

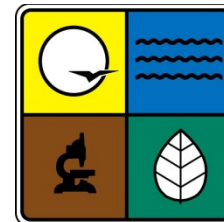
Understanding EPA's Proposed Carbon Pollution Goal for Missouri

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MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

The Form of State Goals

Statewide CO₂ Emissions from covered fossil fuel fired power plants (lb.)

State electricity generation from covered fossil plants + RE + Nuclear_(AR&UC) + EE (MW-h)

- Numerator – sum of CO₂ emissions at covered power plants
- Denominator – electricity generation in state, including
 - Covered fossil sources,
 - Existing and new renewable energy (RE) (excluding existing hydro),
 - New nuclear and ~ 6% of existing nuclear fleet's generation, and
 - Energy Efficiency (EE) accounted for as zero-emitting MW-h
- Proposed state goal – adjusted average statewide rate in units of pounds of CO₂ per Megawatt-hour (lbs CO₂/MW-h)

EPA's Proposed Goals for Missouri (lbs CO₂/MW-h)

**2020 – 2029
Interim Goal**

**2030 and Beyond
Final Goal**

1,621

1,544

The Four Building Blocks

Proposed rule establishes best system of emission reduction (BSER) to be a combination of four building blocks, which are applied to each state's current (2012) electricity generation portfolio to calculate the state goal:

- (1) measures to make coal plants more efficient,
- (2) increased use of high efficiency, natural gas combined cycle (NGCC) plants,
- (3) generating electricity from low/zero emitting facilities, and
- (4) demand-side energy efficiency

Overview of Missouri's 2030 Goal Calculation

Step		Rate (lbs CO ₂ /MW-h)	
Starting rate	2012 statewide adjusted average emission rate	1,963	} - 114 lbs/MW-h (6%)
After Block 1	Reduce CO ₂ emissions 6% due to heat rate improvements at MO's coal fleet on average	1,849	
After Block 2	Re-dispatch generation from coal to existing NGCC fleet (70% utilization)	1,742	} - 107 lbs/MW-h (5%)
After Block 3	Increase generation from zero- and low-emitting sources	1,711	
After Block 4	Increase cumulative benefits of energy efficiency programs	1,544	} - 167 lbs/MW-h (9%)

Proposed 2030 goal of 1,544 lbs/MW-h is ~21% reduction from 2012 emission rate

Calculating Missouri's Proposed State Goal

Step-by-Step

Step 1 Determine Affected Sources

Affected electric generating unit (EGU) – steam generating unit, integrated gasification combined cycle (IGCC), or stationary combustion turbine that meets following conditions:

- Base load rating greater than 73 MW (250 MMBtu/hr) heat input and
- Constructed for the purpose of supplying one-third or more of its potential electric output and more than 219,000 MW-hr net-electric output to a utility distribution system on an annual basis

Other applicability conditions apply to define the percentages/amounts of fuels burned, etc.

(Proposed regulatory text: 40 CFR 60.5790, 5795, 5800)



EPA Identified Likely Affected Missouri Sources

Plant Name	Owner/Operator
Labadie Meramec Rush Island Sioux	Ameren (Union Electric Company)
New Madrid St Francis Energy Facility Thomas Hill	Associated Electric Cooperative, Inc.
Chamois	Central Electric Power Cooperative and Associated Electric Cooperative, Inc.
Sikeston Power Station	City of Carthage, Sikeston Bd. of Municipal Utilities, City of Fulton, and City of Columbia
Columbia	City of Columbia
James River Power Station John Twitty Energy Center	City of Springfield, MO
Dogwood Energy Facility	Dogwood Energy, LLC and North American Energy Services
Asbury State Line Combined Cycle	Empire District Electric Company
Iatan	Empire District Electric Company, KCP&L, KCP&L GMO, and Missouri Joint Municipal Electric Utility Commission
Blue Valley	Independence Power and Light
Hawthorn Montrose	KCP&L
Lake Road Sibley	KCP&L GMO

Pertinent 2012 Generation Data for Missouri

Generation Type	Generation (MW-h)	Statewide average rate (lbs CO ₂ /MW-hr)
Coal Generation	72,939,512	2,085
NGCC Generation	4,854,569	890
Renewable Energy Generation *	1,298,579	-

* Note: Does not include existing hydropower

Existing Nuclear (At Risk)

2012 Nuclear Generating Capacity: ~ 1,190 MW

5.8% considered “at risk”: ~70 MW

90% capacity factor = 90% x 70MW x 8,784 hours

2012 “at risk” nuclear generation: 549,657 MW-h

Step 2 - Calculation of 2012 MO Statewide Adjusted Average Rate

1.
$$\frac{(\text{Coal gen.} \times \text{Coal emission rate}) + (\text{OG gen.} \times \text{OG emission rate}) + (\text{NGCC gen.} \times \text{NGCC emission rate}) + \text{"Other" emissions}}{\text{Coal gen.} + \text{OG gen.} + \text{NGCC gen.} + \text{"Other" gen.} + \text{Renewable gen.} + \text{"at risk" Nuclear gen.}}$$

2. *
$$\frac{(72,939,512 \times 2,085) + (0) + (4,854,569 \times 890) + (0)}{(72,939,512) + (0) + (4,854,569) + (0) + (1,298,579) + (549,657)}$$

3. 2012 Statewide Adjusted Average Rate: **1,963 lbs CO₂/MW-h**

* Note: In 2012, Missouri reported no net generation from affected oil/gas steam (OG) units or "other" units

Step 3 – Apply Building Block 1 6% Heat Rate Improvement at Affected Coal Plants

1.
$$\frac{(\text{Coal gen.} \times \text{coal emission rate}) + (\text{NGCC gen.} \times \text{NGCC emission rate})}{\text{Coal gen.} + \text{NGCC gen.} + \text{Renewable gen.} + \text{"at risk" Nuclear gen.}}$$

2.
$$\frac{(72,939,512 \times 1,959) + (4,854,569 \times 890)}{(72,939,512) + (4,854,569) + (1,298,579) + (549,657)}$$

3. After Block 1 Rate: **1,849 lbs CO₂/MW-h**

Step 4a – Apply Building Block 2 Re-dispatch Coal Generation to Existing NGCC Fleet

1.
$$\frac{(\text{Coal gen.} \times \text{coal emission rate}) + (\text{NGCC gen.} \times \text{NGCC emission rate})}{\text{Coal gen.} + \text{NGCC gen.} + \text{Renewable gen.} + \text{"at risk" Nuclear gen.}}$$

2.
$$\frac{(65,012,570 \times 1,959) + (12,781,511 \times 890)}{(65,012,570) + (12,781,511) + (1,298,579) + (549,657)}$$

	Pre-redispatch (MW-h)	Post-redispatch (MW-h)
Coal	72,939,512	65,012,570
NGCC	4,854,569 (27% capacity)	12,781,511 (70% capacity)

3. After Block 2 Rate: **1,742 lbs CO₂/MW-h**

Step 4b – Apply Building Block 2 Account for Under Construction NGCC Capacity

- This step did not apply to Missouri
- Proposed rule did not identify any “under construction” or planned new NGCC capacity in Missouri

Step 5a – Apply Building Block 3 Grow Renewable Energy

1.
$$\frac{(\text{Coal gen.} \times \text{coal emission rate}) + (\text{NGCC gen.} \times \text{NGCC emission rate})}{\text{Coal gen.} + \text{NGCC gen.} + \text{Renewable gen.} + \text{"at risk" Nuclear gen.}}$$

2.
$$\frac{(65,012,570 \times 1,959) + (12,781,511 \times 890)}{(65,012,570) + (12,781,511) + (2,763,528) + (549,657)}$$

	Renewable Generation (MW-h)
Existing as of 2012	1,298,579 (1%)
Amount assumed in 2030 goal	2,763,528 (3%)

3. After Block 3 Rate: **1,711 lbs CO₂/MW-h**

Step 5b – Apply Building Block 3 Account for Under Construction New Nuclear Capacity

- This step did not apply to Missouri
- Proposed rule did not identify any “under construction” or planned new nuclear capacity in Missouri

Step 6 – Apply Building Block 4

Account for Increased Demand-side Energy Efficiency

1.
$$\frac{(\text{Coal gen.} \times \text{coal emission rate}) + (\text{NGCC gen.} \times \text{NGCC emission rate})}{\text{Coal gen.} + \text{NGCC gen.} + \text{Renewable gen.} + \text{"at risk" Nuclear gen.} + \text{EE MW-h}}$$

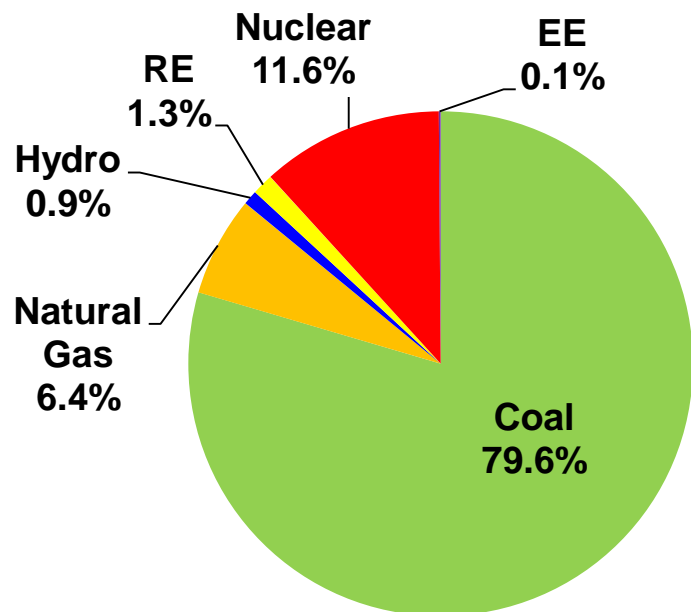
2.
$$\frac{(65,012,570 \times 1,959) + (12,781,511 \times 890)}{(65,012,570) + (12,781,511) + (2,763,528) + (549,657) + \mathbf{(8,741,141)}}$$
 ←

	EE Avoided Generation
2012 Sales (scaled up by 7.51%)	88,626,254 MW-hr
Cumulative EE Savings in 2030	9.92% of 2012 Sales
Net Import Adjustment	99.47%
EE avoided generation in 2030	8,741,141

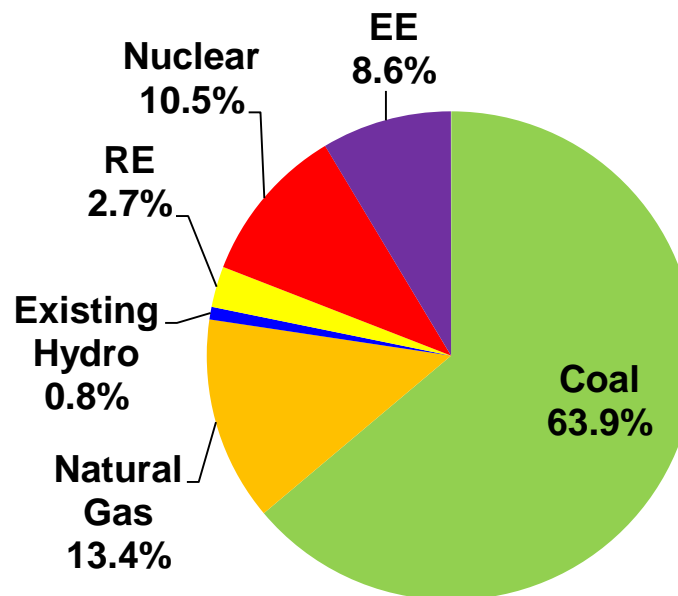
3. After Block 4 Rate: **1,544 lbs CO₂/MW-h**

Missouri Fuel Mix Comparison

Actual 2012 Generation



2030 Scenario Based on Application of
EPA's Building Blocks as Proposed



Note: This is for illustrative purposes only. The 2030 pie chart depicts one possible scenario based on applying EPA's building blocks exactly as proposed. EPA is not prescribing this approach; Missouri's 111(d) plan can be based on any mix of measures provided the goals are met in the established timeframe.

Compliance Options

Four Building Blocks

- Improve efficiency at the plant level
- Redispatch generation to lower emitting sources
- Increase renewable energy
- Demand-side energy efficiency projects

Can do more or less of any building block

Other Options

- Co-fire natural gas at coal units
- Combined heat and power
- Build new nuclear
- Build new NGCC units
- Transmission/distribution improvements
- Renewable Energy Credits?
- Biomass?

States have Flexibility

- States choose form of the goal
 - Rate-based: meet statewide average rate (lbs CO₂/MW-h)
 - Mass-based: meet a statewide budget (tons CO₂)
- States can use averaging or trading with both rate- or mass-based approaches
- Existing State EE/RE programs can be recognized

Rate-Based Considerations

- Growth is not limited as long as the goal is met
 - No need to project electricity demand
- Measures that avoid EGU emissions, such as EE/RE, can be credited
 - Requires evaluation, measurement, and verification (EM&V), which is administratively complex
- Credits/Allowances are based on generation
 - Not known each year
- EGU compliance is determined on an annual basis (or less)

Mass-Based Considerations

- Growth can be accounted for, but forecast must be accurate
 - Emissions budget cannot change after plan approval
- Administratively straightforward
 - No EM&V
- Credits/Allowances are based on statewide cap
 - Known number of allowances
- EGU compliance is determined using a 3-year average (or less)

Questions?

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