

Round 3 Strategy Modeling: Emissions

The purpose of this document is to summarize the emission estimates prepared for the Round 3 strategy modeling. A list of the Round 3 modeling scenarios is provided in Table 1. The state-level VOC, NO_x, and SO₂ emissions for these scenarios are provided in Figure 1 and Table 2.

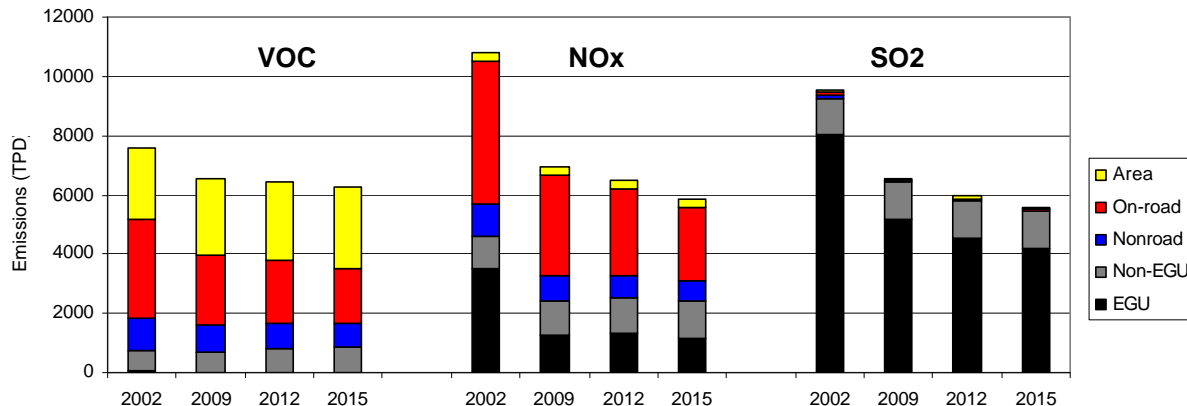


Figure 1. Round 3 Emissions Summary for 5-State LADCO Region (TPD, July weekday)

Base Year and Future Years

Updates to the 2002 base year emissions include: (1) revised area source emission estimates, (2) new NMIM runs by WDNR, which produced lower nonroad emissions, (3) revised non-EGU point source emissions for Illinois, and (4) new emissions inventories for other RPOs.

Four future year inventories were developed: 2009, 2012, 2015, and 2018. The emissions for 2009 and 2018 were derived by running the emissions model for each source sector, and the emissions for the other years were derived by using year-specific emissions for EGUs and interpolating (between 2009 and 2018) for the other source sectors.

Scenario 2

Unlike Round 2, where “on the books” was modeled first (Scenario 1) and “on the books” plus “on the way” controls were modeled second (Scenario 2), only Scenario 2 was modeled during Round 3. The on-the-books” and “on the way” controls consist of:

“On-the-books” Controls

- Current State/local regulations to meet 1-hour ozone requirements (e.g., regulations implementing Phase I/II NO_x SIP Call)
- Federal control programs incorporated into NONROAD model (e.g., Nonroad diesel rule) and the evaporative Large Spark Ignition and Recreational Vehicle standards that are not included in current model
- Federal Railroad Locomotive standards
- Federal Commercial Marine Vessel engine standards
- Federal woodstove standards
- Title IV for Phase I and II EGUs
- Federal Consumer Products standards
- Federal Architectural and Industrial Maintenance (AIM) Coatings standards
- Maximum Achievable Control Technology (MACT) standards, including several surface coating MACT standards, the Combustion Turbine MACT and the Industrial Boiler/Process Heater/reciprocating internal combustion engines (RICE) MACT

“On-the-way” Controls

- Clean Air Interstate Rule (CAIR)
- Clean Air Mercury Rule (CAMR)

Two significant changes were made to the Scenario 2 emissions: (1) new IPM modeling was conducted using updated NEEDS data and the final CAIR and CAMR rules¹, and (2) growth rates for area sources were adjusted for the 5-state region plus MN, IA, and MO (i.e., no growth was assumed for residential wood combustion and pesticides application, and all other categories were capped at 3% per year based on 1.5 times the growth in the Midwest Manufacturing Index over the last 7 years, which is 21% over 7 years).

The same “on the books” control files were used as in the Round 2 modeling. The effect of CAIR and CAMR, which affect EGUs, was accounted for in IPM.

Scenario 4

This scenario reflects “on the books”, “on the way”, plus the SO₂ and NO_x candidate control measures in the “Interim White Paper, Source Category: Electric Generating Units” (January 14, 2005). Scenario 4c approximate the effect of EGU2 for the 5-state LADCO region and Scenario 4d approximates the effect of EGU2 throughout the 5-state LADCO region, plus seven neighboring states: MN, IA, MO, KY, TN, WV, and PA.

The derivation of control factors is explained in “Identification and Evaluation of Candidate Control Measures”, prepared by: MACTEC Federal Programs / MACTEC Engineering and Consulting, Inc. (MACTEC), April 14, 2005. For SO₂, a single annual average control factor was calculated on a unit-by-unit basis. For NO_x, two control factors were calculated – one for the 7-month winter season (January to April, October to December) and the second for the 5-month summer season (May to September). This was done because units affected by the NO_x SIP Call have lower average NO_x emission rates in the summer than in the winter, and the degree of reduction needed to meet the average emission rate is less in the summer months.

Scenario 6

This 2018 scenario reflects “on the books”, “on the way”, and BART controls. The assumed BART controls apply to approximately 25 facilities in the 5-state LADCO region that were determined to be subject to BART and which were examined by MACTEC (see “Determining Which BART-Eligible Sources are Subject to BART: Summary”, December 21, 2004, and “Best Available Retrofit Technology Engineering Analysis for Non-EGU Sources – Summary and Recommendations for Next Steps”, March 30, 2005). In addition, based on preliminary information provided by MN and ND, BART controls were applied to a handful of facilities in those two states. The following control assumptions were made:

- MRPO Sources: SO₂ – 70% for taconite plants; 90% control for boilers, iron/steel plants, and refineries; 95% control for cement kilns; NO_x – 60% for taconite plants; 80% control for boilers, iron/steel plants, refineries, chemical plants, and cement kilns
- MN Sources: SO₂ – 70% for six taconite plants; 90% for boilers at two facilities; NO_x – 60% for six taconite plants; 80% for boilers at two facilities
- ND Sources: SO₂ - 63-92% for six EGUs; NO_x – 0-50% for six EGUs (control factors based on 2002 and future year actual emissions provided by State)

¹ These runs were conducted using the global model assumptions from USEPA latest IPM modeling (version 2.1.9). As a sensitivity analysis, an alternative set of fuel cost curves were developed and used in another set of IPM model runs. The results based on the 2.1.9 assumptions were used in the Round 3 modeling

Table 1. Round 3 Modeling Runs

Run	Description	2002	2009	2012	2018
Base J	2002 baseyear emissions inventory	x*			
Scenario 1	"On the books" controls		x*		
Scenario 2	a. "On the books" controls plus CAIR (based on IPM)		x*	x*	x
	b. "On the books" controls plus CAIR (simple no trading approach)				
	<i>Note: a decision is needed on whether 2a, 2b, or both should be modeled</i>				
Scenario 4	c. EGU2 in LADCO States		x*	x*	
	d. EGU2 in 12-state region (LADCO States plus MN,IA,MO,KY,TN,WV,PA)		x*	x*	
Scenario 5	Scenario 2a, plus:				
	a. EGU2 in 12-state region (LADCO States plus MN,IA,MO,KY,TN,WV,PA)				
	b. MACTEC point source SOx/NOx controls (ICI boilers and cement kilns)				
	c. MACTEC area source VOC controls in all ozone nonattainment counties				
	d. Regional fuels strategy (RFG in mandatory counties, RVP=7.0 in all other ozone NA counties)				
Scenario 6	Scenario 2 plus BART for non-EGU sources in LADCO States plus MN, ND				x
	<i>EGU1= 2009 - SOx:0.36 lb/MMBTU, NOx: 0.15 lb/MMBTU</i>				
	<i>2013 - SOx:0.15 lb/MMBTU, NOx: 0.10 lb/MMBTU</i>				
	<i>EGU2= 2009 - SOx:0.24 lb/MMBTU, NOx: 0.12 lb/MMBTU</i>				
	<i>2013 - SOx:0.10 lb/MMBTU, NOx: 0.07 lb/MMBTU</i>				
			* = additional 12 km run		

Table 2. Round 3 Emissions Summary

Round 3	VOC											
July	2002	2009C	4c	4d	2012C	4c	4d	2015C	2018C	4c	4d	6
Nonroad												
IL	228	167	167	167	167			166	166	166	166	166
IN	125	95	95	95	97			98	100	100	100	100
MI	343	301	301	301	272			242	213	213	213	213
OH	222	160	160	160	166			171	177	177	177	177
WI	215	194	194	194	173			151	130	130	130	130
5-State	1133	917	917	917	873			830	786	786	786	786
Area												
IL	471	462	462	462	469			475	482	482	482	482
IN	476	555	555	555	581			606	632	632	632	632
MI	452	466	466	466	481			497	512	512	512	512
OH	546	573	573	573	594			614	635	635	635	635
WI	488	518	518	518	538			558	578	578	578	578
5-State	2433	2574	2574	2574	2662			2751	2839	2839	2839	2839
On-Road												
IL	683	520	520	520	460			401	341	341	341	341
IN	661	411	411	411	365			318	272	272	272	272
MI	818	576	576	576	513			451	388	388	388	388
OH	802	652	652	652	580			507	435	435	435	435
WI	329	211	211	211	182			152	123	123	123	123
5-State	3293	2370	2370	2370	2100			1829	1559	1559	1559	1559
EGU												
IL	11				7			0				
IN	6				4			0				
MI	5				3			0				
OH	5				3			0				
WI	3				2			0				
5-State	30	0			20			0				
Non-EGU												
IL	256	248	248	248	279			310	341	341	341	341
IN	150	157	157	157	174			192	209	209	209	209
MI	130	113	113	113	135			156	178	178	178	178
OH	77	70	70	70	82			95	107	107	107	107
WI	88	88	88	88	99			111	122	122	122	122
5-State	701	676	676	676	770			863	957	957	957	957
IL	1649	1397	1397	1397	1382	0	0	1352	1330	1330	1330	1330
IN	1418	1218	1218	1218	1220	0	0	1215	1213	1213	1213	1213
MI	1748	1456	1456	1456	1404	0	0	1346	1291	1291	1291	1291
OH	1652	1455	1455	1455	1425	0	0	1388	1354	1354	1354	1354
WI	1123	1011	1011	1011	994	0	0	972	953	953	953	953
5-State	7590	6537	6537	6537	6425	0	0	6273	6141	6141	6141	6141

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Round 3	NOx											
July	2002	2009C	4c	4d	2012C	4c	4d	2015C	2018C	4c	4d	6
Nonroad												
IL	322	259	259	259	226			194	161	161	161	161
IN	178	141	141	141	125			110	94	94	94	94
MI	191	148	148	148	137			127	116	116	116	116
OH	253	195	195	195	179			163	147	147	147	147
WI	144	114	114	114	102			91	79	79	79	79
5-State	1088	857	857	857	770			684	597	597	597	597
Area												
IL	60	68	68	68	70			72	74	74	74	74
IN	64	67	67	67	68			70	71	71	71	71
MI	58	61	61	61	62			62	63	63	63	63
OH	50	56	56	56	58			59	61	61	61	61
WI	32	35	35	35	36			37	38	38	38	38
5-State	264	287	287	287	294			300	307	307	307	307
On-Road												
IL	1068	702	702	702	602			503	403	403	403	403
IN	856	602	602	602	518			433	349	349	349	349
MI	1119	802	802	802	700			597	495	495	495	495
OH	1215	861	861	861	738			615	492	492	492	492
WI	562	417	417	417	347			276	206	206	206	206
5-State	4820	3384	3384	3384	2904			2425	1945	1945	1945	1945
EGU												
IL	886	207	190	190	220	203	203	216	211	169	169	
IN	832	392	281	281	410	282	282	286	274	164	164	
MI	429	254	189	189	258	201	201	261	290	150	150	
OH	1074	300	228	228	285	229	229	254	240	209	209	
WI	277	137	117	117	130	111	111	133	138	84	84	
5-State	3498	1290	1005	1005	1303	1026	1026	1150	1153	776	776	
Non-EGU												
IL	363	378	378	378	402			426	450	450	450	
IN	239	234	234	234	254			275	295	295	295	
MI	218	228	228	228	246			264	282	282	282	
OH	180	174	174	174	189			204	219	219	219	
WI	102	107	107	107	111			114	118	118	118	
5-State	1102	1121	1121	1121	1202			1283	1364	1364	1364	
IL	2699	1614	1597	1597	1521	203	203	1410	1299	1257	1257	
IN	2169	1436	1325	1325	1376	282	282	1173	1083	973	973	
MI	2015	1493	1428	1428	1403	201	201	1311	1246	1106	1106	
OH	2772	1586	1514	1514	1449	229	229	1295	1159	1128	1128	
WI	1117	810	790	790	726	111	111	651	579	525	525	
5-State	10772	6939	6654	6654	6473	1026	1026	5842	5366	4989	4989	

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Round 3	SOX											
July	2002	2009C	4c	4d	2012C	4c	4d	2015C	2018C	4c	4d	6
Nonroad												
IL	31	5	5	5	5			5	5	5	5	5
IN	17	3	3	3	3			3	3	3	3	3
MI	17	3	3	3	3			3	3	3	3	3
OH	23	4	4	4	4			4	4	4	4	4
WI	13	2	2	2	2			2	2	2	2	2
5-State	101	17	17	17	17			17	17	17	17	17
Area												
IL	11	12	12	12	12			12	12	12	12	12
IN	32	32	32	32	32			32	32	32	32	32
MI	16	16	16	16	16			16	16	16	16	16
OH	22	26	26	26	26			26	26	26	26	26
WI	9	10	10	10	10			10	10	10	10	10
5-State	90	96	96	96	96			96	96	96	96	96
On-Road												
IL	31	4	4	4	4			4	4	4	4	4
IN	17	3	3	3	3			3	3	3	3	3
MI	17	3	3	3	3			3	3	3	3	3
OH	23	4	4	4	4			4	4	4	4	4
WI	13	2	2	2	2			2	2	2	2	2
5-State	101	16	16	16	16			16	16	16	16	16
EGU												
IL	1074	856	606	606	707	587	587	710	717	363	363	363
IN	2430	1362	698	698	1362	756	756	1160	1090	303	303	303
MI	1048	1130	463	463	1140	515	515	1138	1165	227	227	227
OH	2920	1322	588	588	887	525	525	737	622	862	862	862
WI	557	480	253	253	459	251	251	462	467	123	123	123
5-State	8029	5150	2608	2608	4555	2634	2634	4207	4061	1878	1878	1878
Non-EGU												
IL	374	393	393	393	341			288	236	236	236	
IN	292	308	308	308	321			334	347	347	347	
MI	163	180	180	180	190			200	210	210	210	
OH	240	241	241	241	248			255	262	262	262	
WI	163	158	158	158	163			169	174	174	174	
5-State	1232	1280	1280	1280	1263			1246	1229	1229	1229	
IL	1521	1270	1020	1020	1069	587	587	1019	974	620	620	384
IN	2788	1708	1044	1044	1721	756	756	1532	1475	688	688	341
MI	1261	1332	665	665	1352	515	515	1360	1397	459	459	249
OH	3228	1597	863	863	1169	525	525	1026	918	1158	1158	896
WI	755	652	425	425	636	251	251	645	655	311	311	137
5-State	9553	6559	4017	4017	5947	2634	2634	5582	5419	3236	3236	2007