



IOWA DEPARTMENT OF NATURAL RESOURCES

LEADING IOWANS IN CARING FOR OUR NATURAL RESOURCES

Calculation of EPA's Proposed 111(d) CO₂ Emissions Goals for Iowa

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EPA's Proposed CO₂ Emissions Goals for Iowa

- Iowa's interim goal is 1,341 lbs./MWh
- The 2030 final goal is 1,301 lbs./MWh.
- The goals are in the form of an adjusted emission rate (pounds of CO₂ emitted per megawatt-hour of *net* electricity generated).

Adjusted =	lbs. CO₂	=	<u>Emissions from fossil fuel-fired affected units</u>			
Emissions	MWh-net		Generation	+ Nuclear	+ Renewable	+ Energy Efficiency
Rate			from Fossil Fuels	Capacity	Generation	Adjustment

- EPA did not set limits on individual units. Compliance is shown by the average emission rate of the affected units in the state.
- EPA has identified 42 affected units at 21 Iowa facilities.
 - 3 of those units (at Fair Station and Pella) have recently shut down.
- The goals are calculated starting with 2012 emissions and generation.
- EPA did not include hydroelectric generation in their calculations.

2012 Emissions and Generation – Data Sources

- For units that are acid rain-affected, reported CO₂ emissions were used.
 - EPA’s Clean Air Markets Division data
- For units that are not acid rain-affected, fuel use reported on Form EIA-923 and emission factors from the national greenhouse gas inventory or The Climate Registry were used.
- Net generation was taken from EIA-923 data.
- Renewable generation and electrical sales are from the Electric Information Administration (EIA).
- Nuclear capacity is from EPA’s National Electric Energy Data System (NEEDS) database.

Step 1 – Unadjusted 2012 Fossil Fuel Emission Rate for Covered Sources

2012 Rate (lbs./MWh)			2012 Generation (MWh)			2012 Capacity	Resulting Rate (lbs./MWh)
Coal Rate	OG Steam Rate	NGCC Rate	Coal Gen	OG Steam Gen	NGCC Gen	NGCC MW	Starting Point
2,251	2,422	894	33,055,156	305,111	1,437,496	1263.9	2,197

$$\text{Emissions Rate} = \frac{(\text{Coal Rate} * \text{Gen}) + (\text{OG Steam Rate} * \text{Gen}) + (\text{NGCC Rate} * \text{Gen})}{\text{Coal Gen} + \text{OG Steam Gen} + \text{NGCC Gen}}$$

As we move through the calculation steps, application of the building blocks will:

- Reduce the coal rate by heat rate improvements
- Reallocate the generation and rate for each fuel due to increased NGCC dispatch
- Add generation from nuclear and renewables to the denominator
- Add avoided generation from demand-side energy efficiency (EE) to the denominator

OG = Oil & Gas
 NGCC = Natural Gas Combined Cycle

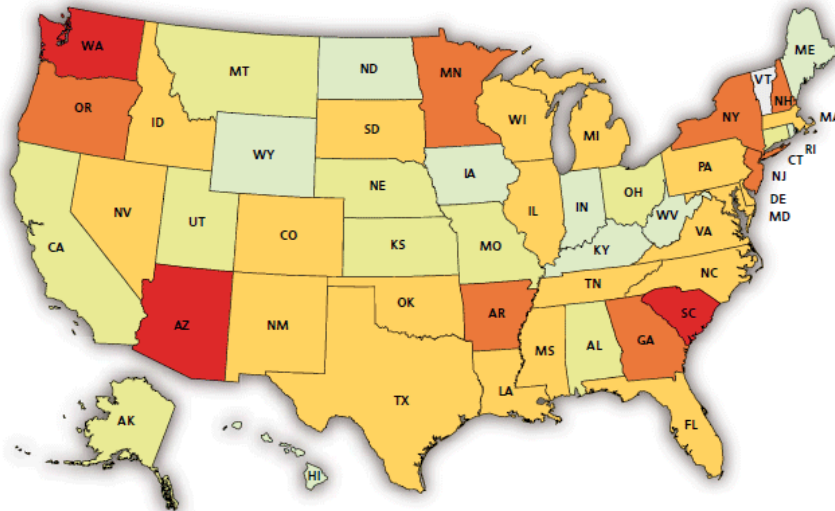
Iowa's 2012 Carbon Intensity before BSER Blocks are Applied

2012 Rate (lbs./MWh)			2012 Generation (MWh)			Capacity	2012 Generation (MWh)	Resulting Rate (lbs./MWh)
Coal Rate	OG Steam Rate	NGCC Rate	Coal Gen	OG Steam Gen	NGCC Gen	At-Risk Nuclear	Renewables	
2,251	2,422	894	33,055,156	305,111	1,437,496	277,784	14,183,424	1,552

- The 2030 final goal is a 16% reduction from the 2012 carbon intensity of 1,552 lbs./MWh.
- This is the 5th-lowest percent reduction in the U.S.

$$\text{Emissions Rate} = \frac{(\text{Coal Rate} * \text{Gen}) + (\text{OG Steam Rate} * \text{Gen}) + (\text{NGCC Rate} * \text{Gen})}{\text{Coal Gen} + \text{OG Steam Gen} + \text{NGCC Gen} + \text{Nuclear Cap} + \text{Renewable Gen}}$$

EPA's proposed carbon emissions rates for existing power plants (lbs/MWh)



Percent change (2012-2030)



State	Historical emissions rate (2012)	Avg. Interim emissions rate goal (2020 - 2029)	Final emissions rate goal (2030+)	Required change (2012-2030)	State	Historical emissions rate (2012)	Avg. Interim emissions rate goal (2020 - 2029)	Final emissions rate goal (2030+)	Required change (2012-2030)
Alabama	1,444	1,147	1,059	27%	Montana	2,245	1,882	1,771	21%
Alaska	1,351	1,097	1,003	26%	Nebraska	2,009	1,596	1,479	26%
Arizona	1,453	735	702	52%	Nevada	988	697	647	34%
Arkansas	1,640	968	910	45%	New Hampshire	905	546	486	46%
California	698	556	537	23%	New Jersey	932	647	531	43%
Colorado	1,714	1,159	1,108	35%	New Mexico	1,586	1,107	1,048	34%
Connecticut	765	597	540	29%	New York	983	635	549	44%
Delaware	1,234	913	841	32%	North Carolina	1,646	1,077	992	40%
Florida	1,200	794	740	38%	North Dakota	1,994	1,817	1,783	11%
Georgia	1,500	891	834	44%	Ohio	1,850	1,452	1,338	28%
Hawaii	1,540	1,378	1,306	15%	Oklahoma	1,397	931	895	36%
Idaho	339	244	228	33%	Oregon	717	407	372	48%
Illinois	1,895	1,366	1,271	33%	Pennsylvania	1,540	1,179	1,052	32%
Indiana	1,923	1,607	1,531	20%	Rhode Island	907	822	782	14%
Iowa	1,552	1,341	1,301	16%	South Carolina	1,597	840	772	52%
Kansas	1,940	1,578	1,499	23%	South Dakota	1,135	800	741	35%
Kentucky	2,158	1,844	1,763	18%	Tennessee	1,903	1,254	1,163	39%
Louisiana	1,466	948	883	40%	Texas	1,298	853	791	39%
Maine	437	393	378	14%	Utah	1,813	1,378	1,322	27%
Maryland	1,870	1,347	1,187	37%	Virginia	1,297	884	810	38%
Massachusetts	925	655	576	38%	Washington	763	264	215	72%
Michigan	1,696	1,227	1,161	32%	West Virginia	2,019	1,748	1,620	20%
Minnesota	1,470	911	873	41%	Wisconsin	1,827	1,281	1,203	34%
Mississippi	1,130	732	692	39%	Wyoming	2,115	1,808	1,714	19%
Missouri	1,963	1,621	1,544	21%					

Sources: U.S. EPA Clean Power Plan, CleanPowerPlanmaps.epa.gov
Map credit: Whit Varner



Calculating the Interim and Final Goals

- EPA set state-specific goals based on four best system of emission reduction (BSER) “building blocks”:

BSER Block 1	BSER Block 2	BSER Block 3	BSER Block 4
Improve coal steam EGU heat rates by 6%.	Dispatch natural gas combined cycle units to 70% capacity factor.	Increase renewables and nuclear generation.	Increase demand-side energy efficiency to 1.5% annually.

- Calculations start with the 2012 Fossil Fuel emission rate of 2,197 lbs./MWh.
 - My presentation will follow the step numbers in EPA’s Goal Computation TSD.
 - For brevity’s sake I did not include columns for “other generation” and “other emissions” i.e. useful thermal output, as Iowa’s value is zero.

Step 2 – BSER Block 1: Goal Resulting from 6% Heat Rate Improvement (HRI)

- All changes to values in each calculation step are shown in red.

2012 Rate (lbs./MWh)			2012 Generation (MWh)			2012 Capacity	Resulting Rate (lbs./MWh)
Coal Rate	OG Steam Rate	NGCC Rate	Coal Gen	OG Steam Gen	NGCC Gen	NGCC MW	
2,251	2,422	894	33,055,156	305,111	1,437,496	1,263.9	2,197
2,116	2,422	894	33,055,156	305,111	1,437,496	1,263.9	2,068

BSER Block 1 - HRI

EPA assumes a 6% heat rate improvement at a facility will directly translate to a 6% reduction in the net CO2 emission rate.

$$2,251 \text{ lbs./MWh} * 0.94 = 2,116 \text{ lbs./MWh}$$

Step 3a & 3b – BSER Block 2: Goal Resulting from HRI and Redispatch of Existing and “Under Construction” NGCC Capacity

2012 Rate (lbs./MWh)			2012 Generation (MWh)			2012 Capacity	Resulting Rate (lbs./MWh)
Coal Rate	OG Steam Rate	NGCC Rate	Coal Gen	OG Steam Gen	NGCC Gen	NGCC MW	
2,116	2,422	894	33,055,156	305,111	1,437,496	1,263.9	2,068
2,116	2,422	894	26,779,114 ↓	247,181 ↓	7,771,468 ↑	1,263.9	1,846

BSER Block 2 – NGCC

- Reflects the potential dispatch of the state’s existing NGCC fleet up to a 70% capacity factor level. Iowa’s current level is 12%.

$$1,263.9 \text{ MW NGCC capacity} * 8784 \text{ hours} * 0.70 = 7,771,468 \text{ MWh}$$

- The remaining 2012 generation is reapportioned to coal (99.09%) and OG steam (0.91%)
- Iowa currently does not have any “Under Construction” NGCC capacity.

Step 4a – BSER Block 3: Goal Resulting from 6% HRI, Redispatch of NGCC, and “Under Construction” and “At Risk” Nuclear Capacity

2012 Rate (lbs./MWh)			2012 Generation (MWh)			Capacity	Resulting Rate (lbs./MWh)
Coal Rate	OG Steam Rate	NGCC Rate	Coal Gen	OG Steam Gen	NGCC Gen	At-Risk Nuclear	
2,116	2,422	884	26,779,114	247,181	7,771,468	277,784	1,831

BSER Block 3 – Nuclear and Renewables

- EPA adds in the generation from “Under Construction” and “At Risk” nuclear capacity.
- Iowa currently does not have any “Under Construction” nuclear.
- EPA considers “At Risk” nuclear to be 5.8% of the state’s summer-time nuclear capacity with a 90% capacity factor:

$$601.4 \text{ MW capacity} * 0.058^1 * 0.90 * 8784 \text{ hours} = 277,784 \text{ MWh}$$

$$\text{Emissions Rate} = \frac{(\text{Coal Rate} * \text{Gen}) + (\text{OG Steam Rate} * \text{Gen}) + (\text{NGCC Rate} * \text{Gen})}{\text{Coal Gen} + \text{OG Steam Gen} + \text{NGCC Gen} + \text{Nuclear Cap}}$$

Step 4b – BSER Block 3: Goal Resulting from 6% HRI, Redispatch of NGCC, Under Construction and “At Risk” Nuclear Capacity, and Renewables (RE)

BSER Block 3 (continued)

- Iowa is in the North Central Region with IL, IN, MI, MN, MO, ND, SD, and WI.
- The regional (RE) target is calculated by averaging the 2020 renewable portfolio standards (RPS) of from the 5 North Central states with RPS on the books (IL, MI, MN, MO, WI) = 15%

Iowa's RE Target =

$$2012 \text{ RE Gen (from EIA) of } 56,675,403.92 \text{ MWh} * 0.15^2 = 8,565,921 \text{ MWh}$$

Step 4b – BSER Block 3 – Continued

2012 Rate (lbs./MWh)			2012 Generation (MWh)			Capacity	RE Target	Resulting Rate (lbs./MWh)
Coal Rate	OG Steam Rate	NGCC Rate	Coal Gen	OG Steam Gen	NGCC Gen	At-Risk Nuclear	RE	
2,116	2,422	884	26,779,114	247,181	7,771,468	277,784	8,565,921	1,472

BSER Block 3 (continued)

Iowa has already surpassed the North-Central regional 15% RE target, so EPA doesn't assume any additional RE for Iowa in future years.

- 2012 Iowa RE generation =14,183,424 MWh (25% of total generation)

$$\text{Emissions Rate} = \frac{(\text{Coal Rate} * \text{Gen}) + (\text{OG Steam Rate} * \text{Gen}) + (\text{NGCC Rate} * \text{Gen})}{\text{Coal Gen} + \text{OG Steam Gen} + \text{NGCC Gen} + \text{Nuclear Cap} + \text{Renewables Gen}}$$

If EPA had used Iowa's actual 2012 RE generation, the resulting rate would be 1,304 lbs./MWh.

Step 5 – BSER Block 4: Goal Resulting from HRI, Redispatch of NGCC, Nuclear Capacity, Renewables (RE), and Demand-side EE

BSER Block 4 – End-use Energy Efficiency (EE)

- Increases state EE to reach 1.5% annual incremental savings.
 - States < best practice level are given time to ramp up (0.2%/year)
 - States \geq best practice level are not required to (but get credit if they) do more

Annual EE Savings as % of Retail Sales				
Incremental Savings			Net Cumulative Savings	
2017	2020	2029	2020	2029
1.02%	1.50%	1.50%	4.65%	11.66%

- Calculate net cumulative EE from annual incremental savings
 - Annual incremental savings = first year savings from EE investment
 - EE investments continue to deliver savings for several years
 - Cumulative savings includes savings from past EE investments

Net cumulative EE for a year (GWh) =
 $(\text{incremental savings} - \text{total expiring savings})_{\text{year}} + (\text{cumulative savings})_{\text{last year}}$

Step 5 – BSER Block 4: Goal Resulting from HRI, Redispatch of NGCC, Nuclear Capacity, Renewables (RE), and Demand-side EE

2012 Rate (lbs./MWh)			2012 Generation (MWh)			Capacity	RE Target	Demand-side EE	Resulting Rate (lbs./MWh)
Coal Rate	OG Steam Rate	NGCC Rate	Coal Gen	OG Steam Gen	NGCC Gen	At-Risk Nuclear	RE	Avoided Generation	
2,116	2,422	884	26,779,114	247,181	7,771,468	277,784	8,565,921	5,730,306	1,301

BSER Block 4

- Iowa's final net cumulative savings is 11.66%. It is multiplied by the 2012 retail sales and by a 7.51% scaling factor (accounts for losses in transmission and distribution).

2029 avoided generation = 45,709,100 MWh (from EIA) * .1166 * 1.0751 = 5,730,306 MWh

Emissions =	$(\text{Coal Rate} * \text{Gen}) + (\text{OG Steam Rate} * \text{Gen}) + (\text{NGCC Rate} * \text{Gen})$
Rate	$\text{Coal Gen} + \text{OG Steam Gen} + \text{NGCC Gen} + \text{Nuclear Cap} + \text{Renewable Gen} + \text{EE gen}$

Calculating the Interim Goals 2020 – 2029

- Iowa’s EE assumptions change for each year from 2020 – 2029 based on the differing annual net cumulative savings percentages, changing the interim yearly goal.
- The interim goal of 1,341 is the average of the yearly goals from 2020 – 2029.

Year	Net Cumulative Savings%	Avoided Generation (MWh)	Yearly Goal (lbs./MWh)
2020	4.65%	2,283,039	1,398
2021	5.78%	2,841,171	1,382
2022	6.82%	3,352,063	1,367
2023	7.77%	3,817,304	1,353
2024	8.62%	4,238,412	1,341
2025	9.39%	4,616,833	1,331
2026	10.08%	4,953,948	1,322
2027	10.69%	5,251,072	1,313
2028	11.21%	5,509,459	1,307
2029	11.66%	5,730,306	1,301 Final Goal
Average 2020 - 2029			1,341 Interim Goal

Summary of Goal Computation

BSER Block	Description	Emission Rate after Block is Applied (lbs. CO2/MWh)	Reduction from Previous Block (lbs. CO2/MWh)
Starting Point	2012 Fossil Fuel Emission Rate	2,197	
1	Improve Coal Heat Rate	2,068	-128
2	Increase Dispatch of NGCC	1,846	-222
3	Renewables and Nuclear	1,472	-375
4	Expand Energy Efficiency	1,301	-170
			-895 Total

Alternate Goals

EPA is also seeking comment on two alternate Iowa goals. They were calculated using:

- 4% HRI instead of 6%
- 65% NGCC capacity instead of 70%
- 1.0% annual incremental electricity savings instead of 1.5%
- A 5 year interim goal period instead of 10 years

	Interim Goal Period	Interim Goal	Final Goal
Proposed Goal	2020 - 2029	1,341	1,301
Alternate Goal	2020 - 2024	1,436	1,417

Questions?

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<http://www.iowadnr.gov/InsideDNR/RegulatoryAir/GreenhouseGasEmissions/CarbonPollutionStandards.aspx>

<http://www2.epa.gov/carbon-pollution-standards>

<http://www2.epa.gov/cleanpowerplanttoolbox>

Acronyms

Acronym	Definition
BSER	best system of emission reduction
CAMD	Clean Air Markets Division
CO2	carbon dioxide
EE	energy efficiency
EIA	Energy Information Administration
HRI	heat rate improvement
MWh	megawatt hour
NEEDS	National Electric Energy Data System
NGCC	natural gas combined cycle
OG	oil and gas
RE	renewable energy
RPS	renewable portfolio standard
TSD	technical support document