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EPA's Proposed Clean Power Plan: Rate to Mass Conversion

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ARKANSAS STAKEHOLDER MEETING

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EPA June Guidance on Rate to Mass Conversion

Apply State Goal to projected scenario

Projection scenario
- *Includes impact of "on the books" requirements, but*
- *Excludes actions /programs intended to be enforceable under a state plan*

Projected CO_2 emissions from affected EGUs for 2020-2029 and 2030, represent the interim and final mass-based State Goal

* Unit conversion: 1 ton/2000 lbs

Considerations: Rate to Mass Conversion of State Goals

Adjusted Emission Rate * Generation = Mass Emissions

(state goal in lbs CO_2/MWh) (MWh) (lbs CO_2 *1/2000 = short tons CO_2)

- State goal is not a simple emission rate and includes adjustments to account for CO_2 mass reductions from EE, RE, some Nuclear
- Future generation is unknown: projected or historic
- New NGCC: states choose whether to include new NGCC under state goals
- Existing programs: states choose whether to include existing programs (e.g., RPS) in 111(d) state plan
  - EPA proposes that existing programs included in plan become federally enforceable
  - EPA proposes that such existing programs are excluded from the conversion scenario

Projection Approach

Apply State Goal to projected scenario

BPC Assumption:
- BSER level of EE
- Economic or BSER level of RE
- Existing nuclear units remain in operation
- Exclude new NGCC from state goal

Projection scenario
- *Includes impact of "on the books" requirements, but*
- *Excludes actions /programs intended to be enforceable under a state plan*

BPC Assumption:
- With or without RPS, RGGI, AB32

Projected CO_2 emissions from affected EGUs for 2020-2029 and 2030, represent the interim and final mass-based State Goal

* Unit conversion: 1 ton/2000 lbs

Example Projection Approaches

IPM Projection Scenarios with load growth from AEO2014

Mass A: impose rate-based state goals

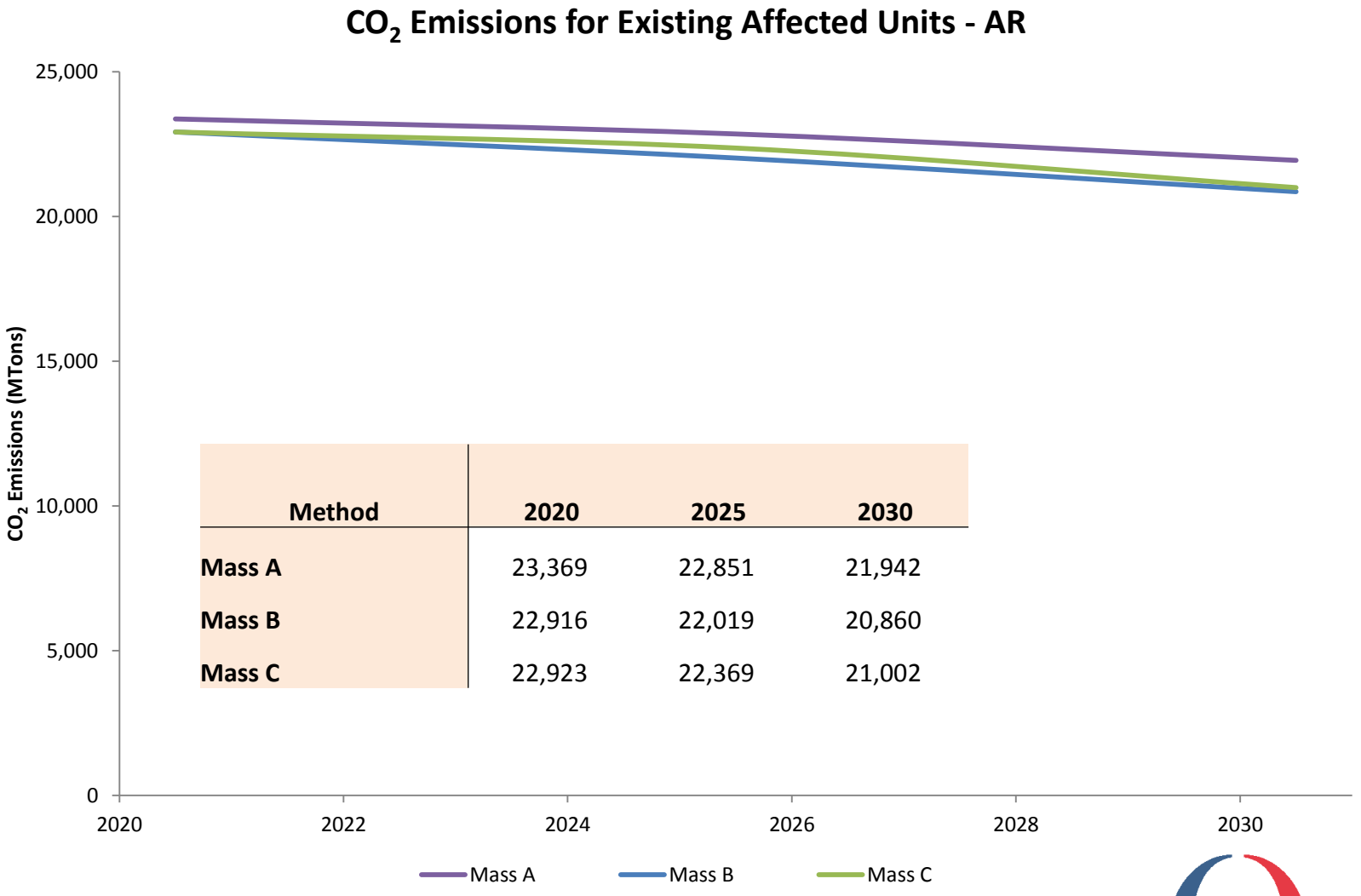
- with BSER level of EE
- economic decision to build RE or new nuclear
- existing nuclear units remain in operation
- existing programs (RPS, RGGI, AB32) turned off

Mass B: impose rate-based state goals

- with BSER level of EE and RE
- existing nuclear units remain in operation
- existing programs (RPS, RGGI, AB32) remain in scenario

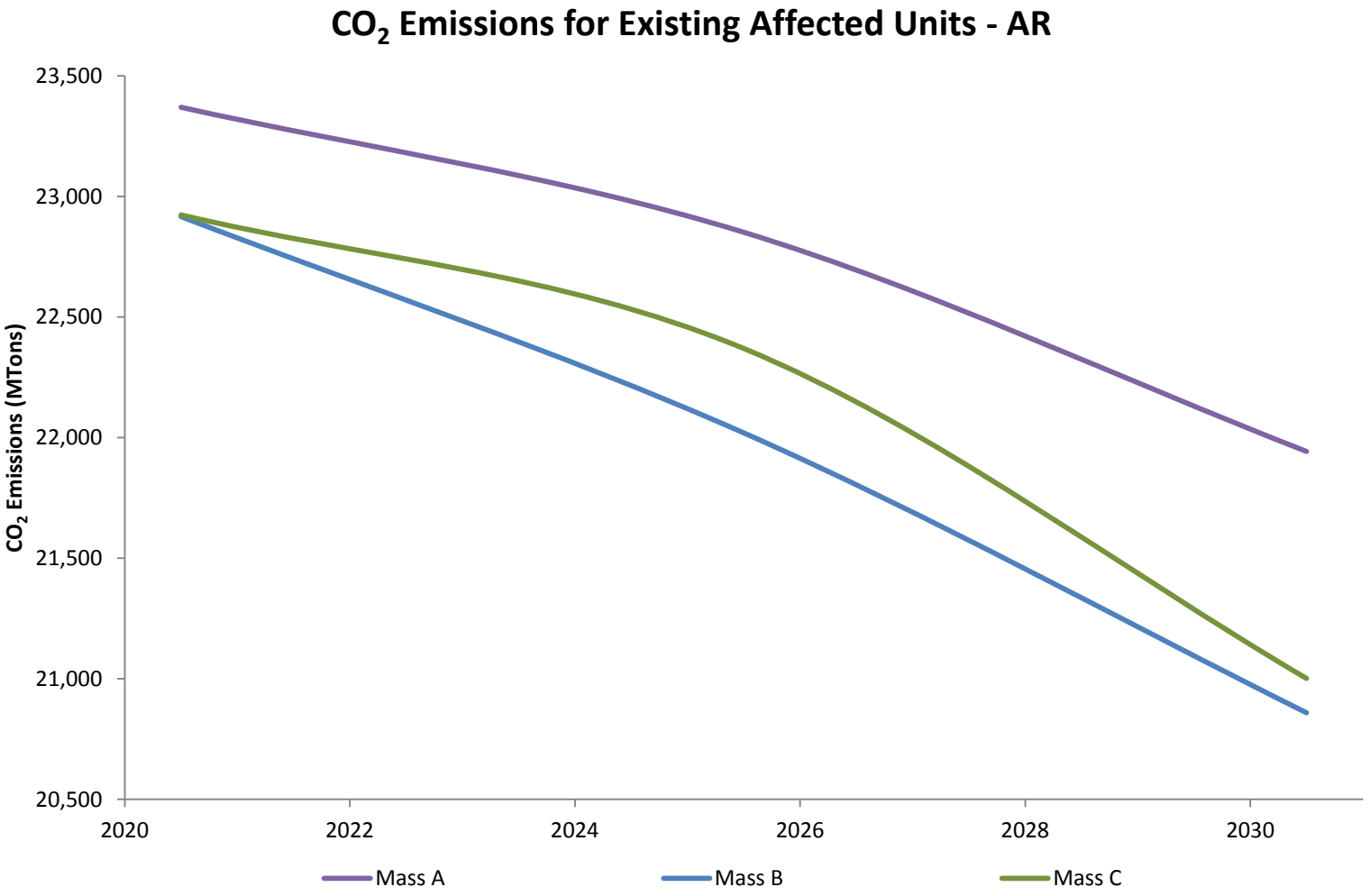
Mass C: same as Mass B, except existing programs turned off

Example Projection Approaches



Method	2020	2025	2030
Mass A	23,369	22,851	21,942
Mass B	22,916	22,019	20,860
Mass C	22,923	22,369	21,002

Example Projection Approaches (same graph, zoomed in scale)



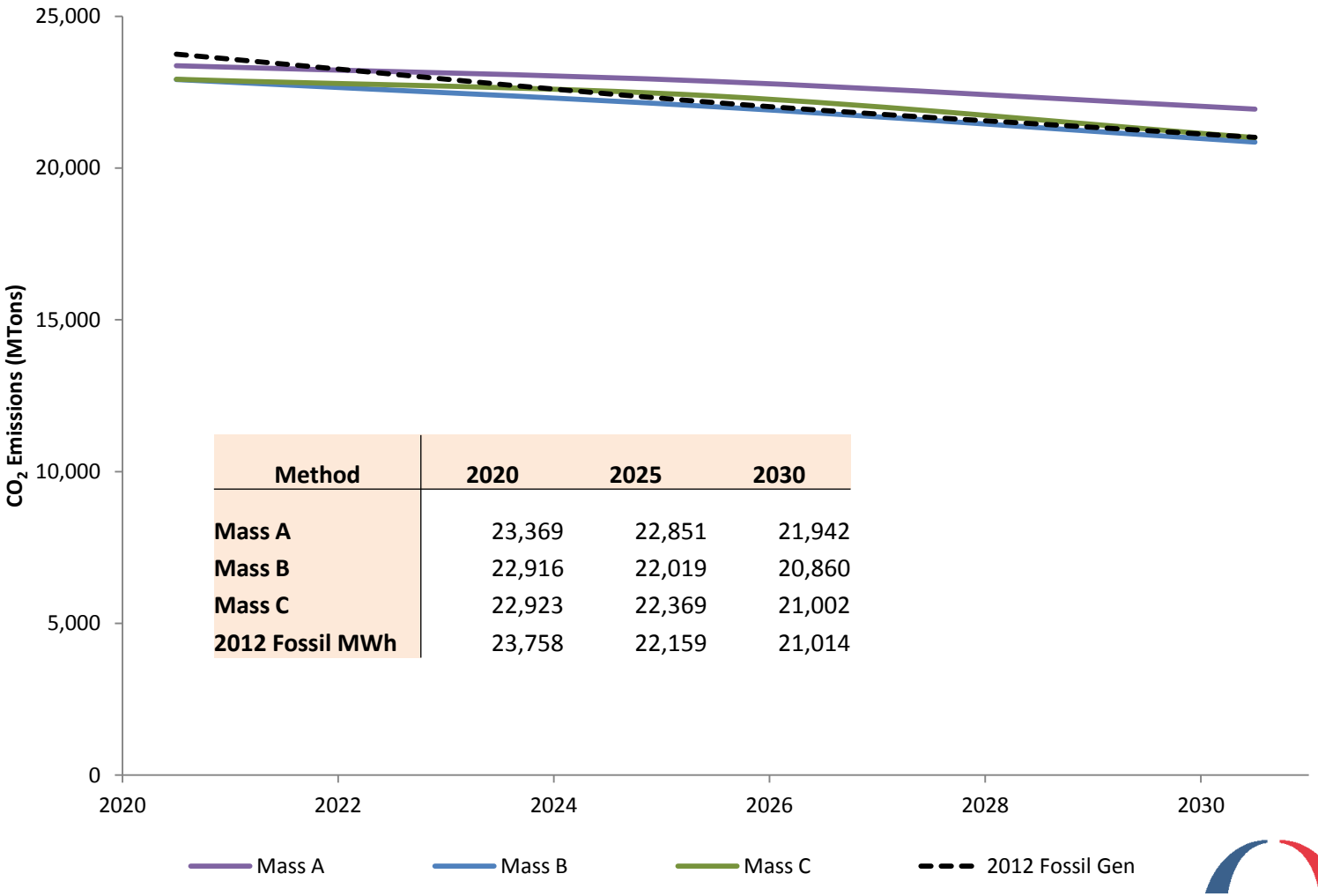
Example Historic Approaches

Rate-based State Goal * ? Generation = Mass Goal

Generation =

- 2012 fossil generation
  - For some states may be overly stringent (e.g., if already have RE in 2012)
  - Account for existing programs and clean generation?
- 2012 fossil generation [adjusted for block 3 and 4 existing] and adjusted for projected load growth

CO_2 Emissions for Existing Affected Units - AR



Method	2020	2025	2030
Mass A	23,369	22,851	21,942
Mass B	22,916	22,019	20,860
Mass C	22,923	22,369	21,002
2012 Fossil MWh	23,758	22,159	21,014

Historic or Projected?	Include new NGCC?	Exclude existing programs?
Historic	No	No
Historic	No	Yes
Historic w/load growth	Yes	No
Historic w/load growth	Yes	Yes
Projected	No	No
Projected	No	Yes
Projected	Yes	No
Projected	Yes	Yes

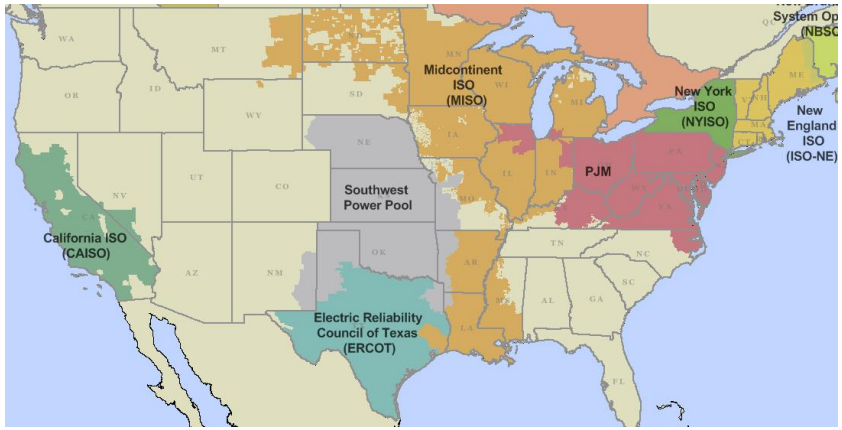
Potential Advantages of Mass-based State Goal

- Simplifies linking with other states in multi-state approach
  - Because mass-based state goals add up to a multi-state mass-based goal, a mass-based approach more readily accommodates on-ramps and off-ramps to a multi-state approach, with individual states retaining their individual mass-based state goals
- Better accommodates compliance measures that result in mass emission reductions
  - Anything that reduces CO_2 mass emissions at affected electric generating units will count towards compliance
  - Simplifies evaluation, measurement and verification of end-use energy efficiency
  - Doesn't require approved protocols to account for reductions from innovative measures (e.g., if energy storage allows for more renewable and/or nuclear power to serve peak demand)
  - Accounts for coal plant retirements

Key Take-Aways

- Magnitude of impacts from §111(d) is dependent on EPA & state interpretations & decisions, as well as market factors
- Predicting the least cost pathway to deliver energy services in compliance with §111(d) is challenging due to uncertainty over important variables, such as:
  - the price of natural gas,
  - the availability of demand-side energy efficiency, and
  - the implementation/policy decisions of other states
- This uncertainty increases the value of policy designs (such as market-based trading systems) that inherently create the incentives for implementing least cost compliance and allow affected companies flexibility to adapt to changing circumstances, rather than rely on upfront decisions about the least cost path

Key Take-Aways (continued)



- Harmonizing policy design across states, particularly in the same power market, and
- Adopting policy designs that allow access to emission reduction opportunities in other states:
  - Reduces costs
  - Limits generation shifts and differences in compliance costs across states
- Regional collaboration reduces the cost of implementation
- The availability of demand-side energy efficiency is a key driver in determining the impacts of implementing §111(d)
- Coal is projected to remain key source of generation
  - Energy efficiency may displace coal, but also free up room under the standard to enable continued fossil generation

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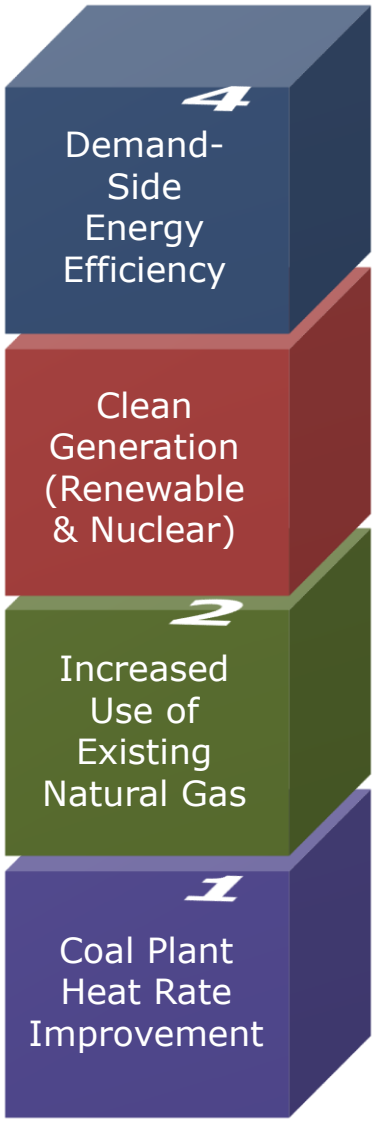
Appendix: Reference



$$\text{STATE GOAL} = \frac{\text{emissions (lbs } CO_2\text{)}}{\text{re-dispatched fossil } CO_2 \text{ emissions}}$$

$$\frac{\text{baseline fossil generation + RE goal + Nu goal + EE goal}}{\text{generation (MWh)}}$$

$$\text{GENERATION WEIGHTED AVERAGE EMISSION RATE} =$$

Zero carbon generation doesn't impact numerator

$$\frac{[\text{ER (lbs } CO_2\text{/MWh) * MWh}]_{\text{Fossil}} + [\text{0 (lbs/MWh) * MWh}]_{\text{RE}} + [0]_{\text{Nu}} + [0]_{\text{EE}}}{\text{MWh}_{\text{Fossil}} + \text{MWh}_{\text{RE}} + \text{MWh}_{\text{6\% Nu}} + \text{MWh}_{\text{EE}}}$$

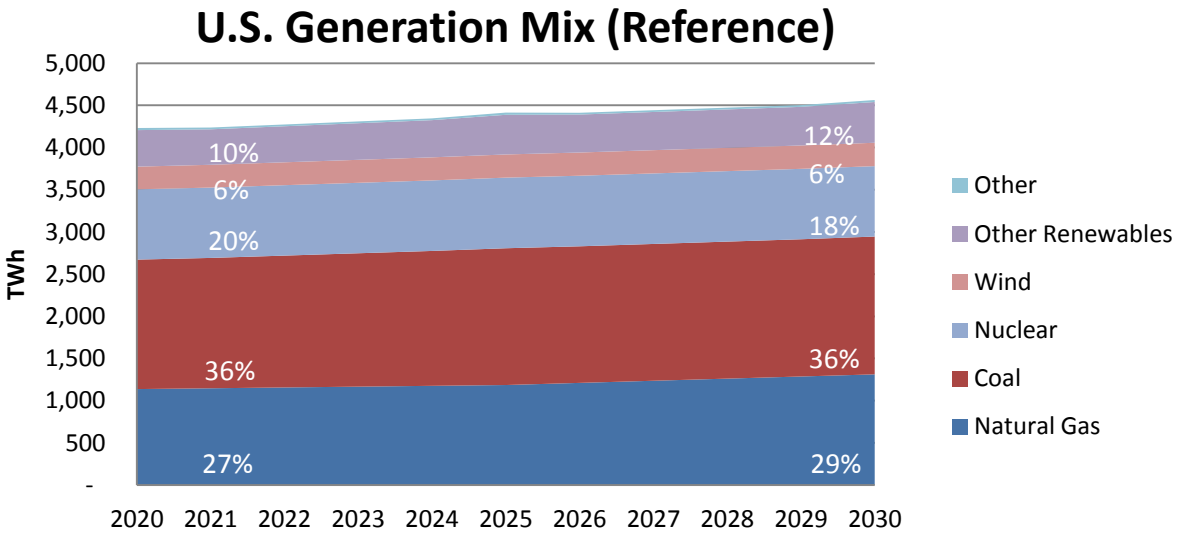
Zero carbon generation ↑ denominator, ↓ overall adjusted emission rate

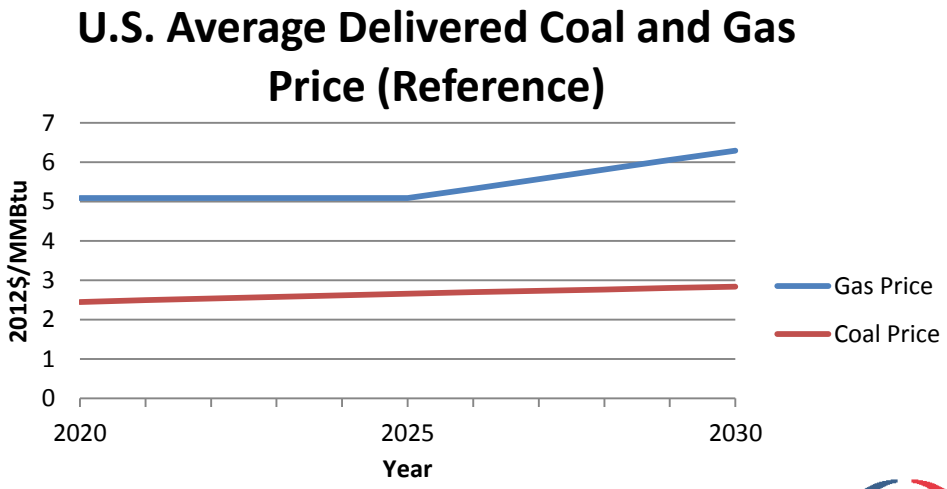
$$= \frac{\text{Emitted } CO_2 \text{ (tons)}_{\text{Fossil}} - \text{Credits (avoided tons)}_{\text{RE+NU+EE}}}{\text{Fossil Generation (MWh)}}$$

State	2012 Fossil Emission Rate (lb/MWh)	Adjusted Baseline Rate (lb/MWh)	Percent Reduction from Baseline Rate by Building Block				Total Reduction from Baseline	2030 Goal (lb/MWh)
			1	2	3	4*		
Alabama	1,518	1,444	-4%	-8%	-9%	-6%	-27%	1,059
Alaska	1,368	1,351	-1%	-8%	-3%	-14%	-26%	1,003
Arizona	1,551	1,453	-4%	-38%	-2%	-8%	-52%	702
Arkansas	1,722	1,634	-5%	-30%	-4%	-5%	-44%	910
California	900	698	0%	-5%	-7%	-11%	-23%	537
Colorado	1,959	1,714	-5%	-17%	-7%	-7%	-35%	1,108
Connecticut	844	765	0%	-4%	-12%	-13%	-29%	540
Delaware	1,255	1,234	-2%	-17%	-8%	-4%	-32%	841
Florida	1,238	1,199	-3%	-24%	-6%	-6%	-38%	740
Georgia	1,598	1,500	-4%	-14%	-19%	-6%	-44%	834
Hawaii	1,783	1,540	-2%	0%	-2%	-12%	-15%	1,306
Idaho	858	339	0%	0%	-14%	-19%	-33%	228
Illinois	2,189	1,894	-6%	-9%	-7%	-11%	-33%	1,271
Indiana	1,991	1,924	-6%	-2%	-3%	-9%	-20%	1,531
Iowa	2,197	1,552	-6%	-10%	11%	-11%	-16%	1,301
Kansas	2,320	1,940	-6%	0%	-9%	-8%	-23%	1,499
Kentucky	2,166	2,158	-6%	-2%	-1%	-9%	-18%	1,763
Louisiana	1,533	1,455	-4%	-25%	-4%	-7%	-39%	883
Maine	873	437	0%	-3%	6%	-17%	-14%	378
Maryland	2,029	1,870	-5%	-3%	-18%	-11%	-37%	1,187
Massachusetts	1,001	925	-1%	-10%	-17%	-9%	-38%	576
Michigan	1,814	1,690	-5%	-12%	-4%	-11%	-31%	1,161
Minnesota	2,013	1,470	-6%	-27%	3%	-11%	-41%	873
Mississippi	1,140	1,093	-2%	-24%	-5%	-5%	-37%	692

State	2012 Fossil Emission Rate (lb/MWh)	Adjusted Baseline Rate (lb/MWh)	Percent Reduction from Baseline Rate by Building Block				Total Reduction from Baseline	2030 Goal (lb/MWh)
			1	2	3	4*		
Missouri	2,010	1,963	-6%	-5%	-2%	-9%	-21%	1,544
Montana	2,439	2,246	-6%	0%	-8%	-7%	-21%	1,771
Nebraska	2,162	2,009	-6%	-4%	-8%	-9%	-26%	1,479
Nevada	1,091	988	-2%	-17%	-8%	-7%	-35%	647
New Hampshire	1,119	905	-2%	-20%	-20%	-5%	-46%	486
New Jersey	1,035	928	-1%	-11%	-21%	-9%	-43%	531
New Mexico	1,798	1,586	-5%	-15%	-7%	-7%	-34%	1,048
New York	1,096	978	-1%	-15%	-18%	-11%	-44%	549
North Carolina	1,772	1,647	-5%	-19%	-7%	-8%	-40%	992
North Dakota	2,368	1,994	-6%	0%	-1%	-4%	-11%	1,783
Ohio	1,897	1,850	-5%	-4%	-9%	-9%	-28%	1,338
Oklahoma	1,562	1,387	-4%	-20%	-6%	-5%	-35%	895
Oregon	1,081	717	-2%	-19%	-16%	-11%	-48%	372
Pennsylvania	1,627	1,531	-5%	-4%	-15%	-7%	-31%	1,052
Rhode Island	918	907	0%	0%	-4%	-9%	-14%	782
South Carolina	1,791	1,587	-5%	-10%	-30%	-6%	-51%	772
South Dakota	2,256	1,135	-6%	-30%	15%	-14%	-35%	741
Tennessee	2,015	1,903	-6%	-5%	-20%	-8%	-39%	1,163
Texas	1,420	1,284	-4%	-20%	-9%	-5%	-38%	791
Utah	1,874	1,813	-6%	-11%	-3%	-7%	-27%	1,322
Virginia	1,438	1,302	-3%	-16%	-12%	-6%	-38%	810
Washington	1,379	756	-4%	-38%	-19%	-11%	-72%	215
West Virginia	2,056	2,019	-6%	0%	-10%	-3%	-20%	1,620
Wisconsin	1,988	1,827	-5%	-13%	-6%	-10%	-34%	1,203
Wyoming	2,331	2,115	-6%	-1%	-9%	-3%	-19%	1,714

- **Reference case (no 111(d) policy) is largely based on EIA Annual Energy Outlook 2014**





EIA: Energy Information Administration

Assumption	Sources	Description
Electric and Peak Demand Growth	AEO 2014	
Capacity Build Costs	AEO 2014 & LBNL	Costs for all technologies come from AEO 2014, except on-shore wind capacity costs come from Lawrence Berkeley National Laboratory's (LBNL) 2012 Wind Technologies Market Report.
Natural Gas Price	ICF Integrated Gas Model	ICF estimate of the resource base serves as input to the model.
Coal Supply/Prices	AEO 2014	ICF coal supply is calibrated to AEO 2014 average minemouth prices.
Air Pollution Control Costs	EPA, EIA, AEO 2014, & AEO 2013 Early Release	Retrofit costs for most pollution control technologies come from EPA. DSI costs come from EIA. CCS retrofit costs for coal and gas come from AEO 2014 and AEO 2013 Early Release.
Nuclear Power Licensing/Operation	AEO 2014 & BPC	Reference case retirements come from AEO 2014. Plants are able to relicense at 60 years.
Firm Builds and Retirements	Research by ICFI using NEEDS and other data sources, and state (IN, IL) input.	

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