Supporting Materials

LADCO Recommendations to EPA on a CAIR Replacement Rule

The purpose of this document is to review LADCO's recommendations to EPA on a CAIR replacement rule, along with the rationale and any supporting materials.

Introduction

Section 110(a)(2)(D) requires SIPs to…

> "… contain adequate provisions – (i) prohibiting…any source or other type of emissions activity within the State from emitting any air pollutant in amounts which will –
>
> (I) contribute significantly to nonattainment in, or interfere with maintenance by, any other State with respect to any (NAAQS)…, or
>
> (II) interfere with measures required to be included in the applicable implementation plan for any other State under part C to prevent significant deterioration of air quality or to protect visibility…"

In its decision, the U.S. Court of Appeals for the D.C. Circuit rejected EPA's approach in CAIR in which it gave "interfere with maintenance" much the same meaning as "contribute significantly to nonattainment". The Court discussed the problem of areas struggling to meet the National Ambient Air Quality Standards (NAAQS) – i.e., areas which "could fall back into nonattainment because of the historic variability" in their air quality levels. It is, therefore, necessary for EPA to independently address the "contribute significantly to nonattainment" and "interfere with measures" provisions of section 110(a)(2)(D).

To ease the administrative (and technical) burden, LADCO recommends that a necessary first step in addressing significant contribution and interference with maintenance is to identify the downwind areas of interest. (Note: LADCO's recommended test is broad enough to consider "historic variability", as instructed by the Court.) For those areas, a threshold level is proposed to determine which upwind states need to be considered for emission reductions. A 2-part, multi-sector process is then recommended to meet Clean Air Act requirements.

In summary, a 3-step approach is proposed to address the transport requirements of section 110(a)(2)(D):

(1) identify areas of interest;

(2) identify upwind states which contribute significantly to nonattainment or interfere with maintenance in these areas, and

(3) implement a multi-sector approach, as necessary, to provide an appropriate remedy to meet Clean Air Act requirements.

Identifying Areas of Interest

LADCO Recommendation:

A. While the requirements of Section 110(a)(2)(D) apply to all areas, most attention should be given to those areas not meeting or struggling to maintain the NAAQS. These "areas of interest" should be identified using monitoring and modeling data.

B. Specifically, these are areas with both base monitored design values and future modeled design values above the applicable NAAQS should be designated as areas of interest. The monitored design values are based on the maximum design value from the periods 2003-2005 through the most recent three-year period, and the future modeled values are based on future year modeling which reflects legally enforceable control measures and a conservative model attainment test - i.e., use of maximum design values rather than average design values.

   1. The use of maximum design values and a conservative model attainment test are intended to account for historic variability, which is necessary to ensure maintenance. An alternative means of accounting for historic variability is to conduct a statistical analysis of the year-to-year variation in meteorology.

   2. Requiring a more conservative model attainment test will necessitate a change in EPA's modeling guidance. EPA should also establish performance criteria to insure that the modeling is capturing transport appropriately.

   3. EPA's approach in CAIR also reflects a "monitored and modeled" test to identify areas of interest.

Discussion: In the Clean Air Interstate Rule (CAIR), EPA relied on a “modeled plus monitored” test to identify the areas of interest. Specifically, a county had to have both a measured design value for the most recent period of available ambient data (i.e., 2001-2003) and a modeled value for the 2010 base case above the air quality standard to qualify “as the downwind receptors for determining which upwind States make a significant contribution” in downwind States. EPA identified 62 counties for PM2.5 and 40 counties for ozone.

EPA was challenged by the State of North Carolina on its test to identify areas of interest. North Carolina argued that EPA’s test should address areas that are currently monitoring nonattainment. The Court found that EPA’s approach in CAIR was identical to its approach in the NOx SIP call and that EPA’s approach was reasonable. It denied North Carolina’s petition on this issue. As such, LADCO recommends that EPA continue to use a modeled plus monitored test to identify areas of interest. However, the test will need to deal with both areas not meeting and those struggling to maintain the air quality standards. In particular, as instructed by the Court, the test will need to account for historic variability in air quality levels.

We considered two methods, which assume similar approaches for ‘significant contribution to nonattainment’ and ‘interference with maintenance’. In the first method, a statistical analysis of the year-to-year variability in meteorology was conducted using the method developed by Cox and Chu (1993). Under this method, a threshold value slightly below the NAAQS could be used to address maintenance.

A second method to address maintenance uses the year-to-year variability already reflected in the ambient measurements. Under this method, areas of interest would be identified based on the monitoring data for the **highest** of the last three 3-year periods and the future year modeled values (based on the **highest** of the three 3-year periods included in the modeled attainment test, rather than the average of these three periods, which is what EPA's modeling guidelines currently recommend). An area would be on the list if the monitored and modeled values both exceed the NAAQS. Key advantages of this method are that it accounts for historic variability based on actual monitoring data, and it uses the NAAQS as the threshold. For these reasons, we recommend this approach be used.

Identifying Upwind States that Significantly Contribute to Nonattainment or Interfere with Maintenance

<u>LADCO Recommendation:</u>

A. An upwind state significantly contributes to nonattainment or interferes with maintenance in a downwind area of interest if its total impact from all source sectors equals or exceeds 1% of the applicable NAAQS.

B. Individual state contributions should be determined through a weight-of-evidence approach, including source apportionment modeling

C. Use of 1% of the NAAQS as the significance threshold is consistent with EPA's approach in CAIR.

<u>Discussion:</u> In the NOx SIP Call, EPA assumed a significance threshold for ozone of 2 ppb, which represented about 1.5% of the 1-hour ozone standard and 2.5% of the 8-hour standard (1997 version). In the Clean Air Interstate Rule (CAIR), EPA relied on this same threshold for ozone and assumed a significance threshold for PM2.5 initially based on 1% of the 15 ug/m3 annual standard. EPA subsequently rounded this value to 0.2 ug/m3, which is 1.3% of the NAAQS.

EPA was challenged by the State of North Carolina on its significance threshold for PM2.5, including its rounding to 0.2 ug/m3. The Court found that EPA's approach was reasonable and denied North Carolina's petition on this issue. As such, LADCO recommends that EPA continue to rely on significance values consistent with its prior rulemakings. Given that the ozone and PM2.5 standards have changed since these rulemakings, a reasonable approach would be to assume a specific percentage of the NAAQS as the significance threshold. Taken as a whole, the prior rulemakings suggest a value on the order of 1 – 1.5% of the NAAQS. For simplicity, we recommend a value of 1% of the NAAQS for a state to be deemed significant and included in the applicability of a CAIR replacement rule.

Implementing a Multi-Sector Remedy to Meet Clean Air Act Requirements
<u>LADCO Recommendation:</u>
A two-part process is recommended consisting of: (A) a national/regional control program adopted by EPA for electrical generating units (EGUs) and additional federal control measures for other sectors, and (B) state-led efforts to develop, adopt, and implement federally enforceable plans for each area of interest that is not expected to attain the standards even after implementation of the national/regional program.

A. <u>National/Regional Control Program</u>

A significantly contributing state (i.e., a state which contributes at least 1% to a downwind area of interest) must comply with the national/regional control program described below.

1. EGU point source strategy (applicable to units $\geq$ 25 MW)

In adopting a CAIR replacement rule, EPA should:

(a) make federally enforceable through appropriate mechanisms all NOx and SO_2 controls to comply with the original CAIR Phase I program;

(b) make federally enforceable through appropriate mechanisms optimization by no later than early 2014 of existing NOx and SO_2 controls;

(c) make federally enforceable through appropriate mechanisms application by 2015 of low capital cost NOx controls;

(d) establish statewide emission caps by no later than 2017 for all fossil fuel-fired units ≥25MW. The caps should reflect an analysis of NOx and SO_2 controls on coal-fired units ≥ 100 MW which, in combination with the three measures above, will achieve rates that are not expected to exceed 0.25 lb/MMBTU for SO_2 (annual average for all units ≥25 MW) and 0.11 lb/MMBTU for NOx (ozone seasonal and annual average for all units ≥25 MW) and which will result in lower rates in some states. Previously banked emissions under the Title IV or CAIR programs shall not be used to comply with the state-wide emission caps; and

(e) to the fullest extent allowed under the Clean Air Act, EPA should work with the states to establish regional emissions caps with full emissions trading to replace the caps currently applicable under CAIR.

We believe that regional emissions caps for any earlier year (e.g., 2015) should not be established, either in addition to or in lieu of a 2017 cap. We conducted a state-by-state analysis of what level of EGU control for NOx and SO2 is achievable over the next several years. A fundamental assumption in our analysis is a July 2012 start date for the planning, engineering, and construction of any new NOx and SO2 controls. This date reflects a January 2011 promulgation date for a CAIR replacement rule and another 18 months for adoption of state rules. Four “layers” of control were considered: (1) all NOx and SO2 controls to comply with the original CAIR Phase I program, (2) optimization of existing NOx and SO2 controls by 2014, (3) application of low capital cost NOx controls (e.g., combustion modifications) by 2015, and (4) installation of new NOx and SO2 controls (e.g., SCRs for NOx and FGDs for SO2) by 2017. We believe that the first three measures identified above are all that can be done by 2015.

We understand that EPA is considering a hybrid approach in its CAIR replacement rule involving regional emissions trading and unit-specific performance standards (cite: July 9, 2009, testimony by Regina McCarthy before the Subcommittee on Clean Air and Nuclear Safety, Committee on Environment and Public Works, U.S. Senate). As noted above, we strongly support and encourage EPA to include regional emissions trading to the fullest extent allowed under the Clean Air Act.

We believe, however, that unit-specific performance standards go beyond the requirements of section 110 and the scope of a CAIR replacement rule; inhibit trading; and that performance standards with a near-term compliance timeframe, such as 2017, are not practical for all EGUs. Although we firmly believe that is not appropriate to include performance standards in a CAIR replacement rule, if EPA decides to consider including performance standards, then EPA should work with the states to take into account the basis and timing of the requirements identified above, cost effectiveness, site specific factors (such as space limitations) and the pollution control equipment already in place on the existing fleet of EGUs. Specifically, on this last point, we believe that EPA should not require replacement or repowering of units or control systems that are sound technology and operating at a reasonable effectiveness.

2. Non-EGU point source strategy

    a. EPA should identify and prioritize other categories of point sources with major emissions of NOx and/or SO_2 (e.g., cement plants) based on a review of available emissions inventories and other information, such as source apportionment studies.

    b. For the non-EGU point sources, EPA should identify and evaluate control options for reducing NOx and/or SO_2 emissions. The evaluation should consider the technological, engineering, and economic feasibility of each control option.

    c. At a minimum, EPA should evaluate the technological, engineering, and implementation feasibility, and cost-effectiveness of controlling SO_2 and NOx emissions from industrial, commercial, and institutional boilers $\geq$ 100 MMBTU/hour.

3. Mobile source strategy, such as new engine standards for on-highway and off-highway vehicles and equipment, and a single consistent environmentally-sensitive formulated fuel.

4. Area source strategy, such as new federal standards for consumer products and architectural, industrial and maintenance coatings as originally promised by EPA in 2007.

B. <u>State- Led Attainment Planning</u>

We recommend the use of a state-led attainment planning process concurrent with developing the transport SIP to address areas of interest that are not expected to attain after implementation of the national/regional control program. The advantages of this state-led planning effort include:

- A one-size-fits-all federal solution cannot provide the most appropriate and cost-effective solution for each area;
- Attainment planning is more effective and more likely to succeed if it is done on a non-attainment area basis with a key subset of contributing states;
- Additional controls are identified where they are needed; and
- States maintain their responsibility under the Clean Air Act to establish state implementation plans.

A major contributing state (i.e., a state which contributes at least 4% to a downwind area of interest that is not expected to attain after implementation of the national/regional program) must also either:

1. In conjunction with other major contributing states, develop, adopt, and implement an appropriate attainment strategy for the area of interest, as follows:

   a. An upwind state's responsibility for achieving air quality benefits in a downwind area should be commensurate with the magnitude of the upwind state's contribution to the downwind air quality problem.
   b. To facilitate flexibility in developing control programs and reduce control costs, state planning efforts should accommodate interstate emissions trading to the fullest extent allowed by the Clean Air Act.
   c. Photochemical modeling, performed in accordance with EPA modeling guidance, should be conducted to determine the amount of emission reduction needed to provide for attainment and the relative contributions of the participating states and source sectors, and to assess candidate control measures.

2. In the event that the multi-state planning effort is unsuccessful, then each 4% state may still be able to satisfy its section 110(a)(2)(D) obligation if it can demonstrate to EPA that it has emission reductions measures for significantly contributing source categories that are commensurate with a Reasonably Available Control Measure analysis for the affected area. These measures should be determined by first identifying key pollutants and source categories that contribute to the air quality problem, and then identifying and evaluating control measures for the contributing source categories.

Discussion: A 2-part, multi-sector process is recommended consisting of: (1) a national/regional control program adopted by EPA for EGUs and additional federal control measures for other sectors, and (2) state-led efforts to develop, adopt, and implement appropriate attainment plans for each nonattainment and maintenance area of interest.

Regional air quality modeling conducted by the State Collaborative demonstrates the need for a multi-sector approach ("Regional Modeling for the Eastern U.S.: Technical Support Document", July 9, 2009). This modeling shows for ozone, mobile sources (on-road and off-road) are the dominant contributors (about 60%), and for PM2.5, point, area, and mobile sources are all important contributors – see Figure 1. Thus, a complete remedy to section 110(a)(2)(D) must deal with EGUs **and other important source sectors**.

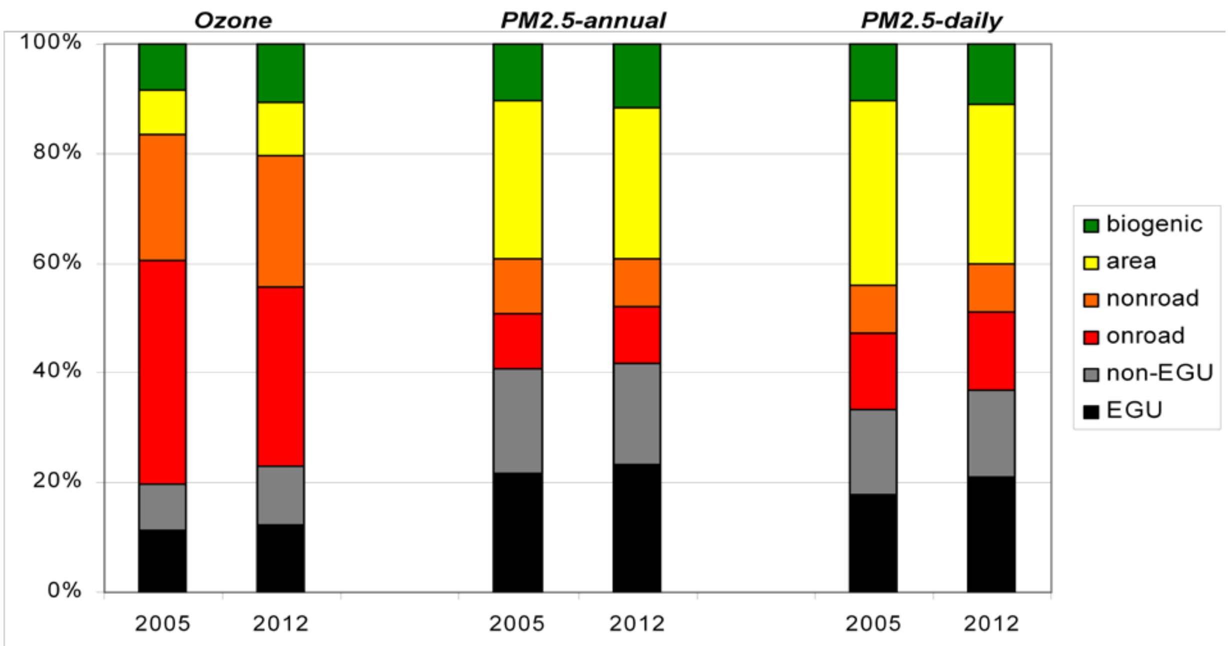


Figure 1. Source sector contributions for ozone PM2.5-annual, and PM2.5-daily based on 20-30 select (high concentration) monitors

National/Regional Control Program: A key part of the recommended national/regional control program covers EGUs, which, as seen in Figure 2, contribute about 10% (on average) for ozone and 20% (on average) for PM2.5. The LADCO States examined the level of EGU control for NOx and SO2 that is achievable over the next several years – see, for example, Attachment I. A fundamental assumption in the LADCO analysis is a **July 2012** start date for the planning, engineering, and construction of any new NOx and SO2 controls. This date reflects a January 2011 promulgation date for a CAIR replacement rule and another 18 months for adoption of state rules.

Achievable state-wide average NOx and SO2 emission rates (annual average) were determined for four future years: 2013, 2014, 2015, and 2017.

Four "layers" of control were considered on a plant-by-plant basis:

1. Current "in the pipeline" controls pursuant to CAIR Phase I; state rules; state permits; or Consent Decrees

2. By 2014, optimization of existing NOx and SO2 controls to achieve 90% (SCRs) and 95% or more (FGDs) reduction, respectively

3. By 2015, application of low capital cost NOx controls (e.g., combustion modifications)

4. By 2017, installation of new NOx and SO2 controls (e.g., SCRs for NOx and FGDs for SO2) on units $\geq$ 100 MW to support state-wide average emissions rates

Based on this plant-level, unit-level analysis of coal-fired units, the LADCO States identified the following achievable annual average emission rates:

Table 1. Results of LADCO analysis of achievable emission rates (lb/MMBTU)

NOx					
Year	**Illinois**	**Indiana**	**Michigan**	**Ohio**	**Wisconsin**
2008	0.23	0.305	0.29	0.36	0.21
2013	0.11-0.12	0.297	0.18	0.24	0.13
2014	0.11-0.12	0.171	0.15	0.18	0.12
2015	0.11-0.12	0.165	0.13	0.17	0.10
2017	0.11-0.12	0.114	0.11	0.12	0.09
SO2					
Year	**Illinois**	**Indiana**	Michigan	**Ohio**	**Wisconsin**
2008	0.50	0.93	0.91	1.09	0.57
2013	0.24-0.44	0.67	0.58	0.75	0.39
2014	0.20-0.43	0.66	0.45	0.65	0.39
2015	0.19-0.28	0.66	0.37	0.65	0.25
2017	0.15-0.23	0.25	0.25	0.256	0.16

It should be noted that the analysis is based on coal-fired units. Consideration of all units (coal, oil, gas, and biomass) will result in emission rates slightly below those indicated above. The number of post-combustion controls assumed in this analysis is provided in Table 2. The total amount of mega-wattage controlled in each state is on the order of 80-90%.

Table 2. Number of controls assumed in LADCO analysis of achievable emission rates

	NOx																**SO2**				
	SCR					**SNCR**					**ALL**						**FGD**				
	IL	IN	MI	OH	WI	IL	IN	MI	OH	WI	IL	IN	MI	OH	WI		IL	IN	MI	OH	WI
2008		23	3	19	1		4	0	15	1	17	27	3	34	2		6	23	2	16	1
2013		23	7	25	5		7	0	11	8	32	30	7	36	13		20	29	7	25	6
2014		23	12	26	5		7	0	11	8	34	30	12	37	13		29	29	12	33	6
2015		23	17	27	5		17	0	11	15	36	40	17	38	20		35	29	17	33	6
2017		32	25	34	8		17	0	14	15	36	49	27	48	23		37	48	27	56	13

Note: IL and OH numbers reflect number of units controlled, and IN and WI numbers reflect number of installations (which may cover multiple units)

Based on the above analysis, the LADCO States recommend the federal control program for EGUs reflect the state-wide average emission rates not to exceed 0.25 lb/MMBTU for SO2 (annual average) and 0.11 lb/MMBTU for NOx (ozone seasonal average).

To supplement the regional air quality modeling conducted by the State Collaborative (see "Regional Modeling for the Eastern U.S.: Technical Support Document", July 9, 2009), LADCO conducted modeling for two additional EGU control scenarios[1]:

	NOx (lb/MMBTU)	SO2 (lb/MMBTU)
Scenario E (2018)	0.125	0.25
Scenario E2 (2018)	0.11	0.25

The average improvement in air quality concentrations for the EGU scenarios (for 2018) is as follows:

Table 3. Domainwide average change in air quality concentrations between EGU scenarios

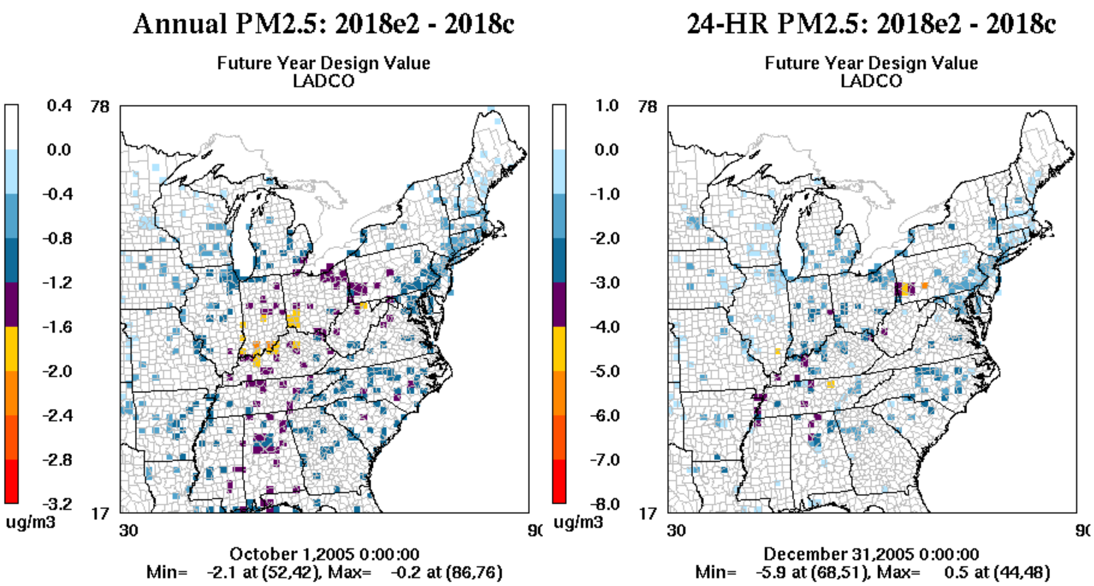
	PM-annual			**PM-daily**			**Ozone**	
	C v. E	**C v. E2**		**C v. E**	**C v. E2**		**C v. E**	**C v. E2**
NE	0.7	0.8		1.2	1.2		1.6	2.0
MW	1.1	1.1		1.3	1.4		1.8	1.8
SE	0.9	0.9		1.1	1.1		2.0	2.2
Domain	0.9	0.9		1.1	1.1		1.7	1.8

[1] The base control scenario, which reflects all existing ("on the books") controls (including all legally enforceable EGU controls and all planned EGU controls pursuant to CAIR, as identified by EPA), is referred to as Scenario C.

The amount of improvement varies spatially, as shown in Figure 2. Based on these results, two key findings should be noted:

- Scenario E2, which is consistent with the LADCO proposal for EGUs in the national/regional strategy, provides considerable air quality benefit.

- Scenario E2 provides similar air quality benefit compared to other EGU control strategies considered in the regional air quality modeling.



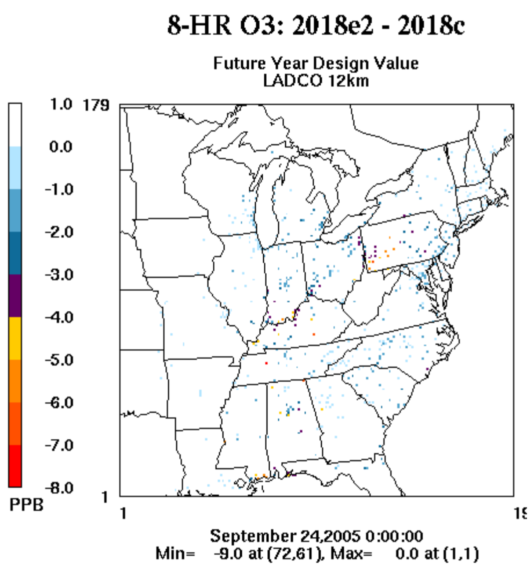


Figure 2. Change in PM2.5-annual, PM2.5-daily, and ozone concentrations, Scenario E2 v. Scenario C

State-led Planning: A major contributing state (i.e., a state which contributes at least 4% to a downwind area of interest) must, in conjunction with other major contributing states, develop, adopt, and implement an appropriate attainment strategy for the area of interest. The selection of 4% or more as the definition of a major contributing state was based on available contribution information, which showed: (1) a 4% threshold is sufficient to capture most of the total impact at key monitoring sites in eastern nonattainment areas, and (2) a 4% threshold results in a manageable number of states, which is important for a successful planning process, yet includes the necessary states specific to each residual nonattainment area. These focused, manageable state-led planning efforts will produce air quality benefits farther downwind as well, assisting farther downwind nonattainment areas in achieving the NAAQS. Specific justification is summarized below.

The regional air quality modeling conducted by the State Collaborative was reviewed to determine state and source region contributions. From a regional perspective, the home region is the dominant contributor – see Figure 3. From an individual state perspective, states with a 4% or more contribution make-up a large portion (70-80%) of the total concentration in the areas of interest – see Table 4.

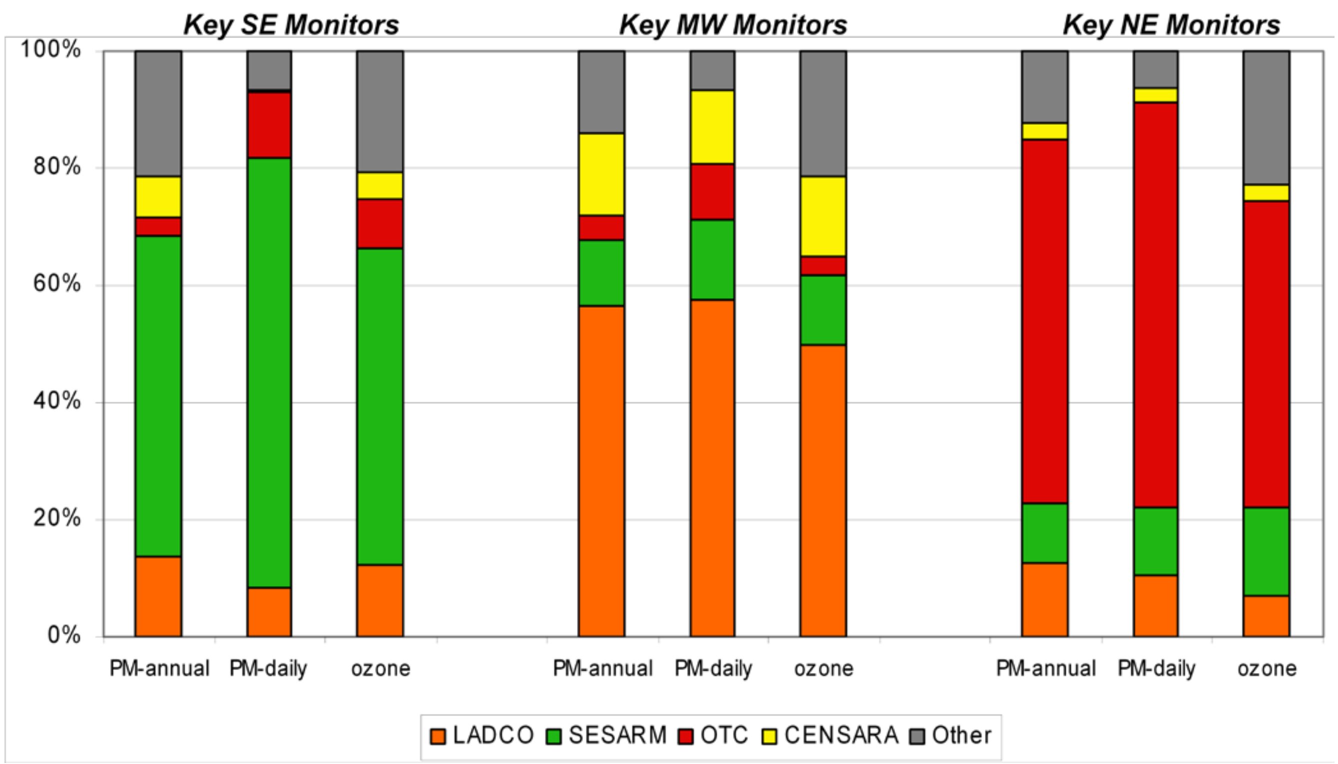


Figure 3. Source region contributions for ozone PM2.5-annual, and PM2.5-daily based on 20-30 select (high concentration) monitors

Table 4. Average (%) state-level contributions for 20-30 select monitors

	In-State	Out-State		Total						Out-of-state Contribution				
				1%	2%	3%	4%	5%		1%	2%	3%	4%	5%
PM2.5-Annual														
2005	40	60		94	86	77	71	67		89	75	58	50	42
2012	43	57		94	85	77	72	68		89	72	58	49	42
PM2.5-Daily														
2005	38	62		95	89	83	78	75		91	82	71	63	57
2012	43	57		95	90	83	78	74		91	81	70	60	52
Ozone														
2005	25	75		93	83	76	69	64		90	77	66	57	50
2012	26	74		92	84	78	71	66		93	78	68	59	52

Additional information on which states are important contributors to nonattainment problems is available from analyses of measurement data:

- Back trajectory analyses were generated by LADCO based on 2003 ozone air quality data for select locations in the eastern half of the U.S. Example results are presented in Figure 4. These contour plots are based on 72-hour, concentration-weighted back trajectories for a 500 m release height and noon start time. Upwind areas most associated with higher concentrations reflect darker red shading. Consistent with the modeling, higher concentrations are associated with the home states and nearby neighboring states (e.g., for Chicago, important upwind areas include IL, IN, and MO; and for Baltimore, MD, PA, VA, WV, and OH). Note, the plots are meant to be more qualitative than quantitative, and should not be over-analyzed to yield individual state contributions.

- Maryland Department of Environment recently presented a conceptual model of ozone formation and transport in the Northeast (Maryland Department of the Environment, 2009, and NESCAUM, 2006). The conceptual model identifies multiple transport features, including long-range transport (from sources to the south and west of the OTR), regional-scale transport within the OTR from channeled flows in nocturnal low-level jets, and local-scale transport along coastal shores due to sea and lake breezes. Evidence of an aloft ozone reservoir is based on aloft aircraft measurements and higher altitude monitoring sites. An educated estimated of the relative impacts for Baltimore suggests 30-40% from westerly transport, 10-20% from southerly nocturnal low-level jets, 10-20% from city-to-city local transport, and 10-20% local. These estimates generally agree with the regional modeling-based source apportionment, which ascribes 30-40% from states to the west (mostly, VA, WV, and PA), 20-30% from MD, 5-10% from states to the south, and 20% from background.

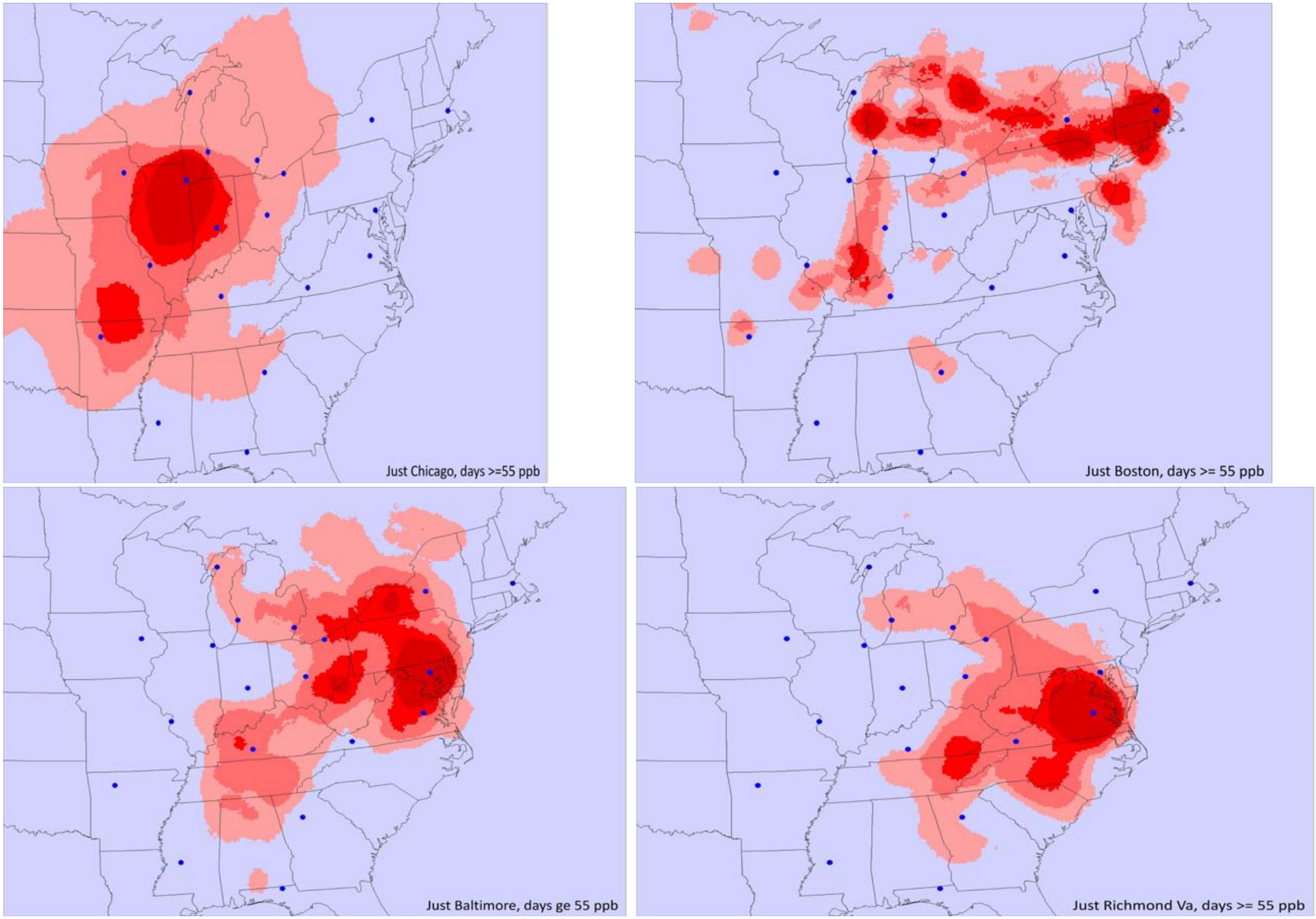


Figure 4. Contour plots of back trajectories for high concentration days for Chicago (upper left), Boston (upper right, Baltimore (lower left), and Richmond (lower right)

Note: the plots are meant to be more qualitative than quantitative and do not reflect specific individual state contributions.

- Preliminary analysis of aircraft data during the August 2003 blackout period in the Northeast was conducted by the University of Maryland (Marufu, et al, 2004). Comparison of aircraft spirals over central PA on August 15, 2003 and August 4, 2002 indicate aloft ozone about 50% lower and surface ozone about 38 ppb lower. The limited nature of this analysis (e.g., comparison of only two days) suggests the need for a more rigorous analysis. LADCO intends to examine further this event by conducting ambient data analyses (e.g., back trajectories) and applying a regional air quality model. Source apportionment methods (trajectory-based and model-based) will be used to determine the relative source sector contributions. The results of this analysis will be provided to EPA later this year. We believe this analysis will provide useful information on the effect of a large reduction in EGU emissions on air quality concentrations, and on the model's ability to simulate transport in the eastern U.S.

- Over a period from 1987 to 2003, LADCO sponsored the collection of aloft (aircraft) data for ozone, ozone precursors, and PM chemical species (2002-2003 only). An overview of the data, along with limited analyses, is presented in "Data Processing and Analysis of Aloft Air Quality Data Collected in the Upper Midwest", prepared for LADCO by Sonoma Technology, Inc.., August 5, 2004. Based on a case study analysis of the August 13-20, 2003, period, which included the blackout event noted above, key findings included: (1) background ozone levels (i.e., air entering the LADCO region) were usually about 60-70 ppb, (2) these background levels were lower than those observed in the 1991 LMOS field program when boundary conditions were about 70-100 ppb during episodes, and (3) local contributions were generally on the order of 20-40 ppb (and as high as 60 ppb). Furthermore the report stated that "it is not clear from this analysis whether the shutdown of power plants had any influence on air quality in the Midwest."

The regional air quality modeling conducted by the State Collaborative was also reviewed to determine which states contribute at different threshold levels – 1%, 2%, 3%, 4%, and 5% of the NAAQS. Tables 5 – 7 summarize the states which contribute to the areas of interest for PM2.5-annual, PM2.5-daily, and ozone. (Note, Table 8 includes a representative set of ozone areas of interest relative to the 75 ppb NAAQS.) The tables show that the number of 4% or more states is generally on the order of 3-4, while the number 1% or more states is 10-15. This shows that a threshold on the order of 4% will provide for a manageable number of states, which is important for a successful planning effort.

Table 5. Areas of interest and contributing states (at different thresholds) for PM2.5-annual

	>0.15 ug/m3	>0.30	>0.45	>0.60	>0.75
Southeast					
* Atlanta, GA	IN, OH, AL, GA. SC, NC, TN, KY	AL, GA, SC, TN	AL, GA	GA	GA
* Macon, GA (M)	IN, OH, AL, GA, FL, SC, NC, TN, KY, VA	AL, GA, SC, NC	GA	GA	GA
Midwest					
* Cleveland, OH	IL, IN, MI, OH, WI, KY, WV, PA, NY, CAN	IL, IN, MI, OH, WV, PA, CAN	IN, MI, OH, PA, CAN	MI, OH, PA, CAN	MI, OH, PA, CAN
* Detroit, MI	IL, IN, MI, OH, WI, IA, MN, MO, KY, WV, PA, NY, CAN	IL, IN, MI, OH, WI, PA, CAN	IL, IN, MI, OH, CAN	IN, MI, OH, CAN	MI, OH, CAN
* Granite City, IL	IL, IN, OH, MI, WI, IA, MN, MO, TN, KY	IL, IN, MI, IA, MO	IL, IN, MO	IL, MO	IL, MO
* Cincinnati, OH (M)	IL, IN, MI, OH, WI, IA, MO, TN, KY, WV, PA, CAN	IL, IN, MI, OH, KY	IL, IN, MI, OH, KY	IN,OH, KY	IN, OH, KY
* Chicago, IL (M)	IL, IN, MI. OH, WI, IA, MN, MO, KY, CAN	IL, IN, MI, OH, WI, IA, MO	IL, IN, MI, WI	IL, IN, MI, WI	IL, IN, MI, WI
* Indianapolis, IN (M)	IL, IN, MI. OH, WI, IA, MN, MO, TN, WV, PA, KY, CAN	IL, IN, MI, OH, WI, MO, KY	IL, IN, MI, OH, KY	IL, IN, MI, OH, KY	IL, IN, OH
Northeast					
* Liberty-Clairton, PA	IL, IN, MI, OH, WI, KY, WV, VA, PA, NY,CAN	IN, OH, MI, KY, WV, PA, CAN	MI, OH, WV, PA	OH, WV, PA	OH, WV, PA
* New York, NY	OH, MI, VA, MD, PA, NY, NJ, CT/RI, MA, CAN	PA, NY, NJ, CAN	PA, NY, NJ	PA, NY, NJ	PA, NY, NJ

Table 6. Areas of interest and contributing states (at different thresholds) for PM2.5-daily

	>0.35 ug/m3	>0.75	>1.05	>1.5	>1.75
Southeast					
* Birmingham, AL (M)	IN, OH, GA, SC, NC, TN, KY, VA, WV, PA, NY	IN, OH, GA, TN, KY, VA, WV, PA	OH, GA, TN, KY, WV, PA	OH, GA, TN, KY, WV, PA	OH, GA, KY, WV, PA
Midwest					
* Chicago, IL	IL, IN, MI. OH, WI, IA, MO, KY, PA, CAN	IL, IN, MI, OH, WI, IA, MO, KY	IL, IN, MI, OH, WI, MO	IL, IN, MI	IL, IN, MI
* Cleveland, OH	IL, IN, MI, OH, WI, KY, WV, PA, NY, CAN	IN, MI, OH, PA, NY, CAN	IN, MI, OH, PA, CAN	MI, OH, PA, CAN	MI, OH, PA, CAN
* Detroit, MI	IL, IN, MI. OH, WI, IA, MO,TN, KY, WV, PA, NY, CAN	IL, IN, MI, OH, KY, PA, CAN	IL, IN, MI, OH, KY, CAN	IL, IN, MI, OH, CAN	IN, MI, OH, CAN
* Milwaukee, WI	IL, IN, MI, OH, WI, IA, MN, MO, KY, CAN	IL, IN, MI, WI, IA, MN, MO	IL, IN, MI, WI	IL, IN, MI, WI	IL, WI
* Green Bay, WI	IL, IN, MI, OH, WI, IA, MN, MO, KY, CAN	IL, IN, MI, WI, IA, MN, MO	IL, IN, MI, WI, IA, MN, MO	IL, MI, WI, IA	IL, MI, WI, IA
* Granite City, IL (M)	IL, IN, OH, MI. WI, IA, MN, ND, MO, PA, CAN	IL, IN, OH, MI, WI, IA, MN, MO	IL, IN, OH, MI, IA, MO	IL, MO	IL, MO
* Muscatine, IA (M)	IL, IN, OH, MI, WI, IA, MN, ND. WV. PA, CAN	IL, IN, MI, OH, WI, IA, MN, MO	IL, IN, MI, WI, IA, MN, MO	IL, IN, MI, WI, IA, MN	IL, IN, MI, WI, IA, MN
Northeast					
* Baltimore, MD	IN, OH, NC, VA, WV, MD, DE, PA, NY, NJ, KY, CT/RI, MA, CAN	OH, VA, WV, MD, PA, NY, NJ	VA, MD, PA, NY, NJ	VA, MD, PA, NY	VA, MD, PA
* Lancaster, PA	IN, MI, OH, NC, VA, WV, MD, DE, PA, NY, NJ, CT/RI, MA, CAN	OH, VA, MD, PA, NY, NJ	VA, MD, PA, NY, NJ	VA, MD, PA, NY, NJ	MD, PA, NY
* Liberty-Clairton, PA	IL, IN, MI, OH, KY, WV, PA, NY, VA, MD, CAN	IN, MI, OH, KY, WV, PA, NY	OH, KY, WV, PA	OH, WV, PA	OH, WV, PA
* New York, NY	IN, MI, OH, VA, WV, MD, PA, NY, NJ, MA, CT/RI, DE, NC, CAN	OH, VA, MD, PA, NY, NJ, MA, CT/RI	PA, NY, NJ	PA, NY, NJ	PA, NY, NJ

Table 7. Areas of interest and contributing states (at different thresholds) for ozone

	>0.85 ppb	>1.70	>2.55	>3.40	>4.25
Southeast					
* Atlanta, GA	AL, MS, GA, FL, SC, NC, TN, KY, VA	AL, GA, SC, NC, TN	AL, GA, SC, TN	AL, GA	AL, GA
* Charlotte, NC	IN, OH, AL, GA, SC, NC, TN, KY, VA. WV	SC, NC, TN, KY, VA	SC, NC, TN, VA	SC, NC, TN, VA	SC, NC
Midwest					
* Chicago, IL (Kenosha, WI)	IL, IN, OH, MI, WI, MO, KY, WV, CAN	IL, IN, MI, OH, WI, MO, KY, CAN	IL, IN, MI, OH, WI, MO, KY	IL, IN, MI, WI, MO	IL, IN
* Holland, MI	IL, IN, OH, MI, WI, IA, MO, TN, KY, PA, CAN	IL, IN, OH, MI, WI, MO	IL, IN, MI, WI, MO	IL, IN, MI, WI, MO	IL, IN, MI, MO
* St. Louis, MO	IL, IN, OH, MI, MO, MS, KY, TN, IA	IL, IN, OH, MO, TN, KY	IL, IN, MO, KY	IL, IN, MO	IL, MO
* Cleveland, OH	IL, IN, OH, MI, MO, TN, KY, VA, WV, PA, NY, CAN	IL, IN, OH, MI, KY, PA, CAN	IL, IN, OH, MI, KY, PA, CAN	IN, OH, MI, KY, PA, CAN	IN, OH, MI, PA
* Cincinnati, OH (Campbell, KY)	IL, IN, MI, OH, MO, TN, KY WV, PA, CAN	IL, IN, OH, MO, TN, KY	IL, IN, OH, TN, KY	OH, KY	OH, KY
* Sheboygan, WI	IL, IN, OH, MI, WI, MO, TN, KY, VA, WV, PA, CAN	IL, IN, OH MI, WI, MO, KY	IL, IN, OH, MI, WI, MO, KY	IL, IN, MI, WI	IL, IN, WI
Northeast					
* Washington, DC	IN, OH, MI, NC, KY, VA, WV, MD, PA, NJ, NY, CAN	OH, NC, VA, WV, MD, PA, NY	OH, VA, WV, MD, PA	OH, VA, MD, PA	VA, MD, PA
* Baltimore, MD	IN, OH, MI, NC, TN, KY, VA, WWV, MO, PA, NJ, NY, CAN	OH, KY, VA, WV, MD, PA, NY	OH, VA, WV, MD, PA	VA, WV, MD, PA	VA, MD, PA
* Philadelphia, PA	IL, IN, OH, MI, NC, KY, VA, WV, MD, DE, PA, NJ, NY, CAN	OH, VA, MD, WV, PA, NJ, NY, CAN	MD, DE, PA, NJ, NY	NY, PA, NJ	NY, PA, NJ
* Springfield, MA	OH, NC, KY, VA, WV, MD, PA, NJ, NY, CT/RI, MA, CAN	OH, NC, VA, MD, PA, NJ, NY, CT/RI, MA, CAN	MD, VA, PA, NJ, NY, CT/RI, MA	VA, PA, NJ, NY, CT/RI, MA	PA, NJ, NY, CT/RI, MA
* Greater Connecticut	OH, NC, KY, VA, WV, MD, PA, NJ, NY, CT/RI, MA, CAN	OH, NC, VA, MD, PA, NJ, NY, CT/RI, CAN	VA, NC, PA, NJ, NY, CT/RI	VA, PA, NJ, NY, CT/RI	PA, NJ, NY, CT/RI
* New York, NY (Danbury, CT)	IN, OH, NC, KY, VA, WV, MD, PA, NJ, NY, CT/RI, CAN	OH, NC, VA, MD, PA, NJ, NY, CT/RI, CAN	VA, PA, NJ, NY, CT/RI	VA, PA, NJ, NY, CT/RI	PA, NJ, NY, CT/RI

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Attachment I

State-Level Analysis of Achievable EGU Emission Rates in the LADCO Region

Illinois – see State of Illinois' Multi-Pollutant Standard/Combined Pollutant Standard (Illinois Mercury Rule, 35 Ill. Adm. Code Part 225)

Indiana – copy attached

Michigan

Ohio – copy attached

Wisconsin – copy attached

Indiana Analysis

SO_2

1. Incorporated changes/controls that occurred or are projected to occur between the baseline year and the year 2013. Due to the timing of the controls that were installed between the years 2005 and the year 2008, 2005 was chosen the base year for analysis to capture the effect of controls installed. One power plant is projected to switch to IGCC and three coal-fired units are projected to shutdown. During this time, interval scrubbers were installed on several units and the scrubbers on several units were upgraded. Several more controls are projected to be installed.

2. By the year 2015, several pre-2005 with reported efficiencies less than 95% were assumed to be upgraded to 95%.

3. By the year 2017, new scrubbers were installed on units in order of their capacities and emissions. Units >100 MW were considered for installation and an efficiency equal to 95% or a floor rate equal to 0.06 lb/MMBtu was assumed. The projected emission rates are given below:

Year	Emission rate (lb/MMBtu)
2005	1.31
2006	1.27
2007	1.08
2008	0.93
2013	0.67
2015	0.68
2017	0.25

NO_x

1. Incorporated changes/controls that occurred or are projected to occur between the baseline year and the year 2013. The year 2008 was chosen as the base year for analysis. One power plant is projected to switch to IGCC and three coal-fired units are projected to shutdown. SNCRs are projected to be installed on three units.

2. In the year 2014, existing post-combustion controls were assumed to begin year round operation. Emission rates equal to 0.25 lb/MMBtu for SNCRs and 0.06 lb/MMBtu were assumed.

3. In the year 2015, low capital cost controls were applied. SNCRs were considered for units <200 MW at an efficiency equal to 35% or at a floor rate equal to 0.25 lb/MMBtu. Controls were installed on units in order of their capacities and emissions.

4. In the year 2017, SCRs on units >200 MW at a control efficiency equal to 90% or at a floor emission rate equal to 0.06 lb/MMBtu were applied. Controls were installed on units in order of their capacities and emissions. The projected emissions are given below:

Year	Emission rate (lb/MMBtu)
2008	0.305
2013	0.297
2014	0.171
2015	0.165
2017	0.114

Ohio Analysis[2]

SO2

- Incorporated reductions in rates based upon in the pipes controls that are locked in by the companies based on company provided schedule.
    - o If consent decree required retire, retrofit or repower in the future we assumed a retrofit level of control would be applied.
- Incorporated additional control requirements for units where the company has not indicated future control:
    - o Required scrubbers installed by 2017.
    - o Required optimization by 2014 if it was to meet 95% or by 2017 if it was to achieve greater than 95% efficiency based on 2008 base year.
- Required continuous operation for all controls upon installation or by 2015-2017 (assessed on unit-by-unit basis).
- Applied rates of 0.20 for scrubbers which would equate to approximately 97+% control for higher sulfur coals or 95% control for blends.
    - o This rate was still applied to sources currently controlled whose baseline rates were below 0.20 in 2008 to provide a safety margin so that coal use would not be limited.
    - o This rate was also applied to sources currently controlled whose baseline rates were above 0.20 in 2008 but we had reason to believe optimization is realistic. See next bullet for exception.
- Applied rates of 0.25 to known high sulfur units based upon factors such as: company indications of continuing to use high sulfur coals, recently installed scrubbers, company indications of 95% efficiencies during 2007 and 2008, etc.
- Applied rates of 0.30 to two small units currently controlled (120 MW each) with known higher rates.
- Did not require control on the following units based upon size and fuel use characteristics. However, required these sources to maintain use of lower S coal/blends or begin use of lower S coal/blends. This was a unit-by-unit analysis of 2008 base year rates, S content used and company indications of future coal use:
    - o Four units at 100 MW and below – no changes.

[2] This identifies the methodology that was used to arrive at interim and final 2017 rates. Use of terminology such as “required” does not imply these exact strategies and cutoffs will be used to implement said rates.

NOx

- Incorporated reductions in rates based upon in the pipes controls that are locked in by the companies based on company provided schedule.
    - If consent decree required retire, retrofit or repower in the future we assumed a retrofit level of control would be applied.
- Incorporated additional control requirements for units where the company has not indicated future control:
    - Required SCR or SNCR installed by 2017.
        - SCR required for sources roughly greater than 250 MW. Assumed a 0.08 rate could be achieved (assessed on unit-by-unit basis).
            - This rate was still applied to sources currently controlled whose baseline rates were below 0.08 in 2008 to provide a safety margin.
            - This rate was also applied to sources currently controlled whose baseline rates were above 0.09 in 2008 but we had reason to believe optimization is realistic.
            - This required some sources to upgrade from SNCR to SCR.
        - SNCR required for sources roughly between 130 and 250 MW. Assumed 50% reduction in rate over base year. Rates ranged from 0.11 to 0.25 (higher end rare).
- Required low NOx burners by 2015 for those missing regardless of size (assumed 30% reduction over base year).
- Required optimization by 2014 of existing controls where it appeared realistic (assessed on unit-by-unit basis).
- Required continuous operation for all controls upon installation or by 2015-2017 (assessed on unit-by-unit basis).
- Did not require SCR or SNCR on units roughly at 150 MW or below (assessed on unit-by-unit basis).

The following rates achieved applying the above, through the requested years, is outlined below:

NOx (annual/ozone)					
Year	**Illinois**	**Indiana**	**Michigan**	**Ohio**	**Wisconsin**
2008				0.36/0.19	
2013				0.24/0.17	
2014				0.18/0.16	
2015				0.17/0.16	
2017				0.12/0.115	
SO2					
Year	**Illinois**	**Indiana**	**Michigan**	**Ohio**	**Wisconsin**
2008				1.09	
2013				0.75	
2014				0.65	
2015				0.65	
2017				0.256	

The table below summarizes the number of controls assumed over time:

	2008			**2013**			**2014**			**2015**			**2017**		
	#	total MW controlled	% total MW	#	total MW controlled	% total MW	#	total MW controlled	% total MW	#	total MW controlled	% total MW	#	total MW controlled	% total MW
SCR	19	11274	51%	25	13751	63%	26	14422	66%	27	14731	67%	34	17173	78%
SNCR	15	4335	20%	11	2823	13%	11	2823	13%	11	2823	13%	14	2737	12%
FGD	16	10049	46%	25	12636	58%	33	15261	70%	33	15261	70%	56	20933	95%

Wisconsin Analysis

SOx (lbs/mmBtu)	2008	2013	2014	2015	2017	2017
	Existing	**In Pipeline**	**Improve existing controls**	**Controls without major investment**	**With available FGD**	**High Control**
State Average (approved CAs)	**0.57**	**0.39**	**0.39**	**0.25**	**0.16**	**0.16**
Large Utilities						
2013 Base (approved CAs)	0.23 - 0.93	0.12 - 0.77	0.12 - 0.77	0.12 - 0.77	0.12 - 0.26	0.12 - 0.26
2013 Base (w/ pending CAs)	0.26 - 0.77	0.12 - 0.59	0.12 - 0.59	0.12 - 0.43	0.06 - 0.16	0.03 - 0.07
Small Utilities						
2013 Base (approved CAs)	0.41 - 2.18	0.00 - 0.53	0.00 - 0.53	0.00 - 0.17	0.00 - 0.17	0.00 - 0.17

notes

1) Dry FGD (95% efficiency) control assumed for many utilities, due to small unit sizes at plant sites and/or timing constraints.

2) This is a "best case" analysis using FGD technology. Alternative controls - such as lime injection or substituting more low-sulfur coal - may be used in practice at some utilities in order to avoid deep controls, but still be below 0.25 #/MMBtu.

NOx (lbs/mmBtu)	2008	2013	2014	2015	2017	2017
	Existing	**In Pipeline**	**Improve existing controls**	**Controls without major investment**	**With available SCR**	**High Control***
State Average (approved CAs)	**0.21**	**0.13**	**0.12**	**0.10**	**0.09**	**0.07**
Large Utilities						
2013 Base (approved CAs)	0.13 - 0.36	0.08 - 0.24	0.08 - 0.24	0.08 - 0.14	0.08 - 0.10	0.06 - 0.09
2013 Base (pending CAs) / Possible	0.13 - 0.36	0.08 - 0.15	0.07 - 0.15	0.07 - 0.13	0.07 - 0.09	0.05 - 0.06
Small Utilities	0.19 - 0.55	0.06 - 0.25	0.06 - 0.25	0.06 - 0.2	0.06 - 0.2	0.06 - 0.2

notes

1) "CA" - Certificate of Authorization
2) Controls without major investment include combustion modifications, LNBs, and SNCR
3) The 2015 control levels reflect the WeEnergies consent decree, NOx RACT, and approved CAs for major controls.
4) The schedule for installing SCRs is built around the schedule for installing dFGDs.
5) Accommodating an SCR installation in the needed timeframe may require altering the schedule for a major outage which occurs every 5 to 10 years. An SCR tie-in usually requires major outage as it impacts existing ductwork in typically restricted space as compared to dFGD.
6) The default control for SCR is 0.06 lbs/mmbtu to reflect average accounting for less efficient operation during winter to prevent ammonium sulfate buildup.
7) "*" - Reflects pushing SCR control to 90% control on a year-round basis
8) "Possible" - This case addresses a potentially accelerated schedule for SCR installations