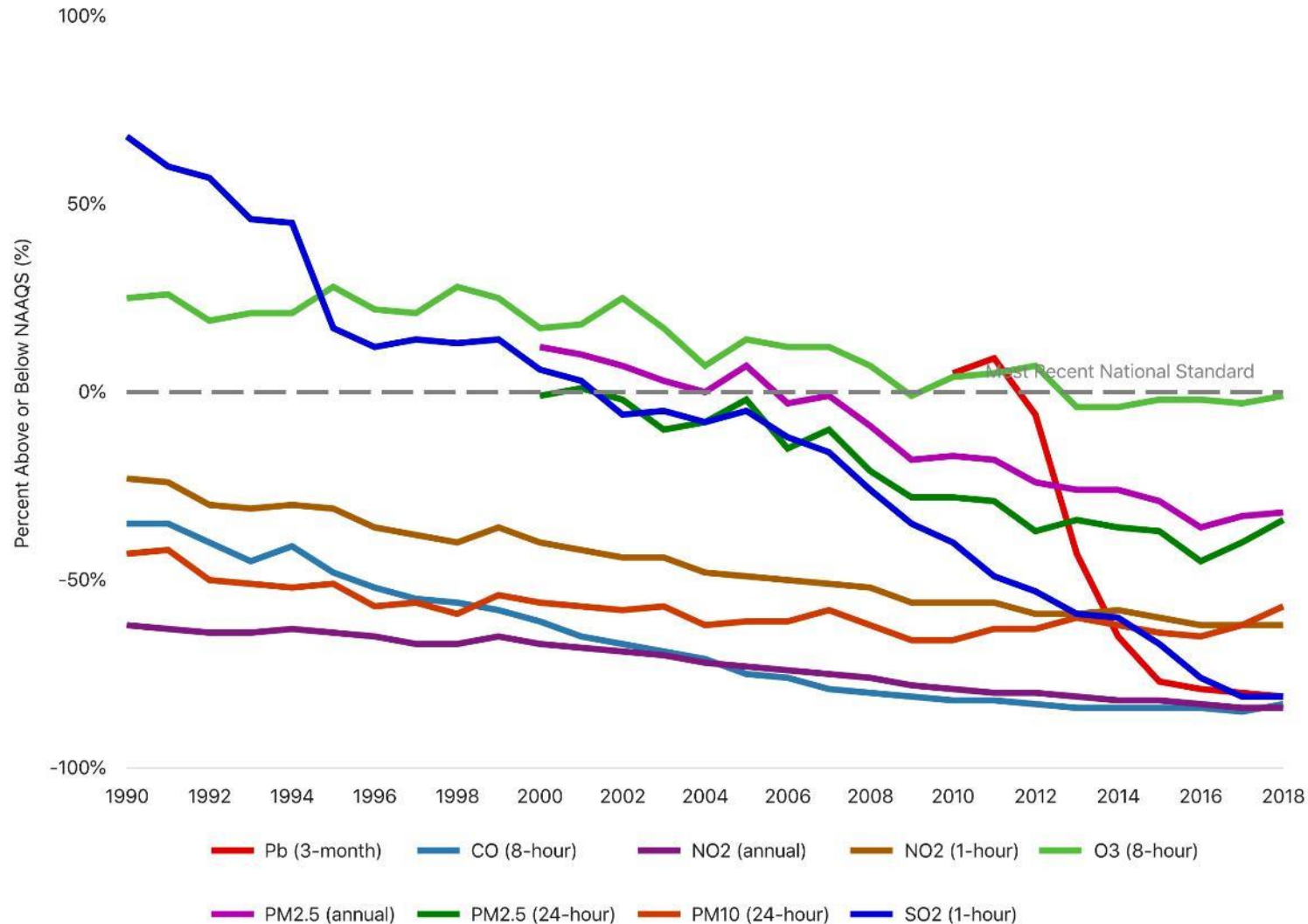




# Then and Now: 50 Years of Success - *We Internalized the Externalities of Pollution*

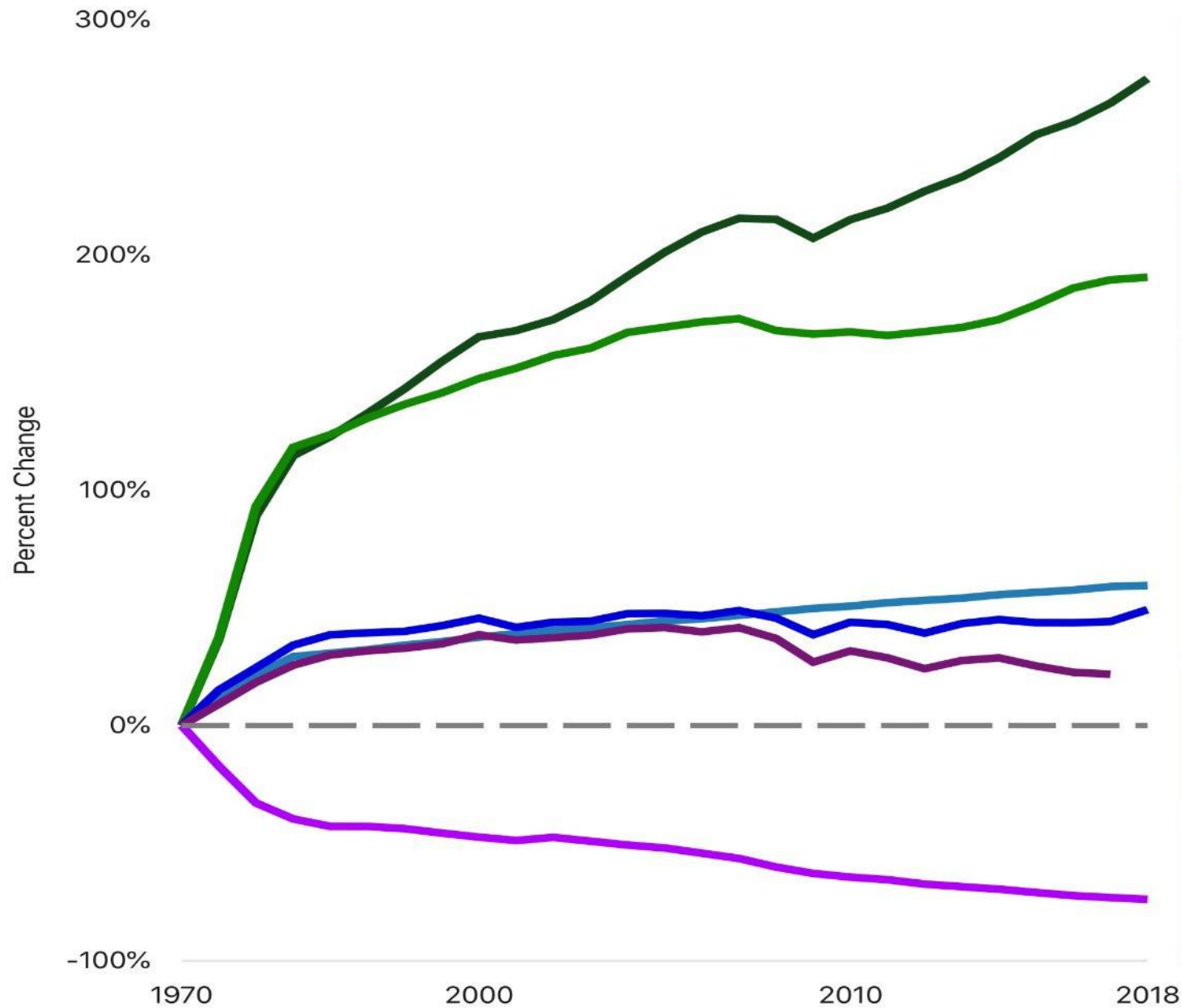
Declining National Air Pollutant Concentration Averages

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# Comparison of Growth Areas and Declining Emissions

## 1970-2018



Gross Domestic Product



Vehicles Miles Traveled



Population



Energy Consumption

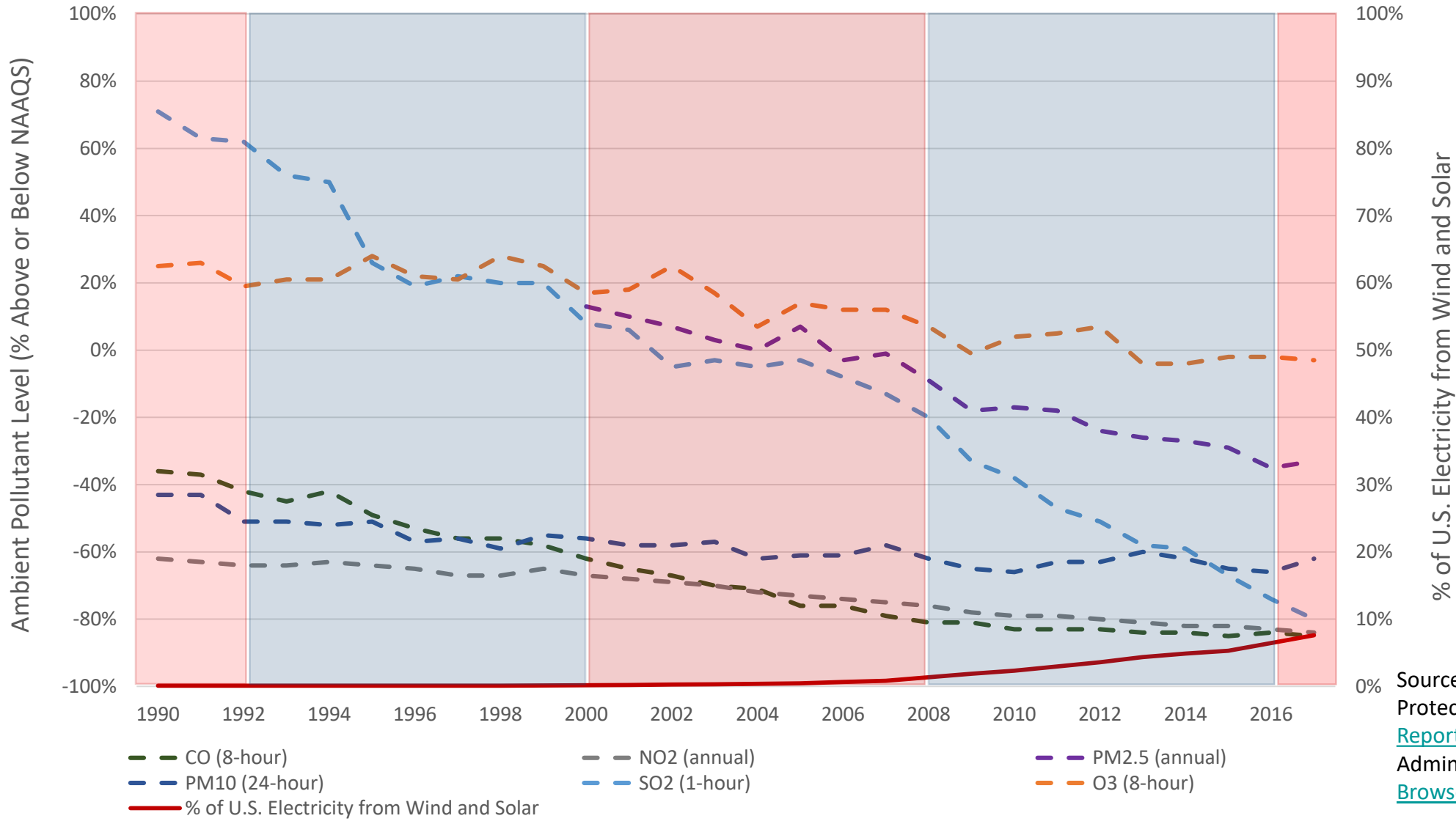


CO<sub>2</sub> Emissions



Aggregate Emissions  
(Six Common Pollutants)

# We Made our Air Safe with Technology, Not Anti-Fossil Fuel Ideology

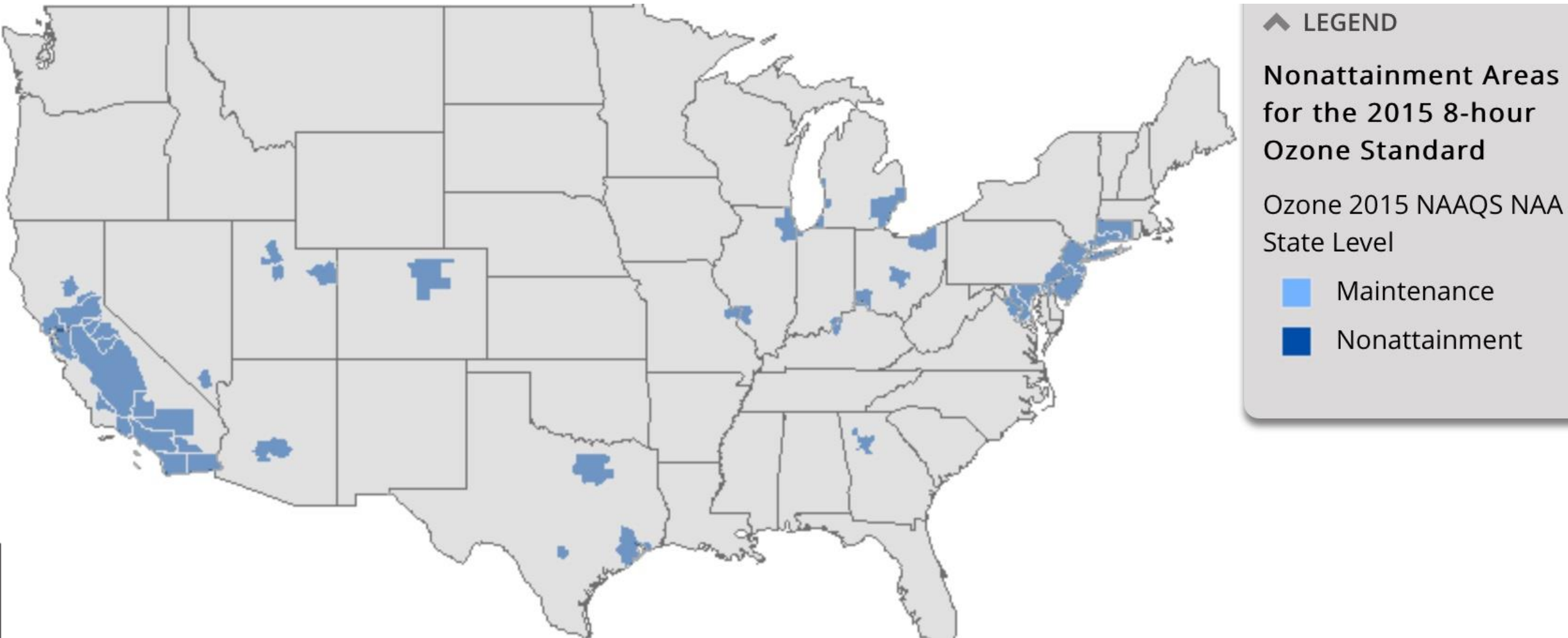


Sources: Environmental Protection Agency, [Air Trends Report 2018](#); Energy Information Administration, [Total Energy Data Browser](#)





# CASE STUDY: OZONE NONATTAINMENT

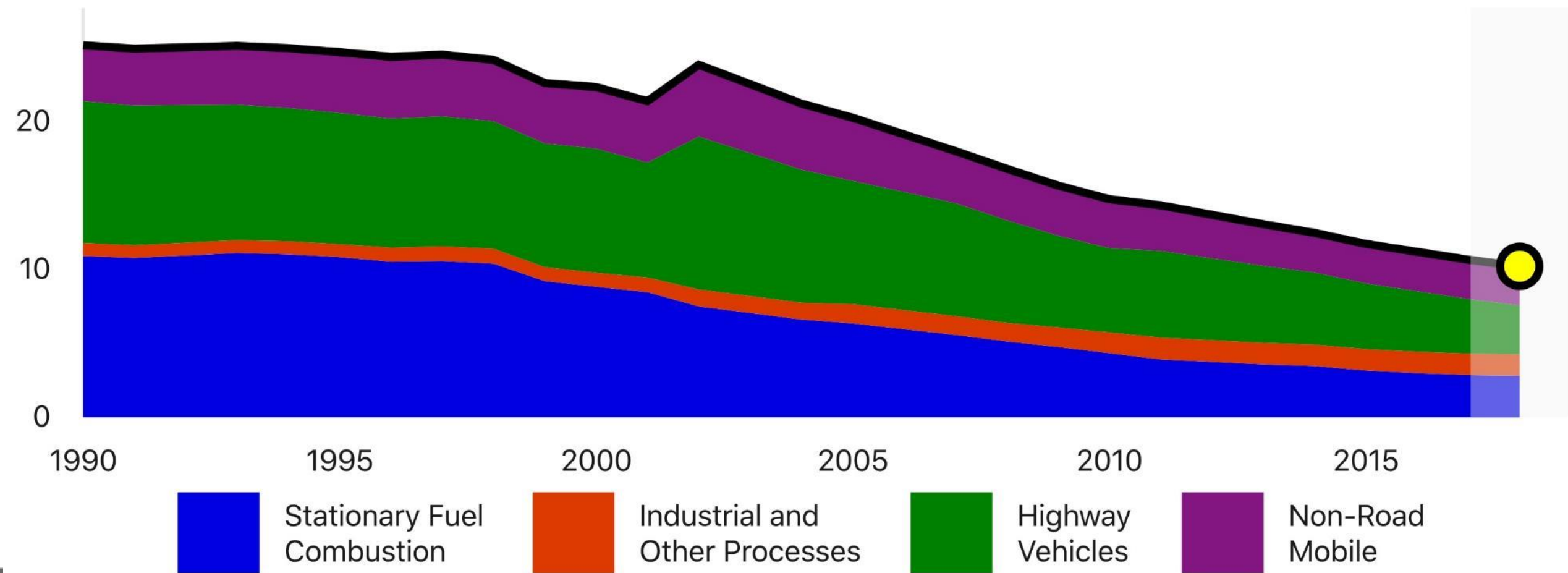




# Power Plants No Longer Drive Nonattainment

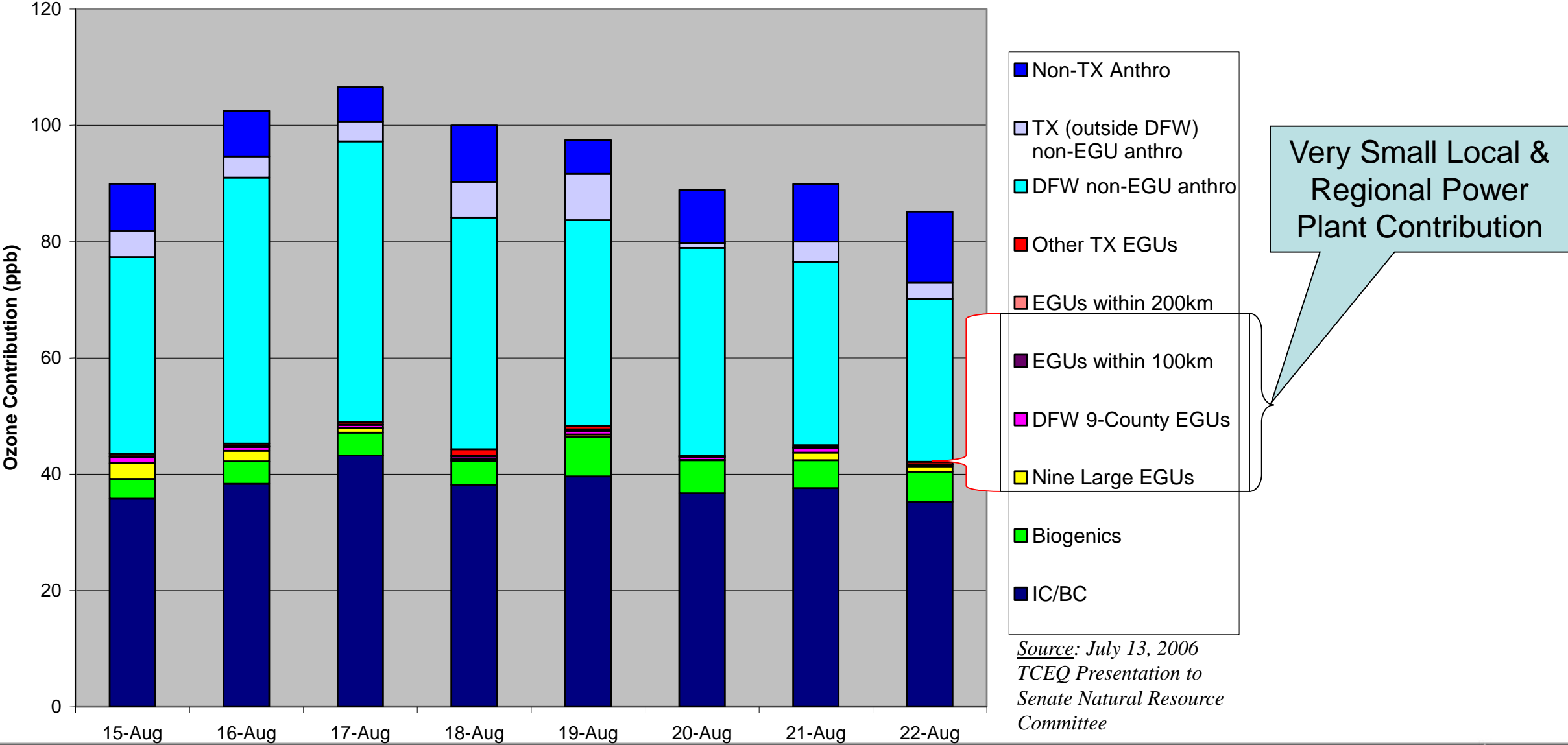
NO<sub>x</sub> Emissions

ooo



Source: U.S. EPA National Emissions Inventory 2014 ver. 2

# EXAMPLE – DFW: Power Plants Have Not Driven Attainment Status for over a decade



# CASE STUDY: PM<sub>2.5</sub> NONATTAINMENT

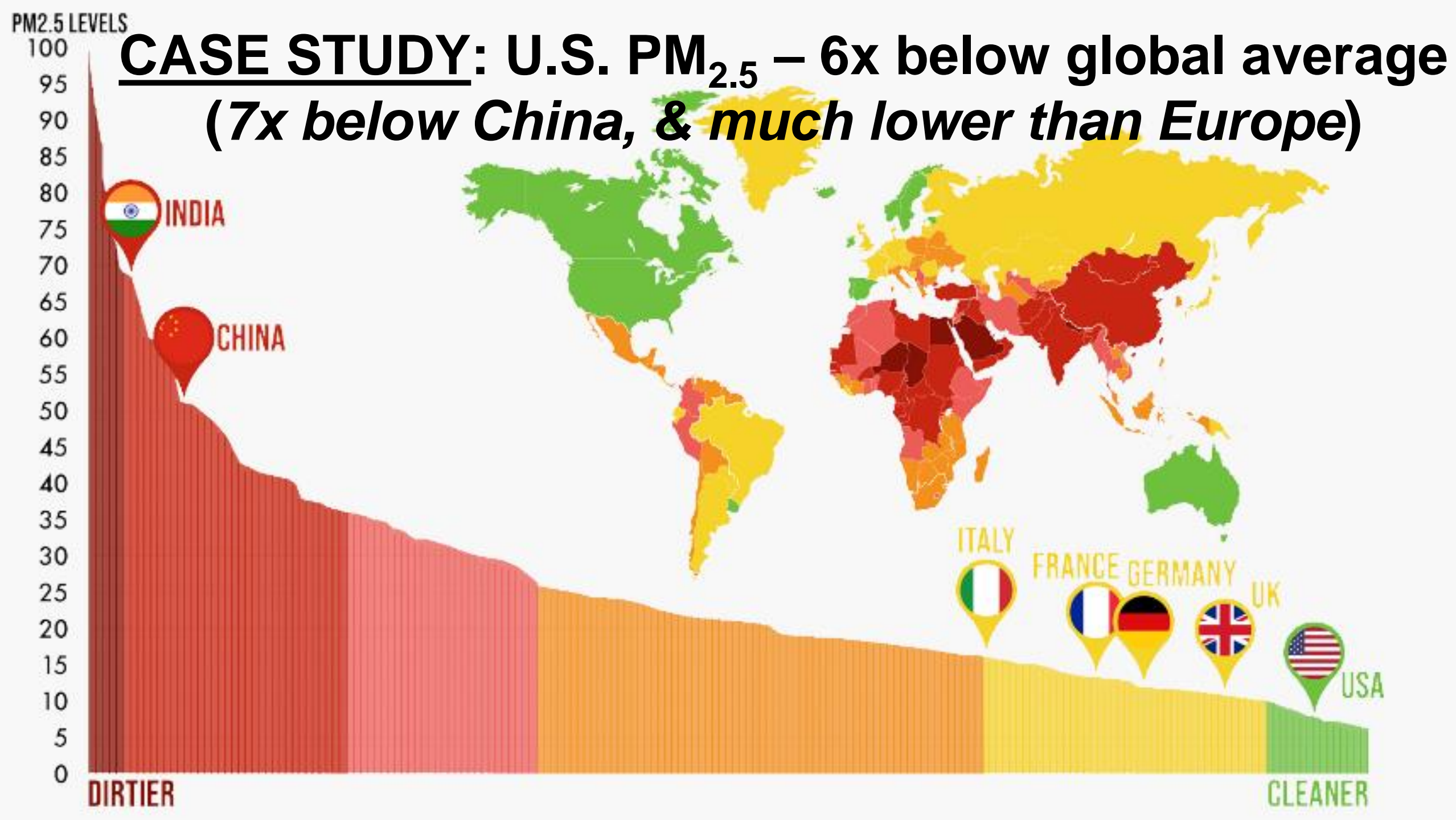


## ▲ LEGEND

Nonattainment Areas  
for the 2012 Annual  
Fine Particle (PM<sub>2.5</sub>)  
Standards

PM<sub>2.5</sub> Annual 2012  
Nonattainment Areas

- Maintenance
- Nonattainment







# For Non-GHGs, When Ambient Air Quality is “Safe,” We Should NOT Count Benefits for “Cleaner”

- Per the FCAA, NAAQS are based on what is considered a “safe” level of constituents for humans (plus a margin of safety).
- Only NAAQS nonattainment remaining in the U.S. is NOT being driven by power plants (natural/foreign/mobile sources).
- Thus, it is inappropriate to continue assuming “benefits” from lowering power plant emissions down to absolute zero.
- Yet, 99% of “benefits” of EPA air rules assumed by the prior administration were derived from reducing ambient levels below the NAAQS “safe” levels.





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# **Not All Carbon Reductions are Created Equal**

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- Early retirement of well-controlled coal units rarely economically justified.
- State & Federal subsidies and mandates for renewables has already been a significant internalizing function of carbon as an externality.
- Because carbon captured from a dispatchable fossil fuel plant innovates CCUS & provides baseload low-carbon power, it is a much more valuable low-carbon asset (to the grid & the world) than intermittent wind or solar.
- If we are serious about mitigating anthropogenic CO<sub>2</sub> & ensuring market transparency, regulatory approvals/planning must ensure that ratepayers know the true and total cost (and benefits) of their low-carbon options.





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# DON'T FORGET THE MATH:

## The World Needs our Technology, Not Anti-Fossil Fuel Ideology

### 2050 IMPACT OF DECARBONIZING ELECTRICITY:

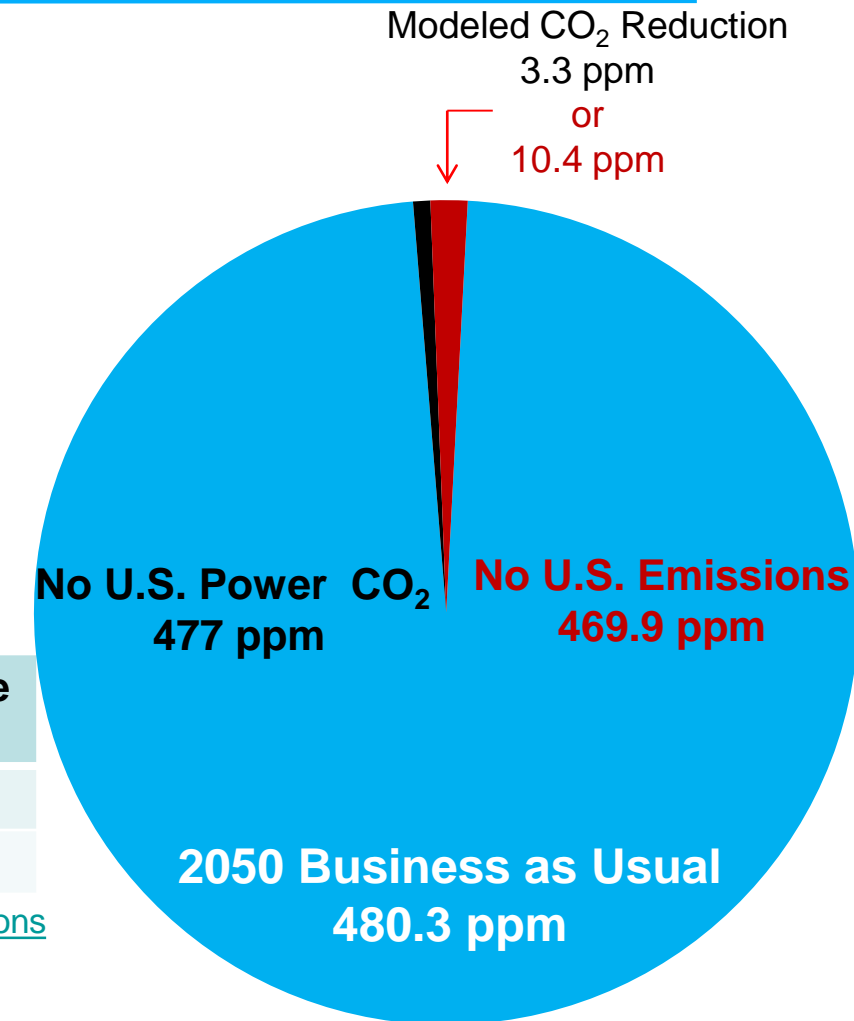
- NO COAL FLEET = 2.06 ppm (0.4%) reduction in CO<sub>2</sub> concentration.
- NO FOSSIL FLEET = 3.3 ppm (0.7%) reduction in CO<sub>2</sub> concentration.
- Modeled global temperature reduced by a mere 0.016°C.

### 2050 IMPACT OF DECARBONIZING ENTIRE U.S.:

- 10.4 ppm (2.2%) reduction in CO<sub>2</sub> 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](#).







# Petra Nova:

## Power Generation:

- Gas CT/peaker for parasitic load

## Carbon Capture:

- Post-combustion amine solvent
- 90% of 250 MW slip stream
- 1.65 short tons of CO<sub>2</sub> annually

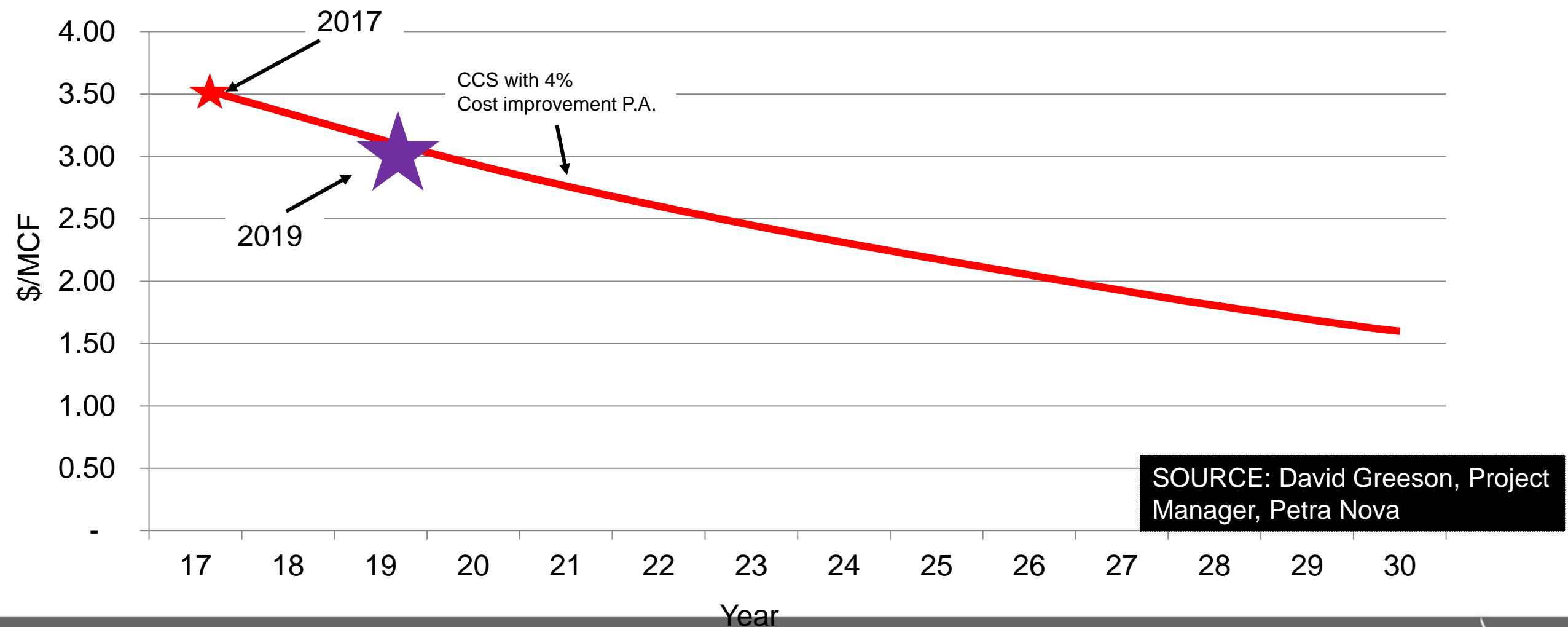
## Product Delivery and Utilization:

- CO<sub>2</sub> EOR via 80-mile pipeline
- West Ranch oil recovery up from 500 to 5,000-10,000 Barrels Per Day





# Path to success – Improving CCUS Economics



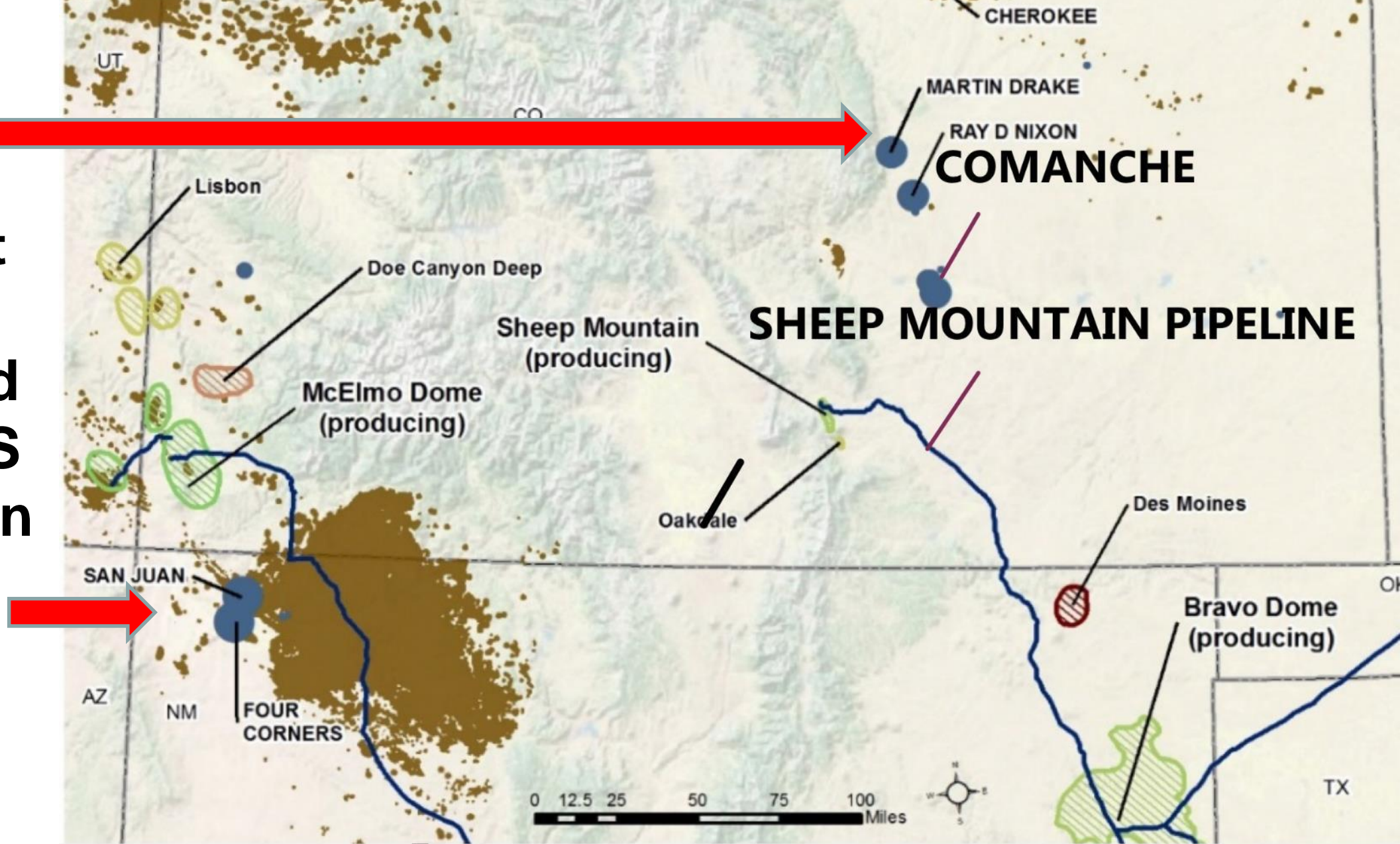
SOURCE: David Greeson, Project Manager, Petra Nova



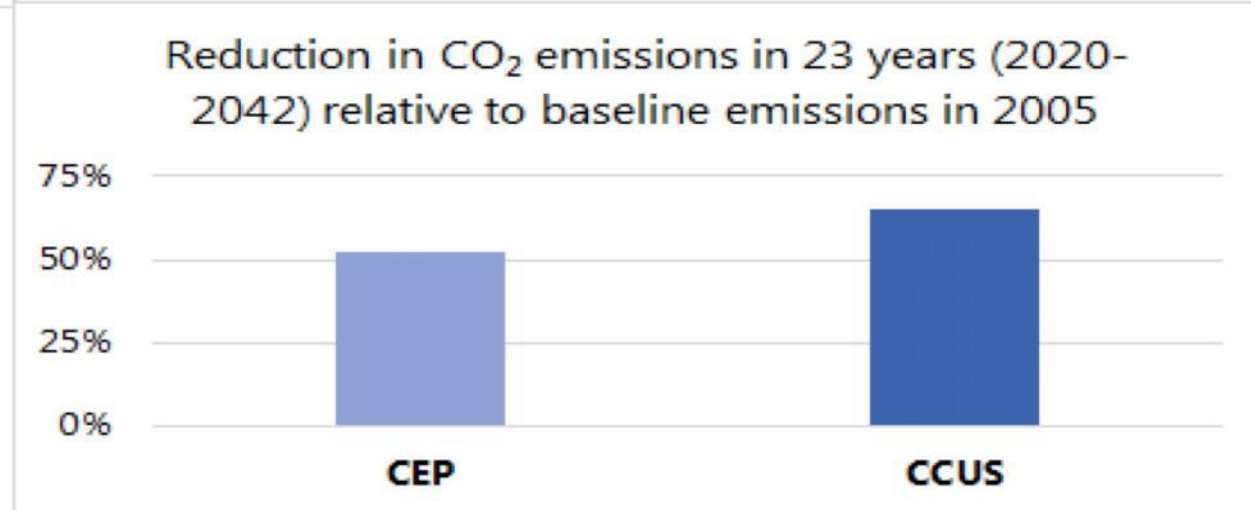


# CASE STUDY:

**CO & NM  
Units that  
Could be  
Retrofitted  
with CCUS  
Rather than  
Retired**



# DOE STUDY: Demonstrates Viability of CCUS Retrofit Rather than Retire & Replace with Wind/Solar/Storage (Tax Equity Owner reduces cost to the consumer even more!)





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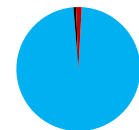


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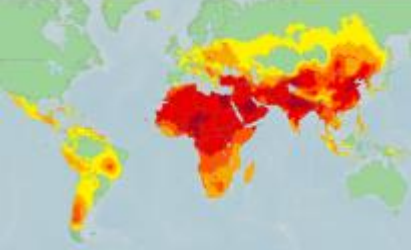


# Factors That Regulators Should Address When Comparing CCUS & Renewable Energy

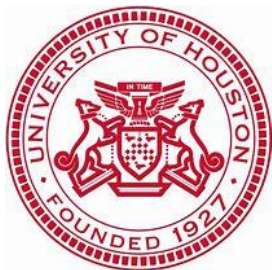


WIND/SOLAR/STORAGE	KEY CONSIDERATIONS	CCUS RETROFIT
<ul style="list-style-type: none"><li>• Low Capacity Factors</li><li>• Transmission Additions</li><li>• Reliability &amp; Resilience Penalty</li></ul>	<b>True &amp; Total LCOE</b>	<ul style="list-style-type: none"><li>• High Capacity Factors</li><li>• No New Transmission</li><li>• High Reliability &amp; Resilience</li></ul>
<ul style="list-style-type: none"><li>• Bird Strikes</li><li>• Habitat Destruction</li><li>• Lithium/Cobalt Mining for Batteries</li><li>• Rare Earths for Turbines &amp; Solar</li></ul>	<b>Non-GHG Externalities</b>	<ul style="list-style-type: none"><li>• Air Quality Not Impacted &gt; Known “Safe” Levels (NAAQS)</li><li>• Successful &amp; Established Coal Reclamation Programs</li></ul>
<ul style="list-style-type: none"><li>• Backup Power Emissions</li><li>• Life-Cycle GHGs From Construction &amp; Land Use</li><li>• Missed R&amp;D opportunity</li></ul>	<b>GHG Externalities</b>	<ul style="list-style-type: none"><li>• No Backup Power Required – (24/7 carbon-free resource)</li><li>• R&amp;D Drives Down Future Costs (global game changer)</li></ul>
<ul style="list-style-type: none"><li>• Dependence on Minerals &amp; Products Not Mined/Made in US</li></ul>	<b>Economic Impact &amp; Geopolitical</b>	<ul style="list-style-type: none"><li>• Domestic fuels (coal &amp; gas) + export commodity (oil &amp; tech)</li></ul>





# The Low Carbon Role for Coal



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Director, Life:Powered

## QUESTIONS?

# ***“Converting Carbon to a Commodity” Video***

<https://www.youtube.com/watch?v=TIXVvAoQBjc>



# **APPENDIX: *Why U.S. Power***

## ***Markets are NOT Transparent***

- 1. The premise of U.S. RE moving the needle on global climate change is fundamentally flawed.**
  - Even if we were to eliminate all U.S. power sector emissions by 2030, it would only reduce 2050 global concentrations by .7% (3.3 out of 480.3 ppm)
- 2. PTC/ITC subsidies are hidden from consumers.**
- 3. All fuels receive subsidies but there is massive disparity in Return on Investment (in \$/MW).**
- 4. Direct/Indirect Subsidies Distort Markets:**
  - Transmission socialized across entire markets.
  - Growing costs of balancing wind & solar.
  - Stranded costs & lack of market signals for capacity.



***The Lack of  
Transparency in  
American Power  
Markets Leads to  
“Grid Parity” Claims  
& and “100%  
Renewable”  
Mandates that  
Mislead Ratepayers  
& Endanger Grid  
Resilience.***



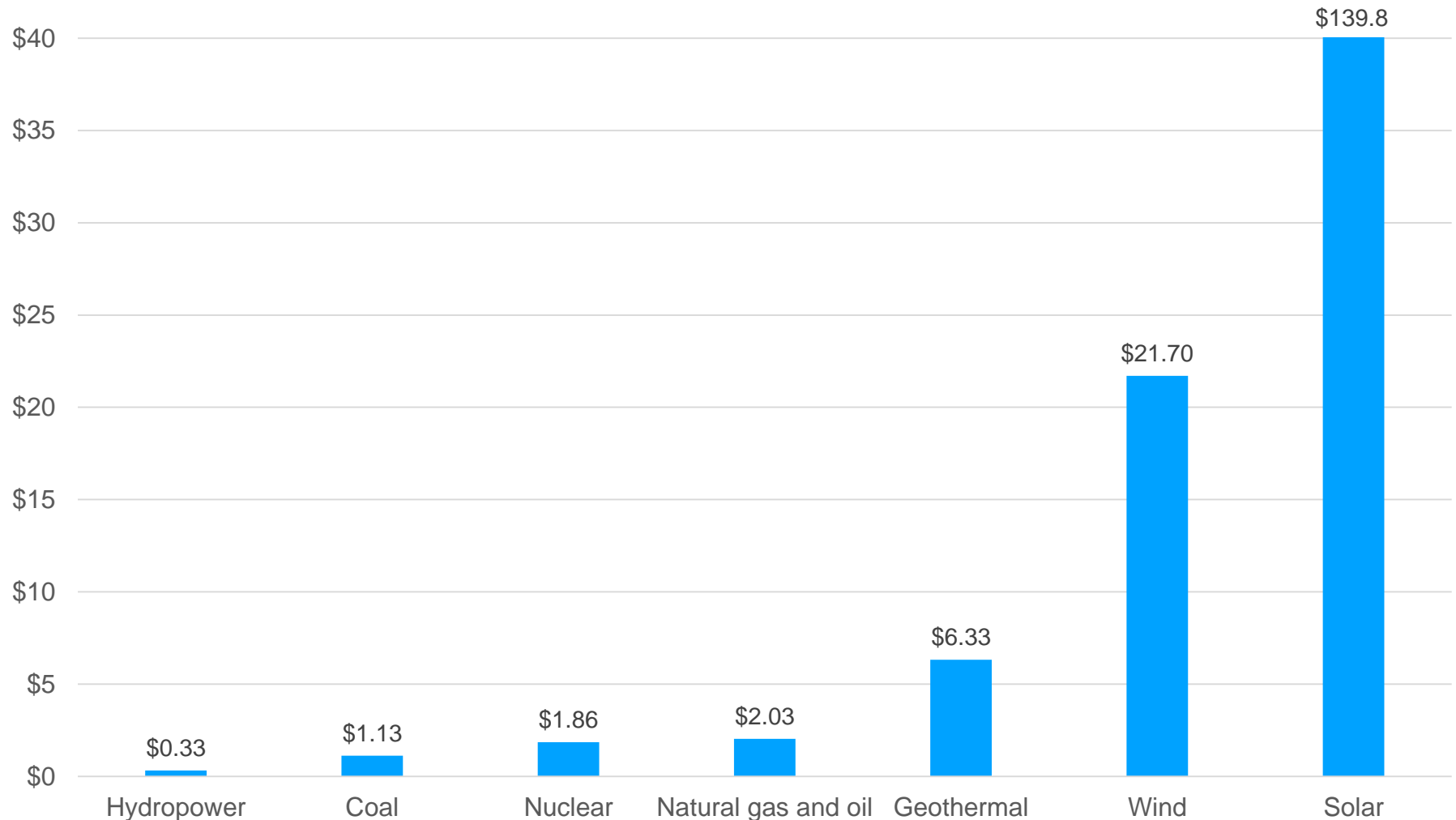
# Comparing the ROI of Federal Energy “Subsidies”

Many claim that all forms of energy receive “subsidies,” but wind & solar deliver far less return on investment (ROI).

Production tax credit subsidies for existing renewable energy technologies do not promote innovation.

Sources: Office of Management and Budget, [Analytical Perspectives](#); Joint Committee on Taxation, [Estimates of Federal Tax Expenditures](#); Department of Energy, [Statistical Tables by Appropriation](#); Census Bureau, [Consolidated Federal Funds Report](#); Department of the Treasury, [Section 1603 List of Awards](#); Energy Information Administration, [Electricity Data Browser](#)

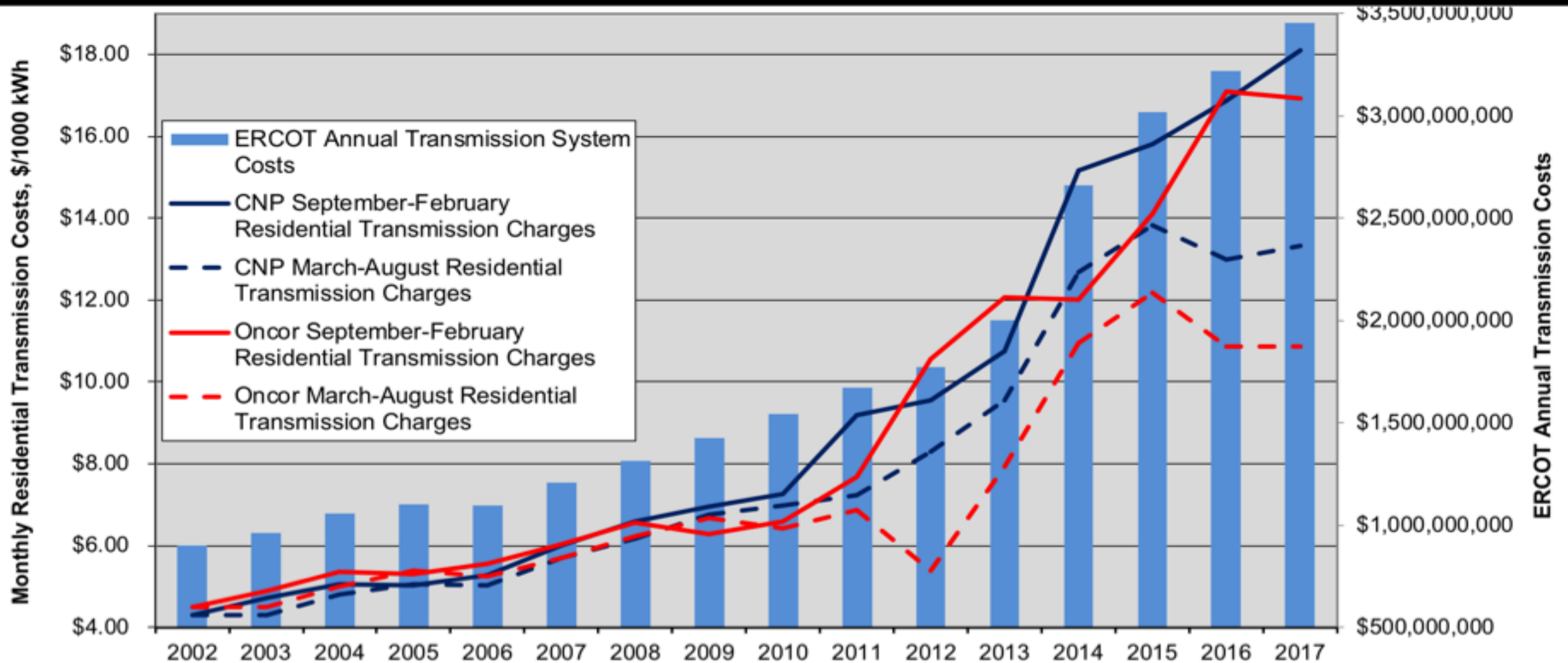
## Subsidies per Unit of Electricity Generated (2017 USD/MWh, 2003 - 2017 Average)



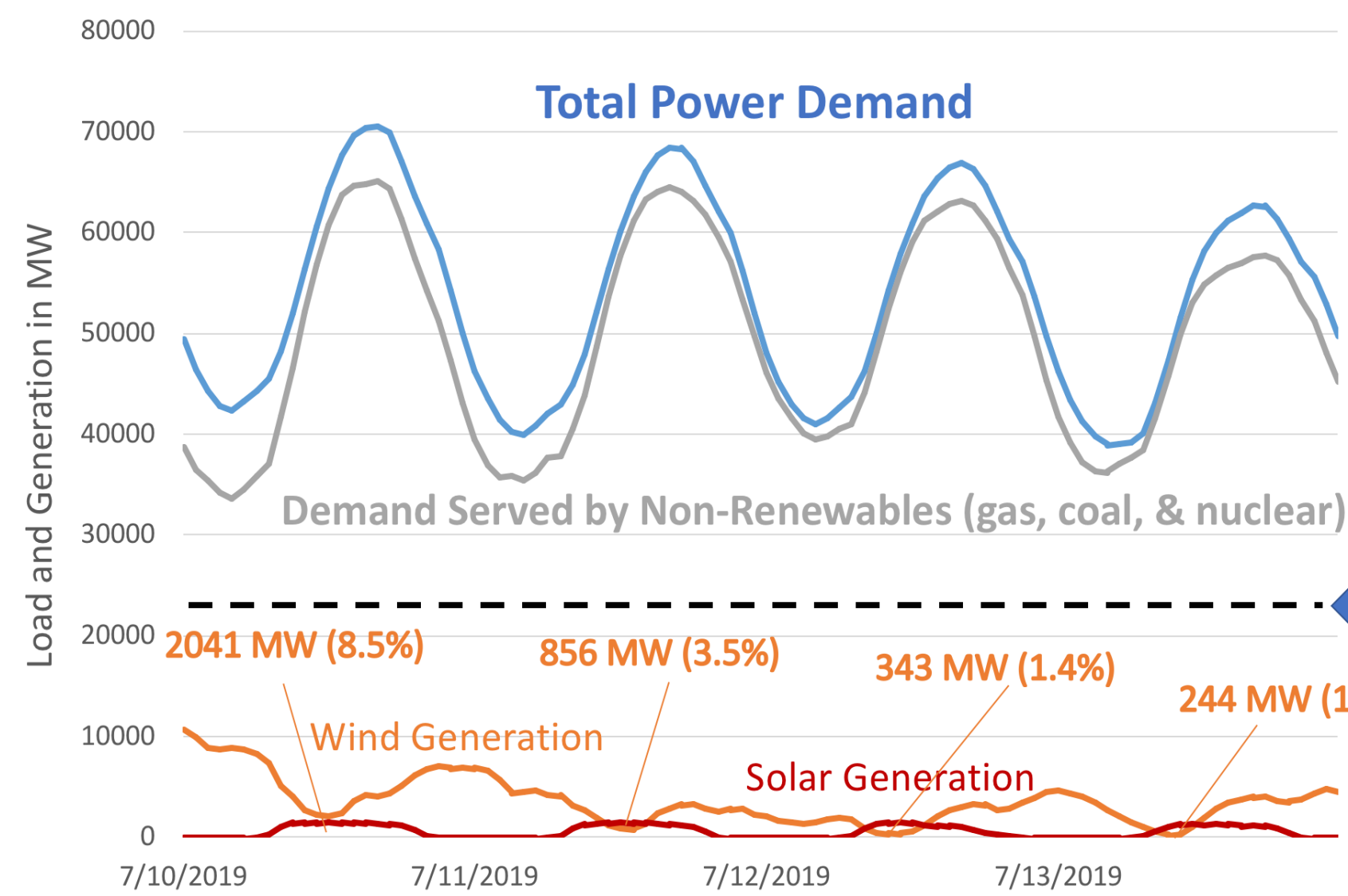


# Transmission Costs of Integrating Renewables

## *Case Study: ERCOT*



# Off-Peak Exuberance vs. On-Peak Reality:



**OFF-PEAK EXUBERANCE:**  
[Houston Chronicle](#) headline,  
*“Texas wind generation breaks record, ERCOT reports”*  
(19,168 MW Wind on 12/14/18 when entire grid needed only 36,760)

**ON-PEAK REALITY:**  
Wind underperformance from 7/10-7/13/19 on & off peak.

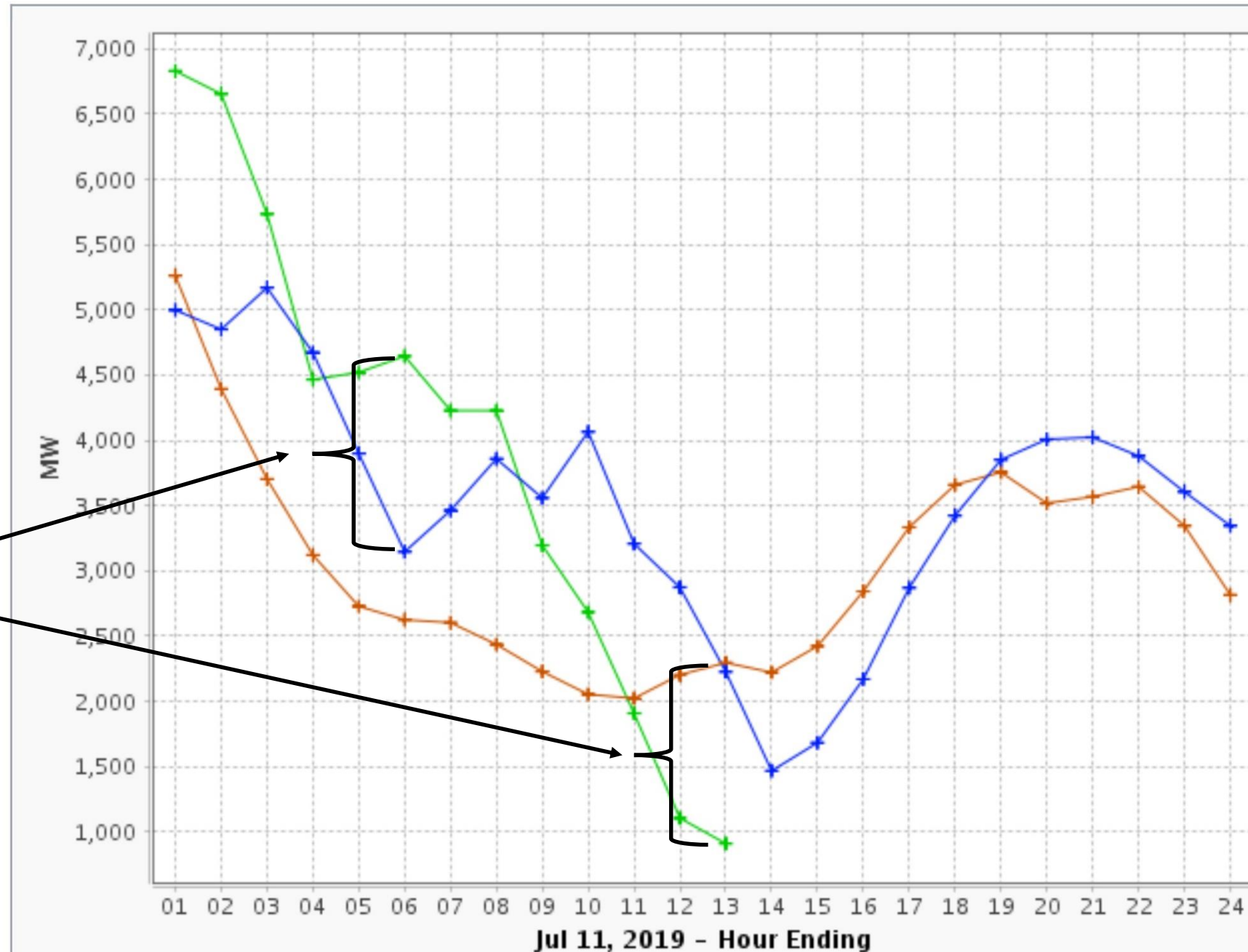
**Installed Wind:**  
~24,000 MW

**Average from 12 to 6 PM:**  
**2,704 MW (11% capacity factor)**

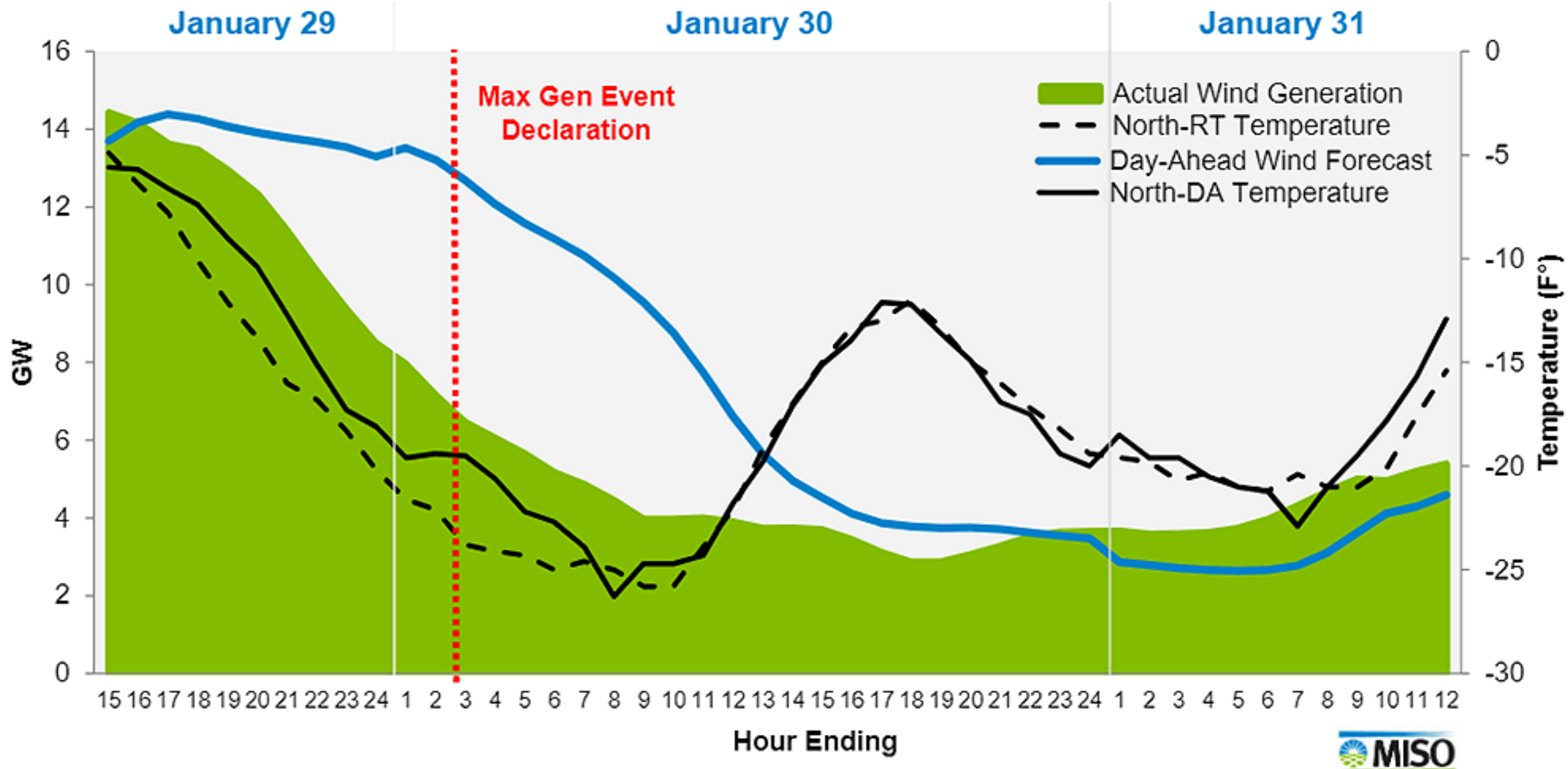
Graph Updated: Jul 11, 2019 13:56

**The Imputed Cost  
of Wind on (& off)  
the Grid is NOT  
Being Adequately  
Reflected in  
Market Designs –**

**Note the  
Forecasting vs.  
Actual Generation**



# And it's Not Just Texas in the Summer!





# PJM Bomb Cyclone

## Case Study in Energy Resilience

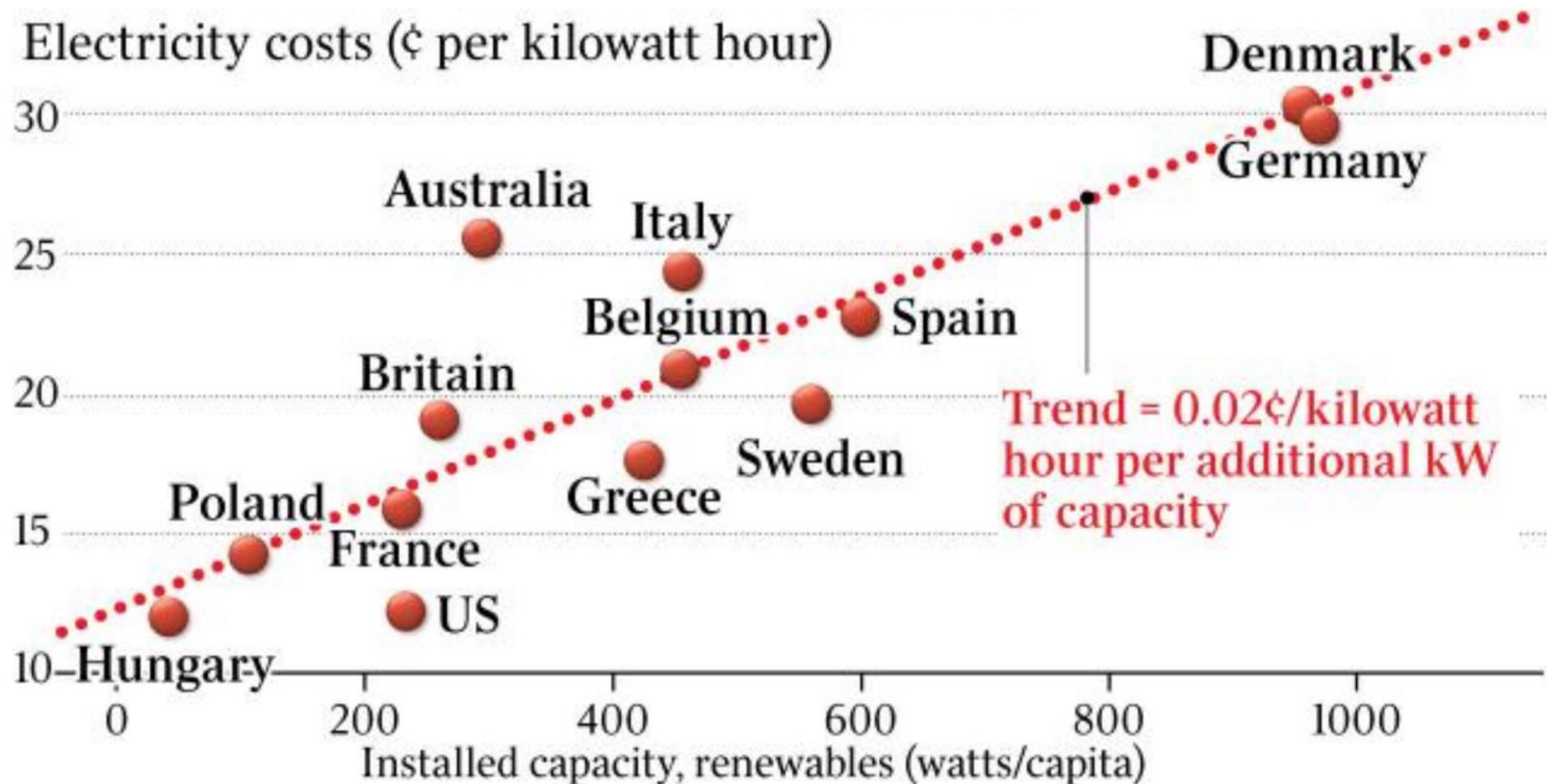
Average Daily GWh

*How is it Again that America is  
Going to Live Without Coal?*

Fuel	12/1- 12/26	12/27- 1/8	Positive Delta Total	Percentage Change	Share of Positive Increase
Coal	746	1,113	367	49%	73%
Gas	607	619	12	2%	2%
Renewables	127	122	-5	-4%	-
Nuclear	846	851	5	1%	1%
Oil	6	117	112	1994%	22%
Multiple fuels	2	10	8	383%	2%
Total	2,334	2,832	504	21.6%	100%

Source:  
DOE/NETL  
2018

# Globally, More Renewable Energy Means More Expensive Power



# Expensive Energy Hurts the Poor the Worst

## Civil Rights Suit Exposes California's Regressive Green Energy Agenda

"California's climate change policies ... have caused and will cause unconstitutional and unlawful disparate impacts to California's minority populations ..."

"Since most of the world's energy is still produced from fossil fuels, energy consumption is still highly correlated to economic productivity and per capita incomes ..."

SUPERIOR COURT OF THE STATE OF CALIFORNIA  
COUNTY OF FRESNO  
UNLIMITED CIVIL JURISDICTION

THE TWO HUNDRED, an unincorporated association of civil rights leaders, including LETICIA RODRIGUEZ, TERESA MURILLO, and EUGENIA PEREZ,

Plaintiffs/Petitioners,

v.

CALIFORNIA AIR RESOURCES BOARD, RICHARD COREY, in his Official Capacity, and DOES 1-50,

Respondents/Defendants.

Case No. \_\_\_\_\_

**VERIFIED PETITION FOR WRIT OF MANDATE; COMPLAINT FOR DECLARATORY AND INJUNCTIVE RELIEF**

[Code Civ. Proc. §§ 1085, 1094.5, 1060, 526; Gov. Code § 12955 *et seq.* (FEHA); 42 U.S.C. § 3601 *et seq.* (FHA); Cal. Const. Art. I, § 7; Art. IV, § 16; U.S. Const. Amd. 14, § 1; 42 U.S.C. § 1983; Pub. Res. Code § 12000 *et seq.* (CEQA); Gov. Code § 11346 *et seq.* (APA); H&S Code § 38500 *et seq.* (GWSA); H&S Code § 39000 *et seq.* (CCAA); Gov. Code § 65088 *et seq.* (Congestion Management Plan)]

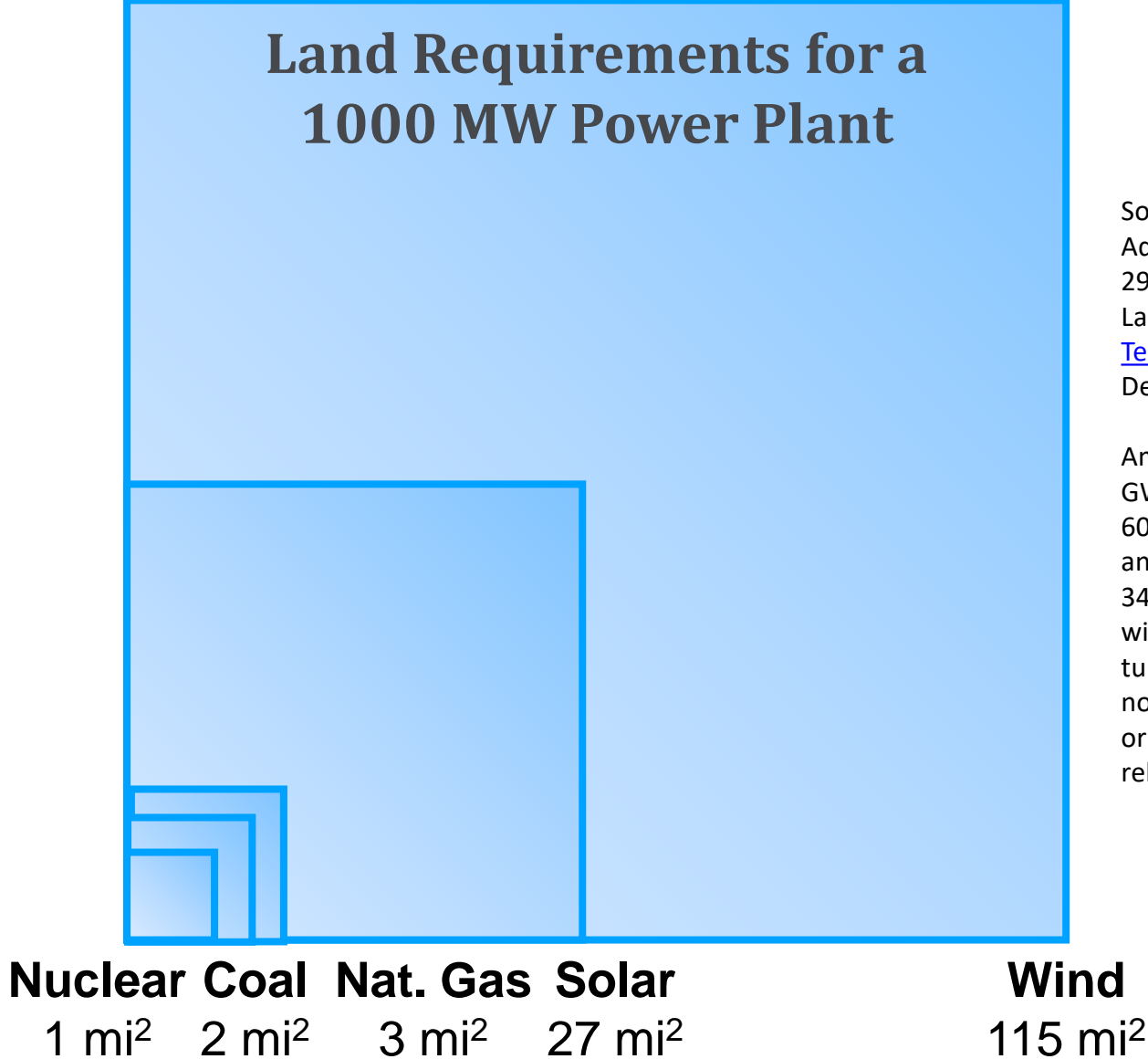
"... the 'net zero' GHG threshold would operate unconstitutionally so as to disproportionately disadvantage low income minorities in need of affordable housing relative to wealthier, whiter homeowners who currently occupy the limited existing housing stock..."

"CARB's VMT reduction scheme and its ongoing efforts to intentionally increase congestion are an assault on the transportation mobility of people, which disparately harm minority workers..."

# ENERGY DENSITY = ENVIRONMENTAL STEWARDSHIP

Density of U.S. Energy Resources	
Power Source	W/m <sup>2</sup>
Nuclear	307
Coal	182
Natural Gas	101
Crude Oil	22
Solar	8
Hydroelectric	1.7
Wind	1.0
Ethanol	0.3

Source: Vaclav Smil, *Power Density*, MIT Press, 2015.



Sources: Energy Information Administration, [Today in Energy](#), Nov. 29, 2017; National Renewable Energy Laboratory, [Land Use by System Technology](#); Vaclav Smil, *Power Density*, MIT Press, 2015.

Amount of land required for 5,000 GWh of annual production, assuming 60% capacity factor for nuclear, coal, and natural gas, 20% for solar, and 34% for wind. Land requirements for wind include spacing between turbines. Values for wind and solar do not include land for transmission lines or energy storage to ensure equal reliability to dispatchable power.