2012 Annual Fine Particulate ($PM_{2.5}$) Attainment Demonstration

State Implementation Plan

Division of Air Pollution Control
State Implementation Plan, Rulemaking and Inventory Section

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Acknowledgement

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Acronyms and Abbreviations

AERR	Air Emissions Reporting Rule
AEO	Annual Energy Outlook
AQS	Air Quality System database
BART	Best Available Retrofit Technology
BAT	Best Available Technology
CAA	Clean Air Act
CAIR	Clean Air Interstate Rule
CAMD	Clean Air Markets Division
CAMx	Comprehensive Air Quality Model with Extension
CI	Compression ignition
CISWI	Commercial/Industrial Solid Waste Incinerators
CMAQ	Congestion Mitigation and Air Quality
Cond	Condensable fraction of particulate matter
CPP	Clean Power Plan
CSAPR	Cross-State Air Pollution Rule
EAF	Electric arc furnace
EGU	Electric generating units
EIA	Energy Information Administration
ERTAC	Eastern Regional Technical Advisory Committee
Filt	Filterable fraction of particulate matter
FRM	Federal Reference Method
GCRTA	Greater Cleveland Regional Transit
I/M	Inspection and maintenance
IPM	Integrated Planning Model
iSIP	Infrastructure State Implementation Plan
LADCO	Lake Michigan Air Directors Consortium
MATS	Mercury Air Toxics Standards
MATS	Modeled Attainment Test Software
MJO	Multi-jurisdictional planning organization
MOVES	MOtor Vehicle Emissions Simulator
NAAQS	National Ambient Air Quality Standard
NEI	National Emissions Inventory
NH_3	Ammonia
NHSM	Non-hazardous secondary materials
NOACA	Northeast Ohio Areawide Coordinating Agency
NO_x	Oxides of Nitrogen, generally NO and NO_2
NA	Nonattainment area
NNSR	Nonattainment New Source Review
NSR	New Source Review
ODOT	Ohio Department of Transportation
PM	Particulate matter
$PM_{2.5}$	Particulate matter having an aerodynamic diameter of 2.5 microns or less
PM_{10}	Particulate matter having an aerodynamic diameter of 10 microns or less
PSD	Prevention of Significant Deterioration

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RACM	Reasonably Available Control Methods
RACT	Reasonably Available Control Technology
RIA	Regulatory Impact Analysis
RFP	Reasonable Further Progress
RRF	Relative Response Factors
SASS	Spiral Ambient Speciated Sampler
SCC	Source classification code
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
TPY	Tons per year
TSP	Total Suspended Particulates
µm	Micrometer, or micron
U.S. EPA	United States Environmental Protection Agency
VMT	Vehicle miles travelled
VOC	Volatile Organic Compounds

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1. Introduction

When a National Ambient Air Quality Standard (NAAQS) for a criteria pollutant is revised, States have the authority and primary responsibility for developing and implementing attainment plans that contain emission control measures needed to achieve the NAAQS in each nonattainment area, consistent with the requirements of the Clean Air Act (CAA).

The annual NAAQS for fine particulate matter (PM), having an aerodynamic diameter of 2.5 µm or less ($PM_{2.5}$), was revised on January 15, 2013 [1]. Due to their small size, they can penetrate deeply into the lungs of people who inhale them, where they can accumulate, react, or be absorbed into the body. Epidemiological studies have shown a significant association between elevated $PM_{2.5}$ levels and a number of serious health effects, including premature mortality, aggravation of respiratory and cardiovascular disease (as indicated by increased hospital admissions, emergency room visits, absences from school or work, and restricted activity days), lung disease, decreased lung function, asthma attacks, and certain cardiovascular problems such as heart attacks and cardiac arrhythmia. Individuals particularly sensitive to $PM_{2.5}$ exposure include older adults, people with heart and lung disease, and children [2].

States with areas designated as nonattainment are required to submit a moderate attainment plan not later than 18 months after designations. Designations became effective April 15, 2015, therefore, the moderate attainment plan is due by October 15, 2016 [3].

This document is the $PM_{2.5}$ State Implementation Plan (SIP) for nonattainment area, initially classified as moderate, in the State of Ohio. The SIP will show that with the control strategies adopted by the state, the nonattainment area will have achieved NAAQS by the statutory deadline.

2. Background

Standards for particulate matter were promulgated with the first set of NAAQS in 1971 for Total Suspended Particulates (TSP), which are any liquid (aerosol) or solid substance found in the atmosphere. The reference method for measuring attainment was the “high-volume” sampler, collecting particulate matter up to a nominal size of 25-45 µm diameter [4]. The standard was revised in 1987 to account more strictly for respirable fractions having an aerodynamic diameter of 10 µm or less (PM_{10}) [5].

With further scientific review of evidence linking ambient particulate matter exposure to health and welfare effects, the NAAQS were revised separately for coarse and fine fractions in 1997 [6]. Primary and secondary annual standards for $PM_{2.5}$ were initially set to 15.0 µg/m^3. Implementation of the revision, delayed by litigation, began in 2002 with attainment designations promulgated January 5, 2005 [7, 8]. In order to assist states with implementation of the 1997 standards, in April of 2007 U.S. Environmental Protection Agency (U.S. EPA) issued a detailed implementation rule [9]. In May 2008, U.S. EPA issued another rule to assist states with SIP submissions to meet the specific

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requirements for permitting programs for nonattainment new source review (NNSR) purposes in designated nonattainment areas [10]. U.S. EPA premised both of these rules on U.S.EPA's interpretation of the statute that nonattainment areas for the $PM_{2.5}$ NAAQS were subject solely to the general nonattainment plan requirements of Subpart 1, Part D of Title I of the CAA.

In 2006, U.S. EPA strengthened the primary 24-hour $PM_{2.5}$ NAAQS from 65 µg/m^3 to 35 µg/m^3 and retained current primary annual $PM_{2.5}$ NAAQS at 15.0 µg/m^3. The revised 24-hour $PM_{2.5}$ standard was published on October 17, 2006 and became effective on December 18, 2006 [11]. Although again delayed, nonattainment designations followed with an effective date of December 14, 2009 [12]. On March 2, 2012, U.S. EPA provided a memo guiding states to continue to follow the 2007 implementation rule and implement under Subpart 1 when preparing their attainment demonstrations [13].

On December 14, 2012, the primary annual standard for $PM_{2.5}$ was strengthened to 12.0 µg/m^3 with final rule promulgated January 15, 2013 [1]. During the same action, U.S. EPA retained the existing secondary annual $PM_{2.5}$ standard which remains at 15.0 µg/m^3 and retained the existing 2006 24-hour $PM_{2.5}$ standard of 35 µg/m^3. In January 2015, three areas in Ohio were initially designated moderate nonattainment for 2012 $PM_{2.5}$ standards based upon quality-assured, quality-controlled, and certified air quality data for the 2011 to 2013 period [14]. Because States would soon have certified data for 2014, in that final action U.S. EPA provided States with the opportunity to certify 2014 data by February 27, 2015 so that U.S. EPA could use that data to inform designations. Ohio provided such data and, therefore, U.S. EPA withdrew the initial designations for two areas (Canton-Massillon and Cincinnati-Hamilton) and designated them as unclassifiable/attainment [15]. One area in Ohio, Cleveland, comprised of Cuyahoga and Lorain Counties, remained designated as moderate nonattainment. The effective date for all designations was set at April 15, 2015.

On January 4, 2013, D.C. Circuit Court of Appeals remanded the 2007 implementation rule and 2008 NNSR rule issued for the 1997 standard to the U.S. EPA, finding that U.S. EPA had erred in implementation without considering particulate matter-specific provisions of Subpart 4 of Part D of Title I of the CAA [16]. As a result, on March 23, 2015, U.S. EPA proposed a new implementation rule addressing the court's remand and requiring implementation under both Subpart 1 and Subpart 4 [17]. On July 29, 2016, U.S. EPA finalized requirements for existing and future nonattainment areas (2016 Implementation Rule), interpreting statutory requirements applicable to $PM_{2.5}$ NAAQS under Subparts 1 and 4 of the nonattainment provisions of the CAA [3].

When a new or revised standard is set, States are also required to submit a SIP addressing the CAA elements required under Section 110(a)(1) and (2) within 3 years of promulgation (signature) of the new standard, in this case December 13, 2015 [18]. Section 110(a)(1) provides procedural and timing requirements for SIPs. Section 110(a)(2) lists elements and sub-elements required in a complete and approvable SIP. Many Section 110(a)(2) SIP elements relate to the general information and authorities that constitute "infrastructure" of a state's air quality program. Hence, these SIPs are

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referred to as infrastructure SIPs (iSIP). On December 4, 2015, Ohio submitted its iSIP for the 2015 annual $PM_{2.5}$ standard in accordance with the "Guidance on Infrastructure State Implementation Plan (SIP) Elements Under Clean Air Act Sections 110(a)(1) and 110 (a)(2)" of September 13, 2013 [19]. On June 23, 2016 U.S. EPA proposed to approve the majority[1] of Ohio's iSIP elements [20].

The 2016 Implementation Rule establishes requirements for SIP components specific to moderate area attainment plans with respect to plan due dates, emissions inventory requirements, pollutants to be addressed, attainment plan control strategy, modeling for attainment demonstration, reasonable further progress, quantitative milestones, contingency measures, and attainment dates and extensions. These components frame and present the SIP development process, by which the State presents a criteria pollutant-specific review of enforceable measures for attainment and maintenance of the NAAQS for U.S. EPA-approval.

To develop an attainment plan that regulates emissions necessary for timely attainment, States are presumptively required to evaluate and potentially control emissions of primary $PM_{2.5}$ emissions, both filterable and condensable, and precursors that significantly contribute to secondary $PM_{2.5}$ formation. With scientifically credible technical analyses and reasoned justification, States may converge on exclusion of a precursor or precursors from major stationary, area, and mobile sources for expeditious attainment, control requirements from major sources, and NNSR permitting.

This document is the $PM_{2.5}$ attainment planning SIP for the Cleveland, OH moderate nonattainment area and is based upon requirements identified in the 2016 Implementation Rule and addresses both Subpart 1 and Subpart 4 of the CAA. Sections 189(a), (c), and (e) of Subpart 4 of the CAA require that moderate area attainment plans contain the following elements [21]:

- An approved permit program for construction of new and modified major stationary sources (CAA Section 189(a)(1)(A));
- A demonstration that the plan provides for attainment by no later than the applicable moderate area deadline (December 31, 2021) or a demonstration that attainment by that deadline is impracticable (CAA Section 189(a)(1)(B));
- Provisions for the implementation of reasonably available control measures (RACM) and reasonably available control technology (RACT) no later than 4 years after designation (CAA Section 189(a)(1)(C));
- Quantitative milestones that will be used to evaluate compliance with the requirement to demonstrate reasonable further progress (RFP) (CAA Section 189(c)); and,
- Evaluation and regulation of $PM_{2.5}$ precursors (in general to meet RACM and RACT and other attainment planning requirements, and as specifically required for major stationary sources by CAA Section 189(e)).

[1] This rulemaking did not cover four substantive areas that are not integral to acting on a state's infrastructure SIP submission. U.S. EPA will take action on those elements at a later date.

Other Subpart 1 requirements for attainment plans continue to apply to $PM_{2.5}$ nonattainment areas subject to Subpart 4 and include the following [22]:

- A description of the expected annual incremental reductions in emissions that will demonstrate RFP (CAA Section 172(c)(2));
- Emissions inventories (CAA Section 172(c)(3));
- Other control measures (besides RACM and RACT) needed for attainment (CAA Section 172(c)(6)); and,
- Contingency measures (CAA Section 172(c)(9)).

Each of these statutory requirements is addressed more fully below based upon the requirements provided in the 2016 Implementation Rule.

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3. Nonattainment Area and Monitoring Data

The Cleveland area covering Cuyahoga and Lorain Counties, shown in Figure 1, is Ohio's only moderate nonattainment area.

Figure 1. Ohio 2012 $PM_{2.5}$ (12.0 µg/m^3) Nonattainment Areas effective April 15, 2015

Table 1 shows annual mean and three-year averages of the annual mean from certified monitoring data retrieved from the U. S. EPA Air Quality System (AQS) database for the Cleveland, OH area from 2010 to 2015. See Appendix A for the AQS database report and most recent certification letter for monitor values provided.

Table 1. Nonattainment area $PM_{2.5}$ monitor design values

Site	County	Design value[1]						Annual $PM_{2.5}$ NAAQS DV[2]			
		2010	2011	2012	2013	2014	2015	10-12	11-13	12-14	13-15
39-035-0034	Cuyahoga	10.9	10.0	9.3	9.5	9.6	9.2	10.1	9.6	9.5	9.4
39-035-0038		14.0	12.6	12.3	12.2	12.3	11.8	13.0	12.4	12.3	12.1
39-035-0045		13.3	11.9	11.4	11.2	11.4	11.0	12.2	11.5	11.3	11.2
39-035-0060		13.7	12.5	12.8	12.2	12.1	12.0	13.0	12.5	12.4	12.1
39-035-0065		13.2	12.6	12.3	11.4	12.5	13.3	12.7	12.1	12.0	12.4
39-035-1002		11.3	10.4	9.7	9.2	9.7	9.1	10.5	9.7	9.5	9.3
39-093-3002	Lorain	10.4	9.4	9.5	8.8	9.1	8.2	9.8	9.2	9.1	8.7

1 Highlighted cells indicate less than 75% capture for at least one quarter.
2 Monitor 39-035-0060 does not meet eligible site criteria for NAAQS DV designation.

The annual $PM_{2.5}$ primary ambient air quality standards are met at an ambient air quality monitoring site when the three-year average of annual averages for three complete years of monitoring data is less than 12.0 µg/m^3. While calculating design values, three significant digits must be carried in the computations, with final values rounded to the nearest 0.1 µg/m^3. Decimals 0.05 or greater are rounded up, and those less than 0.05 are rounded down, such that 12.049 µg/m^3 is the largest concentration considered meeting the NAAQS 12.0 µg/m^3 [23].

An individual site's 3-year average of the annual average concentrations is also called the site's design value. The air quality design value for the area is the highest design value among all sites in the area. Only those measurements derived in accordance with 40 CFR part 58 are used in comparison to the $PM_{2.5}$ NAAQS. Eligible sites meet criteria specified in parts 58.11 and 58.30. Monitor 39-035-0600 data is provided in Table 1, though it is not used in comparison to NAAQS at this time due to insufficient performance. Data handling conventions are found in Appendix N to 40 CFR part 50. As seen in Table 1, monitor 39-035-0065 in Cuyahoga County is the area's design value monitor with a 2013 to 2015 design value of 12.4 µg/m^3.

Figure 2 shows locations of the seven Federally-approved $PM_{2.5}$ (FRM) monitors in the nonattainment area [24]. Two of these sites, shown in yellow, are also equipped with a Spiral Ambient Speciation Sampler (SASS).

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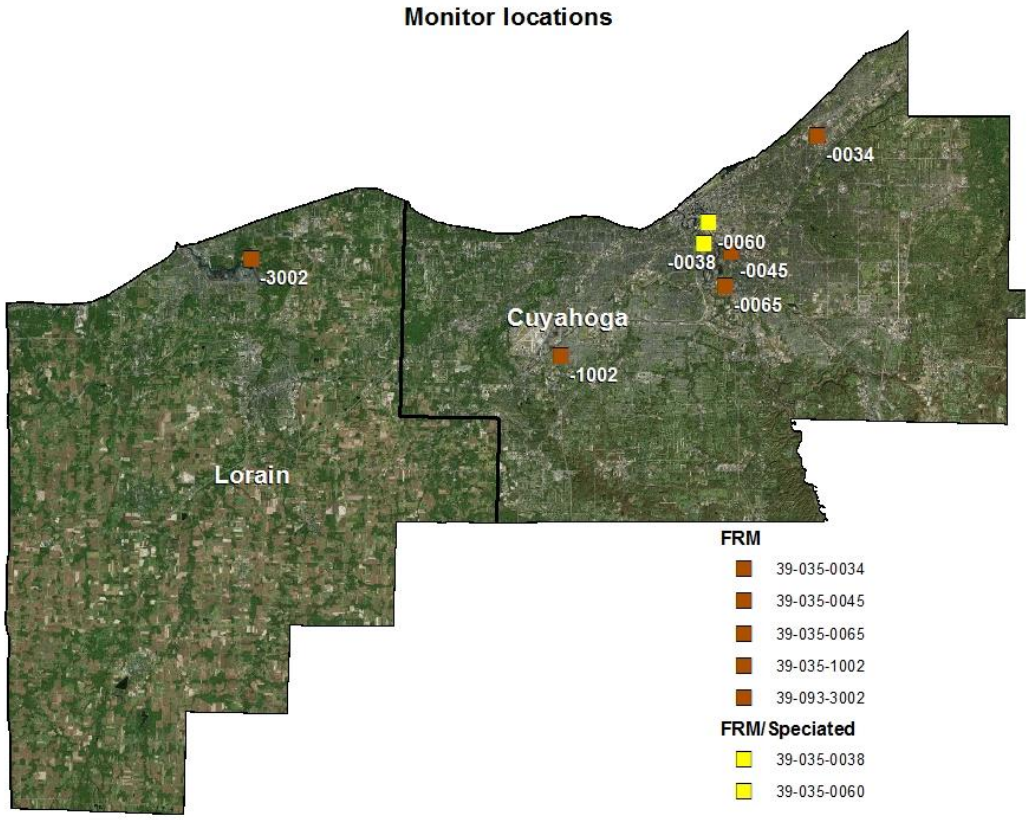

Figure 2. Nonattainment area $PM_{2.5}$ monitors

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4. Emissions Inventories: CAA Section 172(c)(3)

CAA Section 172(c)(3) states:

> "Such plan provisions shall include a comprehensive, accurate, current inventory of actual emissions from all sources of the relevant pollutant or pollutants in such area, including such periodic revisions as the Administrator may determine necessary to assure that the requirements of this part are met."

U.S. EPA interprets this provision to require States to submit at least two separate and distinct nonattainment area emissions inventories. The first emissions inventory is relevant for assessing the current, or base year, emissions in the nonattainment area; the second emissions inventory is a projected inventory relevant for assessing emissions in the target attainment year in the nonattainment area. The first type of inventory is expressly required by CAA Section 172(c)(3), and is called the ''base year inventory for the nonattainment area.'' The second type of inventory is necessary to implement the attainment demonstration requirement of CAA Section 189(a)(1)(B), and is called the ''attainment projected inventory for the nonattainment area.'' This section addresses these inventories.

Inventories used as part of attainment modeling demonstration are prepared for both a modeled base year and projected attainment year. Respectively, these are called the ''base year (baseline) inventory for modeling'' and the ''attainment projected inventory for modeling.''

U.S. EPA acknowledges there may be some inconsistencies between the nonattainment area inventories and the modeling inventories and that where possible, the nonattainment area base year and projected attainment year inventories can be a sum (for annual data) of day-specific or hour-specific data used for modeling. In some cases, however, this approach may not be sufficient for modeling purposes and U.S. EPA expects states to attempt to promote consistency where feasible.

Ohio's base year inventory for the nonattainment area is the same inventory used to develop the base year (baseline) inventory for modeling. Likewise, Ohio's attainment projected inventory for the nonattainment area was generated from modeling conducted using the attainment projected inventory for modeling. All inventories were developed in accordance with U.S. EPA guidance document ''Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze," commonly called "SIP Emissions Inventory Guidance [25]." The attainment modeling demonstration is discussed in Section 6 of this submittal.

In Ohio, major point sources in all counties are required to submit air emissions information annually, in accordance with U.S. EPA's Air Emissions Reporting Rule (AERR). Ohio prepares a new periodic inventory for filterable and condensable $PM_{2.5}$ and precursor emissions for all sectors every three years and these inventories are submitted into the National Emissions Inventory (NEI). These $PM_{2.5}$ precursor inventories will be

prepared for future years as necessary to comply with the inventory reporting requirements established by U.S. EPA.

a. Base year inventory for the nonattainment area

Ohio has prepared the base year emission inventory in accordance with the 2016 Implementation Rule which puts forth the following requirements according to 40 CFR 51.1008:

1) The inventory year must be one of the 3 years used for designations or another technically appropriate inventory year. Ohio has selected 2011 for the base year inventory, one of the years used for designations.
2) The inventory must include actual emissions of all sources within the nonattainment area. Sources outside of the nonattainment area are explicitly not included.
3) The emissions values must either be annual total emissions or average season-day emissions, as appropriate for the nonattainment problem. Ohio has prepared an annual inventory to coincide with the annual standard for which the Cleveland area is in nonattainment. Ohio does not have any 24-hour $PM_{2.5}$ nonattainment areas that could warrant inclusion of seasonal emissions.
4) The inventory must include emissions of direct $PM_{2.5}$ (separately reported as filterable $PM_{2.5}$ and condensable $PM_{2.5}$), as well as all scientific $PM_{2.5}$ precursors: ammonia (NH_3), volatile organic compounds (VOC), sulfur dioxide (SO_2) and nitrogen oxides (NO_X).
5) The emissions thresholds for which emissions sources must be reported as point sources must be followed from the AERR, 40 CFR part 51, Subpart A. Ohio reports sources smaller than those required under 40 CFR part 51, Subpart A (major sources under 40 CFR Part 70) to be reported as point sources. Ohio also reports emissions from synthetic minor sources in the point source inventory rather than the nonpoint inventory.
6) The detail of the emissions included in the inventory must be consistent with the detail required by 40 CFR Part 51, Subpart A. For example, all emissions must be subdivided to individual emissions processes within a facility or county. While these details should underlie the inventory, the emissions included in the attainment plan can be summarized.
7) The base year inventory must still meet all public review requirements associated with that plan.

Base year emissions for 2011 are based on U.S. EPA's 2011 emission inventory (Version 2011EH), following from the 2011 NEI, version 2 (2011NEIv2). This inventory informed U.S. EPA's modeling platforms, as described in U.S. EPA's "Notice of Availability of the Environmental Protection Agency's Updated Ozone Transport Modeling Data for the 2008 Ozone National Ambient Air Quality Standard (NAAQS) [26]." States provided point source and area source emissions data, Motor Vehicle Emission Simulator (MOVES) input files and onroad source activity data to U.S. EPA's 2011 NEI database. U.S. EPA prepared emissions data for other categories not provided by the states, including nonroad sources, ammonia, fires, and biogenics. Ohio, through the Lake Michigan Air

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Directors Consortium (LADCO) and its contractors, developed improved emissions data for Ohio and several other states for onroad mobile sources.

Onroad emissions were prepared through a contract with Ramboll-Environ to evaluate and develop improved mobile emissions inventories using U.S. EPA's MOVES2014 emissions model [27, 28]. As part of this contractual effort, Ramboll-Environ quality-assured the MOVES inputs used by U.S. EPA in developing the 2011NEIv2 inventory. This quality assurance effort identified some significant problems in the MOVES inputs in 2011NEIv2 that impacted the Cleveland area. Based on these findings, LADCO worked with its member states and three adjacent states (IA, KY, and MO) to review and update key MOVES inputs, including vehicle population, vehicle miles travelled (VMT), speed, and vehicle inspection and maintenance characteristics.

The TSD contained in Appendix B provides more details on the inventory development.

The following summary table, Table 2, presents the 2011 base year emissions inventory for NH_3, VOC, $PM_{2.5}$, SO_2 and NO_x in tons per year (TPY) The $PM_{2.5}$ in the table below identify both the filterable and condensable portions. Emissions presented here are categorized into the following sectors: Point EGU, Point Non-EGU, Area (Nonpoint), Prescribed Fire/Wildfire (FIRE), Marine/Air/Rail (MAR), Onroad, and Nonroad.

Table 2. Nonattainment area base year (2011) inventory (TPY)

		$PM_{2.5}$					
		Filt	**Cond**	**NO_X**	**SO_2**	**NH_3**	**VOC**
Cuyahoga	Area (Nonpoint)	1443.13	534.61	4989.24	188.94	670.62	12116.58
	Marine/Air/Rail (MAR)	96.88	0.02	2822.27	187.78	0.99	288.66
	Nonroad	508.69	0.00	6045.40	17.35	8.66	8349.38
	Onroad	800.00	0.00	18764.59	132.17	428.60	8568.15
	Point EGU	32.90	33.50	771.22	1941.86	0.10	11.40
	Point Non-EGU	599.48	407.26	2404.05	4461.80	65.87	986.52
	Prescribed Fire/Wildfire (FIRE)	4.92	0.00	1.20	0.54	0.88	12.61
	County total	3486.00	975.39	35797.97	6930.44	1175.72	30333.30
Lorain	Area (Nonpoint)	477.68	72.00	844.19	44.37	448.73	2721.24
	Marine/Air/Rail (MAR)	44.39	0.00	1289.44	55.68	0.57	73.94
	Nonroad	160.82	0.00	1971.11	5.39	2.66	3009.78
	Onroad	195.49	0.00	4580.85	31.75	101.84	2177.01
	Point EGU	94.90	298.62	4673.50	32041.30	0.54	31.82
	Point Non-EGU	156.45	175.78	705.89	374.63	6.01	916.35
	Prescribed Fire/Wildfire (FIRE)	0.00	0.00	0.00	0.00	0.00	0.00
	County total	1129.72	546.41	14064.98	32553.12	560.35	8930.14
Nonattainment area total		**4615.72**	**1521.80**	**49862.95**	**39483.56**	**1736.07**	**39263.44**

In addition to the sector summary emissions inventory above, Appendix C contains the detailed inventory by source classification code (SCC) for all sectors.

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Ohio is also including in Tables 3 through 7 and Figures 3 through 7 a detailed inventory for 2011 of specific major point sources[2]. The purpose of these data is to better characterize and understand the location of major point sources in the Cleveland area.

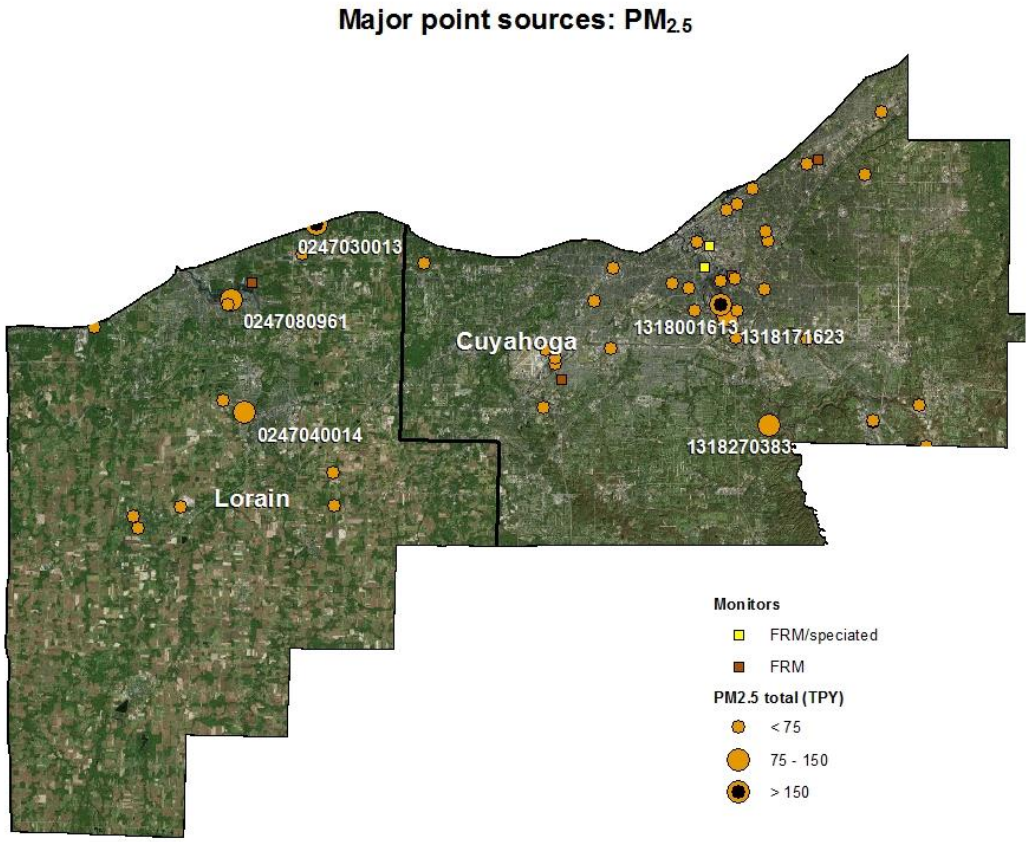

Figure 3. Major point source emissions for base year 2011: $PM_{2.5}$, filterable and condensable (TPY)

[2] These tables and figures include emissions from Title V sources only. The Table 2 summary emissions also include synthetic minor and certain smaller (non-Title V) sources that were included in the NEI by U.S. EPA.

Table 3. Major point source emissions inventory (2011): $PM_{2.5}$

OEPA ID	County	Coordinates		Facility name	$PM_{2.5}$ (TPY)		
		X	Y		Total	Cond	Filt
1318001613	**Cuyahoga**	**444314.9**	**4588927.7**	**ArcelorMittal Cleveland Inc.**	**553.18**	**226.12**	**327.06**
0247030013	**Lorain**	**412114.5**	**4595323.5**	**Avon Lake Power Plant**	**394.16**	**295.15**	**99.01**
1318171623	**Cuyahoga**	**444865.7**	**4588090.8**	**Charter Steel - Cleveland Inc**	**138.36**	**70.82**	**67.54**
0247040014	**Lorain**	**406402.5**	**4580343.9**	**Elyria Foundry**	**115.92**	**48.62**	**67.30**
0247080961	**Lorain**	**405335.6**	**4589333.1**	**Lorain Tubular Company LLC**	**89.46**	**61.14**	**28.31**
1318270383	**Cuyahoga**	**448191.6**	**4579338.7**	**DiGeronimo Aggregates LLC**	**77.75**	**6.11**	**71.64**
0247000760	Lorain	413540.1	4572914.8	BFI - Lorain County Facilities	68.83	48.94	19.88
1318000246	Cuyahoga	442405.6	4593876.7	Cleveland Thermal LLC	68.53	35.22	33.31
1318000245	Cuyahoga	446819.6	4598160.7	Cleveland Electric Illuminating Co., Lake Shore Plant	66.44	33.50	32.94
1318003059	Cuyahoga	448133.8	4594018.7	The Medical Center Company	37.68	26.24	11.44
1318170314	Cuyahoga	442223.0	4588481.2	ALCOA-Cleveland Works	31.17	2.45	28.72
0247050278	Lorain	413432.7	4575567.6	Ross Incineration Services, Inc.	15.01	0.05	14.96
0247080229	Lorain	405051.4	4588936.0	Republic Steel, f/k/a Republic Engineered Products, Inc	14.92	5.23	9.69
1318000101	Cuyahoga	434247.6	4589227.7	PPG Industries, Inc. - Cleveland	14.80	7.40	7.40
1318172479	Cuyahoga	445571.3	4586265.8	Southerly Wastewater Treatment Center	7.84	1.19	6.65
0247030471	Lorain	410949.3	4592962.7	Ford Motor Company - Ohio Assembly Plant	6.42	$_{2.5}$2	3.89
1318202137	Cuyahoga	457122.5	4604321.6	The Lincoln Electric Company	5.98	3.43	$_{2.5}$5
0247080487	Lorain	394443.1	4587170.9	West Lorain Plant	4.90	3.50	1.40
1318247813	Cuyahoga	460095.9	4580959.8	Cuyahoga Regional Sanitary Landfill	4.47	2.70	1.76
1318544510	Cuyahoga	455817.9	4599272.3	Rochling Glastic Composites	4.44	0.00	4.44
1318120179	Cuyahoga	431113.5	4584230.6	Ford Motor Company, Cleveland Engine Plants	4.36	0.61	3.75
1318001618	Cuyahoga	445628.0	4596905.0	SIFCO Forge Group, Inc.	4.23	2.32	1.90
1318004311	Cuyahoga	447907.4	4594792.0	Cleveland Clinic Foundation	3.63	2.69	0.93
0247100408	Lorain	397549.5	4572073.4	OBERLIN COLLEGE	3.39	3.21	0.18
1318006552	Cuyahoga	444814.0	4596510.3	Day-Glo Color Corp.	3.19	0.00	3.19
1318247721	Cuyahoga	460705.1	4577655.8	BFI - Glenwillow Landfill	2.99	1.84	1.15
1318003929	Cuyahoga	445467.6	4591016.2	Stein, Inc.	2.18	0.43	1.75
1318001169	Cuyahoga	430358.6	4585348.1	NASA John H. Glenn Research Center - Lewis Field	1.67	1.22	0.45
1318002965	Cuyahoga	441773.4	4590212.4	MetroHealth Medical Center	1.27	0.95	0.32
0247100968	Lorain	401328.2	4572822.8	Lorain County LFG Power Station	1.06	0.48	0.59
1318281215	Cuyahoga	435709.3	4591837.0	GrafTech International Holdings Inc.	0.97	0.48	0.48
1318617346	Cuyahoga	420682.8	4592232.9	USG Interiors, Inc., American Metals Corp., Westlake	0.90	0.37	0.53
1318170235	Cuyahoga	445656.9	4588424.6	FERRO CORPORATION - CLEVELAND FRIT PLANT	0.82	0.38	0.44
0247040195	Lorain	402664.0	4607999.4	BASF Corporation	0.63	0.48	0.16
1318031627	Cuyahoga	456441.0	4579593.1	Morgan Electro Ceramics	0.42	0.00	0.42
1318451029	Cuyahoga	435583.4	4585484.0	General Motors LLC - Parma Plant	0.38	0.29	0.10
1318394002	Cuyahoga	430174.4	4580723.3	Southwest General Health Center	0.37	0.28	0.09
1318120180	Cuyahoga	431095.1	4584662.7	Ford Motor Company, Cleveland Casting Plant	0.30	0.23	0.07
0247040822	Lorain	404695.6	4581260.0	3M Elyria	0.18	0.11	0.07
1318030172	Cuyahoga	456511.1	4579715.9	Hukill Chemical Corporation	0.17	0.10	0.07
1318000133	Cuyahoga	440431.5	4590655.2	Cleveland Public Power - Service Center	0.13	0.03	0.10
1318226136	Cuyahoga	451234.7	4586194.3	Automated Packaging Systems	0.07	0.04	0.04

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OEPA ID	County	Coordinates		Facility name	$PM_{2.5}$ (TPY)		
		X	Y		Total	Cond	Filt
0247100320	Lorain	397862.2	4571144.0	Oberlin Municipal Light & Power System	0.07	0.01	0.06
1318000132	Cuyahoga	451165.9	4600104.0	Cleveland Public Power - Collinwood Substation	0.05	0.00	0.05
1318000399	Cuyahoga	447804.7	4590166.3	North Coast Container Corp.	0.01	0.00	0.01
1318005949	Cuyahoga	444329.2	4590778.4	Goodrich Landing Gear-Plating Operations	0.008	0.003	0.005

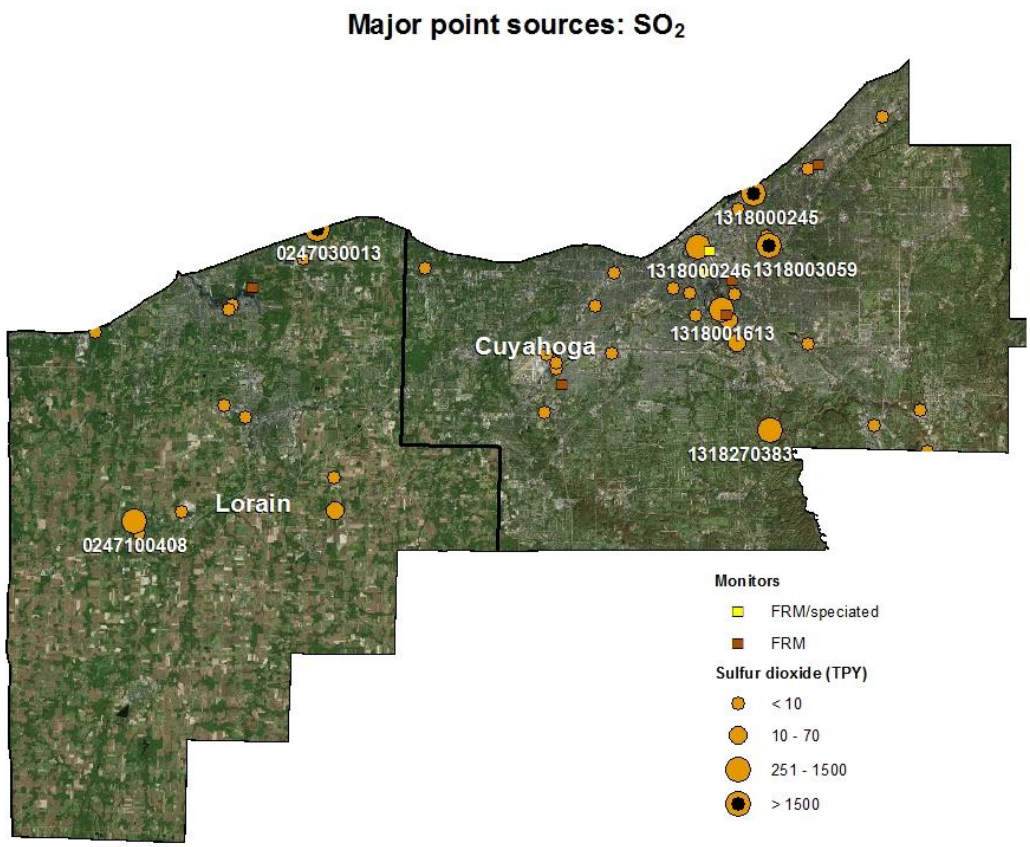

Figure 4. Major point source emissions for base year 2011: SO_2 (TPY)

Table 4. Major point source emissions inventory (2011): SO_2

OEPA ID	County	Coordinates		Facility name	SO_2 (TPY)
		X	Y		
0247030013	**Lorain**	**412114.5**	**4595323.5**	**Avon Lake Power Plant**	**32041.37**
1318003059	**Cuyahoga**	**448133.8**	**4594018.7**	**The Medical Center Company**	**2133.08**
1318000245	**Cuyahoga**	**446819.6**	**4598160.7**	**Cleveland Electric Illuminating Co., Lake Shore Plant**	**1942.00**
1318000246	**Cuyahoga**	**442405.6**	**4593876.7**	**Cleveland Thermal LLC**	**930.18**
1318001613	**Cuyahoga**	**444314.9**	**4588927.7**	**ArcelorMittal Cleveland Inc.**	**722.54**
1318270383	**Cuyahoga**	**448191.6**	**4579338.7**	**DiGeronimo Aggregates LLC**	**523.86**
0247100408	**Lorain**	**397549.5**	**4572073.4**	**OBERLIN COLLEGE**	**325.31**
1318171623	Cuyahoga	444865.7	4588090.8	Charter Steel - Cleveland Inc	64.89
0247000760	Lorain	413540.1	4572914.8	BFI - Lorain County Facilities	23.99
1318172479	Cuyahoga	445571.3	4586265.8	Southerly Wastewater Treatment Center	15.49
0247100968	Lorain	401328.2	4572822.8	Lorain County LFG Power Station	8.69
0247050278	Lorain	413432.7	4575567.6	Ross Incineration Services, Inc.	3.04
1318247813	Cuyahoga	460095.9	4580959.8	Cuyahoga Regional Sanitary Landfill	1.63
0247080961	Lorain	405335.6	4589333.1	Lorain Tubular Company LLC	0.54
1318004311	Cuyahoga	447907.4	4594792.0	Cleveland Clinic Foundation	0.43
0247080229	Lorain	405051.4	4588936.0	Republic Steel, f/k/a Republic Engineered Products, Inc	0.42
1318202137	Cuyahoga	457122.5	4604321.6	The Lincoln Electric Company	0.37
0247030471	Lorain	410949.3	4592962.7	Ford Motor Company - Ohio Assembly Plant	0.27
1318170314	Cuyahoga	442223.0	4588481.2	ALCOA-Cleveland Works	0.26
1318001169	Cuyahoga	430358.6	4585348.1	NASA John H. Glenn Research Center - Lewis Field	0.24
1318281215	Cuyahoga	435709.3	4591837.0	GrafTech International Holdings Inc.	0.21
1318247721	Cuyahoga	460705.1	4577655.8	BFI - Glenwillow Landfill	0.15
0247040014	Lorain	406402.5	4580343.9	Elyria Foundry	0.14
0247100320	Lorain	397862.2	4571144.0	Oberlin Municipal Light & Power System	0.13
1318002965	Cuyahoga	441773.4	4590212.4	MetroHealth Medical Center	0.10
0247080487	Lorain	394443.1	4587170.9	West Lorain Plant	0.10
1318000101	Cuyahoga	434247.6	4589227.7	PPG Industries, Inc. - Cleveland	0.08
1318001618	Cuyahoga	445628.0	4596905.0	SIFCO Forge Group, Inc.	0.07
1318120179	Cuyahoga	431113.5	4584230.6	Ford Motor Company, Cleveland Engine Plants	0.06
0247040195	Lorain	402664.0	4607999.4	BASF Corporation	0.05
1318000133	Cuyahoga	440431.5	4590655.2	Cleveland Public Power - Service Center	0.05
1318000132	Cuyahoga	451165.9	4600104.0	Cleveland Public Power - Collinwood Substation	0.04
1318451029	Cuyahoga	435583.4	4585484.0	General Motors LLC - Parma Plant	0.03
1318394002	Cuyahoga	430174.4	4580723.3	Southwest General Health Center	0.03
1318617346	Cuyahoga	420682.8	4592232.9	USG Interiors, Inc., American Metals Corp., Westlake	0.03
1318120180	Cuyahoga	431095.1	4584662.7	Ford Motor Company, Cleveland Casting Plant	0.02
0247040822	Lorain	404695.6	4581260.0	3M Elyria	0.02
1318170170	Cuyahoga	445368.1	4590122.1	Angstrom Graphics Midwest, Inc.	0.01
1318030172	Cuyahoga	456511.1	4579715.9	Hukill Chemical Corporation	0.01
1318226136	Cuyahoga	451234.7	4586194.3	Automated Packaging Systems	0.01

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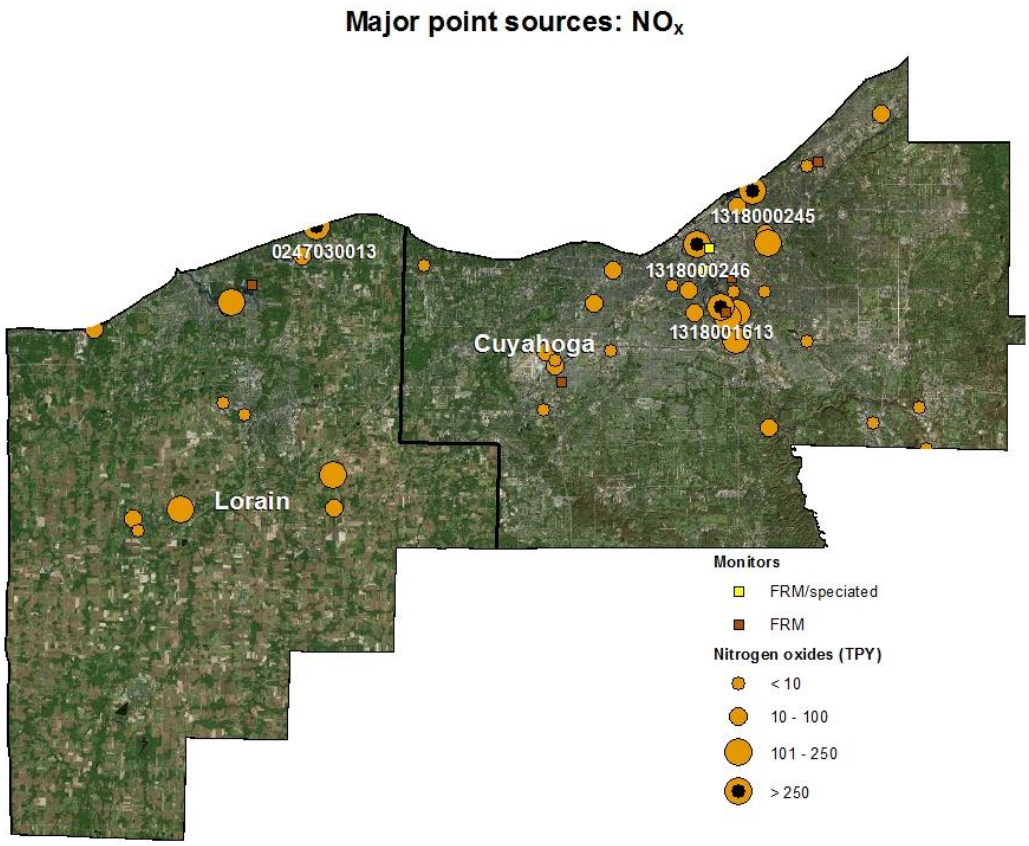

Figure 5. Major point source emissions for base year 2011: NO_x (TPY)

Table 5. Major point source emissions inventory (2011): NO_x

OEPA ID	County	Coordinates		Facility name	NO_x (TPY)
		X	Y		
0247030013	**Lorain**	**412114.5**	**4595323.5**	**Avon Lake Power Plant**	**4659.44**
1318001613	**Cuyahoga**	**444314.9**	**4588927.7**	**ArcelorMittal Cleveland Inc.**	**1164.86**
1318000245	**Cuyahoga**	**446819.6**	**4598160.7**	**Cleveland Electric Illuminating Co., Lake Shore Plant**	**771.30**
1318000246	**Cuyahoga**	**442405.6**	**4593876.7**	**Cleveland Thermal LLC**	**252.05**
1318003059	Cuyahoga	448133.8	4594018.7	The Medical Center Company	**204.10**
0247050278	Lorain	413432.7	4575567.6	Ross Incineration Services, Inc.	162.30
1318170235	Cuyahoga	445656.9	4588424.6	FERRO CORPORATION - CLEVELAND FRIT PLANT	148.88
0247100968	Lorain	401328.2	4572822.8	Lorain County LFG Power Station	146.40
1318172479	Cuyahoga	445571.3	4586265.8	Southerly Wastewater Treatment Center	131.82
1318171623	Cuyahoga	444865.7	4588090.8	Charter Steel - Cleveland Inc	110.93
0247080961	Lorain	405335.6	4589333.1	Lorain Tubular Company LLC	102.11
1318270383	Cuyahoga	448191.6	4579338.7	DiGeronimo Aggregates LLC	68.45
0247080229	Lorain	405051.4	4588936.0	Republic Steel, f/k/a Republic Engineered Products, Inc	62.11
1318170314	Cuyahoga	442223.0	4588481.2	ALCOA-Cleveland Works	52.76
0247000760	Lorain	413540.1	4572914.8	BFI - Lorain County Facilities	45.71
0247030471	Lorain	410949.3	4592962.7	Ford Motor Company - Ohio Assembly Plant	44.30
0247100408	Lorain	397549.5	4572073.4	OBERLIN COLLEGE	38.08
1318001169	Cuyahoga	430358.6	4585348.1	NASA John H. Glenn Research Center - Lewis Field	28.92
1318202137	Cuyahoga	457122.5	4604321.6	The Lincoln Electric Company	28.78
1318004311	Cuyahoga	447907.4	4594792.0	Cleveland Clinic Foundation	25.07
0247040195	Lorain	402664.0	4607999.4	BASF Corporation	19.58
1318281215	Cuyahoga	435709.3	4591837.0	GrafTech International Holdings Inc.	19.20
1318002965	Cuyahoga	441773.4	4590212.4	MetroHealth Medical Center	16.70
0247080487	Lorain	394443.1	4587170.9	West Lorain Plant	15.00
1318001618	Cuyahoga	445628.0	4596905.0	SIFCO Forge Group, Inc.	14.90
1318000101	Cuyahoga	434247.6	4589227.7	PPG Industries, Inc. - Cleveland	12.50
1318120179	Cuyahoga	431113.5	4584230.6	Ford Motor Company, Cleveland Engine Plants	10.64
1318247813	Cuyahoga	460095.9	4580959.8	Cuyahoga Regional Sanitary Landfill	7.33
1318617346	Cuyahoga	420682.8	4592232.9	USG Interiors, Inc., American Metals Corp., Westlake	5.35
1318394002	Cuyahoga	430174.4	4580723.3	Southwest General Health Center	4.86
1318451029	Cuyahoga	435583.4	4585484.0	General Motors LLC - Parma Plant	4.79
1318247721	Cuyahoga	460705.1	4577655.8	BFI - Glenwillow Landfill	4.70
0247100320	Lorain	397862.2	4571144.0	Oberlin Municipal Light & Power System	4.36
0247040822	Lorain	404695.6	4581260.0	3M Elyria	3.60
1318000399	Cuyahoga	447804.7	4590166.3	North Coast Container Corp.	2.45
1318000133	Cuyahoga	440431.5	4590655.2	Cleveland Public Power - Service Center	2.38
1318120180	Cuyahoga	431095.1	4584662.7	Ford Motor Company, Cleveland Casting Plant	2.25
1318030172	Cuyahoga	456511.1	4579715.9	Hukill Chemical Corporation	1.63
1318226136	Cuyahoga	451234.7	4586194.3	Automated Packaging Systems	1.21
1318000132	Cuyahoga	451165.9	4600104.0	Cleveland Public Power - Collinwood Substation	0.47
1318170170	Cuyahoga	445368.1	4590122.1	Angstrom Graphics Midwest, Inc.	0.09
0247040014	Lorain	406402.5	4580343.9	Elyria Foundry	0.07

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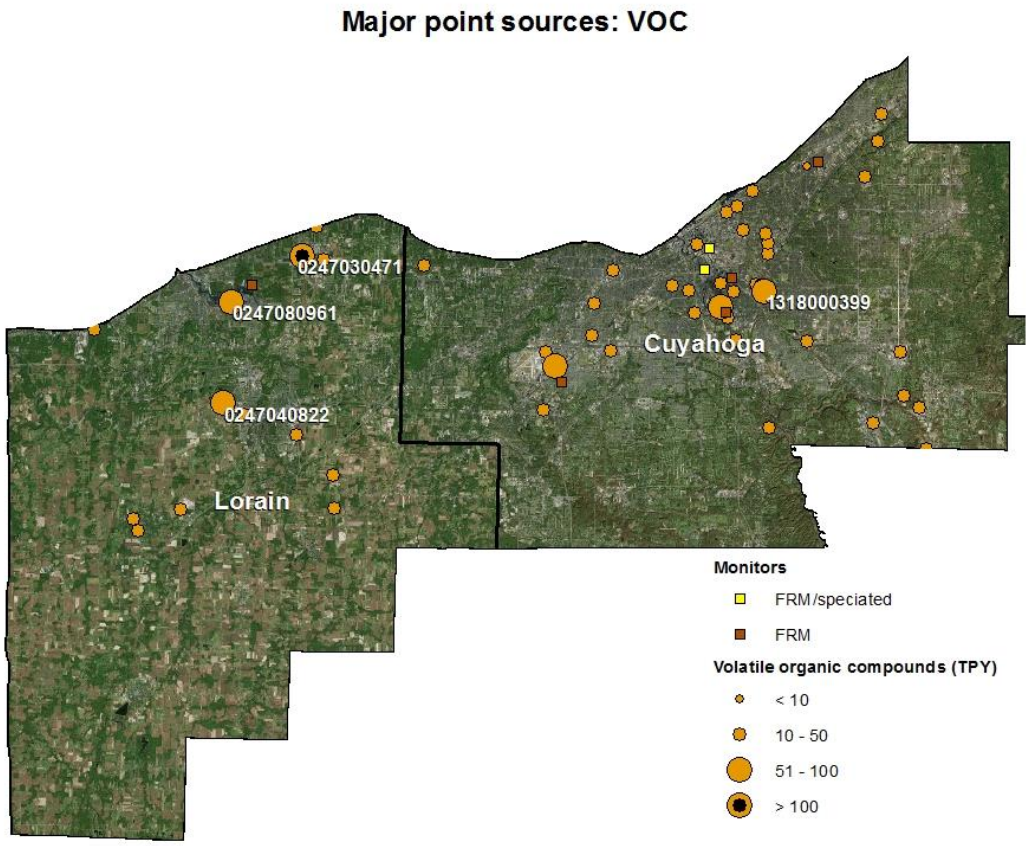

Figure 6. Major point source emissions for base year 2011: VOC (TPY)

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Table 6. Major point source emissions inventory (2011): VOC

OEPA ID	County	Coordinates		Facility name	VOC (TPY)
		X	Y		
0247030471	**Lorain**	**410949.3**	**4592962.7**	**Ford Motor Company - Ohio Assembly Plant**	**440.31**
0247040822	**Lorain**	**404695.6**	**4581260.0**	**3M Elyria**	**172.68**
0247080961	**Lorain**	**405335.6**	**4589333.1**	**Lorain Tubular Company LLC**	**124.78**
1318000399	**Cuyahoga**	**447804.7**	**4590166.3**	**North Coast Container Corp.**	**113.50**
1318001613	Cuyahoga	444314.9	4588927.7	ArcelorMittal Cleveland Inc.	94.10
1318120179	Cuyahoga	431113.5	4584230.6	Ford Motor Company, Cleveland Engine Plants	78.67
1318226136	Cuyahoga	451234.7	4586194.3	Automated Packaging Systems	64.49
1318171623	Cuyahoga	444865.7	4588090.8	Charter Steel - Cleveland Inc	48.00
0247040014	Lorain	406402.5	4580343.9	Elyria Foundry	40.89
1318000101	Cuyahoga	434247.6	4589227.7	PPG Industries, Inc. - Cleveland	40.69
0247030996	Lorain	412686.5	4592726.0	Perry Fiberglass Products Inc	36.99
0247030013	Lorain	412114.5	4595323.5	Avon Lake Power Plant	29.65
1318002698	Cuyahoga	447113.3	4590757.5	Sunoco Partners Marketing & Terminals LP	28.43
1318008053	Cuyahoga	434061.1	4586639.1	AUTO-TAP, INC	27.81
0247000760	Lorain	413540.1	4572914.8	BFI - Lorain County Facilities	23.30
0247100968	Lorain	401328.2	4572822.8	Lorain County LFG Power Station	21.95
1318170170	Cuyahoga	445368.1	4590122.1	Angstrom Graphics Midwest, Inc.	21.88
1318170314	Cuyahoga	442223.0	4588481.2	ALCOA-Cleveland Works	21.02
1318544510	Cuyahoga	455817.9	4599272.3	Rochling Glastic Composites	17.10
1318040267	Cuyahoga	458610.8	4585346.8	The Sherwin-Williams Co.	12.90
1318030172	Cuyahoga	456511.1	4579715.9	Hukill Chemical Corporation	11.98
1318000245	Cuyahoga	446819.6	4598160.7	Cleveland Electric Illuminating Co., Lake Shore Plant	11.40
1318202137	Cuyahoga	457122.5	4604321.6	The Lincoln Electric Company	10.75
1318538170	Cuyahoga	458892.9	4581891.3	Card Pak Incorporated	8.87
0247050278	Lorain	413432.7	4575567.6	Ross Incineration Services, Inc.	8.54
1318207468	Cuyahoga	456853.9	4602072.8	Eaton Industrial Corporation	8.44
1318617346	Cuyahoga	420682.8	4592232.9	USG Interiors, Inc., American Metals Corp., Westlake	7.96
1318247813	Cuyahoga	460095.9	4580959.8	Cuyahoga Regional Sanitary Landfill	7.74
1318006552	Cuyahoga	444814.0	4596510.3	Day-Glo Color Corp.	6.95
1318008350	Cuyahoga	448127.6	4593155.0	Cansto Coatings LLC	6.87
1318008262	Cuyahoga	447506.8	4590661.4	ARCHITECTURAL FIBERGLASS INC.	6.74
1318000838	Cuyahoga	446147.6	4595082.5	Manufacturers Plating Company, Inc.	6.18
1318281215	Cuyahoga	435709.3	4591837.0	GrafTech International Holdings Inc.	4.76
1318003059	Cuyahoga	448133.8	4594018.7	The Medical Center Company	4.39
0247040179	Lorain	410542.1	4578718.3	Invacare Corporation	3.28
0247030987	Lorain	411501.6	4592586.1	HELICAL LINE PRODUCTS COMPANY	2.99
1318004311	Cuyahoga	447907.4	4594792.0	Cleveland Clinic Foundation	2.78
1318247721	Cuyahoga	460705.1	4577655.8	BFI - Glenwillow Landfill	2.30
0247080487	Lorain	394443.1	4587170.9	West Lorain Plant	2.20
1318000246	Cuyahoga	442405.6	4593876.7	Cleveland Thermal LLC	1.68
1318001169	Cuyahoga	430358.6	4585348.1	NASA John H. Glenn Research Center - Lewis Field	1.31
1318002965	Cuyahoga	441773.4	4590212.4	MetroHealth Medical Center	0.92
1318005949	Cuyahoga	444329.2	4590778.4	Goodrich Landing Gear-Plating Operations	0.90
1318172479	Cuyahoga	445571.3	4586265.8	Southerly Wastewater Treatment Center	0.68
1318001618	Cuyahoga	445628.0	4596905.0	SIFCO Forge Group, Inc.	0.61
1318270383	Cuyahoga	448191.6	4579338.7	DiGeronimo Aggregates LLC	0.50
0247040195	Lorain	402664.0	4607999.4	BASF Corporation	0.39
0247100320	Lorain	397862.2	4571144.0	Oberlin Municipal Light & Power System	0.34
0247100408	Lorain	397549.5	4572073.4	OBERLIN COLLEGE	0.34
0247080229	Lorain	405051.4	4588936.0	Republic Steel, f/k/a Republic Engineered Products, Inc	0.28

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OEPA ID	County	Coordinates		Facility name	VOC (TPY)
		X	Y		
1318451029	Cuyahoga	435583.4	4585484.0	General Motors LLC - Parma Plant	0.28
1318394002	Cuyahoga	430174.4	4580723.3	Southwest General Health Center	0.27
1318120180	Cuyahoga	431095.1	4584662.7	Ford Motor Company, Cleveland Casting Plant	0.23
1318000133	Cuyahoga	440431.5	4590655.2	Cleveland Public Power - Service Center	0.01
1318000132	Cuyahoga	451165.9	4600104.0	Cleveland Public Power - Collinwood Substation	0.0003

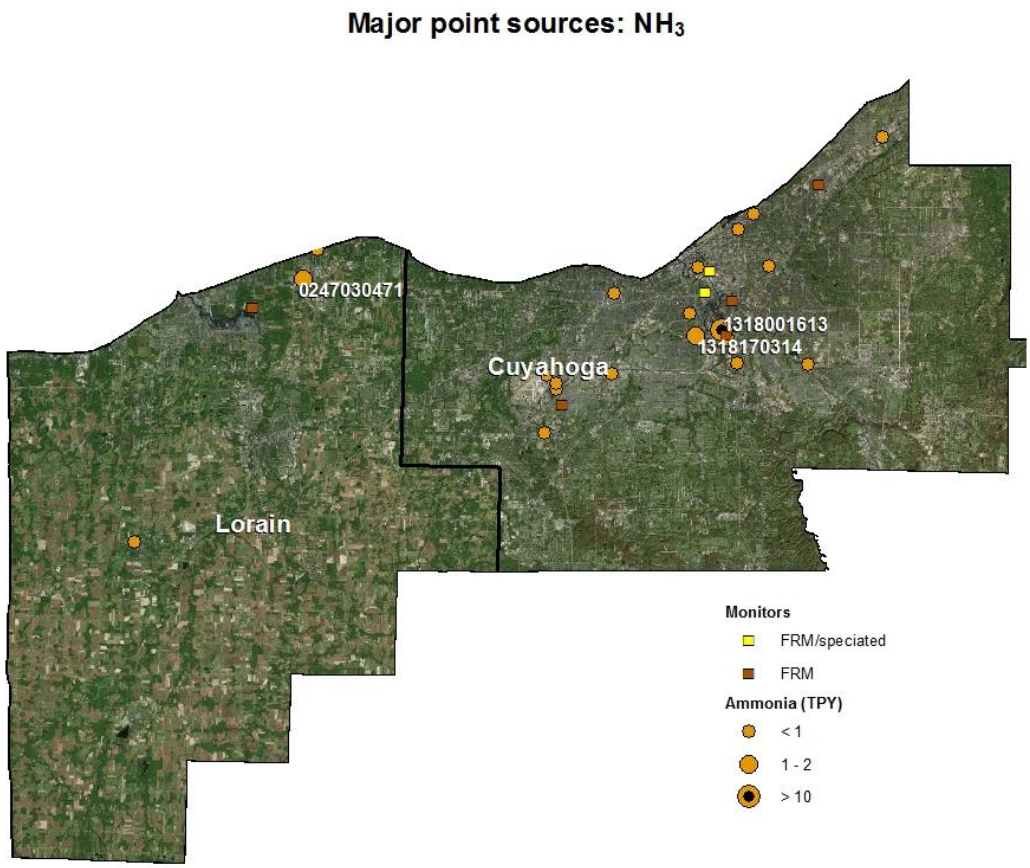

Figure 7. Major point source emissions for base year 2011: NH_3 (TPY)

Table 7. Major point source emissions inventory (2011): NH_3

OEPA ID	County	Coordinates		Facility name	NH_3 (TPY)
		X	Y		
1318001613	**Cuyahoga**	**444314.9**	**4588927.7**	**ArcelorMittal Cleveland Inc.**	**10.96**
0247030471	**Lorain**	**410949.3**	**4592962.7**	**Ford Motor Company - Ohio Assembly Plant**	**1.42**
1318170314	**Cuyahoga**	**442223.0**	**4588481.2**	**ALCOA-Cleveland Works**	**1.23**
1318171623	Cuyahoga	444865.7	4588090.8	Charter Steel - Cleveland Inc	0.96
1318001169	Cuyahoga	430358.6	4585348.1	NASA John H. Glenn Research Center - Lewis Field	0.69
0247030013	Lorain	412114.5	4595323.5	Avon Lake Power Plant	0.56
1318202137	Cuyahoga	457122.5	4604321.6	The Lincoln Electric Company	0.50
1318001618	Cuyahoga	445628.0	4596905.0	SIFCO Forge Group, Inc.	0.36
1318120179	Cuyahoga	431113.5	4584230.6	Ford Motor Company, Cleveland Engine Plants	0.34
0247040195	Lorain	402664.0	4607999.4	BASF Corporation	0.27
1318172479	Cuyahoga	445571.3	4586265.8	Southerly Wastewater Treatment Center	0.26
1318451029	Cuyahoga	435583.4	4585484.0	General Motors LLC - Parma Plant	0.16
1318394002	Cuyahoga	430174.4	4580723.3	Southwest General Health Center	0.16
1318120180	Cuyahoga	431095.1	4584662.7	Ford Motor Company, Cleveland Casting Plant	0.13
1318000246	Cuyahoga	442405.6	4593876.7	Cleveland Thermal LLC	0.11
1318000245	Cuyahoga	446819.6	4598160.7	Cleveland Electric Illuminating Co., Lake Shore Plant	0.10
1318003059	Cuyahoga	448133.8	4594018.7	The Medical Center Company	0.08
1318002965	Cuyahoga	441773.4	4590212.4	MetroHealth Medical Center	0.08
1318226136	Cuyahoga	451234.7	4586194.3	Automated Packaging Systems	0.04
1318281215	Cuyahoga	435709.3	4591837.0	GrafTech International Holdings Inc.	0.02
0247100408	Lorain	397549.5	4572073.4	OBERLIN COLLEGE	0.01

b. Attainment projected inventory for the nonattainment area

Ohio has prepared the attainment projected inventory in accordance with the 2016 Implementation Rule which puts forth the following requirements according to 40 CFR 51.1008:

- The year of the projected inventory must be the first year for which expeditious attainment is demonstrated by the modeled attainment plan. Ohio has modeled expeditious attainment in 2021.
- The emissions values must be projected emissions of the same source included in the base year inventory for the nonattainment area (*i.e.,* only those located within the nonattainment area) and any new sources. The projected emissions values should be the best available representation of expected emissions, and thus should take into account emissions growth and contraction, facility closures, new facilities, new controls and other factors forecast to occur between the base year and the attainment year.
- The temporal period of emissions must be the same temporal period (annual or average-season-day) as the base year inventory for the nonattainment area.
- Consistent with the base year inventory for the nonattainment area, the inventory must include all emissions of direct $PM_{2.5}$ (both filterable and condensable $PM_{2.5}$), as well as all emissions of all scientific precursors (SO_2, NO_X, VOC and NH_3).
- The same sources reported as point sources in the base year inventory for the nonattainment area must also be provided as point sources in the attainment projected inventory for the nonattainment area. Likewise, nonpoint and mobile

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source projected emissions must also be provided using the same detail (*e.g.,* state, county and process codes) as the base year inventory.

- The detail of the emissions included must be consistent with the level of detail in the base year.
- The attainment projected inventory must still meet all public review requirements associated with that plan.

Projected year 2021 emissions are based upon U.S. EPA's modeling platforms, as described in U.S. EPA's "Notice of Availability of the Environmental Protection Agency's Updated Ozone Transport Modeling Data for the 2008 Ozone National Ambient Air Quality Standard (NAAQS) [26]."

For all sectors except EGU and mobile emissions, Ohio and LADCO relied on U.S. EPA-developed future emission inventories based on the 2011 base case as part of their 2011 modeling platform. Emissions are projected from 2011 to 2017 and 2025. The future year scenarios incorporate current "on-the-books" regulations. LADCO developed the 2021 emissions inventory for these categories by interpolating between U.S. EPA's 2017 and 2025 inventories. This interpolation was done for each chemical and for each modeling cell.

EGU and mobile source emissions were prepared by LADCO and their contractors for the 2021 year. EGU emissions were prepared through the Eastern Regional Technical Advisory Committee (ERTAC) using the ERTAC EGU Forecasting Tool, version 2.4 [29]. ERTAC is a collaborative effort to improve emission inventories among the Northeastern, Mid-Atlantic, Southeastern, and Lake Michigan area states; other member states; industry representatives; and multi-jurisdictional planning organization (MJO) representatives. Mobile source emissions were prepared by Ramboll-Environ [27].

For EGU's, the ERTAC EGU Forecasting Tool was used to develop future year estimates of hourly emissions for this category. The tool uses base year hourly data from U.S. EPA's Clean Air Markets Division (CAMD) data, and fuel-specific growth rates from the Annual Energy Outlook (AEO) forecast prepared annually by the U.S. Energy Information Administration (EIA) to estimate future emissions. EIA's forecasts have historically overestimated the amount of coal that will be used in future years and have underestimated the use of natural gas. LADCO compared actual coal and natural gas utilization to AEO's 2015 reference case and EIA's "High Oil and Gas Resource" (Appendix B) and found that the AEO2015 reference case forecasts much higher coal use and much lower natural gas use than were actually occurring. Ohio and LADCO concluded that the "High Oil and Gas Resource" scenario reflected a much more realistic forecast from which to base the 2021 projection of EGU NO_x and SO_2 emissions.

LADCO sought updated information from States and stakeholders on new unit shutdowns and controls. The 2021 emissions for EGU's projected by the ERTAC EGU Forecast Tool reflect enforceable "on-the-books" control measures, fuel switches and unit shutdowns. The model does not forecast unit shutdowns or fuel switches or incorporate assumptions about pending regulatory actions such as the Clean Power Plan (CPP), the proposed Cross-State Air Pollution Rule (CSAPR) Update proposed by U.S. EPA in 2015, or the

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Mercury and Air Toxics (MATS) rule. These regulatory programs are expected to reduce emissions from Midwestern EGU's but their impacts are as yet uncertain. LADCO made no attempt to quantify these future reductions and considers the 2021 emissions projections for EGU's to be conservative (i.e., future emissions are likely to be less than the emissions used in this analysis). For example, U.S. EPA's EGU emission model (the Integrated Planning Model (IPM)) predicted the complete shutdown of Avon Lake power plant by 2018 while the ERTAC model preserved this facility and its future emissions.

For mobile sources, Ramboll-Environ's future year (2021) on-road mobile emissions inventories developed using U.S. EPA's MOVES2014 emissions model were used.

The TSD contained in Appendix B provides more details on the inventory development.

The following summary table, Table 8, present the 2021 projected emissions inventory for NH_3, VOC, $PM_{2.5}$, SO_2 and NO_x. The $PM_{2.5}$ in the tables below represent both the filterable and condensable fractions. Emissions presented here are again categorized into the following sectors: EGU, Non-EGU, Area, MAR, FIRE, Onroad and Nonroad.

Table 8. Nonattainment area projected year (2021) inventory (TPY)

		$PM_{2.5}$					
		Filt	**Cond**	**NO_X**	**SO_2**	**NH_3**	**VOC**
Cuyahoga	Area (Nonpoint)	1513.46	529.61	5122.63	148.09	678.09	12140.58
	Marine/Air/Rail (MAR)	72.20	0.02	2471.12	101.88	0.97	276.07
	Nonroad	345.81	0.00	3508.63	8.78	9.64	5502.23
	Onroad	410.23	0.00	7501.91	57.42	346.78	3667.05
	Point EGU	0.00	0.00	0.00	0.00	0.00	0.00
	Point Non-EGU	542.01	313.28	2046.33	1411.28	65.81	918.89
	Prescribed Fire/Wildfire (FIRE)	4.92	0.00	1.20	0.54	0.88	12.61
	County total	2888.63	842.91	20651.82	1727.99	1102.17	22517.43
Lorain	Area (Nonpoint)	499.86	71.65	878.65	36.14	454.13	2712.49
	Marine/Air/Rail (MAR)	27.68	0.00	967.71	3.08	0.57	47.98
	Nonroad	89.81	0.00	1174.17	2.69	2.94	$172_{2.5}2$
	Onroad	101.59	0.00	1847.08	14.00	83.76	947.10
	Point EGU	90.18	283.18	5082.98	34870.26	0.00	36.98
	Point Non-EGU	157.80	176.74	730.63	280.71	6.54	910.55
	Prescribed Fire/Wildfire (FIRE)	0.00	0.00	0.00	0.00	0.00	0.00
	County total	966.92	531.57	10681.22	35206.88	547.94	6377.62
Nonattainment area total		**3855.54**	**1374.49**	**31333.04**	**36934.87**	**1650.11**	**28895.05**

With respect to nearby regional emissions likely to impact the Cleveland area, projected NO_x, $PM_{2.5}$, and SO_2 emissions for 2021 are compared to 2011 base year emissions for Ohio and neighboring states for several emissions categories in Figures 8, 9, and 10. As shown in the figures, emissions of $PM_{2.5}$, NO_x, and SO_2 are expected to decrease significantly between 2011 and 2021 in Ohio and regionally due to "on-the-books" control measures.

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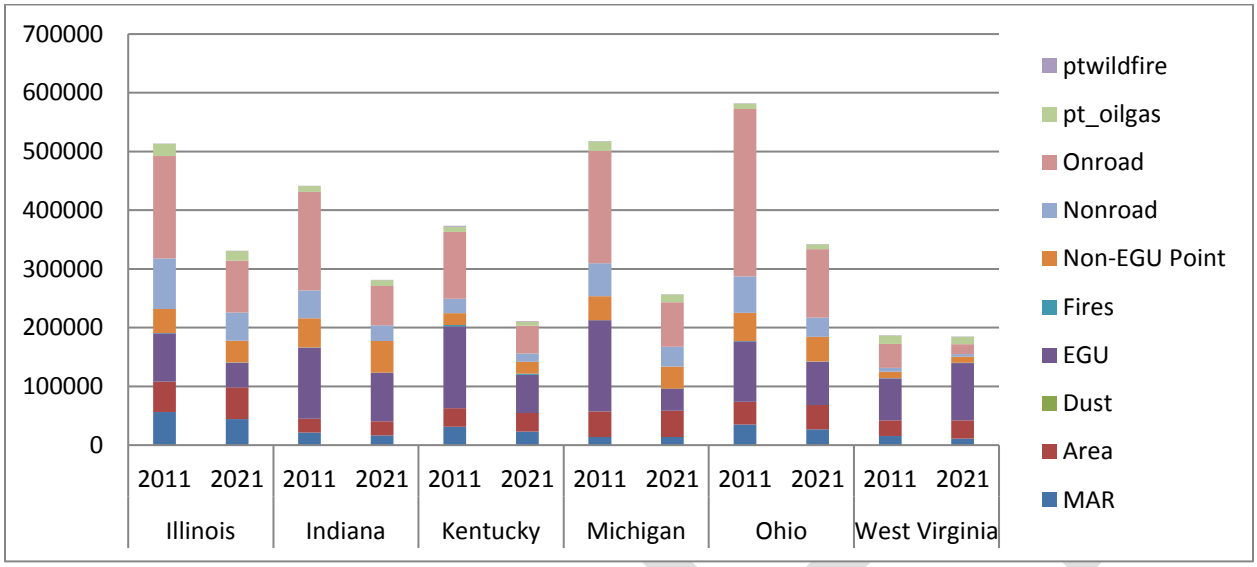

Figure 8. Base year (2011) and future year (2021) NO_x emissions

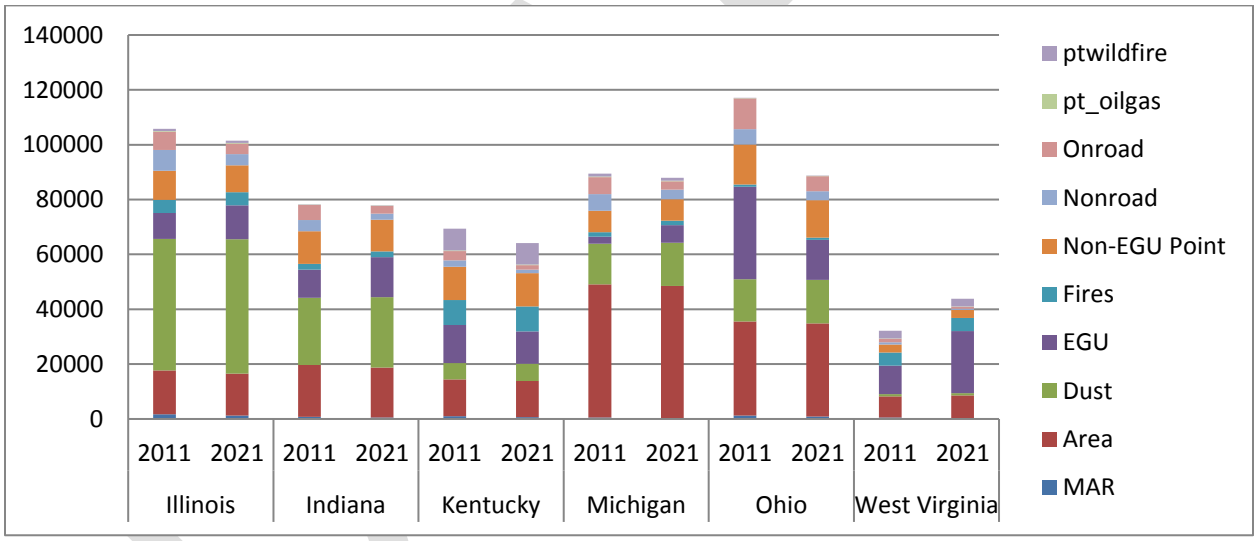

Figure 9. Base year (2011) and future year (2021) $PM_{2.5}$ emissions

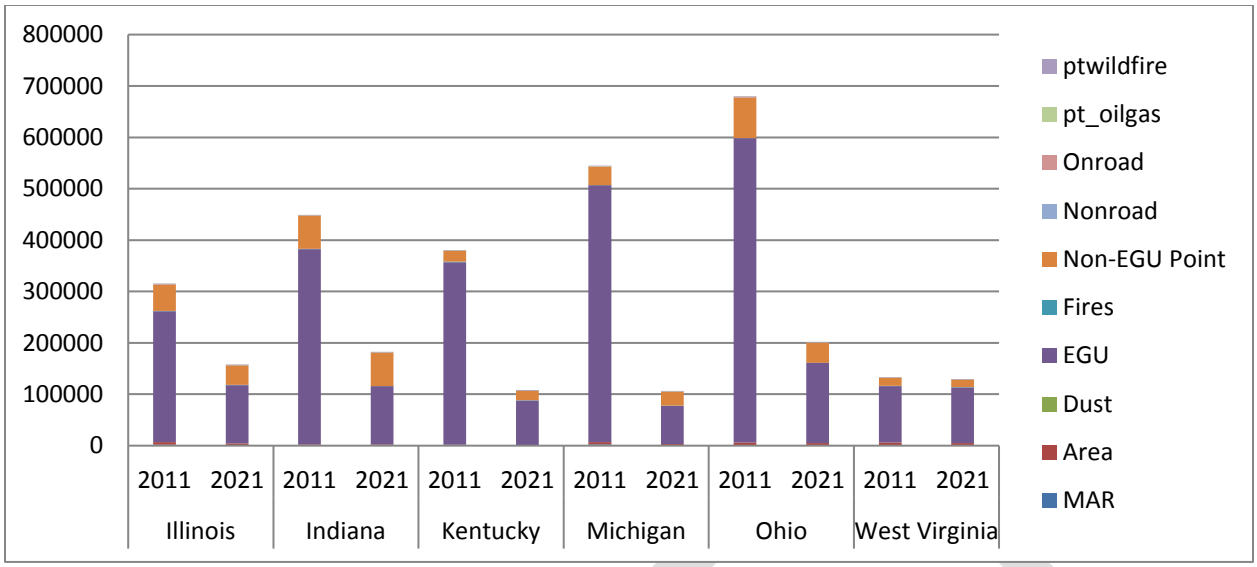

Figure 10. Base year (2011) and future year (2021) SO_2 emissions

c. Mobile emissions budgets

The transportation conformity rule (40 CFR Part 93) requires that attainment plans establish motor vehicle emissions budgets for the area's attainment year (2021) for direct $PM_{2.5}$ and any relevant $PM_{2.5}$ precursors. A motor vehicle emissions budget for the purposes of a $PM_{2.5}$ attainment plan is that portion of the total allowable emissions within the nonattainment area allocated to on-road sources as defined in the submitted attainment plan as being necessary to attain the NAAQS.

In addition to attainment year budgets, the transportation conformity rule requires that attainment plans establish motor vehicle emissions budgets with respect to the RFP plans submitted as part of an attainment plan submission. Motor vehicle emissions budgets for RFP are established in accordance with quantitative milestone requirements of 40 CFR Part 51.1013 [3]. (RFP and milestone requirements are discussed in Section 7 of this submittal). For Ohio, the RFP milestone years are 2019 and 2022.

Transportation conformity is required by CAA Section 176(c) (42 U.S.C. 7506(c)) to ensure that Federal funding and approval are given to highway and transit projects that are consistent with ("conform to") the air quality goals established by a State SIP. Conformity, for the purpose of the SIP, means that transportation activities will not cause new air quality violations, worsen existing violations, or delay timely attainment or interfere with maintenance of the NAAQS. The Federal requirements apply to areas designated as nonattainment for one or more NAAQS, or which have been redesignated to attainment with Federally approved air quality maintenance plans.

The Federal transportation conformity rule (40 CFR 93.100-160) provides the process by which the air quality impacts of transportation plans, transportation improvement programs, and transportation projects are analyzed. The agency preparing the plans,

programs, or projects must analyze the emissions expected from such proposals in accordance with the transportation conformity rule (40 USC. Section 7506).

The transportation conformity rule provides under 40 CFR 93.102(b)(2)(iv) and (v)):

> "(2) The provisions of this subpart also apply with respect to emissions of the following precursor pollutants:
>
> > (iv) NO_x in $PM_{2.5}$ areas, unless both the EPA Regional Administrator and the director of the state air agency have made a finding that transportation-related emissions of NO_x within the nonattainment area are not a significant contributor to the $PM_{2.5}$ nonattainment problem and has so notified the MPO and DOT, or the applicable implementation plan (or implementation plan submission) does not establish an approved (or adequate) budget for such emissions as part of the reasonable further progress, attainment or maintenance strategy; and
> >
> > (v) VOC, sulfur dioxide (SO_2) and/or ammonia (NH_3) in $PM_{2.5}$ areas either if the EPA Regional Administrator or the director of the state air agency has made a finding that transportation-related emissions of any of these precursors within the nonattainment area are a significant contributor to the $PM_{2.5}$ nonattainment problem and has so notified the MPO and DOT, or if the applicable implementation plan (or implementation plan submission) establishes an approved (or adequate) budget for such emissions as part of the reasonable further progress, attainment or maintenance strategy."

Ohio nor U.S. EPA have made a finding that transportation-related emissions of VOC, SO_2 or NH_3 are significant contributors to the nonattainment problem, therefore Ohio's on-road mobile emissions budgets are being established for the Cleveland area for primary $PM_{2.5}$ and NO_x. In addition, Ohio provided an NH_3 and VOC precursor analysis in Section 5(c) identifying these precursors are insignificant for attainment planning purpose.

As discussed in Section 4(a) and Section 4(b), Ohio's motor vehicle emissions inventories used for the base year and attainment modeling (using CAMx) were developed by Ramboll-Environ from quality-assured MOVES inputs used by U.S. EPA in developing the 2011NEIv2 inventory. Key updates to MOVES inputs, including vehicle population, vehicle miles travelled (VMT), speed, and vehicle inspection and maintenance characteristics were incorporated. These inventories were not used for the development of these mobile budgets. Rather, the Northeast Ohio Areawide Coordinating Agency (NOACA), a metropolitan planning agency, and Ohio Department of Transportation (ODOT), in consultation with Ohio EPA and U.S. EPA Region 5, prepared motor vehicle emissions inventories for 2019, 2021 and 2022 for the purpose of setting mobile emissions budgets. These inventories were developed using appropriate and up-to-date assumptions about vehicles mile traveled (VMT), socioeconomic variables, fuels used, weather inputs, other planning assumptions, and the latest approved motor vehicle emissions model (MOVES2014). NOACA, ODOT and Ohio EPA, in consultation with

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U.S. EPA Region 5, agreed upon variables and inputs that would be necessary to promote consistency between the Ramboll-Environ motor vehicle emissions estimates used in the attainment demonstration modeling and those estimates that would be used for mobile budget setting. All methodology is detailed in Appendix D.

The mobile budgets, agreed upon as part of the interagency consultation process, include the emission estimates calculated for 2019, 2021 and 2022 with an additional margin of safety (up to 15%) allocated to those estimates. In an effort to accommodate future variations in travel demand models and VMT forecast when no change to the network is planned, U.S. EPA has historically approved such a reasonable approach to address this variation.

The margin of safety and final budgets were calculated as follows:

- 2019: As discussed in Section 7, 2019 RFP mobile inventory estimates were made by interpolating the 2011 and 2021 motor vehicle emissions estimates derived by Ramboll-Environ. NOACA/ODOT developed the 2019 motor vehicle emissions estimates for budget setting. Ohio determined the percent difference between 2019 RFP mobile inventory estimates and the NOACA/ODOT motor vehicle emissions estimates. The results showed NOACA/ODOT estimates for NO_x were 24% below Ramboll-Environ estimates and the NOACA/ODOT estimates for $PM_{2.5}$ were 30% below Ramboll-Environ estimates. Ohio then calculated 15% of the NOACA/ODOT estimates and summed those numbers to derive the total budget.
- 2021: The 2021 mobile inventory discussed in Section 4(b), was derived by Ramboll-Environ and used to demonstrate attainment by 2021. NOACA/ODOT developed the 2021 motor vehicle emissions estimates for budget setting. Ohio determined the percent difference between 2021 Ramboll-Environ estimates and the NOACA/ODOT motor vehicle emissions estimates. The results showed NOACA/ODOT estimates for NO_x were 11% below Ramboll-Environ estimates and the NOACA/ODOT estimates for $PM_{2.5}$ were 22% below Ramboll-Environ estimates. Ohio retained an 11% margin of safety for the NO_x budget to remain consistent with the Ramboll-Environ estimates used to demonstrate attainment. Ohio then calculated 15% of the NOACA/ODOT estimate for $PM_{2.5}$ and summed those numbers to derive the total budget for $PM_{2.5}$.
- 2022: As discussed in Section 7, 2022 RFP mobile inventory estimates are based upon 2021 mobile inventory estimates. However, due to the requirement to establish a mobile emissions budget for 2022, even if the area is expected to attain, NOACA/ODOT developed 2022 motor vehicle emissions estimates. To determine an appropriate margin of safety, Ohio relied upon 2028 Ramboll-Environ motor vehicle estimates[3]. Ohio derived a 2022 Ramboll-Environ mobile inventory by interpolating the 2021 and 2028 motor vehicle emissions estimates derived by Ramboll-Environ. Ohio determined the percent difference between interpolated 2022 Ramboll-Environ inventory and the NOACA/ODOT motor vehicle emissions estimates. The results showed NOACA/ODOT estimates for NO_x were 19% below

[3] The 2028 Ramboll-Environ motor vehicle emissions estimates are not used in this attainment demonstration other than for this purpose, these estimates were derived using the same methodologies as the 2011 and 2021 estimates.

Ramboll-Environ estimates and the NOACA/ODOT estimates for $PM_{2.5}$ were 25% below Ramboll-Environ estimates. However, examining the results at the county level indicated NOACA/ODOT estimates for Lorain County NO_x were 9% below Ramboll-Environ estimates while NOACA/ODOT estimates for Cuyahoga County NO_x were 22% below Ramboll-Environ estimates. Ohio retained a 9% margin of safety for the Lorain County portion of the NO_x budget to remain consistent with the Ramboll-Environ inventory. Ohio then calculated 15% of the NOACA/ODOT estimate for NO_x for the Cuyahoga County portion of the NO_x budget. The final total NO_x budget for the area then included a 14% safety margin overall for NO_x. Lastly, Ohio then calculated 15% of the NOACA/ODOT estimate for $PM_{2.5}$ and summed those numbers to derive the total budget for $PM_{2.5}$.

Up to a 15% margin of safety is appropriate because: 1) there is an acknowledged potential variation in VMT forecast and potential estimated mobile source emissions due to expected modifications to TDM and mobile emissions models; and 2) the NOACA/ODOT derived motor vehicle emissions estimates with a safety margin:

- remains below the Ramboll-Environ $PM_{2.5}$ estimates for 2021 used in the attainment modeling by 7%,
- remains at the Ramboll-Environ NO_x estimates for 2021 used in the attainment modeling,
- remains below the 2019 RFP inventory motor vehicle estimates discussed in Section 7 by 9% for NO_x and 15% for $PM_{2.5}$, and
- remains below the interpolated 2022 motor vehicle emissions based on 2021 and 2028 motor vehicle estimates generated by Ramboll-Environ by 4% for NO_x and 10% for $PM_{2.5}$.

Safety margin, as defined by the conformity rule at 40 CFR 93.101, looks at the total emissions from all sources in the area. The definition states "safety margin" means the amount by which the total projected emissions from all sources of a given pollutant are less than the total emissions that would satisfy the applicable requirement for reasonable further progress, attainment, or maintenance. Ohio's actual allocation of up to a 15% safety margin is at, or well below, the levels required for RFP or attainment. Table 9 identifies Ohio's mobile emissions budgets with a safety margin for the Cleveland area.

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Table 9. 2019, 2021 and 2022 mobile emissions budgets with safety margin

	$PM_{2.5}$				NO_x			
	Estimate (TPY)	Safety Margin (%)	Safety Margin (TPY)	Total[1] (TPY)	Estimate (TPY)	Safety Margin (%)	Safety Margin (TPY)	Total[1] (TPY)
2019								
Cuyahoga	373.91	15%	56.09	430.00	7759.79	15%	1163.97	8923.76
Lorain	93.88	15%	14.08	107.96	2025.09	15%	303.76	2328.85
Total	467.79	15%	70.17	537.96	9784.88	15%	1467.73	11252.61
2021								
Cuyahoga	336.13	15%	50.42	386.55	6736.26	11.37%	765.65	7501.91
Lorain	82.05	15%	12.31	94.36	1706.52	8.24%	140.56	1847.08
Total	418.18	15%	62.73	480.91	8442.78	10.73%	906.21	9348.99
2022								
Cuyahoga	311.64	15%	46.75	358.39	5809.41	15%	871.41	6680.82
Lorain	80.74	15%	12.11	92.85	1610.49	9.08%	146.29	1756.78
Total	392.38	15%	58.86	451.24	7419.90	13.72%	1017.70	8437.60

[1]Budget with Safety Margin

5. RACT/RACM and Additional Reasonable Measures: CAA Section 189(a)(1)(C), CAA Section 189(e) and CAA Section 172(c)(6)

Under Subpart 4, Reasonably Available Control Measures (RACM) (including Reasonably Available Control Technology (RACT)) are those measures that can and must be implemented within 4 years of the area's designation as nonattainment (pursuant to CAA Section 189(a)(1)(C)).

U. S. EPA has interpreted the RACM (and RACT) requirement in the CAA as requiring imposition of all reasonable controls as needed for expeditious attainment or to advance the attainment date by at least one year and, therefore, imposition of additional controls that do not collectively advance the attainment date, are not necessary.

U.S. EPA recognizes that other, similarly reasonable emissions reduction measures could be implemented after this 4-year period, and as late as the end of the 6th calendar year following designation, to help an area attain as expeditiously as practicable. The 2016 Implementation Rule terms those technologically and economically feasible control measures that could not be implemented within the 4-year period after designation, but could be implemented starting any time after that 4-year period through the end of the 6th calendar year after designation, as ''additional reasonable measures.'' Furthermore, U.S. EPA requires implementation of these ''other'' control measures to the extent necessary to demonstrate attainment by the applicable attainment date pursuant to CAA Section 172(c)(6).

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For attainment planning purposes, the 2016 Implementation Rule provides that emissions reduction measures analyses only need to address those emissions within the nonattainment area, although States may choose to address emissions outside the nonattainment area.

Under Subpart 4, States are initially required to analyze and evaluate emissions reduction measures for all sources of direct $PM_{2.5}$ and $PM_{2.5}$ precursors (*i.e.,* SO_2, NO_X, VOC and NH_3). However, U.S. EPA does provide proposed options for a ''precursor demonstration'' to supports a State's finding that one or more $PM_{2.5}$ precursors need not be subject to control requirements in a given nonattainment area.

For certain moderate nonattainment areas, the State may be able to demonstrate that attainment of the standard ''as expeditiously as practicable'' is possible by the end of the 6th year after designation (the moderate area attainment date) or sooner, and could be achieved by adopting regulations to reduce emissions of only a subset of the four $PM_{2.5}$ precursors. Under certain "precursor demonstrations" the State would be expected to provide analytical information showing that, even though new economically and technically feasible control measures may be available for one or more precursors, the reductions in emissions of the precursor(s) that could be achieved are not necessary for expeditious attainment and would not advance the attainment date by at least a year. In this case, for the purposes of the attainment plan, the State would not need to identify and adopt additional control measures for that $PM_{2.5}$ precursor given that additional regulation of that $PM_{2.5}$ precursor would not be necessary for attaining the standard as expeditiously as practicable.

Lastly, U.S. EPA guidance for RACM (and RACT) guides that the state should inventory (for the base year) all emissions of the relevant pollutants and precursors in the nonattainment area for all sources, including area sources, mobile sources and stationary sources.

This section describes Ohio's RACT/RACM and additional reasonable measures analysis for $PM_{2.5}$, VOC and NO_x. Ohio has found existing measures for $PM_{2.5}$, SO_2 and NO_x for area sources, mobile sources and stationary sources constitute RACT/RACM. Furthermore, this section identifies Ohio's NH_3 and VOC precursor demonstration of insignificance for the purpose of attainment planning (including RACT/RACM).

a. RACT/RACM

While CAA Section 172(c)(1) under Subpart 1 describes the general RACT/RACM requirements (that must occur as expeditiously as practicable), CAA Section 189(a)(1)(C) under Subpart 4 more specifically requires:

> "Provisions to assure that reasonably available control measures for the control of PM–10 shall be implemented no later than December 10, 1993, or 4 years after designation in the case of an area classified as moderate after November 15, 1990."

U.S. EPA reads CAA Sections 172(c)(1) and 189(a)(1)(C) together to require that attainment plans for moderate nonattainment areas must provide for the implementation of RACM and RACT for existing sources of $PM_{2.5}$ and $PM_{2.5}$ precursors in the nonattainment area as expeditiously as practicable but no later than four years after designation.

The 2016 Implementation Rule notes the terms RACM and RACT are not defined within Subpart 4, nor do the provisions of Subpart 4 specify how States are to meet the RACM and RACT requirements. However, U.S. EPA's longstanding guidance describes, in detail, considerations for determining what control measures constitute RACM and RACT for purposes of Subpart 4 [30]. The RACT/RACM stationary source analysis is required only for major stationary sources, but States are given the flexibility to address smaller sources if they wish.

The 2016 Implementation Rule requires the State's process for identifying RACT/RACM include the following steps. Ohio has followed this process and notes below specific decisions made where flexibility was provided:

i. Step 1: sources

Identify all sources of emissions of direct $PM_{2.5}$ (filterable and condensable) and all $PM_{2.5}$ precursors in the nonattainment area and all potential control measures to reduce emissions from those source. This includes existing major stationary sources as points sources, nonpoint sources (as defined by 40 CFR 51.50) inducing non-major point sources, and mobile sources. These sources are all identified in the point, area and mobile analyses discussed in Section 4. Ohio's developed a process, in consultation with U.S. EPA Region 5, for determining the appropriate level and types of sources for a RACT/RACM analysis. U.S. EPA acknowledges the 2016 Implementation Rule provides sufficient flexibility to identify predominant source categories/sources contributing to violations so that States do not waste valuable resources. Ohio's process took into consideration levels that would be reasonable in light of the area's attainment needs and existing analyses performed by U.S. EPA regarding emissions levels that would more accurately depict available controls. This provides a relatively straightforward path to identify the predominant source categories/sources that may be contributing to $PM_{2.5}$ violations. This process is described below for the stationary (point), area (nonpoint) and mobile source categories.

- Stationary sources:
  1. From Ohio's list of major stationary sources, Ohio generated a list of every major source facility in the nonattainment area with combined emissions of $PM_{2.5}$ (filterable and condensable) and all precursors (SO_2, NO_x, VOC and NH_3) totaling over 100 tons per year (TPY) actual emissions for 2011. (See Appendix E.1, "Stationary source" file, "FacilityEmissionsII" tab for totals for all facilities in the area and "FacilityListMajor" tab for those meeting this criteria.)

  2. Using the NAICS, Ohio looked at both the 4th and 6th level of classification. Emissions from all sources identified in Step 1 were allocated to each 4th and

6th classification category. The 4th and 6th level emissions were then totaled and those categories that captured at least 90% of the areas $PM_{2.5}$ emissions (filterable and condensable) were selected for further analysis. The most conservative results from the 4th and 6th digit NAICS code evaluations were used to determine which source categories and major facility sources would be subject to the RACM/RACT analysis and which source categories could be excluded from further consideration. However, within those categories, Ohio focuses on analyzing RACT/RACM for individual facilities/units. (See Appendix E.1, "Stationary source" file, "NAICSList4", "NAICSEmissions4", and "NAICSCONTRB4" tabs to generate a list by 4th level NAICS of all emissions at a facility in the area, to see a list by the 4th level NAICS of the percentage of pollutant(s) for each category, and to see a list of all categories emitting greater than 90% of the area emissions at the 4th level NAICS, respectively; and "NAICSCONTRB6" tabs for the same information at the 6th level.)

3. Ohio selected any emissions unit from the list of emissions units generated under Step 2 that had greater than 50 TPY of $PM_{2.5}$ emissions (filterable and condensable combined) or significant precursors (NO_x and SO_2) as warranting a RACT/RACM analysis. The 2016 Implementation Rule provides that a State may develop a precursor demonstration showing the precursor(s) does not contribute significantly. When such a demonstration is made the State would not be required to adopt control measures for the precursor. Ohio is providing such a demonstration for NH_3 and VOC in Section 5(c); therefore, our RACT/RACM analysis is limited to those sources in the inventory identified in this step that emit $PM_{2.5}$, SO_2 and NO_x. The 50 TPY threshold was selected to be consistent with U.S. EPA's Regulatory Impact Analysis (RIA) associated with the revised $PM_{2.5}$ NAAQS where U.S. EPA employed a decision rule in which controls were not applied to any non-EGU or area sources with 50 TPY of emissions or less to more accurately depict available controls [31]. (See Appendix E.1, "Stationary source" file, "EU>50 PMPE" tab.)

4. Ohio then generated a list of all emissions units in the categories identified under Step 2 that were located at any facility identified in Step 3 above and focused our RACT/RACM analysis on these sources. (See Appendix E.1, "Stationary source" file, "DiGeronimo", "Avon", "CEI", "Clev Thermal", "Med Center", "Lor Tubular", "Ross", "Southerly", "Charter", "AMittal", and "BFI Lor" tabs.)

5. Furthermore, controls were not applied to sources unless at least 5 TPY of emission reductions were achieved. This was based on an approach used by U.S. EPA in the RIA because it was found that most point sources with emissions of this level or less had controls already in place.

- Area sources:

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1. Ohio used the 10-digit SCC categories. Those categories that captured at least 90% of the areas $PM_{2.5}$ emissions (filterable and condensable) were selected for further analysis. (See Appendix E.2, "Area source" file, "%Contribution" tab)

2. Of the 190 area source SCC categories that were identified in the nonattainment area (See Appendix E.2, "Area source" file, "SUM(All)" tab):
   - 46 SCC categories made up 94% of the total affected pollutants ($PM_{2.5}$ (filterable and condensable) SO_2, NO_x, NH_3, and VOC). (See Appendix E.2, "Area source" file, "%Contribution" tab.)
   - Seven SCC categories made up 94% of the $PM_{2.5}$ filterable emissions impacting the nonattainment area. (See Appendix E.2, "Area source" file, "SumPM2.5Filt" tab.)
   - Four SCC categories made up 91% of the $PM_{2.5}$ condensable emissions impacting the nonattainment area. (See Appendix E.2, "Area source" file, "SumPMCond" tab.)
   - Nine SCC categories made up 95% of the NO_x emissions impacting the nonattainment area. (See Appendix E.2, "Area source" file, "SumNOx" tab.)
   - Thirteen SCC categories made up 91% of the SO_2 emissions impacting the nonattainment area. (See Appendix E.2, "Area source" file, "SumSO2" tab.)

3. Ohio eliminated analysis of VOC or NH_3 for RACT/RACM since Ohio determined these precursors were insignificant for attainment planning purposes (see Section 5(c)).

4. Ohio then focused its RACT/RACM analysis on control options for $PM_{2.5}$, SO_2 and NO_x for the remaining SCC categories. (See Appendix E.2, "Area source" file, "INTRO-EVAL" tab.)

- Mobile sources:
  1. Ohio used the 10-digit SCC categories. Those categories that captured at least 90% of the areas $PM_{2.5}$ emissions (filterable and condensable) were selected for further analysis. (See Appendix E.3, "Mobile source" file, "%Contribution" tab.)

  2. Ohio eliminated analysis of VOC or NH_3 for RACT/RACM since Ohio determined these precursors were insignificant for attainment planning purposes (see Section 5(c)).

  3. Ohio eliminated analysis of SO_2 for RACT/RACM for traditional mobile sources as Ohio nor U.S. EPA have made a finding that transportation-related emissions of SO_2 are significant contributors to the nonattainment problem (See Section 4(c)). RACT/RACM for marine and locomotive sources was analyzed for SO_2.

  4. Of the 30 mobile source SCC categories that were identified in the nonattainment area (See Appendix E.3, "Mobile source" file, "SUM(All)" tab):

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- Six SCC categories made up 89% of the affected pollutant emissions ($PM_{2.5}$ (filterable and condensable), NO_x, SO_2, VOC, and NH_3) and 91% of the $PM_{2.5}$ (filterable and condensable) emissions impacting the nonattainment area. Five SCC categories were common to both of these and they include passenger cars and trucks using gasoline; combination short and long-haul trucks using diesel; and railroad locomotives (Class I) using diesel. (See Appendix E.3, "Mobile source" file, "%Contribution" tab)
- Seven SCC categories made up 92% of the NO_x emissions and the five common SCC categories noted above accounted for 85% of the NO_x emissions. (See Appendix E.3, "Mobile source" file, "SumNOx" tab.)

5. Ohio then focused its RACT/RACM analysis on control options for $PM_{2.5}$ and NO_x for the 5 common SCC categories and SO_2 for marine and locomotive. (See Appendix E.3, "Mobile source" file, "INTRO-EVAL" tab.)

ii. Step 2: measures

U.S. EPA requires that States consider a variety of types of measures because RACT/RACM applies to stationary, mobile and area sources. U.S. EPA notes that reducing air emissions may not justify adversely affecting other resources, for example, by increasing pollution in bodies of water, creating additional solid waste disposal problems or creating excessive energy demands. States are to provide reasoned judgment for such decisions in their SIP. Where Ohio found a measure to be unreasonable based upon the above, it is noted and justified in Ohio's analysis.

U.S. EPA requires a State to include in its initial list of those control measures and technologies that are being implemented or will be implemented due to promulgated and/or adopted (*i.e.,* ''on the books'') regulations. Ohio has identified in its analysis (Appendix E) current controls for sources analyzed and Section 6(a) of this submittal also identifies "on the books" regulations currently being implemented for stationary, mobile, and area sources.

In addition to identifying existing control measures, U.S. EPA requires a comprehensive list of potential control measures. U.S. EPA suggests the use of sources such as: U.S. EPA's Office of Air Quality Planning and Standards maintains a Menu of Control Measures document, available online at *http:// www.epa.gov/air/criteria.html*; U.S. EPA's Office of Transportation and Air Quality Web site at *http://www.epa.gov/otaq* (mobile source measures); and the RACT/BACT/LAER Clearinghouse (RBLC) at *http://cfpub.epa.gov/rblc/*. Ohio used these sources for identifying potential control measures where appropriate.

iii. Step 3: technological feasibility

Determine if any of the identified potential control measures or technologies are technologically feasible.

U.S. EPA reiterates their interpretation that technological feasibility includes consideration of factors such as a source's processes and operating procedures, raw

materials, physical plant layout, and potential environmental impacts such as increased water pollution, waste disposal and energy requirements. In regard to area and mobile sources, a state may consider relevant factors in conducting its analysis and local circumstances, such as the condition and extent of needed infrastructure, population size, or workforce type and habits, which may prohibit certain potential control measures from being implementable. Ohio has considered the parameters identified above and provided appropriate justification in our analysis.

iv. Step 4: economic feasibility

Determine if any of the identified technologically feasible control measures and technologies are economically feasible.

U.S. EPA proposed the use of their longstanding interpretation of the term ‘‘economic feasibility’’ which involves considering the cost of reducing emissions and the difference between the cost of an emissions reduction measure at a particular source and the cost of emissions reduction measures that have been implemented at other similar sources in the same or other areas. Specifically, a State must evaluate the economic feasibility of the measure or control, through consideration of the capital costs, operating and maintenance costs, and cost effectiveness (*i.e.,* cost per ton of pollutant reduced by that measure or technology) associated with such measure or control. The cost effectiveness of a measure is its annualized cost ($/year) divided by the emissions reduced (tons/ year) which yields a cost per amount of emission reduction ($/ton); however, U.S. EPA does not establish a fixed $/ton threshold. Similar to U.S. EPA’s approach, Ohio is not selecting a fixed $/ton threshold. While Ohio has not identified a fixed $/ton threshold as being cost-effective, Ohio does not believe that any of the technologically feasible measures are reasonably cost-effective. For example, of reasonable measures that were found to be technologically feasible for major stationary sources, cost-effectiveness ranged from $5800/ton to >$40,000/ton. U.S. EPA recognizes that each nonattainment area has its own profile of emitting sources, and thus neither requires specific RACT/RACM to be implemented in every nonattainment area, nor includes a specific source size threshold for the RACT/RACM analysis. Where the severity of the nonattainment problem makes reductions more imperative or where essential reductions are more difficult to achieve, the acceptable cost of achieving those reductions could increase. Given the lack of a significant level of severity of the Cuyahoga area, it will be reasonable and appropriate for this area with its less serious $PM_{2.5}$ air quality problem and lower design values (current and modeled) to impose emission reduction requirements with generally higher costs per ton of reduced emissions, if necessary. Control measures that directly reduce emissions of $PM_{2.5}$ in proximity to the exceeding monitors have the potential to be most effective at bringing areas into attainment, with NO_x and SO_2 controls supplementing the $PM_{2.5}$ controls depending upon the monitor speciation data.

v. Step 5: implementation within four years

Determine which technologically and economically feasible measures can be implemented, in whole or in part, within 4 years from the date of designation of the area and which can be implemented, in whole or in part, by the end of the sixth calendar year following designation.

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U.S. EPA states the term ‘‘implement’’ to mean that a control measure or technology has not only been submitted to U.S. EPA for approval as part of a SIP but has also been built, installed and/or otherwise physically manifested, and is achieving the intended emissions reductions. However, U.S. EPA recognizes that a state may be able to implement a given control measure only partially within 4 years after designation; and therefore requires a state to adopt as RACM and RACT that portion of a control measure or technology that can feasibly be implemented within 4 years of the effective date of designation.

vi. Step 6: earliest practicable attainment

Perform an analysis to determine the earliest practicable attainment date for the area and identify the control measures and control technologies that will be needed to achieve attainment by the demonstrated attainment date and to meet statutory control requirements. The statutory attainment date for moderate nonattainment areas is as expeditiously as practicable, but not later than the end of the 6th calendar year after designation of the area as nonattainment. In the case of moderate areas that can reach attainment by the statutory attainment date, and consistent with existing policies, states would be required to evaluate the combined effect of reasonably available control measures that are not necessary to demonstrate attainment within the maximum statutory timeframe to determine whether implementation of the remaining measures could advance the attainment date by at least one year. U.S. EPA has long applied this particular test—whether reasonably available control measures that were not necessary to demonstrate attainment within the maximum statutory timeframe, collectively can advance an area’s applicable attainment date by at least one year—to satisfy the statutory provision related to an area demonstrating attainment ‘‘as expeditiously as practicable.’’ In the case of moderate areas that cannot practicably attain by the statutory attainment date, states would be required to implement all RACM and RACT, together with any additional reasonable measures on sources in the nonattainment area. Section 6(c) of this submittal identifies Ohio’s modeling analysis to determine an attainment date.

For areas that can demonstrate attainment by the attainment date, U.S. EPA proposed to define as ‘‘reasonable’’ as only those technologically and economically feasible measures that are necessary for expeditious attainment of the NAAQS, as the CAA does not require a State to adopt measures that are not needed for expeditious attainment in a moderate $PM_{2.5}$ nonattainment area. Thus, a state may exclude those otherwise reasonably available measures that, if adopted and considered collectively, would not advance the attainment date for the area by at least one year.

vii. Summary conclusion

Under the 2016 Implementation Rule, a State must submit the following information:

- A list of all sources and activities in the nonattainment area that emit direct $PM_{2.5}$ or any $PM_{2.5}$ precursors;
- For each source or activity in the nonattainment area, an inventory of direct $PM_{2.5}$ emissions and emissions of all $PM_{2.5}$ precursors, and a comprehensive list of potential control measures considered by the State for the nonattainment area;

    - If a State submits a precursor analysis showing insignificance, the state would not be required to submit a list of sources and potential measures to control emissions for that precursor(s).
- For each potential control measure considered by the State but eliminated from further consideration due to a determination by the State that the control measure or technology was not technologically feasible, a narrative explanation and quantitative or qualitative supporting documentation to justify the State's conclusion;
- For each technologically feasible emission control measure or technology, the State must provide the following information relevant to economic feasibility:
    - the control efficiency by pollutant;
    - the possible emissions reductions by pollutant;
    - the estimated cost per ton of pollutant reduced; and,
    - a determination of whether the measure is economically feasible, with narrative explanation and quantitative supporting documentation to justify the State's conclusion.
- For each technologically and economically feasible emission control measure or technology, the date by which the technology or measure could reasonably be implemented, in whole or part.

Ohio's full RACM/RACT analysis is included in Appendix E. Consistent with the above, Ohio has prepared its analysis in accordance with the 2016 Implementation Rule. Ohio has found existing measures for $PM_{2.5}$, SO_2 and NO_x for area sources, mobile sources and stationary sources constitutes RACT/RACM and no new additional measures or controls are economically or technically feasible. In addition, as demonstrated in Section 6(c) of this submittal, Ohio has modeled attainment in the Cleveland area by the end of the 6th calendar year from designation (2021).

In 1972, 1980, and 1991, Ohio promulgated rules requiring RACT/RACM for particulate emissions from stationary sources. Statewide RACT rules have been applied to all new sources locating in Ohio since that time. RACT requirements are incorporated into permits along with monitoring, recordkeeping, and reporting necessary to ensure ongoing compliance. Ohio also has an active enforcement program to address violations discovered by field office staff. The Ohio RACT rules are found in OAC Chapter 3745-17[4].

As detailed in the RACT/RACM analysis in Appendix E, many of the sources are well controlled beyond RACT/RACM levels already. Also as noted in Section 6(a), both the Federal and State on the books controls have led to additional control and will lead to more controls in the future. Because of the historic nonattainment status of this area for both ozone and $PM_{2.5}$, the Cleveland nonattainment area is one of the most well controlled in the State for both $PM_{2.5}$ and ozone, including precursors. Ohio's current rules, current controls and the federal on the books controls continue to satisfy RACT/RACM for the annual $PM_{2.5}$ standard.

[4] http://www.epa.ohio.gov/dapc/regs/3745_17.aspx

b. Additional Reasonable Measures

CAA Section 172(c)(6) states:

> "Such plan provisions shall include enforceable emission limitations, and such other control measures, means or techniques (including economic incentives such as fees, marketable permits, and auctions of emission rights), as well as schedules and timetables for compliance, as may be necessary or appropriate to provide for attainment of such standard in such area by the applicable attainment date specified in this part."

The 2016 Implementation Rule interprets this statutory provision to require a state to identify, select and implement additional measures to those identified as RACM and RACT for the area if needed to provide for timely attainment of the area. As a part of the RACT/RACM process discussed above, U.S. EPA proposed that a State must separately identify those technologically and economically feasible control measures that can only be implemented, in whole or part, after the statutory window for implementing RACM and RACT but before the end of the 6th calendar year from designations to address CAA Section 172(c)(6) requirements for ''other measures'' (additional reasonable measures) necessary to provide for timely attainment in an area. The same process used for the RACT/RACM analysis would apply.

Because Ohio found no new additional measures or controls are economically or technically feasible, and because Ohio demonstrated in Section 6(c) of this submittal attainment modeling for 2021; Ohio has met the statutory requirement to address CAA Section 172(c)(6).

c. Insignificance of NH_3 and VOC

CAA Section 189(e) states:

> "The control requirements applicable under plans in effect under this part for major stationary sources of PM–10 shall also apply to major stationary sources of PM–10 precursors, except where the Administrator determines that such sources do not contribute significantly to PM–10 levels which exceed the standard in the area. The Administrator shall issue guidelines regarding the application of the preceding sentence."

For attainment planning purposes, U.S. EPA provides the ability for a State to perform a precursor demonstration showing that additional emission reduction measures for a particular precursor is not needed for the purposes of achieving expeditious attainment nor for advancing the attainment date by at least a year. Specifically, a comprehensive precursor demonstration, covering all existing stationary, area and mobiles sources, could be conducted showing the precursor does not contribute significantly to the $PM_{2.5}$ levels that exceed the standard in the area. Under the 2016 Implementation Rule, the State would first evaluate the contribution of all existing source emissions of the particular precursor to $PM_{2.5}$ concentrations that exceed the $PM_{2.5}$ standard. If the State cannot demonstrate via this concentration-based precursor demonstration the sources of a particular precursor have an insignificant contribution, then the State could still

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demonstration insignificance by conducting a sensitivity analysis to evaluate the sensitivity of ambient $PM_{2.5}$ concentrations in the area to decreases in the precursor emissions in the area. Ohio has performed such an analysis for NH_3 and VOC.

The 2016 Implementation Rule identifies the critical first step in any precursor analysis is the development of a comprehensive inventory of all precursor emissions in the nonattainment area. Ohio's 2011 and 2021 comprehensive modeling inventories were used for this analysis and all area, mobile and stationary sources were included in the analysis (Sections 4(a) and 4(b)).

Ohio presents findings of insignificant contribution for precursors NH_3 and VOC based on the facts and circumstances of the nonattainment area. In accordance with 40 CFR Part 51.1006, Ohio has conducted a concentration-based contribution analysis and a sensitivity-based analysis in determining relative significance of these two precursors to $PM_{2.5}$ levels that exceed the standard in the area. Whereas the concentration-based contribution analysis provides weight of evidence and helps to inform the review of the precursor demonstration, additional analysis evaluating the sensitivity of $PM_{2.5}$ levels in the area to a decrease in emissions of precursors NH_3 and VOC provides a strong technically sound finding of insignificance.

i. Concentration-based contribution analysis

On an annual basis, $PM_{2.5}$ average composition in the region consists mostly of sulfate, nitrate, and organic carbon in similar proportions, while the Cleveland area has higher relative elemental and crustal contributions to total mass (Figure 11).

Regionally, winter nitrate formation lends to seasonally high $PM_{2.5}$ concentrations, though the Cleveland area (east of the Midwest "nitrate bulge") does not demonstrate as strong of seasonal trends compared to the more agricultural Midwest as seen in monitoring data and recent academic studies [32, 33]. Winter $PM_{2.5}$ is most sensitive to NH_3 emissions, and sensitivity decreases with decreasing NO_x and SO_2 emissions, especially in the Midwest [34]. Findings of lower urban excess of winter particulate nitrate concentrations in the Cleveland area are determined to be the result of a deficiency of free NH_3 in the proximity [33]. This finding is supported by inventory analysis of the nonattainment area and is demonstrated in the sensitivity analysis. It has been found that particulate ammonium nitrate contributes significantly to PM mass only when an excess of NH_3 is present beyond that required to neutralize the acid sulfates along with conditions of low temperature and high humidity [33]. Speciation monitoring coupled with inventory analysis of the nonattainment area show that the concentration of sulfates is substantially high, beyond that which would limit availability of NH_3 for the formation of ammonium nitrate.

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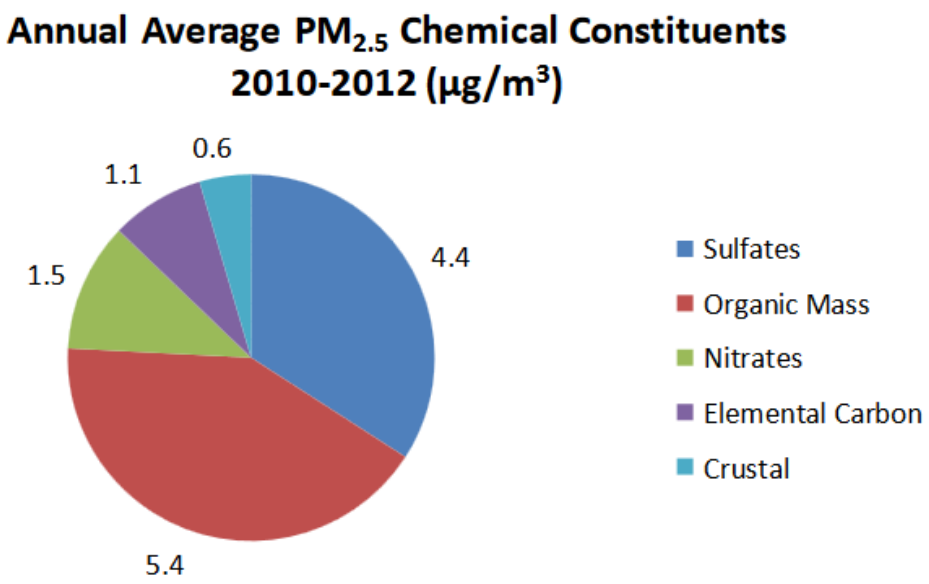

Figure 11. Annual average $PM_{2.5}$ chemical constituents in Cleveland area

It has been found that the regional VOC/NO_x ratio is key to the response of $PM_{2.5}$ components. In a NO_x-saturated area, as in the Midwest, when VOCs are reduced, oxidant levels decrease. In these conditions, the conversion of NO to NO_2 is VOC-limited, leading to lower OH concentrations that inhibit sulfate gas phase formation, found to result in only marginal decreases in $PM_{2.5}$ levels [35]. A study based in the Eastern half of the United States addressed the complex connection between NO_x and VOCs with oxidant levels with an investigation of NO_x-saturated and NO_x-limited conditions [36]. This study found a modeled 50% reduction of anthropogenic VOC emissions lead to an increase in sulfate and nitrate concentration levels in summer months and a subsequent increase in $PM_{2.5}$ levels. The mass increase was marginal despite such large VOC reductions. In winter months, with the opposite effect, the largest decrease in the region was found 0.25 µg/m^3 in western Pennsylvania [36].

The NO_x-saturated conditions of the Midwest with respect to the VOC/NO_x ratio supports concentration-based review, further warranting consideration of a nonattainment area-specific sensitivity analysis. As an initial analysis, the concentration-based analysis does not arrive at an insignificance determination, yet provides good technical information to support review of a more refined sensitivity analysis.

ii. Sensitivity-based contribution analysis

Under the 2016 Implementation Rule, U.S. EPA provides the option for a sensitivity-based analysis that would demonstrate the degree to which concentrations in the nonattainment area are sensitive to decreases of a precursor. This analysis could be used in the event a State cannot conclude via the concentration-based analysis that sources of a precursors have an insignificant contribution.

Ohio's sensitivity analysis for attainment planning purposes was performed for the 2021 attainment period by applying across the board cuts to anthropogenic emissions within the Cleveland area. The full details of this analysis is included in Appendix B.

2021 sensitivity runs examined reducing anthropogenic NH_3 or VOC emissions within the nonattainment counties by 40% for all source categories. The results of the 2021 attainment planning sensitivities are used with the 2011 baseline modeling for input to the Modeled Attainment Test Software (MATS, described in Section 6(c)) to examine the impact of future $PM_{2.5}$ design value. The results of the 2021 sensitivity analysis are shown in Table 10.

Table 10. Projected change in MATS annual $PM_{2.5}$ design values from sensitivity analysis

County	Monitor ID	NH_3 (µg/m3)	VOC (µg/m3)
Cuyahoga	39-035-0034	-0.15	0.00
	39-035-0038	-0.21	0.00
	39-035-0045	-0.20	0.00
	39-035-0060	-0.18	0.00
	39-035-0065	-0.20	-0.10
	39-035-1002	-0.16	0.00
Lorain	39-093-3002	-0.10	0.00

With respect to determining a level that would be deemed significant, the 2016 Implementation Rule does not set a significance level but rather states U.S. EPA will provide guidance with technical details and suggested thresholds at a later date. This guidance was not available at the time of this analysis. Therefore, Ohio EPA in consultation with U.S. EPA Region 5 determined a significance level of 0.2 µg/m^3 (with conventional rounding) would be appropriate. Therefore, based upon the results presented above, VOC and NH_3 emissions are insignificant in the Cleveland moderate nonattainment area and Ohio does not need to adopt additional control measures for VOC or NH_3.

6. Attainment Demonstration: CAA Section 189(a)(1)(B)

CAA Section 189(a)(1)(B) states:

> "Each State in which all or part of a Moderate Area is located shall submit, according to the applicable schedule under paragraph (2), an implementation plan that includes each of the following:
>
> > (B) Either (i) a demonstration (including air quality modeling) that the plan will provide for attainment by the applicable attainment date; or (ii) a demonstration that attainment by such date is impracticable."

The 2016 Implementation Rule identifies the goals of the attainment strategy and modeling (attainment demonstration) as ensuring States implement measures that provide for attainment as expeditiously as practicable; and, that States adopt emissions reduction strategies that will be the most effective, and the most cost effective, at reducing

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$PM_{2.5}$ levels in nonattainment areas. U.S. EPA expands upon this, noting that in addition to having an obligation to meet the statutory requirements for specific control measures on sources located within a nonattainment area (*e.g.,* RACM and RACT), a State has discretion to require reductions from any source inside or outside of a $PM_{2.5}$ nonattainment area, but may need to require emissions reductions on sources located outside of the area if such reductions are needed in order to provide for expeditious attainment.

The 2016 Implementation Rule provides an approvable attainment demonstration must contain analyses, including air quality modeling, supporting the State's determination of its proposed attainment date. The demonstration must include implementation of all measures identified as RACT/RACM plus additional reasonable measures necessary for expeditious attainment along with an explanation of why those measures adopted in the plan provide for the most expeditious attainment and why any measures not adopted will not collectively advance the attainment date by one year.

One important component of a State's control strategy is the suite of control measures that a State is already implementing or will be implementing to comply with national, regional, or state and local regulations already adopted or promulgated that lead to permanent and enforceable reductions in emissions after the area is designated nonattainment. Ohio's attainment demonstration modeling analysis evaluates the potential effects of all of these measures and demonstrates they contribute toward timely attainment for the Cleveland area.

This section describes Ohio's approach for identifying and selecting the complete suite of measures needed for an attainment plan submission for the Cleveland moderate nonattainment area that provides for expeditious attainment. As discussed in Section 5(a) above, Ohio's process analyzed all technologically and economically feasible control measures, including control technologies, for all sources of direct $PM_{2.5}$ and $PM_{2.5}$ precursors in the emissions inventory for the nonattainment area which are not otherwise exempted from consideration for controls. This includes analyzing those measures that can be implemented within four years of designation of the area (and which would thus meet the statutory requirements for RACM and RACT) and any additional reasonable measures after the four-year deadline for RACM and RACT.

In that analysis, Ohio found that existing controls/measures constituted RACM/RACT/additional reasonable measures for $PM_{2.5}$, SO_2 and NO_x, as no other measures were technically or economically feasible (reasonable). Ohio also provided in that analysis a demonstration of insignificance for VOC and NH_3. As will be demonstrated in this section, Ohio's attainment modeling analysis demonstrates expeditious attainment (by 2021) with these existing controls/measures and other on the books controls.

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a. Control strategy

i. Federal on the books programs

U.S. EPA has adopted a number of national rules over the past few years that require or will require emission reductions from sources of both direct $PM_{2.5}$ and $PM_{2.5}$ precursors, especially of SO_2 and NO_x. For Ohio, these rules will provide emissions reductions between 2011 (base year) and 2021 (attainment year). The national rules that will help States meet their attainment dates include, but are not limited to:

- Tier 2 Light-Duty Vehicle Rule

  In February 2000, U.S. EPA finalized a federal rule to significantly reduce emissions from cars and light trucks, including sport utility vehicles (SUVs). Under this rule, automakers are required to sell cleaner cars, and refineries are required to make cleaner, lower sulfur gasoline [37]. This rule applies nationwide. The federal rule was phased in between 2004 and 2009, but fleet turnover will ensure continued emissions reductions from this category for many years. U.S. EPA's MOVES emissions model accounts for the continued emissions reductions from this program in future years due to fleet turnover.

- Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements

  In January 2001, U.S. EPA issued a final rule for Highway Heavy Duty Engines, a program which includes low-sulfur diesel fuel standards, which were phased in from 2004 through 2007 [38]. This rule applies to heavy-duty gasoline and diesel trucks and buses. Fleet turnover will ensure continued emissions reductions from this category for many years. U.S. EPA's MOVES emissions model accounts for the continued emissions reductions from this program in future years due to fleet turnover.

- Clean Air Non-Road Diesel Rule

  In June 2004, U.S. EPA issued the Clean Air Non-Road Diesel Rule. This rule applies to diesel engines used in industries such as construction, agriculture, and mining [39]. It contains a cleaner fuel standard, similar to the highway diesel program, which was implemented in 2009, and new engine standards that took effect, based on engine horsepower, starting in 2008 and be fully phased in for most engines by 2014. Equipment turnover will ensure continued emissions reductions from this category for many years. Together, these rules will substantially reduce local and regional sources of $PM_{2.5}$ precursors.

- Tier 3 Tailpipe and Evaporative Emission and Vehicle Fuel Standards

  In April 2014, U.S. EPA finalized a major program to reduce air pollution from passenger cars and trucks, referred to as "Tier 3" vehicle and fuel standards.

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Multiple air pollutants are addressed in this rule, including PM, VOCs, SO_2, and NO_x, through implementing closely-coordinated requirements for both automakers and refiners in the same rulemaking action [40]. NO_x and VOC emissions reductions in 2018 are projected at over 300,000 tons; by 2030, the reduction is nearly 500,000 tons as cleaner vehicles turn over into the fleet. This amounts to a 10% reduction of NO_x and 3% reduction of VOC in 2018 with 25% and 16%, respectively, by 2030. A 56% reduction of SO_2 is projected in 2018 by immediate reductions through reduced fuel sulfur content.

- Control of Hazardous Air Pollutants from Mobile Sources

  This rule, also known as the Mobile Source Air Toxics (MSAT2) rule, was published on February 26, 2007 (revised October 16, 2008), requiring refiners and importers produce gasoline that has an annual average benzene content of 0.62 volume percent or less beginning in 2011 [41, 42]. U.S. EPA estimates that in 2030 this rule would reduce total emissions of mobile source air toxics by 330,000 tons and VOC emissions by over 1 million tons.

- NO_x Emission Standard for New Commercial Aircraft Engines

  On June 18, 2012, U.S. EPA finalized a rule to adopt NO_x emission standards for certain commercial passenger and freighter aircraft engines in common use at airports across the U.S. [43]. The rule contains six major provisions, two of which are new NO_x emission standards for newly certified-engine models. The first standards, Tier 6, took effect when the rule became effective and represents approximately a 12% reduction from current Tier 4 levels. The second standards, Tier 8, took effect in 2014 and represents approximately a 15% reduction from Tier 6 levels. Equipment turnover will ensure continued emissions reductions from this category for many years.

- Control of Emissions for Nonroad Spark Ignition Engines and Equipment

  On October 8, 2008, U.S. EPA set emission standards for new nonroad spark ignition engines [44]. The exhaust emission standards apply starting in 2010 for new marine spark ignition engines, including first-time U.S. EPA standards for sterndrive and inboard engines, including first-time U.S. EPA standards for sterndrive and inboard engines. Exhaust emission standards also apply starting in 2011 and 2012 for different sizes of new land-based, spark-ignition engines at or below 19 kilowatts (kW). These small engines are used primarily in lawn and garden applications. U.S. EPA also adopted evaporative emission standards for vessels and equipment using any of these engines. U.S. EPA estimates that by 2030, this rule will reduce annual nationwide VOCs by 604,000 tons, NO_x by 132,200 tons, and $PM_{2.5}$ by 5,500 tons.

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- Clean Air Non-Road Diesel Rule

  In June 2004, U.S. EPA issued the Clean Air Non-Road Diesel Rule. This rule applies to diesel engines used in industries such as construction, agriculture, and mining [45]. It also contains a cleaner fuel standard similar to the highway diesel program. The new standards will cut emissions from non-road diesel engines by more than 90%. Non-road diesel equipment, as described in this rule, currently accounts for 47% of diesel PM and 25% of NO_x from mobile sources nationwide. Sulfur levels were reduced in non-road diesel fuel by 99%, from approximately 3,000 parts per million (ppm) down to 15 ppm in 2009. New engine standards took effect, based on engine horsepower, starting in 2008 and was fully phased in for most engines by 2014. Together, these rules continue to substantially reduce local and regional sources of $PM_{2.5}$ precursors.

- Emissions Standards for Locomotives and Marine Compression-Ignition Engines

  On June 30, 2008, U.S. EPA published regulations for a comprehensive program to dramatically reduce pollution from locomotives and marine diesel engines [46]. The controls will apply to all types of locomotives, including line-haul, switch, and passenger, and all types of marine diesel engines below 30 liters per cylinder displacement, including commercial and recreational, propulsion and auxiliary. The near-term emission standards for newly-built engines will phase in starting in 2009. The near-term program also includes new emission limits for existing locomotives and marine diesel engines that apply when they are remanufactured, and take effect as soon as certified remanufacture systems are available, as early as 2008.

  The long-term emissions standards for newly-built locomotives and marine diesel engines begin to take effect in 2015 for locomotives and in 2014 for marine diesel engines. U.S. EPA estimates PM reductions of 90% and NO_x reductions of 80% from engines meeting these standards, compared to engines meeting the current standards. U.S. EPA projects that by 2030, this program will reduce annual emissions of NO_x and PM by 800,000 tons and 27,000 tons, respectively.

- C3 Oceangoing Vessels Rule

  On April 30, 2010, U.S. EPA finalized emission standards for new marine diesel engines with per-cylinder displacement at or above 30 liters (called Category 3 marine diesel engines) installed on U.S. vessels [47]. The emission standards apply in two stages: near-term standards for newly built engines applied beginning in 2011, and long-term standards requiring an 80% reduction in NO_x emissions beginning 2016. U.S. EPA also finalized a change to their diesel fuel program that will allow for the production and sale of 1,000 ppm sulfur fuel for use in Category 3 marine vessels. In addition, the new fuel requirements will generally forbid the production and sale of other fuels above 1,000 ppm sulfur for use in most U.S.

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waters, unless alternative devices, procedures, or compliance methods are used to achieve equivalent emissions reductions.

- Area Source Boilers, Major Source Boilers and Commercial/Industrial Solid Waste Incinerators (CISWI) NESHAPs

  On January 31, 2013, February 1, 2013 and February 7, 2013, U.S. EPA finalized revisions to the March 2011 Clean Air Act emissions standards for large boilers, small boilers and incinerators, respectively [48, 49, 50]. These standards cover more than 200,000 boilers and incinerators that emit harmful air pollution, including mercury, cadmium, and particle pollution.

  Boilers at large sources of air toxics emissions are known as major source boilers. They are located at large sources of air pollutants, including refineries, chemical plants, and other industrial facilities. Boilers located at small sources of air toxics emissions are known as area source boilers. These are located at universities, hospitals, hotels and commercial buildings. A CISWI unit is a device that is used to burn solid waste at a commercial or industrial facility. This includes units designed to discard solid waste; energy recovery units designed to recover heat that combust solid waste; and waste burning kilns that combust solid waste in the manufacturing of a product.

  In a separate but related action, U.S. EPA revised the non-hazardous secondary materials rule (NHSM). This rule defines which materials are, or are not, "solid waste" when burned in combustion units. The NHSM rule helps determine which standards, either boiler or CISWI, a unit that burns these materials will be required to meet. U.S. EPA estimates these combined rules will reduce $PM_{2.5}$ emissions by 18,000 TPY and SO_2 emissions by 580,000 TPY. The compliance deadlines for area boilers, major boilers and CISWI units are early, 2014, 2016 and 2018, respectively.

- Reciprocating Internal Combustion Engines (RICE) NESHAPs

  On July 11, 2006, U.S. EPA issued standards of performance for stationary compression ignition (CI) internal combustion engines [51]. These engines are used at facilities such as power plants and chemical and manufacturing plants to generate electricity and to power pumps and compressors. They are also used in emergencies to produce electricity and to pump water for flood and fire control. The final standards limited emissions from stationary CI internal combustion engines to the same stringent levels required by U.S. EPA's nonroad diesel engine regulations. The final rule also limited the amount of sulfur in the diesel fuel used to run these engines.

  On January 15, 2013 the rule was revised due to legal challenges and petitions for reconsideration [52]. U.S. EPA estimates the revised rule will reduce PM by 2,800 TPY, NO_x by 9,600 TPY and VOC by 36,000 TPY starting in 2013.

- Mercury and Air Toxics Standards (MATS)

  On December 16, 2011 (revised February 16, 2012), U.S. EPA finalized a rule which reduces emissions from EGUs larger than 25 MW that burn coal or oil. In addition to the benefits of reducing exposure to air toxics, meeting these standards will reduce SO_2 and $PM_{2.5}$ emissions [53]. The final rule establishes power plant emission standards for mercury, acid gases, and non-mercury metallic toxic pollutants. U.S. EPA estimates this rule will: prevent 90% of the mercury in coal burned in power plants from being emitted to the air; reduce 88% of acid gas emissions from power plants; and cut 41% of sulfur dioxide emissions from power plants beyond the reductions expected from the CSAPR. Existing sources generally will have up to 4 years from the revision to comply with MATS (early 2016) with an option for a 1-year extension.

  This attainment demonstration includes reductions from MATS as implemented by early 2016 when modeling was initiated. Further emissions reductions are expected from MATS that have not been accounted for in this analysis.

- Regional Haze Regulations and Guidelines for Best Available Retrofit Technology (BART) Determinations

  In Ohio's Regional Haze SIP submission, one facility was found to have boilers subject to BART [54]. The facility elected to implement an alternative program to BART as allowed under 40 CFR 51.308(e)(2), projecting to achieve greater emissions reductions than through installation and operation of BART. Subsequently, due to the major source Boiler NESHAP, this source will now be converting to natural gas, achieving even further reductions. Implementation is planned no later than January 31, 2017.

- NO_x SIP Call, CAIR and CSAPR

  The NO_x SIP Call required 22 states to pass rules that would result in significant emission reductions from large EGUs, industrial boilers, stationary combustion engines and cement kilns in the eastern United States. Controls for EGUs under the NO_x SIP Call formally commenced May 31, 2004 [55]. The NO_x SIP Call was ultimately replaced by Clean Air Interstate Rule (CAIR) and then CSAPR for large EGUs [56, 57]. However, Ohio continues to regulate existing and new industrial boilers (non-EGUs), stationary combustion engines and cement kilns under Ohio's NO_x SIP Call rules contained in Ohio Administrative Code (OAC) Chapter 3745-14[5].

  On March 10, 2004, the U.S. EPA promulgated the CAIR. Beginning in 2009, U.S. EPA's CAIR rule required EGUs in 28 eastern states and the District of Columbia

[5] http://www.epa.ohio.gov/dapc/regs/3745_14.aspx

to significantly reduce emissions of NO_x and SO_2. However, on July 6, 2011, U.S. EPA finalized CSAPR as a replacement for CAIR. Although delayed by litigation, CSAPR became effective on January 1, 2015, for SO_2 and annual NO_x, and May 1, 2015 for ozone season NO_x. U.S. EPA estimated CSAPR will reduce EGU SO_2 emissions by 73% and NO_x emissions by 54% from 2005 levels in the CSAPR region, which includes Ohio. Between 2011 and 2015, in Ohio alone, annual NO_x EGU emissions decreased from 103,592 TPY to 67,059 TPY and SO_2 EGU emissions decreased from 575,474 TPY to 177,257 TPY.

On November 16, 2015, U.S. EPA proposed an update to CSAPR that once finalized will bring even greater reductions in NO_x emissions [58]. U.S. EPA estimated the rule would reduce summertime NO_x emissions from EGUs in the East (including Ohio) by 85,000 tons in 2017 compared to projections without the rule. Due to this proposed rule and other changes already underway in the power sector, U.S. EPA estimated ozone season NO_x emission will be 150,000 tons lower in 2017 than in 2014, a reduction of more than 30%. It should be noted that this attainment demonstration does not rely on the additional emissions to be provided by the CSAPR Update Rule.

- NSPS for Residential Wood Heaters

  On March 16, 2015, U.S. EPA finalized the residential wood heaters NSPS [59]. This rule does not affect existing woodstoves or other wood burning devices; however, it does provide more stringent emissions standards for new woodstoves, outdoor hydronic heaters and indoor wood-burning forced air furnaces. New "Phase 1" less-polluting heater standards begin in 2015, with even more-stringent Phase 2 standards beginning in 2020. However, new units are assumed to replace retired units beginning in 2015. U.S. EPA estimates 8,269 tons of $PM_{2.5}$ emissions will occur annually.

ii. Ohio on the books programs

Ohio has adopted a number of state rules, in addition to some of those noted above in response to Federal requirements, over the past years that require or will require emission reductions from sources of both direct $PM_{2.5}$ and $PM_{2.5}$ precursors, especially SO_2 and NO_x. For Ohio, these rules will provide emissions reductions between 2011 (base year) and 2021 (attainment year). The State rules that will help the Cleveland area meet the attainment date include, but are not limited to:

- Existing Ohio PM RACM/RACT

  As discussed above, in 1972, 1980, and 1991, Ohio promulgated rules requiring RACM/RACT for particulate emissions from stationary sources. Statewide RACT rules have been applied to all new sources locating in Ohio since that time. RACT requirements are incorporated into permits along with monitoring, recordkeeping, and reporting necessary to ensure ongoing compliance. Ohio also has an active enforcement program to address violations discovered by field office staff. The

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Ohio RACT rules are found in OAC Chapter 3745-17[6]. Ohio's current rules continue to satisfy RACT/RACM for the annual $PM_{2.5}$ standard.

- Sulfur Dioxide Regulations

  Beginning in 1979, Ohio promulgated rules under OAC Chapter 3745-18[7] requiring SO_2 emissions reductions from fuel burning equipment, including coal-fired units. Over the years Ohio has amended these rules to place tighter restrictions on certain units to ensure compliance with the SO_2 NAAQS. Some of the tightest limitations in the State apply to existing and new sources in Cuyahoga and Lorain Counties, due to their historic designation as nonattainment for SO_2.

  As part of the implementation requirements for the 2010 SO_2 NAAQS, Ohio recently made amendments to our rules and/or required further federal enforceable reductions for several sources located in nonattainment areas in the State that will be effective no later than January 1, 2017. In addition, Ohio is currently analyzing the need for further reductions throughout the state as a part of U.S. EPA's data requirements rule for the 2010 SO_2 NAAQS. If further reductions are necessary, implementation of those reductions would occur prior to 2021. This attainment demonstration does not rely on these potential reductions.

- VOC Regulations

  Over the years Ohio has adopted numerous VOC RACT regulations in OAC Chapter 3745-21[8] in response to requirements under the various ozone NAAQS. The majority of these regulations apply in Ohio's urbanized areas, including the Cleveland area. The counties affected by these ozone regulations in the Cleveland area include Cuyahoga and Lorain, along with Ashtabula, Geauga, Lake, Medina, Portage, and Summit Counties. The Cleveland area ozone counties have the most stringent VOC RACT regulations due to the historic designation as moderate nonattainment for various ozone NAAQS. For the Cleveland area ozone counties, Ohio has adopted all of the current U.S. EPA Control Technique Guidelines[9] as VOC RACT.

  Most recently, Ohio adopted several VOC RACT regulations for the Cleveland area ozone counties in response to RACT requirements for moderate areas under the 1997 ozone NAAQS. These include:

  - On October 15, 2015, Ohio adopted OAC rule 3745-21-26[10] regulating VOC emissions from miscellaneous metal and plastic parts coating operations. New sources are required to comply with the tighter restrictions beginning

[6] http://www.epa.ohio.gov/dapc/regs/3745_17.aspx
[7] http://www.epa.ohio.gov/dapc/regs/3745_18.aspx
[8] http://www.epa.ohio.gov/dapc/regs/3745_21.aspx
[9] https://www3.epa.gov/ttn/caaa/t1ctg.html
[10] http://www.epa.ohio.gov/portals/27/regs/3745-21/3745-21-26_Final.pdf

October 15, 2015 while existing sources must achieve compliance by October 15, 2016.

- On May 12, 2011, Ohio adopted OAC rule 3745-21-27[11] regulating VOC emissions from boat manufacturing operations. New sources are required to comply with the tighter restrictions beginning May 12, 2011 while existing sources must achieve compliance by May 12, 2012.
- On May 12, 2011, Ohio adopted OAC rule 3745-21-28[12] regulating VOC emissions from miscellaneous industrial adhesives and sealant operations. New sources are required to comply with the tighter restrictions beginning May 12, 2011 while existing sources must achieve compliance by May 12, 2012.
- On May 12, 2011, Ohio adopted OAC rule 3745-21-29[13] regulating VOC emissions from automobile and light-duty truck assembly coating operations, heavier vehicle assembly coating operations, and cleaning operations associated with these coating operations. New sources are required to comply with the tighter restrictions beginning May 12, 2011 while existing sources must achieve compliance by May 12, 2012.
- On May 12, 2011, Ohio adopted OAC rule 3745-21-29[14] regulating VOC emissions from automobile and light-duty truck assembly coating operations, heavier vehicle assembly coating operations, and cleaning operations associated with these coating operations. New sources are required to comply with the tighter restrictions beginning May 12, 2011 while existing sources must achieve compliance by May 12, 2012.

- Motor vehicle inspection and maintenance (I/M) program

  U.S. EPA's final I/M regulations in 40 CFR Part 85 required States to submit a fully adopted I/M program by November 15, 1993 under Section 182(b)(4). U.S. EPA approved Ohio's enhanced I/M program (E-Check), on April 4, 1995 and January 6, 1997 [60, 61]. The E-Check program continues to be being implemented in this area. The E-Check program requirements are contained in OAC Chapter 3745-26[15] and is required in Cuyahoga and Lorain, along with Geauga, Lake, Medina, Portage, and Summit Counties. Ohio relies on the reductions from the E-Check I/M program as a part of its attainment demonstration analysis.

- Permits-to-install new sources and permit-to-install and operate program

  Ohio has a longstanding and fully implemented New Source Review (NSR) program. This is addressed in OAC Chapter 3745-31[16]. Not only does this Chapter include provisions for the Prevention of Significant Deterioration (PSD) and NNSR

[11] http://www.epa.ohio.gov/portals/27/regs/3745-21/3745-21-27_Final.pdf
[12] http://www.epa.ohio.gov/portals/27/regs/3745-21/3745-21-28_Final.pdf
[13] http://www.epa.ohio.gov/portals/27/regs/3745-21/3745-21-29_Final.pdf
[14] http://www.epa.ohio.gov/portals/27/regs/3745-21/3745-21-29_Final.pdf
[15] http://www.epa.ohio.gov/dapc/regs/3745_26.aspx
[16] http://www.epa.ohio.gov/dapc/regs/3745_31.aspx

permitting programs, it also contains requirements for minor source permitting. Ohio's minor source permitting program requires best available technology (BAT) to be implemented on all new minor sources and modifications of existing minor sources.

b. Modeling methodology

The 2016 Implementation Rule assumes that photochemical grid modeling (which considers secondary $PM_{2.5}$ formation) will be needed to demonstrate attainment. LADCO, in consultation with Ohio, has prepared our attainment demonstration modeling using the photochemical grid model, the Comprehensive Air Quality Model with extensions (CAMx). CAMx is a three-dimensional grid-based Eulerian air quality model designed to simulate the formation and fate of oxidant precursors, primary and secondary particulate matter concentrations, and deposition over regional and urban spatial scales. CAMx is a "state-of-the-science", open-source air quality model that is computationally efficient, flexible, and publicly available. The selection of CAMx as the primary model is based on several factors: performance, operator considerations (e.g., ease of application and resource requirements), technical support and documentation, model extensions (e.g., process analysis, source apportionment, and plume-in-grid), and model science.

All modeling was conducted in accordance with U.S. EPA's April 2007 (and where appropriate, draft December 2014) "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze" [62, 63]. Ohio's modeling is also consistent with the November 2005 "Guideline on Air Quality Models" [64].

Per the 2016 Implementation Rule, this Modeling Guidance provides recommendations that include developing a conceptual description of the problem to be addressed; developing a modeling/analysis protocol; selecting an appropriate model to support the demonstration; selecting appropriate meteorological episodes or time periods to model; choosing an appropriate area to model with appropriate horizontal/vertical resolution; generating meteorological and air quality inputs to the air quality model; generating emissions inputs to the air quality model; and, evaluating performance of the air quality model. After these steps are completed, the state can apply a model to simulate effects of future year emissions and candidate control strategies.

As discussed above (Section 4) and in the TSD (Appendix B), this technical analysis relies heavily on emissions and other model inputs prepared by U.S. EPA including U.S. EPA's modeling platforms, as described in the "Notice of Availability of the Environmental Protection Agency's Updated Ozone Transport Modeling Data for the 2008 Ozone National Ambient Air Quality Standard (NAAQS)" [26]. U.S. EPA rigorously quality assures their emission inventories. In addition to U.S. EPA derived data, LADCO and Ohio relied on ERTAC (EGU) and Ramboll-Environ (mobile/MOVES2014) emissions. For EGU projections, Ohio and LADCO relied on EIA's "High Oil and Gas Resource" as discussed in Section 4(b). LADCO conducts rigorous quality assurance procedures to ensure high data quality. LADCO's emissions modeling quality assurance procedures include reviewing emissions model output files for errors and warnings, comparing emissions between processing steps, checking that speciation, temporal, and spatial

allocation factors are applied correctly, and reviewing the air quality model emissions inputs and stack parameters.

The modeling platform is quality-assured by comparing LADCO's CAMx model results with U.S. EPA results [65] when using the same inputs. LADCO ran the U.S. EPA 2017 and 2025 modeling platforms provided by U.S. EPA. For this comparison, LADCO used U.S. EPA's emissions inventory, which includes IPM for EGU emissions and the NEI version of national on-road emissions. When comparing LADCO's and U.S. EPA's projected $PM_{2.5}$ design values for 2017 and 2025 for monitors located in Ohio values are within 2% at all locations.

LADCO and Ohio's full methodology and quality assurance process for addressing these recommendations is discussed in detail in the TSD contained in Appendix B.

c. Attainment demonstration modeling results

As discussed in the 2016 Implementation rule, U.S. EPA's attainment demonstration Modeling Guidance recommends a modeled attainment test for the annual and $PM_{2.5}$ NAAQS that uses a combination of ambient $PM_{2.5}$ and $PM_{2.5}$ species data and modeled $PM_{2.5}$ concentrations to estimate future year air quality. In the recommended attainment test, the state applies the test at each $PM_{2.5}$ ambient monitor location within or near a designated nonattainment area. As discussed in the TSD (Appendix B), Ohio used U.S. EPA's Modeled Attainment Test Software (MATS) (version 2.6.1)[17] [66]. The MATS software computes the fractional changes, or relative response factors (RRF), in $PM_{2.5}$ concentrations at each monitor location between the model base year and the future year. The base year monitored design value is multiplied by the corresponding RRF for each monitoring site to determine the future year $PM_{2.5}$ design value for that location. The resulting estimates of future $PM_{2.5}$ design values are then compared to the NAAQS. If the future design value at all monitoring locations in the nonattainment area does not exceed the concentration of $PM_{2.5}$ specified in the NAAQS, the area is projected to attain the NAAQS.

The 2016 Implementation Rule states the last possible year permitted under the statute for determining attainment, 2021, is an appropriate, logical, and efficient starting point. Furthermore, for purposes of determining the attainment date that is as expeditious as practicable, the State must conduct future year modeling which takes into account expected growth and known controls that are already in effect or that are adopted and will be in effect by January 1 of the future year. If this base case scenario demonstrates attainment, then the State must demonstrate whether attainment could be achieved in an earlier year by conducting an analysis to determine if, collectively, all technologically and economically feasible measures identified by the State for which the State can initiate implementation by the beginning of the sixth calendar year (RACM/RACT/additional reasonable measures) following designations, can advance the attainment date by at

[17] The 2016 Implementation Rule cites that MATS was replaced in January 2016 with the "Modeled Attainment Test-Community Edition (SMAT-CE)". However, communication with U.S. EPA in August 2016 (after the final implementation rule was signed) indicated U.S. EPA is currently preparing a beta version of this software and the final version is not expected until the end of 2016 (after attainment demonstrations are due).

least 1 year. U.S. EPA also acknowledges, in conducting this assessment, it is not reasonable to require States to model each and every calendar year to determine the appropriate attainment date.

As noted above, Ohio has found existing measures for $PM_{2.5}$, SO_2 and NO_x for area (nonpoint) sources, mobile sources and stationary sources constitutes RACT/RACM/additional reasonable measures and no new additional measures or controls are economically or technically feasible. Also as noted above, Ohio performed an insignificance analysis determining attainment planning measures are not necessary for VOC and NH_3. Therefore, Ohio's demonstration of attainment for 2021 meets the statutory requirement for attainment as expeditiously as practicable.

Table 11 summarizes the results of this modeling analysis. Projected $PM_{2.5}$ annual design values for 2021 for monitoring sites in Cuyahoga and Lorain counties are compared to the corresponding values in the baseline period. As shown in the table, all monitoring locations in the Cleveland area are projected to meet the level of the 2012 $PM_{2.5}$ NAAQS (12.0 µg/m^3) by 2021.

Table 11. Projected $PM_{2.5}$ design values (µg/m^3) for 2021

County	Monitor ID	2011 Baseline Design Value	2021 Projected Design Value
Cuyahoga	39-035-0034	10.02	8.07
	39-035-0038	12.82	10.69
	39-035-0045	11.99	9.84
	39-035-0060	12.79	10.45
	39-035-0065	12.49	10.32
	39-035-1002	10.36	8.41
Lorain	39-093-3002	9.64	8.08

d. Weight of Evidence

The Modeling Guidance also describes the opportunity for States to supplement their modeling with a ''weight of evidence'' demonstration. States may use other information and analyses, in addition to the modeled attainment test, to estimate whether future attainment of the NAAQS in an area is likely. Other analyses may include, but are not limited to, emissions trends, ambient data trends and analyses, other modeling analyses, and documentation of other non-modeled emissions control strategies, including voluntary programs.

Although Ohio has modeled attainment by the statutory attainment date (2021) with current controls/measures and on the books controls, Ohio is including this additional weight of evidence of attainment in the Cleveland area.

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- ERTAC EGU Projection Tool is conservative.

  The ERTAC EGU Projection Tool is conservative, and by design will overestimate future year EGU emissions. As described in the TSD (Appendix B), the ERTAC tool does not use an economics model to forecast future utilization of generating units beyond the forecasts provided by EIA. Economics models attempt to anticipate responses in this sector to future regulatory mandates (such as the CPP and the CSAPR Update Rule) or anticipated fuel prices (especially future prices of natural gas). As a result, economics models, including U.S. EPA's IPM, predict future controls, unit shutdowns and fuel conversions that may or may not occur.

  The ERTAC EGU Projection Tool only incorporates new controls, unit shutdowns and fuel conversions that have been identified by the states based on enforceable commitments made by the utilities, and is therefore more conservative than economics models that are anticipating the effects of future regulatory requirements and fuel prices. As a result, emissions projections from the ERTAC EGU Projection Tool are consistently higher than those provided by economic-based models, such as IPM. It follows then the air quality modeling using emissions projected by the ERTAC EGU Projection Tool will be more conservative than modeling based on emissions derived from IPM. LADCO's full analysis is discussed in the TSD.

  As noted Section 4(b), as an example, U.S. EPA's IPM predicted the complete shutdown of Avon Lake power plant in Lorain County by 2018 while the ERTAC model preserved this facility and its future emissions.

- EIA's forecasts overestimate coal utilization.

  As mentioned previously, the ERTAC EGU Projection Tool bases projected generation by fuel type on the Annual Energy Outlook forecasts provide by EIA. However, EIA's forecasts have historically overestimated the amount of coal that will be used in future years and have underestimated the use of natural gas. Figure 12 compares EIA's AEO projections for successive years beginning in 2008. As shown in the figure, EIA has lowered its coal generation forecast each year to account for decreases in coal utilization that actually occurred (shown in solid blue line). Since the ERTAC EGU Projection Tool the Annual Energy Outlook forecasts provide by EIA, it is expected that predicted SO_2 and NO_x emissions for this sector based on these forecast will be conservative.

- U.S. EPA's modeling for 2017 showed that Cleveland is expected to attain before 2021.

  U.S. EPA conducted modeling in 2015 in support of regulatory initiatives regarding the revised ozone NAAQS and interstate transport [26]. As shown in the TSD (Appendix B), U.S. EPA's modeling indicates the likelihood that the Cleveland area will attain the $PM_{2.5}$ NAAQS well before the attainment deadline in 2021.

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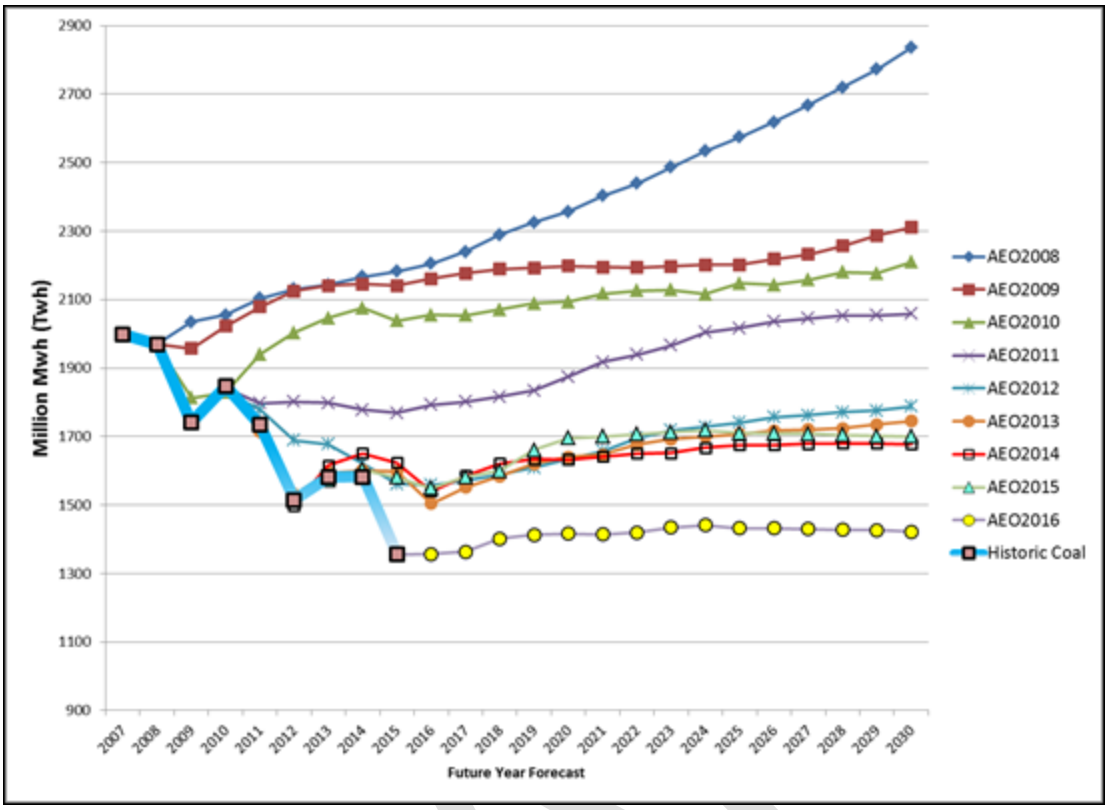

Figure 12. Downward trend in U.S. coal net generation EIA forecasts, 2008-2016

- LADCO's modeling for 2021 shows that Cleveland's design value will be significantly lower than the NAAQS in 2021.

  The highest predicted 2021 design value for the area is 10.69 µg/m^3, nearly 11% lower than the 12.0 µg/m^3 standard. Current on the books controls are sufficient to achieve greater than the NAAQS for this area.

- Emission reductions needed to attain the SO_2 NAAQS have not been included.

  Emission reductions that may be needed to attain the SO_2 NAAQS have not been included in this analysis, although several facilities in this area are actively working with Ohio to implement SO_2 reduction strategies that may be necessary in early 2017. However, due to the timing of this analysis and the fact these strategies were not yet enforceable commitments, they were not accounted for in the future year modeling.

- Emission reductions from Ohio's DERG, Clean Diesel School Bus Retrofit Grant, and Alternative Fuel Vehicle Conversion programs were not included.

  Ohio EPA in partnership with the Ohio Department of Transportation (ODOT) just completed the 6th round of the Diesel Emissions Reduction Grant (DERG) program. The DERG Program is designed to assist successful applicants with

funding to replace older diesel powered mobile source equipment with newer (less polluting) powered equipment. The program targets public agency owned diesel engine fleets and privately owned diesel engine fleets with a public sponsor (Public-Private Partnerships) that will undertake vehicle/equipment replacement, repower, retrofit, or installation of anti-idle equipment for the purpose of $PM_{2.5}$ (and precursor) emissions reduction. For applicants that qualify, the DERG program will provide up to 80% cost reimbursement for the purchase of such new equipment. The DERG Program awards up to $15 million (per grant cycle) in Federal Highway Congestion Mitigation and Air Quality (CMAQ) funding for clean diesel projects in Ohio. Ohio has been guaranteed $12 million in 2016, $10 million in 2017 and $10 million in 2018 and anticipates the program to continue beyond 2018.

Because Ohio receives applications for more money than is available, successful applicants are chosen based on the cost-effectiveness ($/ton of pollutant removed) of the specific project and other factors like location.

Since March, 2012 there have been 3 application cycles and the review committee has approved 58 applications awarding more than $35 million. Ohio EPA estimates that these projects will achieve an estimated annual emission reduction of more than 1,650 tons of air pollutants (at least 50 tons of $PM_{2.5}$ and 1,600 tons of NO_x) in Ohio counties that do not meet or are struggling to meet the NAAQS.

These five projects received a total of $6,014,416 in grants that affect Cuyahoga and Lorain counties. Ohio EPA used the Diesel Emissions Quantifier or appropriate manual calculations to estimate that these projects will reduce emissions of NO_x by 10.88 TPY, and emissions of $PM_{2.5}$ by 0.69 TPY, benefits that will continue to accrue as long as the vehicles and equipment remain in service

- Cleveland Airport Systems, Cuyahoga County, $88,160 to replace the blower engines in two 1994 snow blowers with remanufactured Tier 3 diesel engines.

- Cleveland Clinic, Cuyahoga County, $19,172 to install fuel-operated heaters for idle reduction onto 5 shuttle buses.

- Greater Cleveland Regional Transit Authority (GCRTA), Cuyahoga County, $5,000,000 to replace eleven 2006 trolleys with model year 2018 trolleys.

- Greater Cleveland Regional Transit Authority (GCRTA), Cuyahoga County, $796,000 to replace two model year 2002 diesel transit bus with model year 2016 CNG powered buses.

- Rocky River City School District, Cuyahoga County, $111,084 to replace two model year 2002 diesel school buses with model year 2016 diesel school buses, and to purchase 19 direct-fired heaters for idle reduction, to be installed onto existing fleet buses.

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In addition to the above, the following grants have been given that affect Cuyahoga and Lorain Counties but have the reductions have not been quantified due to the projects encompassing multiple counties outside of the area in addition to Cuyahoga and Lorain Counties. Regardless, these projects provide additional emissions reductions to the Cleveland area as these statewide or multi-county projects address trucks travelling through portions of Cuyahoga and Lorain Counties on a regular basis.

- Home City Ice Co./HC Transport Inc., Ashtabula, Cuyahoga, Fairfield, Franklin, Geauga, Lake, Licking, Portage, Stark and Summit Counties, $873,600 for the cost differential to convert 40 diesel trucks to CNG power. The 40 trucks will be purchased separate from the federal aid conversion project.

- J. Rayl Transport, Inc. (JAM Equipment Ltd.), Summit and other northeastern Ohio counties, $1,475,360 for the cost differential to replace 32 diesel trucks with CNG fueled trucks.

- J. Rayl Transport, Inc. (JAM Equipment Ltd.), Summit and other northeastern Ohio counties, $476,640 to convert 19 short-haul diesel trucks to dual fuel operation with a combination of diesel and natural gas.

- R&L Transfer, Inc., 29 counties statewide, $996,403 to replace 40 model year 1993-2005 diesel trucks with model year 2017 diesel trucks.

- Smith Dairy Trucking Company, Cuyahoga, Franklin, Hamilton, Montgomery, and Summit Counties, $244,000 to convert ten local and over-the-road diesel trucks to operate on a dual fuel system of natural gas and diesel.

- United Parcel Service, Inc., Butler, Cuyahoga, Franklin, Hamilton and Stark Counties, $619,841 to replace 17 1997 delivery trucks with model year 2013 trucks equipped with selective catalytic reduction systems.

In addition to DERG, Ohio EPA provides grants through the Ohio's Clean Diesel School Bus Retrofit Grant Program. The program ran from 2006 to early 2016 and provided grants to retrofit existing school buses with devices that reduce pollution, reduce school bus idling and provides assistance funding to Ohio school districts for successful approaches to reducing bus pollution. Projects in counties that have been in nonattainment for the $PM_{2.5}$ NAAQS were given priority. Ohio Clean Diesel School Bus grants totaling more than $8.5 million were awarded across the State during this period to 179 school districts and county developmental disability programs to install emission control equipment on 2,633 school buses, and idle reduction equipment on 1,036 buses. Ohio EPA estimates that these projects removed more than 110 tons of pollutants (fine particulates, nitrogen oxides,

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hydrocarbons and carbon monoxide) from the air, benefits that will compound every year that the retrofitted buses remain in service.
Within Cuyahoga and Lorain Counties, $397,329 has been provided from 2011 to present[18]. Ohio EPA used the Diesel Emissions Quantifier to estimate 0.83 TPY of $PM_{2.5}$ and 6.75 TPY of NO_x emission reduction benefits of these projects in Cuyahoga and Lorain Counties. The following grants have been given that affect Cuyahoga and Lorain counties:

- Bay Village City Schools, Cuyahoga County, $18,550 to install anti-idling equipment onto seven buses.
- Beachwood City Schools, Cuyahoga County, $11,308 to install DOCS onto eight buses.
- Bedford City Schools, Cuyahoga County, $25,216 to retrofit sixteen buses with preheaters.
- Euclid City Schools, Cuyahoga County, $42,147.00 to install idle reduction equipment in 21 buses.
- Maple Heights City Schools, Cuyahoga County, $54,506 to install emission control equipment on eight buses and anti-idling equipment on sixteen buses.
- Mayfield City Schools, Cuyahoga County. $82,275 to install 15 DOCS with anti-idling equipment, plus one bus with anti-idling equipment.
- North Royalton City Schools, Cuyahoga County, $80,658 to install idle reduction equipment onto 23 buses.
- Shaker Heights City Schools, Cuyahoga County, $15,906.00 to install idle reduction equipment onto six buses.
- First Student, LLC, Hamilton, Stark, Lorain Counties, $394,152 to replace 23 older diesel buses with 2013 clean diesel buses.
- North Ridgeville City Schools, Lorain County, two grants totaling $29,180 to retrofit fourteen buses with DOCs and six buses with anti-idling equipment.

In addition to DERG and the Diesel School Bus programs, in June, 2016, The Ohio General Assembly re-assigned $5 million in State funds for a one-time Alternative Fuel Vehicle Conversion grant program to assist commercial fleets in retrofitting or

[18] In addition, $791,481 has been provided to replace First Student buses in Hamilton, Stark, and Lorain Counties from 2011 to present. This has not been quantified in the total reductions for Cuyahoga and Lorain Counties.

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replacing class seven and eight diesel vehicles (greater than 26,000 pounds) to run on natural gas or propane. The funds come from an Ohio Facilities Establishment Fund that has been used previously to support advanced energy research and development. Ohio expects to award the entire $5 million before June 20, 2017.

Under all three programs, Ohio can target areas that will benefit the most and the Cleveland nonattainment area will be given higher considerations.

- Emission reductions from Ohio's Stage II removal and low permeable hose requirements were not included.

  On April 29, 2013, Ohio submitted a SIP revision request to remove all Stage II controls from gasoline dispensing stations in the Cleveland area ozone counties, which includes Cuyahoga and Lorain Counties. Removal of Stage II requires the installation of low permeable hoses to be phased in completely by January 1, 2017. U.S. EPA proposed to approve this SIP revision on June 30, 2016 [67]. In Ohio's analysis, we found the following VOC benefits:

  - Cuyahoga County: In 2017, retaining Stage II controls would have increased VOC emissions by 7.14 tons during the ozone season and installation of low permeable hoses would decrease VOC by 9.29 tons during the ozone season. Therefore, a net benefit of 16.43 tons of VOC is realized beginning in 2017.

  - Lorain County: In 2017, retaining Stage II controls would have increased VOC emissions by 1.84 tons during the ozone season and installation of low permeable hoses would decrease VOC by 2.34 tons during the ozone season. Therefore, a net benefit of 4.18 tons of VOC is realized beginning in 2017.

- Certain shutdowns and restrictions that have (or will) occurred since development of the attainment modeling are not included.

  A shutdown and restrictions at two coal burning facilities in Lorain County have occurred, or will occur, since the 2011 base year and were not included in the projected modeling due to timing of commitments.

  Avon Lake Power Plant (0247030013) – will be accepting federally enforceable restrictions to address the SO_2 NAAQS. Avon Lake will be accepting a pound per hour facility-wide emission limit that models attainment for the 2010 SO_2 NAAQS. In addition, one of the coal fired boilers will be accepting a 10% limited use provision (also addresses the major source boiler NESHAP) and the remaining large boilers will be accepting a limitation of 1.59 lb/MMBtu (currently permitted at 4.65 lb/MMBtu). Emissions in 2011 were 32,041 TPY for SO_2, 4,659 TPY for NO_x and 394 TPY for $PM_{2.5}$. Projections to 2021 for Avon Lake were 34,870 TPY for SO_2, 5,069 TPY for NO_x and 385 TPY for $PM_{2.5}$. It is expected that there will be substantial reduction in SO_2 emissions in the future. Compliance is required by January 13, 2017.

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Oberlin College (0247100408) – shut down coal fired boilers April 22, 2014. Emissions in 2011 were 325 TPY for SO_2, 38 TPY for NO_x and 3 TPY for $PM_{2.5}$. Projections to 2021 for Oberlin College were 230 TPY for SO_2, 30 TPY for NO_x and 3 TPY for $PM_{2.5}$.

- Ohio's NO_x RACT regulations are not included for reductions after 2011.

  OAC Chapter 3745-110[19] are performance based NO_x regulations for nine counties in the Cleveland area 1997 ozone nonattainment area (including Cuyahoga and Lorain) that became effective in 2007. The rules are not a part of Ohio's SIP and Ohio does not take credit in any SIP's for projected reductions[20]. The rules set NO_x emission limits which must be met, and allow regulated sources to determine the methods by which they will meet the limits.

  The rules also allow a facility the option of preparing a "NO_x Reasonably Available Control Technology (RACT)" study to be submitted for review if a facility cannot meet the regulated limits or for which there is not a predefined emission limit. The study allows facilities to determine an appropriate NO_x emission limit based on technical and economic feasibility of control strategies. To date we have received over 20 NO_x RACT studies. Since 2011, U.S. Steel's emissions unit P039 was retrofitted with new Low NO_x burners in March 2012. The resulting emission reductions are 136 TPY of NO_x based on potential to emit.

- Ohio is working to mitigate local impacts from companies near the monitors.

  Ohio EPA has been in close communication with significant local point sources in the area of the violating monitors. These monitors are located in the industrialized core of Cleveland, which contains a complex array of emission sources. There are several large industrial sources, including steel plants, in this area. Some of these sources (e.g., ArcelorMittal Steel and Charter Steel) have recently been cited for violations.

  U.S. EPA cited ArcelorMittal, Inc. iron and steel mill in Cleveland with violations of the CAA and the Ohio SIP for the control of particulate emissions. Negotiations with ArcelorMittal, Inc. began in November, 2007, and both sides are currently in the final stages of negotiations regarding the Consent Decree. It is anticipated that substantial $PM_{2.5}$ reductions will occur as a result of the injunctive relief in the Consent Decree.

  U.S. EPA cited Charter Steel in Cleveland with violations of the CAA and the Ohio SIP for opacity violations, with respect to their melt shop, in 2008 and 2009 and also failing to maintain pressure drop across their melt shop baghouse between 2007 and 2010. As a result, On September 28, 2012 Charter and U.S. EPA

[19] http://www.epa.ohio.gov/dapc/regs/3745_110.aspx

[20] Any sources that realized reduction in their actual emissions due to a requirement in these rules would be accounted for in the 2011 inventory.

entered into a consent agreement and a final order was issued. The consent agreement included a requirement for a supplemental environmental project (SEP). The SEP would reduce fumes releases (including $PM_{2.5}$ and precursors) from their west end door. The west end door is located in close proximity to the electric arc furnace (EAF) and is designed to be opened to bring scrap materials in and then be closed during charge of the EAF. However, the door routinely blows open and remains open for extended periods of time when high winds occur.

Specifically, the SEP required Charter to install a new roof ventilation hood to collect fumes from the west end melt shop. The work was completed by the December 31, 2013 deadline provided for in the consent agreement. In addition to the SEP, in July 2016, Charter replaced the west end door with a new door capable of sustaining high winds.

Charter Steel is located less than a half kilometer south of the Harvard Yards monitor (the highest (design value) monitor for this area: 39-035-0065). It is expected this SEP and the replacement of the west end door will reduce $PM_{2.5}$ concentrations in the area and especially at the Harvard Yards monitor.

7. Reasonable Further Progress: CAA Section 189(c) and CAA Section 172(c)(2)

CAA Section 172(c)(2) states:

> "Such plan provisions shall require reasonable further progress."

More specifically, CAA Section 189(c), "milestones" states:

> "(1) Plan revisions demonstrating attainment submitted to the Administrator for approval under this subpart shall contain quantitative milestones which are to be achieved every 3 years until the area is redesignated attainment and which demonstrate reasonable further progress, as defined in section 7501(1) of this title, toward attainment by the applicable date.
>
> (2) Not later than 90 days after the date on which a milestone applicable to the area occurs, each State in which all or part of such area is located shall submit to the Administrator a demonstration that all measures in the plan approved under this section have been implemented and that the milestone has been met. A demonstration under this subsection shall be submitted in such form and manner, and shall contain such information and analysis, as the Administrator shall require. The Administrator shall determine whether or not a State's demonstration under this subsection is adequate within 90 days after the Administrator's receipt of a demonstration which contains the information and analysis required by the Administrator.

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> (3) If a State fails to submit a demonstration under paragraph (2) with respect to a milestone within the required period or if the Administrator determines that the area has not met any applicable milestone, the Administrator shall require the State, within 9 months after such failure or determination to submit a plan revision that assures that the State will achieve the next milestone (or attain the national ambient air quality standard for PM–10, if there is no next milestone) by the applicable date."

As discussed in the 2016 Implementation Rule, "reasonable further progress'' (RFP) is a concept to assure that States make steady, incremental progress (generally linear) toward attaining air quality standards in the years prior to the attainment date for a nonattainment area, rather than merely deferring implementation of control measures and therefore emissions reductions until the date by which the standards are to be attained. U.S. EPA clarifies that incremental progress may be generally linear in some cases while other cases may warrant a step-wise progression towards attainment.

U. S. EPA also notes that quantitative milestones required under CAA Section 189(c) are directly linked to the RFP plan, as interim quantifiable indicators intended to demonstrate that an area is making progress toward attaining the $PM_{2.5}$ NAAQS, and are therefore related to the implementation schedule of control measures for a $PM_{2.5}$ nonattainment area.

The 2016 Implementation Rule provides flexibility for States to address RFP, however submissions must contain three components: (1) an implementation schedule for control measures on sources in the nonattainment area that are implemented in the first 4 years as RACT/RACM and in the 5th and 6th years as additional reasonable measures; (2) RFP projected emissions (by source category on a pollutant by pollutant basis) for each applicable quantitative milestone year, based on the anticipated control measures implementation schedule; and (3) an analysis that demonstrates that this schedule of aggregate emissions reductions achieves sufficient progress toward attainment between the applicable baseline year to the attainment year.

The analysis in the third component can be expressed in the form of emissions reductions only, or emissions reductions converted to air quality concentrations. Under the air quality concentration approach, U.S. EPA requires a State to show that the air quality improvement that is anticipated by milestone dates due to the identified control measures in the implementation schedule supports expeditious attainment.

As stated previously, Ohio does not have new RACT/RACM or additional reasonable measures. Therefore, an implementation schedule as a part of the first component is not applicable. Current on the books controls provide for expeditious attainment and the implementation schedule applicable to those federal programs is not within the control of Ohio. As a result, Ohio EPA will assume generally linear progress.

With respect to the second component, projected emissions, on a pollutant by pollutant basis by source type, are for each calendar year in which quantitative milestones must

be met. Per the 2016 Implementation Rule, quantitative milestones are to be achieved every 3 years from the attainment plan due date, or 4.5 years from the effective date of designations. For the Cleveland area, the first milestone date would be October 15, 2019. The 2016 Implementation Rule requires States to demonstrate RFP for the second milestone year, which would be October 15, 2022, even if the area demonstrates attainment by 2021. U.S. EPA states this is necessary in the event an area that demonstrates attainment for 2021 fails to attain by the deadline. Under the 2016 Implementation Rule, the demonstration of RFP is based upon the level of emissions (or air quality) at the end of the calendar year (2019 and 2022).

With respect to the pollutants to be addressed, the 2016 Implementation Rule states only those precursors that are not demonstrated insignificant need to be addressed by RFP, milestones and subsequent reports on RFP. Therefore, Ohio is only addressing $PM_{2.5}$, SO_2 and NO_x based on our demonstration of insignificance for VOC and NH3 (Section 5(c)).

Tables 12 through 14 shows Ohio's 2019 RFP source category inventory on a pollutant-by-pollutant basis. Because Ohio determined new RACT/RACM/additional reasonable measures requirements were not required and on-the-books controls would suffice for expeditious attainment, Ohio is assuming incremental progress will generally be linear. Ohio interpolated the 2019 inventory from the 2011 and 2021 inventories included in this submittal.

Tables 12 through 14 also shows Ohio's 2022 RFP source category inventory on a pollutant-by-pollutant basis. Ohio EPA believes it would be inappropriate to extrapolate further reductions in emissions beyond those that would have been necessary for Ohio's demonstration of attainment for 2021. Per the 2016 Implementation Rule, the purpose of requiring a milestone report, and RFP, for 2022 for an area demonstrating attainment on or before 2021 is in the event the area does not attain. Therefore, appropriate RFP for 2022 would be those emissions reductions that would have been necessary if the area did meet attainment. The emissions modeled for 2021 were at a level that would achieve ambient air quality levels beyond attainment. The highest design value for the area in the modeled attainment demonstration is 10.69 $\mu g/m^3$. Therefore, if Ohio does not attain in 2021 it is more likely that the level of emission reductions expected were not achieved rather than the notion that more reductions than those modeled were necessary to achieve the standard of 12.0 $\mu g/m^3$. Ohio's 2022 RFP inventory is consistent with the inventory projected for 2021.

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Table 12. RFP inventory, PM2.5

PM2.5		2011		2019		2021		2022	
		Filt	Cond	Filt	Cond	Filt	Cond	Filt	Cond
Cuyahoga	Area (Nonpoint)	1443.13	534.61	1499.39	530.61	1513.46	529.61	1513.46	529.61
	Marine/Air/Rail (MAR)	96.88	0.02	77.13	0.02	72.20	0.02	72.20	0.02
	Nonroad	508.69	0.00	378.39	0.00	345.81	0.00	345.81	0.00
	Onroad	800.00	0.00	488.18	0.00	410.23	0.00	410.23	0.00
	Point EGU	32.90	33.50	6.58	6.70	0.00	0.00	0.00	0.00
	Point Non-EGU	599.48	407.26	553.51	332.07	542.01	313.28	542.01	313.28
	Prescribed Fire/ Wildfire (FIRE)	4.92	0.00	4.92	0.00	4.92	0.00	4.92	0.00
	County total	3486.00	975.39	3008.10	869.41	2888.63	842.91	2888.63	842.91
Lorain	Area (Nonpoint)	477.68	72.00	495.42	71.72	499.86	71.65	499.86	71.65
	Marine/Air/Rail (MAR)	44.39	0.00	31.02	0.00	27.68	0.00	27.68	0.00
	Nonroad	160.82	0.00	104.01	0.00	89.81	0.00	89.81	0.00
	Onroad	195.49	0.00	120.37	0.00	101.59	0.00	101.59	0.00
	Point EGU	94.90	298.62	91.13	286.26	90.18	283.18	90.18	283.18
	Point Non-EGU	156.45	175.78	157.53	176.55	157.80	176.74	157.80	176.74
	Prescribed Fire/ Wildfire (FIRE)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	County total	1129.72	546.41	999.48	534.54	966.92	531.57	966.92	531.57
Nonattainment area total		**4615.72**	**1521.80**	**4007.58**	**1403.95**	**3855.54**	**1374.49**	**3855.54**	**1374.49**

Table 13. RFP inventory, NOx

NO_x		2011	2019	2021	2022
Cuyahoga	Area (Nonpoint)	4989.24	5095.95	5122.63	5122.63
	Marine/Air/Rail (MAR)	2822.27	2541.35	2471.12	2471.12
	Nonroad	6045.40	4015.98	3508.63	3508.63
	Onroad	18764.59	9754.45	7501.91	7501.91
	Point EGU	771.22	154.24	0.00	0.00
	Point Non-EGU	2404.05	2117.87	2046.33	2046.33
	Prescribed Fire/Wildfire (FIRE)	1.20	1.20	1.20	1.20
	County total	35797.97	23681.05	20651.82	20651.82
Lorain	Area (Nonpoint)	844.19	871.76	878.65	878.65
	Marine/Air/Rail (MAR)	1289.44	1032.06	967.71	967.71
	Nonroad	1971.11	1333.56	1174.17	1174.17
	Onroad	4580.85	2393.83	1847.08	1847.08
	Point EGU	4673.50	5001.08	5082.98	5082.98
	Point Non-EGU	705.89	725.68	730.63	730.63
	Prescribed Fire/Wildfire (FIRE)	0.00	0.00	0.00	0.00
	County total	14064.98	11357.97	10681.22	10681.22
Nonattainment area total		**49862.95**	**35039.02**	**31333.04**	**31333.04**

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Table 14. RFP inventory, SO2

SO_2		2011	2019	2021	2022
Cuyahoga	Area (Nonpoint)	188.94	156.26	148.09	148.09
	Marine/Air/Rail (MAR)	187.78	119.06	101.88	101.88
	Nonroad	17.35	10.49	8.78	8.78
	Onroad	132.17	72.37	57.42	57.42
	Point EGU	1941.86	388.37	0.00	0.00
	Point Non-EGU	4461.80	2021.38	1411.28	1411.28
	Prescribed Fire/Wildfire (FIRE)	0.54	0.54	0.54	0.54
	County total	6930.44	2768.48	1727.99	1727.99
Lorain	Area (Nonpoint)	44.37	37.79	36.14	36.14
	Marine/Air/Rail (MAR)	55.68	13.60	3.08	3.08
	Nonroad	5.39	3.23	2.69	2.69
	Onroad	31.75	17.55	14.00	14.00
	Point EGU	32041.30	34304.47	34870.26	34870.26
	Point Non-EGU	374.63	299.49	280.71	280.71
	Prescribed Fire/Wildfire (FIRE)	0.00	0.00	0.00	0.00
	County total	32553.12	34676.13	35206.88	35206.88
Nonattainment area total		**39483.56**	**37444.61**	**36934.87**	**36934.87**

Table 15 shows Ohio's 2018 and 2019 predicted overall $PM_{2.5}$ concentrations. This air quality target was interpolated between current air quality for 2015 and a 2021 design value of 11.99, again assuming linear progress. While it is anticipated, and predicted in our attainment demonstration modeling, that design values will be lower than these interpolated values, the requirement for RFP is to "demonstrate reasonable further progress, as defined in section 7501(1) of this title, *toward attainment* by the applicable date." Attainment is achieved by achieving a design value of 12.0 µg/m^3 or less. Ohio is including both a 2018 and 2019 predicted concentration due to the timing of reporting milestones, as discussed later in this section.

Table 15 also shows Ohio's 2022 predicted overall $PM_{2.5}$ concentrations. As discussed above, per the 2016 Implementation Rule, the purpose of requiring a milestone report, and RFP, for 2022 for an area demonstrating attainment on or before 2021 is in the event the area does not attain. Therefore, expecting any design value lower than the standard itself for 2022 would be imposing a requirement to achieve ambient air quality levels beyond those attainment levels required under the CAA. Ohio's 2022 expected design value is to be no more than 11.99 µg/m^3.

Only those monitors currently not achieving the standard for 2018, 2019 and 2022 are identifying predicted overall $PM_{2.5}$ concentrations. Monitors already achieving the standard do not necessitate further progress.

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Table 15. $PM_{2.5}$ monitor design values expected for 2018, 2019 and 2022

Site	County	Annual $PM_{2.5}$ NAAQS DV								
							2018	2019	2021	2022
		2011[1]	10-12[2]	11-13[2]	12-14[2]	13-15[2]	16-18[3]	17-19[3]	2021[4]	2022[4]
39-035-0034	Cuyahoga	10.0	10.1	9.6	9.5	9.4	n/a	n/a	n/a	n/a
39-035-0038		12.8	13.0	12.4	12.3	12.1	12.0	12.0	11.99	11.99
39-035-0045		12.0	12.2	11.5	11.3	11.2	n/a	n/a	n/a	n/a
39-035-0060		12.8	13.0	12.5	12.4	12.1	12.0	12.0	11.99	11.99
39-035-0065		12.5	12.7	12.1	12.0	12.4	12.2	12.1	11.99	11.99
39-035-1002		10.4	10.5	9.7	9.5	9.3	n/a	n/a	n/a	n/a
39-093-3002	Lorain	9.6	9.8	9.2	9.1	8.7	n/a	n/a	n/a	n/a

[1] modeled
[2] actual
[3] interpolated
[4] attainment

In the event Ohio does attain the $PM_{2.5}$ NAAQS by the applicable attainment date, the RFP, milestone and reporting requirements for 2022 will no longer be applicable as a part of this plan.

CAA Section 189(c)(2) requires that, within 90 days of each milestone (January 13, 2020), a State must submit a demonstration that all measures in the approved plan (including RFP) have been implemented and that the milestone has been met. The 2016 Implementation Rule requires the following components in a milestone report: (1) certification by the Governor (or designee) that the SIP control strategy is being implemented consistent with the RFP; (2) technical support, including calculations, sufficient to document completion statistics for each quantitative milestone and to demonstrate the milestones have been satisfied and how the emissions reductions achieved to date compare to the those required or schedule to meet RFP; and (3) a discussion of whether the $PM_{2.5}$ NAAQS will be attained by the projected attainment date.

The precise form that the quantitative milestones should take is not specified, therefore a State must choose milestones constructed in a manner that allows them to be tracked and quantified and/or measured adequately in order for the State to meet its milestone reporting obligation.

As noted in the 2016 Implementation Rule, CAA Section 189(c)(2) allows States to identify milestones that are suitable for the specific facts and circumstances for the attainment plan for the particular area, so long as they provide an objective means to measure RFP. Ohio is selecting the air quality concentration approach for setting a milestone.

Selecting an emissions approach milestone would not allow Ohio to meet its milestone reporting obligation. The RFP inventory requires the inventory to be detailed to a source category level. Ohio relies on the development of inventories as a part of the NEI for sources other than major and synthetic minor sources. An NEI inventory is only generated for every 3rd year (2014, 2017, 2020, 2023) and these years do not correspond to the milestone years. Further, even if these inventories did fall on a milestone year, the

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development of an NEI takes a minimum of two years. These inventories would not be available by the reporting date for the reporting milestone year.

Other milestone methods noted by U.S. EPA, such as electing percent implementation of control strategies or percent compliance with measures or adherence to a compliance schedule, would not be applicable or appropriate approaches for this nonattainment area as Ohio determined no new RACT/RACM/additional reasonable measures were required.

Therefore, the air quality concentration approach for setting a milestone is the only logical approach that will allow Ohio to objectively measure RFP and meet its milestone reporting obligation. The 2019 and 2022 projected $PM_{2.5}$ design values (3-year average) selected as milestones are identified in Table 15 above. It should be noted that even this approach has flaws due to the timing of the milestone report (due January 13 of the following milestone year). Air quality data for a given year is required to be certified and quality assured by April 15 of the following year it was collected. Therefore, data for 2019 and 2022 will likely not be available by the time the milestone report is due. In the event 2019 and 2022 data are not available in time, Ohio will demonstrate reasonable progress with the 2018 and 2021 air quality data for the milestone reports identified in Table 15 above.

8. Program: CAA Section 189(a)(1)(A) and CAA Section 189(e)

a. Permitting program

CAA Section 189(a)(1)(A) states:

> "Each State in which all or part of a Moderate Area is located shall submit, according to the applicable schedule under paragraph (2), an implementation plan that includes each of the following:
>
> > (A) For the purpose of meeting the requirements of section 7502(c)(5) of this title, a permit program providing that permits meeting the requirements of section 7503 of this title are required for the construction and operation of new and modified major stationary sources of PM–10."

To address the regulation of the larger pollutant-emitting sources (defined as major stationary sources), specific permitting requirements are included in CAA Parts C and D of Title I. These requirements for preconstruction permits are commonly known collectively as the major NSR program because they apply specifically to the preconstruction review and permitting of new major stationary sources, and major modifications at existing sources. Part C, the PSD program, applies to areas designated attainment or unclassifiable. Part D, the NNSR program, applies to areas designated nonattainment.

Ohio has a longstanding and fully implemented NSR program. This is addressed in OAC Chapter 3745-31[21]. The Chapter includes provisions for the PSD permitting program in

[21] http://www.epa.ohio.gov/dapc/regs/3745_31.aspx

OAC rules 3745-31-01 to 3745-31-20 and NNSR program in rules 3745-31-21 to 3745-31-27. Ohio's PSD and NNSR programs were conditionally approved on October 10, 2001 and received final approval on January 22, 2003 by U.S. EPA as part of the SIP [68, 69]. Additional amendments were made to include Federal requirements for addressing $PM_{2.5}$ which U.S. EPA approved on June 25, 2015 [70].

b. NNSR precursors demonstration

CAA Section 189(e) states:

> "The control requirements applicable under plans in effect under this part for major stationary sources of PM–10 shall also apply to major stationary sources of PM–10 precursors, except where the Administrator determines that such sources do not contribute significantly to PM–10 levels which exceed the standard in the area. The Administrator shall issue guidelines regarding the application of the preceding sentence.

For NNSR permitting purposes, the 2016 Implementation Rule provides an option for a precursor demonstration showing that new and existing major stationary sources of a particular precursor do not contribute significantly to levels that exceed the $PM_{2.5}$ standard, meaning that the precursor can be exempt from NNSR permitting requirements for new and existing major sources. U.S. EPA suggests the most appropriate approach for NNSR permitting purposes would be through sensitivity analyses of potential increases in emissions through a model simulation that evaluates the effect on $PM_{2.5}$ concentrations in the area resulting from a given set of precursor emission increases from one or more new or modified stationary sources. In addition, U.S. EPA states that any precursor demonstration conducted to assess precursor significance for NNSR purposes should evaluate emissions from major stationary sources of the precursor from within the nonattainment area only. Ohio has performed such an analysis for NH_3 and VOC.

A critical first step in any precursor analysis is the development of a comprehensive inventory of all precursor emissions in the nonattainment area. Ohio's 2011 and 2021 comprehensive modeling inventories were used for this analysis. To determine a theoretical growth scenario as a result of major source expansion (new or modified), Ohio prepared inventories for VOC and NH_3 for 2008 to 2014 for the entire State from Ohio's annual emissions reporting program[22]. Ohio used inventories for the entire State in order to determine what types of major sources/source categories are likely to expand (new or modified) within the Cleveland area and at what magnitude (tons per year) those expansions were likely to occur. These inventories and the full detailed analysis are contained in Appendix F.

The following steps were conducted as a part of Ohio's analysis:

[22] Historic and current point source inventories are available here: http://www.epa.ohio.gov/dapc/aqmp/eiu/eis.aspx#126013925-download-eis-data-and-reports. The 2011 inventory may vary slightly from the point source inventory contained in the summary tables in the inventory section above and Appendix C, which were based upon the NEI. The NEI is often adjusted by U.S. EPA and includes sources smaller than major sources.

1. Initially identify all synthetic minor and major sources in the 2008 to 2014 Ohio inventories.
2. Set a reasonable threshold for analysis to determine what types of major sources/source categories are likely to expand (new or modified) within the Cleveland area. Eliminating sources of VOC less than 25 TPY and sources of NH3 less than 10 TPY would allow a conservative and manageable analysis of larger emitting sources in the State. Any source emitting over these thresholds during one or more of the years (2008 to 2014) were retained for analysis.
3. Determine for each facility the year and the tonnage of actual emissions that was the greatest.
4. Identify the emissions activity associated with the facilities including the NAICS code and description and allocate them to industry categories developed by Ohio.
5. Analyze each industry category and determine the likelihood of expansion or new facilities within the Cleveland area.
6. Select a set of conservative addition (TPY) to the 2021 inventory and modeling to determine if growth in the absence of NNSR would significantly impact the ability to attain the NAAQS. Where emissions increases were identified for existing sources, Ohio compared the 2011 emissions included in the base inventory and insured the decided conservative increase (compared to the highest emitting year) would be in addition to the 2011 emissions. For example, a conservative increase for a facility could be 50% of the emissions for the highest year. A source with 100 TPY during its highest year would be increased to 150 TPY. If the facility emitted 75 TPY in the 2011 inventory, 75 TPY was added to the future year modeling.
7. Add the emissions to the 2021 baseline modeling as point sources in grid cells centers designed to release emissions within the ground layer so they are well mixed within a grid cell. The emission additions and locations are discussed in detail in Appendix F. The emissions rates for existing sources are in addition to those emissions already predicted for 2021 based upon growth and control.
8. The potential impact of the added emissions is examined by the change MATS $PM_{2.5}$ gradient-adjusted unmonitored area analysis among the baseline modeling and NNSR sensitivities. The modeling is discussed in detail in the TSD in Appendix B.

For the insignificance test, U.S. EPA recommends making adjustments to the base year emissions. However, LADCO and Ohio determined adjustment to the attainment year inventory would be more appropriate, accurate, and conservative due to significant changes that have occurred to the base year emissions since 2011. 2021 emissions better represent current emissions within Cuyahoga and Lorain counties due to, for example, shutdown of EGUs and a significant number of conversions to natural gas at coal fired non-EGUs. The model's response to emissions changes would be more representative using 2021 emissions as a starting point.

With respect to determining a level that would be deemed significant, the 2016 Implementation Rule does not set a significance level but rather states U.S. EPA will

provide guidance with technical details and suggested thresholds at a later date. This guidance was not available at the time of this analysis. Therefore, Ohio EPA in consultation with U.S. EPA Region 5, determined a significance level of 0.2 µg/m3 (with conventional rounding) would be appropriate.

Ohio added 1,486 TPY of VOC emissions. Compared to the 2011 inventory, this represents a 75% increase in stationary sources (EGU and non-EGU). Compared to the 2021 projected inventory, this represents an 80% increase in stationary sources. Ohio added 325 TPY of NH_3 emissions. Compared to the 2011 inventory, this represents a 447% increase in stationary sources. Compared to the 2021 projected inventory, this represents a 449% increase in stationary sources. In both cases it can be seen that this is highly conservative growth that is in addition to the emissions already predicted for 2021 based upon growth and control. The likelihood of this type of growth in the Cleveland area is highly unlikely making this an extremely conservative analysis.

Through the monitored and unmonitored area modeling analysis, Ohio found the addition of the above NH_3 emissions would result in peak impact of 0.08 µg/m^3 and that addition of the above VOC emissions would result in a peak impact of 0.02 µg/m^3. Therefore, VOC and NH_3 emissions are insignificant for NNSR purposes in the Cleveland moderate nonattainment area as they are well below the 0.2 µg/m^3 significance threshold.

9. Contingency Measures: CAA Section 172(c)(9)

CAA Section 172(c)(9) states:

> "Such plan shall provide for the implementation of specific measures to be undertaken if the area fails to make reasonable further progress, or to attain the national primary ambient air quality standard by the attainment date applicable under this part. Such measures shall be included in the plan revision as contingency measures to take effect in any such case without further action by the State or the Administrator."

For any moderate nonattainment area, contingency measures can include measures that achieve emissions reductions on sources located outside the nonattainment area as well as from sources within the nonattainment area, provided that the measures are factually demonstrated to produce the appropriate air quality impact within the nonattainment area. U.S. EPA provides that one or more Federal or local measures that are in place and provide reductions in the year following a failure to attain the relevant NAAQS or meet RFP in excess of the reductions required by the attainment demonstration or RFP plan can meet the contingency measure requirements for areas demonstrating attainment by the attainment date.

Ohio will consider contingency measures from a comprehensive list of measures deemed appropriate and effective at the time the selection is made. The 2016 Implementation Rule requires contingency measures be approximately equivalent to one year's worth of emissions reductions. In comparing the 2011 base year emissions with the 2021

attainment year emissions, the following approximations are applicable: 76 TPY of $PM_{2.5}$ filterable, 15 TPY of $PM_{2.5}$ condensable, 1,853 TPY of NO_x, and 255 TPY of SO_2. The selection of measures will be based on cost-effectiveness, emission reduction potential in accordance with one-years' worth of emissions reductions, economic and social considerations, or other factors that Ohio deems appropriate.

Ohio will solicit input from all interested and affected persons in the maintenance area prior to selecting appropriate contingency measures. Because it is not possible at this time to determine what control measures will be appropriate at an unspecified time in the future, the list of contingency measures outlined below is not comprehensive. This list focuses on measures to reduce $PM_{2.5}$, SO_2 and NO_x because Ohio has found VOC and NH_3 to be insignificant for attainment planning purposes. Some of the contingency measures that were evaluated and would be considered are as follows:

1) Diesel reduction emission strategies
2) Alternative fuel (e.g., liquid propane and compressed natural gas) and diesel retrofit programs for fleet vehicle operations
3) Tighter PM, SO_2, and NO_x emission offsets for new and modified major sources
4) Impact crushers located at recycle scrap yards; upgrade wet suppression
5) Charbroiling operations at restaurants; reduce smoke dispersion
6) Concrete manufacturing; upgrade wet suppression
7) Additional NO_x RACT statewide:
    i. ICI Boilers; SO_2 and NO_x controls
    ii. EGUs
    iii. Process heaters
    iv. Internal combustion engines
    v. Combustion turbines
    vi. Other sources greater than 100 TPY.

No contingency measure will be implemented without providing the opportunity for public participation during which the relative costs and benefits of individual measures, at the time they are under consideration, can be evaluated.

10. Public Participation

Ohio published notification for a public hearing and solicitation for public comment concerning the draft attainment demonstration in the widely distributed county publications on (date).

The public hearing to receive comments on the attainment demonstration was held on September 28, 2016 at 3:30pm at Parma-Snow Branch Library in Parma, Ohio. The public comment period closed on (date). _____ testimony was provided at the public hearing, and _____ comments were received during the public comment period. Appendix G includes a copy of the public notice, transcript from the hearing, and response to comments.

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