

IPM Analysis of Individual Building Blocks for 111(d)

This analysis estimates the impacts on the power sector of applying various combinations of the 111(d) building blocks. We analyzed each block in isolation, and blocks 1/2 together with and without blocks 3 and 4. All of these scenarios are comparable to Option 1 State. These scenarios are summarized in the table below.

Scenario	Building Block			
	1	2	3	4
A				
B				
C				
D				
E				
F				
G				

For each of these scenarios, we developed state goals that are consistent with the building blocks included in the scenario. For each block, the CO₂ reduction mechanisms embedded in the state goals and the generation that qualifies for contribution to those goals are summarized below.

Block	CO ₂ Reduction Mechanism Embedded in State Goals	Generation Able to Comply with State Goals
1	6% heat rate improvement for coal steam	Coal steam
2	Re-dispatch to existing NGCC up to 70% in each state	Fossil steam Existing NGCC
3	Generation from non-hydro renewables (existing and new) and nuclear (under construction, at-risk) included in denominator	Fossil steam Non-hydro renewables (new, existing) Nuclear (under construction, at-risk)
4	Demand-side energy efficiency included in denominator	Fossil steam EE sales reductions

Table 1. CO₂ Projected CO₂ Emissions Impacts and Annualized Compliance Costs (billions of 2011\$)

	CO ₂ Emissions: Percent Change from 2005			CO ₂ Emissions: Percent Change from Base Case			Incremental Compliance Cost (billion \$)			Average Cost (\$/tonne)			Average Cost in Preamble (\$/tonne)
	2020	2025	2030	2020	2025	2030	2020	2025	2030	2020	2025	2030	
Option 1 State	-27%	-29%	-30%	-18%	-23%	-25%	7.4	5.5	8.8	19.4	10.9	15.8	
1 only	-15%	-12%	-11%	-4%	-4%	-4%	-2.2	-1.4	-0.8	-26.1	-16.1	-10.2	8
2 only	-20%	-18%	-17%	-10%	-10%	-10%	6.7	7.6	7.2	31.1	32.5	31.9	30
3 only	-15%	-14%	-14%	-4%	-6%	-7%	0.9	0.4	4.3	10.2	3.2	25.8	10-40
4 only	-14%	-16%	-17%	-4%	-8%	-10%	1.9	2.9	3.8	24.2	16.3	17.1	17-24
1 and 2	-22%	-20%	-19%	-12%	-13%	-13%	4.4	4.6	9.8	17.5	16.3	33.7	
1, 2, and 3	-25%	-24%	-24%	-15%	-17%	-18%	6.6	5.9	10.0	19.7	15.3	24.8	
1, 2, and 4	-25%	-26%	-26%	-16%	-19%	-20%	8.3	3.9	4.7	24.1	8.9	10.5	

Table 2. Projected Capacity Changes (GW)

	Coal Capacity in Service (GW)			Incremental Coal Uneconomic to Maintain (GW)			Change in New CC Builds (GW)			Change in New Non-Hydro Renewable Builds (GW)		
	2020	2025	2030	2020	2025	2030	2020	2025	2030	2020	2025	2030
Option 1 State	195	193	191	49	50	50	23	-3	-32	12	9	8
1 only	244	244	241	-2	-2	-2	-2	-1	-2	-1	-1	-1
2 only	212	212	209	31	31	30	19	20	15	1	2	2
3 only	230	229	224	12	12	14	5	10	15	10	16	19
4 only	231	230	227	13	14	14	-4	-30	-63	-1	-5	-5
1 and 2	211	211	209	32	32	31	18	20	17	0	1	1
1, 2, and 3	203	203	200	40	40	39	28	34	37	22	30	32
1, 2, and 4	209	209	206	35	35	35	8	-18	-50	-2	-5	-6

Table 3. Power Sector Gas Use and Projected Change in Delivered Natural Gas Price

	Percent Change in Power Sector Gas Use			Percent Change in Power Sector Delivered Gas Price		
	2020	2025	2030	2020	2025	2030
Option 1 State	14%	7%	-3%	11%	-3%	0%
1 only	-2%	-1%	-1%	-2%	-1%	0%
2 only	27%	28%	26%	12%	9%	7%
3 only	6%	8%	10%	4%	1%	6%
4 only	-5%	-15%	-23%	1%	-7%	-7%
1 and 2	21%	25%	26%	11%	6%	10%
1, 2, and 3	20%	22%	23%	11%	5%	9%
1, 2, and 4	18%	6%	-8%	13%	-4%	-4%

Table 4. Power Sector Coal Use and Projected Change in Minemouth Coal Price

	Percent Change in Power Sector Coal Use			Percent Change in Minemouth Coal Price		
	2020	2025	2030	2020	2025	2030
Option 1 State	-27%	-31%	-32%	-16%	-17%	-18%
1 only	-5%	-5%	-4%	-3%	-2%	-1%
2 only	-22%	-23%	-23%	-7%	-8%	-10%
3 only	-6%	-9%	-12%	-7%	-8%	-12%
4 only	-4%	-6%	-6%	-2%	-3%	-4%
1 and 2	-22%	-25%	-28%	-11%	-10%	-11%
1, 2, and 3	-25%	-28%	-30%	-16%	-17%	-18%
1, 2, and 4	-27%	-29%	-25%	-10%	-12%	-12%

Table 5. Option 1 State Block 1 Only: Modeled CO₂ Emission Rate Constraints (Adjusted MWh-Weighted-Average Pounds of CO₂ Per Net MWh from Affected Generation Included in State Goals)

State	2020 and Beyond
Alabama	2,128
Arizona	2,132
Arkansas	2,140
California	2,551
Colorado	2,092
Connecticut	2,957
Delaware	2,009
Florida	2,152
Georgia	2,157
Idaho	
Illinois	2,194
Indiana	2,029

Iowa	2,116
Kansas	2,222
Kentucky	2,036
Louisiana	2,184
Maine	
Maryland	2,031
Massachusetts	1,958
Michigan	2,121
Minnesota	2,179
Mississippi	2,344
Missouri	1,959
Montana	2,332
Nebraska	2,050
Nevada	2,138
New Hampshire	2,239
New Jersey	2,294
New Mexico	2,200
New York	2,092
North Carolina	1,935
North Dakota	2,226
Ohio	1,999
Oklahoma	2,166
Oregon	1,955
Pennsylvania	2,005
Rhode Island	
South Carolina	2,034
South Dakota	2,130
Tennessee	2,110
Texas	2,104
Utah	1,947
Virginia	2,287
Washington	2,286
West Virginia	1,940
Wisconsin	2,221
Wyoming	2,191

Table 6. Option 1 State Block 2 Only: Modeled CO₂ Emission Rate Constraints (Adjusted MWh-Weighted-Average Pounds of CO₂ Per Net MWh from Affected Generation Included in State Goals)

State	2020 and Beyond
Alabama	1,378

Arizona	901
Arkansas	1,214
California	896
Colorado	1,594
Connecticut	811
Delaware	1,016
Florida	901
Georgia	1,345
Idaho	858
Illinois	2,001
Indiana	1,953
Iowa	1,949
Kansas	2,320
Kentucky	2,110
Louisiana	1,308
Maine	848
Maryland	1,970
Massachusetts	888
Michigan	1,716
Minnesota	1,434
Mississippi	848
Missouri	1,888
Montana	2,481
Nebraska	2,056
Nevada	890
New Hampshire	878
New Jersey	973
New Mexico	1,503
New York	975
North Carolina	1,385
North Dakota	2,368
Ohio	1,810
Oklahoma	1,215
Oregon	862
Pennsylvania	1,604
Rhode Island	918
South Carolina	1,587
South Dakota	1,500
Tennessee	1,900
Texas	1,258
Utah	1,637
Virginia	1,162
Washington	995

West Virginia	2,064
Wisconsin	1,708
Wyoming	2,287

Table 7. Option 1 State Block 3 Only: Modeled CO₂ Emission Rate Constraints (Adjusted MWh-Weighted-Average Pounds of CO₂ Per Net MWh from Affected Generation Included in State Goals)

State	2020	2025	2030 and Beyond
Alabama	1,968	1,829	1,664
Arizona	1,936	1,889	1,841
Arkansas	2,034	1,965	1,892
California	341	320	320
Colorado	1,812	1,703	1,692
Connecticut	365	270	200
Delaware	1,665	1,500	1,291
Florida	1,842	1,669	1,498
Georgia	1,433	1,336	1,298
Idaho			
Illinois	1,944	1,874	1,806
Indiana	2,053	2,020	1,986
Iowa	1,781	1,781	1,781
Kansas	1,837	1,759	1,759
Kentucky	2,152	2,140	2,123
Louisiana	1,842	1,774	1,702
Maine	42	42	42
Maryland	1,831	1,671	1,529
Massachusetts	902	641	460
Michigan	2,001	1,950	1,899
Minnesota	1,659	1,659	1,659
Mississippi	1,651	1,441	1,379
Missouri	2,024	2,009	1,994
Montana	2,234	2,160	2,088
Nebraska	1,985	1,920	1,851
Nevada	1,200	1,036	907
New Hampshire	769	536	472
New Jersey	970	677	455
New Mexico	1,752	1,643	1,612
New York	961	771	608
North Carolina	1,816	1,700	1,614
North Dakota	1,984	1,984	1,984
Ohio	2,027	1,942	1,818

Oklahoma	1,597	1,482	1,482
Oregon	466	368	361
Pennsylvania	1,852	1,683	1,465
Rhode Island			
South Carolina	1,181	1,115	1,058
South Dakota	1,397	1,397	1,397
Tennessee	1,671	1,628	1,571
Texas	1,625	1,463	1,369
Utah	1,970	1,938	1,905
Virginia	1,681	1,323	1,259
Washington	620	498	414
West Virginia	1,994	1,916	1,800
Wisconsin	2,066	1,991	1,920
Wyoming	2,064	1,986	1,911

Table 8. Option 1 State Block 1 and 2: Modeled CO₂ Emission Rate Constraints (Adjusted MWh-Weighted-Average Pounds of CO₂ Per Net MWh from Affected Generation Included in State Goals)

State	2020 and Beyond
Alabama	1,329
Arizona	901
Arkansas	1,183
California	896
Colorado	1,525
Connecticut	811
Delaware	1,013
Florida	899
Georgia	1,298
Idaho	858
Illinois	1,894
Indiana	1,846
Iowa	1,846
Kansas	2,186
Kentucky	1,986
Louisiana	1,280
Maine	848
Maryland	1,870
Massachusetts	888
Michigan	1,639
Minnesota	1,380
Mississippi	848

Missouri	1,784
Montana	2,332
Nebraska	1,941
Nevada	890
New Hampshire	878
New Jersey	973
New Mexico	1,447
New York	975
North Carolina	1,330
North Dakota	2,226
Ohio	1,718
Oklahoma	1,186
Oregon	862
Pennsylvania	1,531
Rhode Island	918
South Carolina	1,515
South Dakota	1,456
Tennessee	1,798
Texas	1,229
Utah	1,559
Virginia	1,138
Washington	995
West Virginia	1,940
Wisconsin	1,627
Wyoming	2,151

Table 9. Option 1 State Blocks 1, 2, 3: Modeled CO₂ Emission Rate Constraints (Adjusted MWh-Weighted-Average Pounds of CO₂ Per Net MWh from Affected Generation Included in State Goals)

State	2020	2025	2030 and Beyond
Alabama	1,243	1,197	1,139
Arizona	837	826	815
Arkansas	1,106	1,081	1,053
California	647	633	633
Colorado	1,295	1,231	1,225
Connecticut	718	685	644
Delaware	981	945	892
Florida	858	831	800
Georgia	988	944	927
Idaho	292	291	291
Illinois	1,602	1,549	1,497

Indiana	1,767	1,742	1,716
Iowa	1,472	1,472	1,472
Kansas	1,731	1,658	1,658
Kentucky	1,973	1,962	1,947
Louisiana	1,192	1,161	1,128
Maine	451	451	451
Maryland	1,662	1,521	1,395
Massachusetts	789	730	662
Michigan	1,502	1,472	1,442
Minnesota	1,050	1,050	1,050
Mississippi	792	757	746
Missouri	1,735	1,723	1,711
Montana	2,100	2,030	1,963
Nebraska	1,769	1,713	1,652
Nevada	785	755	725
New Hampshire	656	565	532
New Jersey	826	744	641
New Mexico	1,238	1,179	1,163
New York	828	757	677
North Carolina	1,222	1,167	1,125
North Dakota	1,865	1,865	1,865
Ohio	1,653	1,598	1,515
Oklahoma	1,011	964	964
Oregon	523	460	455
Pennsylvania	1,401	1,312	1,190
Rhode Island	900	886	867
South Carolina	949	905	866
South Dakota	900	900	900
Tennessee	1,395	1,364	1,322
Texas	1,060	995	955
Utah	1,495	1,475	1,454
Virginia	1,006	911	891
Washington	460	391	338
West Virginia	1,875	1,801	1,692
Wisconsin	1,468	1,426	1,385
Wyoming	1,911	1,840	1,771

Table 10. Option 1 State Blocks 1, 2, 4: Modeled CO₂ Emission Rate Constraints (Adjusted MWh-Weighted-Average Pounds of CO₂ Per Net MWh from Affected Generation Included in State Goals)

State	2020	2025	2030 and Beyond
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Alabama	1,313	1,257	1,222
Arizona	833	785	765
Arkansas	1,163	1,103	1,067
California	817	756	731
Colorado	1,459	1,385	1,352
Connecticut	741	681	655
Delaware	1,004	971	947
Florida	879	834	809
Georgia	1,263	1,173	1,124
Idaho	672	525	475
Illinois	1,758	1,627	1,571
Indiana	1,781	1,685	1,640
Iowa	1,732	1,629	1,585
Kansas	2,147	2,008	1,918
Kentucky	1,946	1,849	1,794
Louisiana	1,260	1,182	1,132
Maine	729	651	620
Maryland	1,722	1,577	1,515
Massachusetts	826	766	740
Michigan	1,530	1,429	1,386
Minnesota	1,249	1,143	1,099
Mississippi	835	791	764
Missouri	1,752	1,660	1,604
Montana	2,254	2,146	2,097
Nebraska	1,886	1,768	1,706
Nevada	857	806	782
New Hampshire	844	787	760
New Jersey	941	835	773
New Mexico	1,392	1,310	1,273
New York	883	799	763
North Carolina	1,283	1,193	1,148
North Dakota	2,209	2,150	2,111
Ohio	1,631	1,538	1,497
Oklahoma	1,166	1,114	1,084
Oregon	739	648	612
Pennsylvania	1,455	1,385	1,354
Rhode Island	884	842	823
South Carolina	1,445	1,312	1,249
South Dakota	1,378	1,181	1,079
Tennessee	1,728	1,586	1,515
Texas	1,202	1,133	1,093
Utah	1,506	1,438	1,408
Virginia	1,118	1,047	1,002

Washington	687	510	454
West Virginia	1,924	1,879	1,852
Wisconsin	1,523	1,429	1,388
Wyoming	2,137	2,094	2,068