EPA's Proposed Clean Power Plan and Carbon Capture & Storage

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NARUC Subcommittee on Clean Coal

About Clean Air Task Force

- Non-profit organization founded in 1996 dedicated to reducing atmospheric pollution through research, advocacy and private sector collaboration.

http://www.catf.us

www.fossiltransition.org

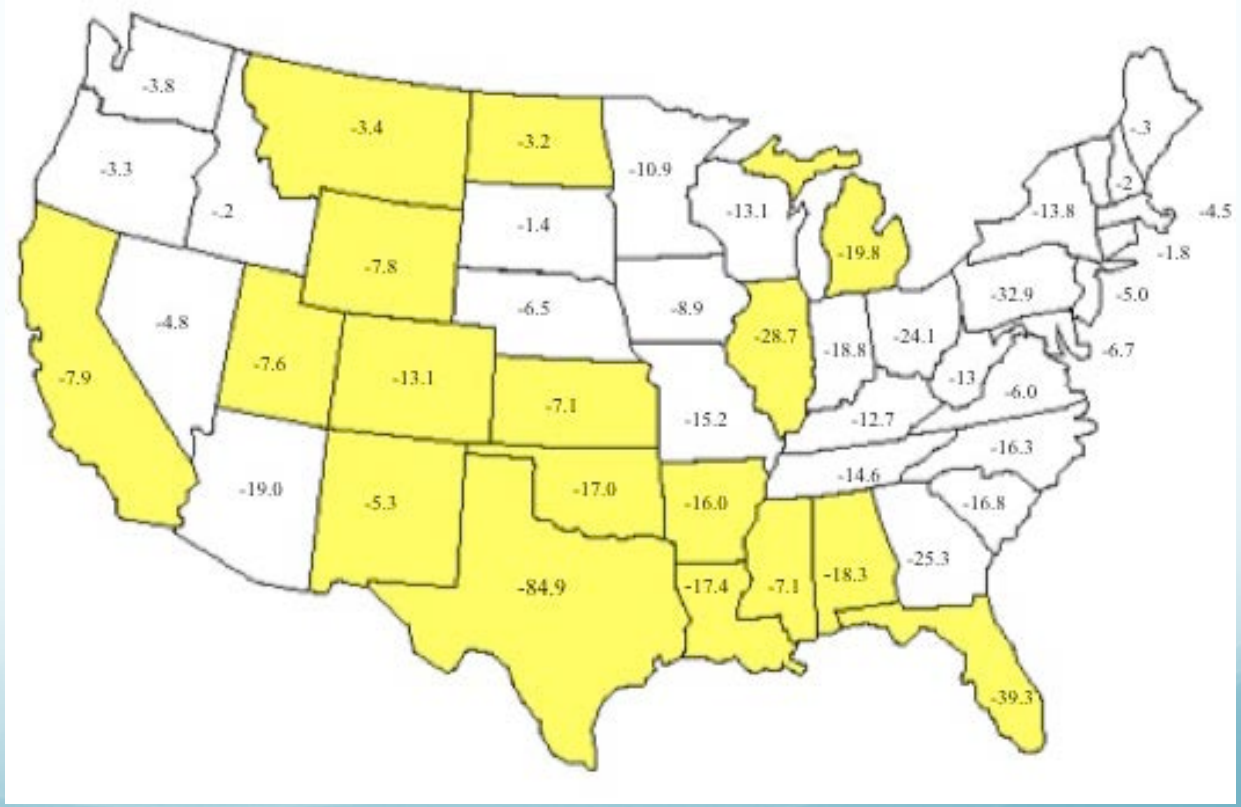
About Fossil Transition Project

- Work to transition fossil fuels to cleaner technology. We focus on several areas:
  - **CCUS*:*** EOR to speed CCS development ("U' stands for utilization)
  - **Policy*:*** Incentives for early CCS deployment and CO_2 limits on sources
  - **Partnerships*:*** To speed projects (especially US and China)
  - **Communication*:*** Shape public discourse to focus on what really counts
  - **Projects*:*** Support coal and gas projects that advance lower emissions

CCS in EPA's Clean Power Plan

CATF examined why EPA's Clean Power Plan (CPP) model runs didn't build any CCS. The result seemed unusual for two reasons:

- EPA model allowed EOR in many states (yellow), and
- The rule's greatest CO_2 reductions occur in EOR states like Texas.



CATF Modeling of CPP Rule

- As we reviewed EPA's CCS assumptions, we found key problems: EOR price was too low, capture options were limited, pipeline costs were too high.
- CATF retained Charles River Associates (CRA) to conduct modeling of the CPP using North American Electricity and Environmental Model (NEEM) model. The model emphasized three states with EOR that CATF deemed to be "CCS Ready".
  - Texas
  - Oklahoma
  - Mississippi

The North American Electricity and Environmental Model (NEEM) is one of the leading models for assessing the impacts of energy and environmental policy on electricity markets

Inputs

New Technology Cost and Performance
- New resources (supply-and demand-side)
- Emission control retrofit costs

Existing Unit Data
- Fossil, Nuclear, Renewable

Fuel Prices
- Gas and oil prices from MRN and CRA's Gas Model
- Coal supply curves from the Coal Supply Model

Electricity Demand
- Consistent with MRN

Environmental Scenarios
- Emissions caps
- Carbon Tax
- RPS

Transmission
- Limits between regions
- Wheeling charges

Model

NEEM Model

A linear programming model that simulates economic dispatch and minimizes the present value of incremental costs to the electric sector while meeting demand and complying with environmental limits.

- Maximizes consumer surplus plus producer surplus
- Has a 45-year horizon (with end-effect modeling to 2070)
- Uses a 20 period load duration curve; expandable to 8760 hours
- Simulates 28 NERC regions/ sub-regions

Forecasts

- New Resources by Region
- Retirement/Mothball Decisions
- Emissions and Allowance Prices
- Emission Control Retrofits
- Wholesale regional on- and off-peak electricity prices
- Coal prices reflecting supply and demand by coal type

CATF Modeling Approach

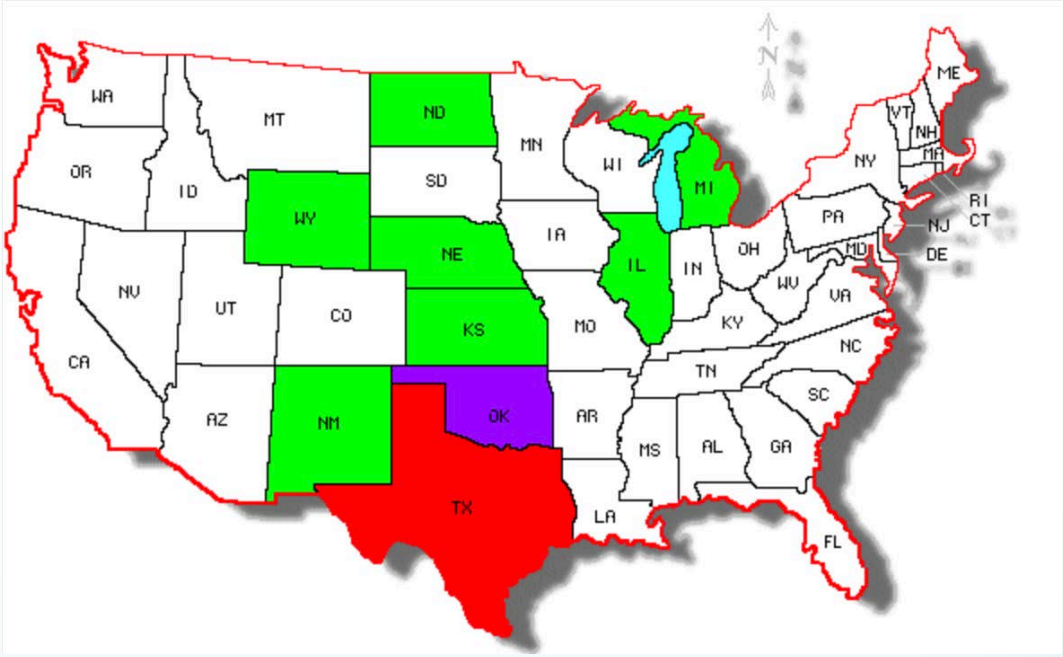
1. Base Case: Recreated EPA Policy Case in NEEM
2. Test Case: Changed only CCS assumptions in Base Case (World 1)
3. Sensitivities: Examine alternative assumptions (Worlds 2-6)

Comparison of CCS Modeling Assumptions

	EPA (IPM)	CATF (NEEM)
Max CO2 Price for EOR	Under $15/short ton CO_2	$20-$35/short ton CO_2
Retrofit Options	Coal only, 90% capture, >400 MW	Coal and gas, 50% and 90%, all sizes
Transport of CO_2 in TX	$4.50-$10.50/short ton	$.40 to $6.70/ short ton
Relative Capture Costs		CATF more expensive than EPA for small units, less expensive for large.

Results

- **97 million short tons of CO_2 captured per year by 2030 from 10 GW of coal retrofits**.



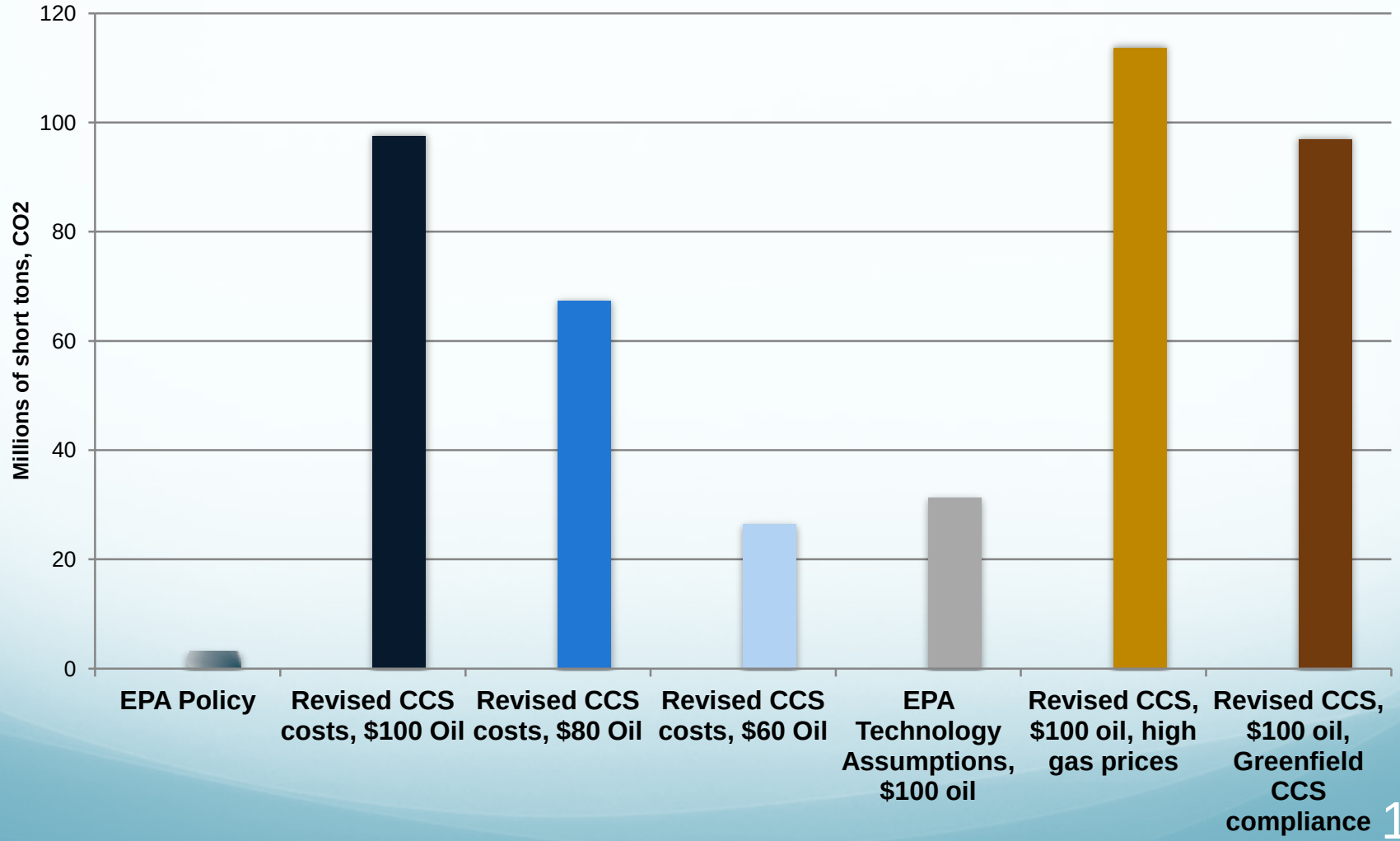
	Retrofit		New Builds	
	# of Units	MW	# of Units	MW
Texas	10	6,469	0	0
Oklahoma	3	1,241	0	0
Mississippi	0	0	1	840
Rest of USA	6	2,376	1	984

Implications

- 97 million short tons/year of CO_2 reductions (85 million metric tons/year) in test case is about 15% of the national 111(d) CO_2 reductions in 2030.
- By comparison, EPA estimates:
  - Building Blocks 3 and 4 account for 232 million tons/yr.
  - Heat Rate Improvements (HRI) account for 97 million metric tons/yr.
  - Rule will drive 10 GW of non-hydro renewables.
- CCS accounts for a key compliance strategy for Texas and Oklahoma where CCS will account for more than 50% and 85% respectively of CO_2 reductions under 111(d).

CLEAN AIR TASK FORCE

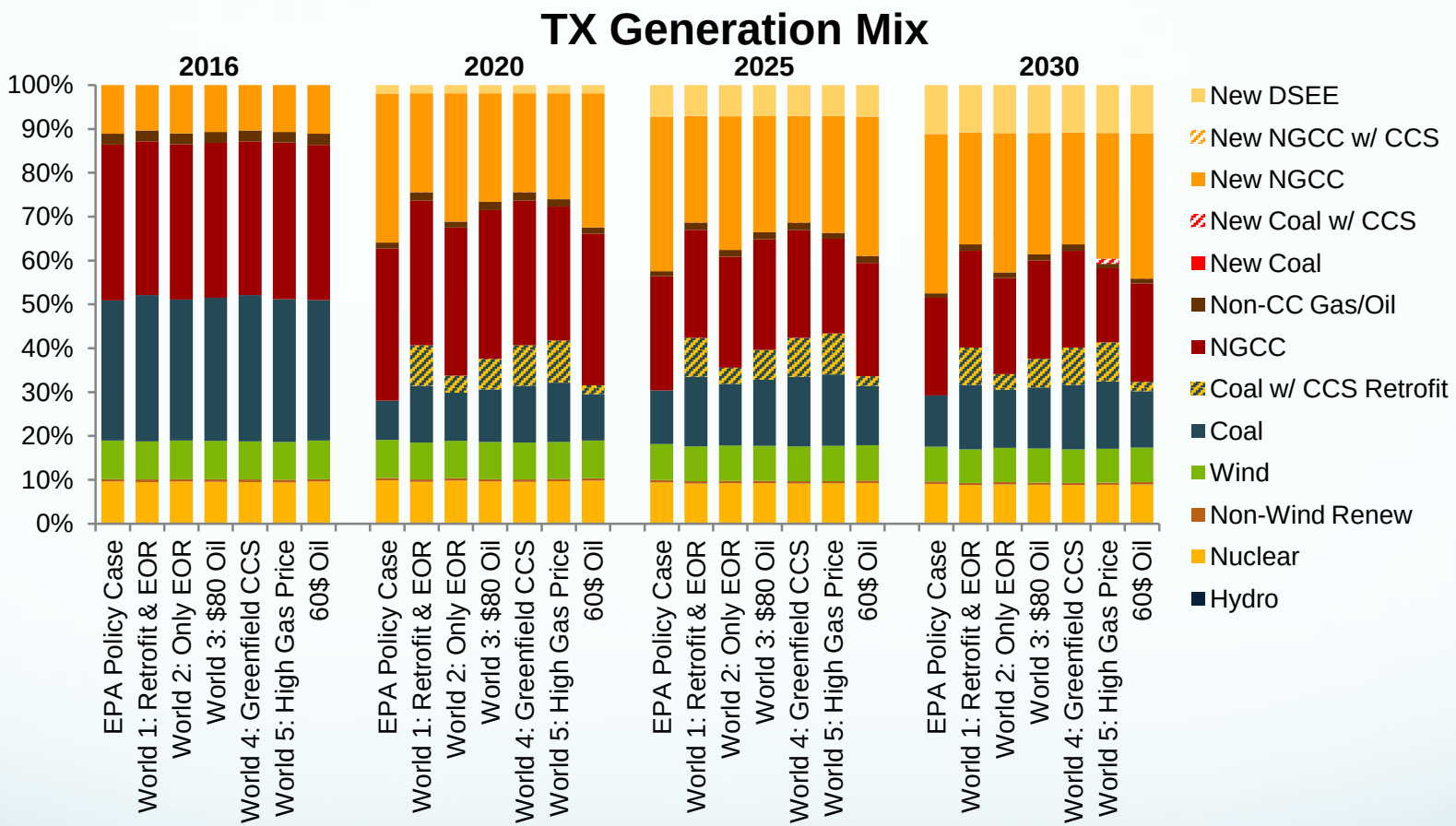
Sensitivity Runs For Alternative Assumptions
CO_2 Reductions per Year in 2030
(Millions of Short Tons)



Conclusions

- CPP will drive an important amount of CCS. About 10 GW of retrofits, primarily in states with existing EOR under conditions CATF believes are representative of the period 2020 to 2030.
- CCS will be an important compliance pathway for some states
- The amount of CCS retrofits will contribute to technology learning curves that drive down CCS costs.
- Even under scenarios of lower oil prices and higher capture costs, CCS will still play an important CPP compliance role.

Appendices


TX Generation Mix
2016
2020
2025
2030
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
EPA Policy Case
World 1: Retrofit & EOR
World 2: Only EOR
World 3: $80 Oil
World 4: Greenfield CCS
World 5: High Gas Price
60$ Oil
New DSEE
New NGCC w/ CCS
New NGCC
New Coal w/ CCS
New Coal
Non-CC Gas/Oil
NGCC
Coal w/ CCS Retrofit
Coal
Wind
Non-Wind Renew
Nuclear
Hydro

There are small but meaningful decreases in total system costs in the RTOs encompassing Texas and Oklahoma, where CCS pops up

Existing

- \+ Fuel
- \+ FOM and VOM
- \+ Fuel switching Annualized Capital, FOM, and VOM
- \+ Retrofit Annualized Capital, FOM, and VOM
- \+ CO_2 Storage and Transport
- \+ Refurbishment

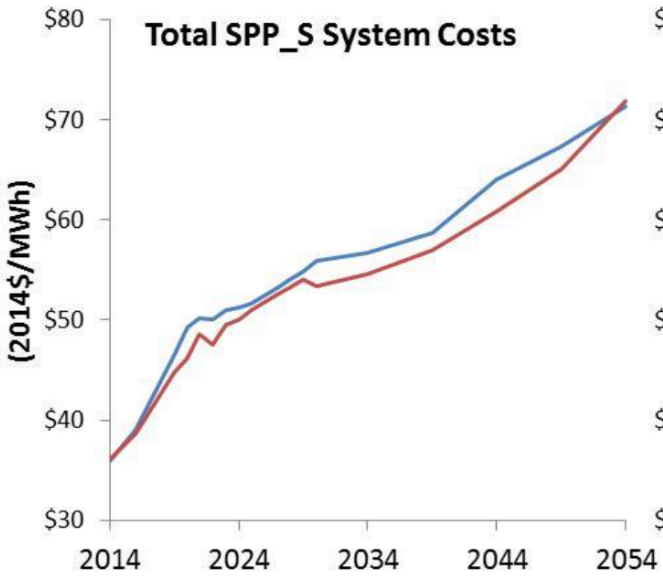
New

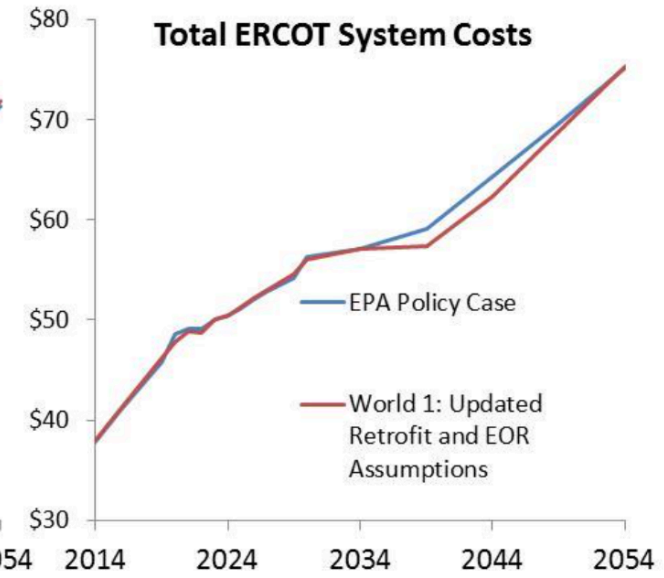
- \+ Above "Existing" components
- \+ New Build Annualized Capital

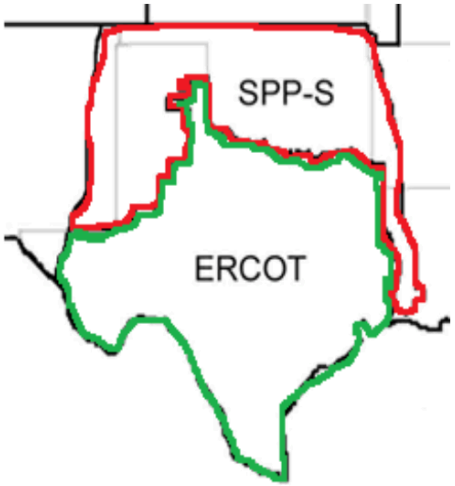
Net Off-System Purchases

- \+ Purchases from Other Regions
- \+ Wheeling Costs
- \- Sales to Other NEEM Regions

= TOTAL SYSTEM COSTS







- **More favorable CCS economics allow more existing coal to survive and in turn forestall new gas-fired combined-cycle builds**
- **In present value (2014-2054) terms, total system costs in**

  SPP_S decrease by $5.1 billion, or 2.4%

  ERCOT decrease by $2.4 billion, or 0.5%

2025 Dispatch Costs for Particular Texas Coal/Gas Units