Appendix 3: Additional Control Strategy Information

3a.1 NonEGU Point and Area Source Controls

3a.1.1 NonEGU Point and Area Source Control Strategies for Ozone NAAQS Final

In the NonEGU point and Area Sources portion of the control strategy, maximum control scenarios were used from the existing control measure dataset from AirControlNET 4.1 for 2020 (for geographic areas defined for each level of the standard being analyzed). This existing control measure dataset reflects changes and updates made as a result of the reviews performed for the final PM2.5 RIA. Following this, an internal review was performed by the OAQPS engineers in the Sector Policies and Programs Division (SPPD) to examine the controls applied by AirControlNET and decide if these controls were sufficient or could be more aggressive in their application, given the 2020 analysis year. This review was performed for nonEGU point NOx control measures. The result of this review was an increase in control efficiencies applied for many control measures, and more aggressive control measures for over 70 SCC's. For example, SPPD recommended that we apply SCR to cement kilns to reduce NOx emissions in 2020. Currently, there are no SCRs in operation at cement kilns in the U.S., but there are several SCRs in operation at cement kilns in France now. Based on the SCR experience at cement kilns in France, SPPD believes SCR could be applied at U.S. cement kilns by 2020. Following this, it was recommended that supplemental controls could be applied to 8 additional SCC's from nonEGU point NOx sources. We also looked into sources of controls for highly reactive VOC nonEGU point sources. Four additional controls were applied for highly reactive VOC nonEGU point sources not in AirControlNET.

3a.1.2 NOx Control Measures for NonEGU Point Sources.

Several types of NOx control technologies exist for nonEGU point sources: SCR, selective noncatalytic reduction (SNCR), natural gas reburn (NGR), coal reburn, and low-NOx burners. In some cases, LNB accompanied by flue gas recirculation (FGR) is applicable, such as when fuel-borne NOx emissions are expected to be of greater importance than thermal NOx emissions. When circumstances suggest that combustion controls do not make sense as a control technology (e.g., sintering processes, coke oven batteries, sulfur recovery plants), SNCR or SCR may be an appropriate choice. Finally, SCR can be applied along with a combustion control such as LNB with overfire air (OFA) to further reduce NOx emissions. All of these control measures are available for application on industrial boilers.

Besides industrial boilers, other nonEGU point source categories covered in this RIA include petroleum refineries, kraft pulp mills, cement kilns, stationary internal combustion engines, glass manufacturing, combustion turbines, and incinerators. NOx control measures available for petroleum refineries, particularly process heaters at these plants, include LNB, SNCR, FGR, and SCR along with combinations of these technologies. NOx control measures available for kraft pulp mills include those available to industrial boilers, namely LNB, SCR, SNCR, along with water injection (WI). NOx control measures available for cement kilns include those available to industrial boilers, namely LNB, SCR, and SNCR. Non-selective catalytic reduction (NSCR) can be used on stationary internal combustion engines. OXY-firing, a technique to modify combustion at glass manufacturing plants, can be used to reduce NOx at such plants. LNB, SCR, and SCR + steam injection (SI) are available measures for combustion turbines. Finally, SNCR is an available control technology at incinerators. Table 3a.1 contains a complete list of the NOx nonEGU point control measures applied and their associated emission reductions obtained in the modeled control strategy for the alternate primary standard. For more information on these measures, please refer to the AirControlNET 4.1 control measures documentation report.

Table 3a.1: NOx NonEGU Point Emission Reductions by Control Measure

Control Measure	Source Type	Modeled Control Strategy Reductions (annual tons/year)
Biosolid Injection Technology	Cement Kilns	1,200
LNB	Asphaltic Conc; Rotary Dryer; Conv Plant	120
	Ceramic Clay Mfg; Drying	370
	Conv Coating of Prod; Acid Cleaning Bath	440
	Fuel Fired Equip; Furnaces; Natural Gas	170
	In-Process Fuel Use; Natural Gas	1,300
	In-Process Fuel Use; Residual Oil	39
	In-Process; Process Gas; Coke Oven Gas	190
	Lime Kilns	5,900
	Sec Alum Prod; Smelting Furn	62
	Steel Foundries; Heat Treating	13
	Surf Coat Oper; Coating Oven Htr; Nat Gas	30
LNB + FGR	Fluid Cat Cracking Units	3,600
	Fuel Fired Equip; Process Htrs; Process Gas	700
	In-Process; Process Gas; Coke Oven Gas	880
	Iron & Steel Mills—Galvanizing	35
	Iron & Steel Mills—Reheating	1,100
	Iron Prod; Blast Furn; Blast Htg Stoves	1,000
	Sand/Gravel; Dryer	11
	Steel Prod; Soaking Pits	100
LNB + SCR	Iron & Steel Mills—Annealing	270
	Process Heaters—Distillate Oil	2,300
	Process Heaters—Natural Gas	27,000
	Process Heaters—Other Fuel	14
	Process Heaters—Process Gas	4,200
	Process Heaters—Residual Oil	37
NSCR	Rich Burn IC Engines—Gas	22,000
	Rich Burn IC Engines—Gas, Diesel, LPG	3,700
	Rich Burn Internal Combustion Engines—Oil	11,000
OXY-Firing	Glass Manufacturing—Containers	7,600
	Glass Manufacturing—Flat	18,000
	Glass Manufacturing—Pressed	3,900
SCR	Ammonia—NG-Fired Reformers	5,800
	Cement Manufacturing—Dry	25,000
	Cement Manufacturing—Wet	22,000
	IC Engines—Gas	54,000
	ICI Boilers—Coal/Cyclone	2,200
	ICI Boilers—Coal/Wall	22,000
	ICI Boilers—Coke	490
	ICI Boilers—Distillate Oil	4,800

Control Measure	Source Type	Modeled Control Strategy Reductions (annual tons/year)
	ICI Boilers—Liquid Waste	730
	ICI Boilers—LPG	280
	ICI Boilers—Natural Gas	36,000
	ICI Boilers—Process Gas	8,600
	ICI Boilers—Residual Oil	17,000
	Natural Gas Prod; Compressors	810
	Space Heaters—Distillate Oil	22
	Space Heaters—Natural Gas	640
	Sulfate Pulping—Recovery Furnaces	9,900
SCR + Steam Injection	Combustion Turbines—Natural Gas	18,000
SCR + Water Injection	Combustion Turbines—Jet Fuel	—
	Combustion Turbines—Natural Gas	—
	Combustion Turbines—Oil	210
SNCR	By-Product Coke Mfg; Oven Underfiring	4,300
	Comm./Inst. Incinerators	1,400
	ICI Boilers—Coal/Stoker	7,000
	Indust. Incinerators	250
	Medical Waste Incinerators	—
	In-Process Fuel Use; Bituminous Coal	32
	Municipal Waste Combustors	4,400
	Nitric Acid Manufacturing	3,100
	Solid Waste Disp; Gov; Other Inc	95
SNCR—Urea	ICI Boilers—MSW/Stoker	120
SNCR—Urea Based	ICI Boilers—Coal/FBC	100
	ICI Boilers—Wood/Bark/Stoker—Large	5,500
	In-Process; Bituminous Coal; Cement Kilns	300
	In-Process; Bituminous Coal; Lime Kilns	31

3a.1.3 VOC Control Measures for NonEGU Point Sources.

VOC controls were applied to a variety of nonEGU point sources as defined in the emissions inventory in this RIA. The first control is: permanent total enclosure (PTE) applied to paper and web coating operations and fabric operations, and incinerators or thermal oxidizers applied to wood products and marine surface coating operations. A PTE confines VOC emissions to a particular area where can be destroyed or used in a way that limits emissions to the outside atmosphere, and an incinerator or thermal oxidizer destroys VOC emissions through exposure to high temperatures (2,000 degrees Fahrenheit or higher). The second control applied is petroleum and solvent evaporation applied to printing and publishing sources as well as to surface coating operations. Table 3a.2 contains the emissions reductions for these measures in the modeled control strategy for the alternate primary standard. For more information on these measures, refer to the AirControlNET 4.1 control measures documentation report.

Table 3a.2: VOC NonEGU Point Emission Reductions by Control Measure

Control Measure	Source Type	Modeled Control Strategy Reductions (annual tons/year)
Permanent Total Enclosure (PTE)	Fabric Printing, Coating and Dyeing	43
	Paper and Other Web Coating	490
Petroleum and Solvent Evaporation	Printing and Publishing	3,600
	Surface Coating	400

3a.1.4 NOx Control Measures for Area Sources

There were three control measures applied for NOx emissions from area sources. The first is RACT (reasonably available control technology) to 25 tpy (LNB). This control is the addition of a low NOx burner to reduce NOx emissions. This control is applied to industrial oil, natural gas, and coal combustion sources. The second control is water heaters plus LNB space heaters. This control is based on the installation of low-NOx space heaters and water heaters in commercial and institutional sources for the reduction of NOx emissions. The third control was switching to low sulfur fuel for residential home heating. This control is primarily designed to reduce sulfur dioxide, but has a co-benefit of reducing NOx. Table 3a.3 contains the listing of control measures and associated reductions for the modeled control strategy. For additional information regarding these controls please refer to the AirControlNET 4.1 control measures documentation report.

Table 3a.3: NOx Area Source Emission Reductions by Control Measure

Control Measure	Source Type	Modeled Control Strategy Reductions (annual tons/year)
RACT to 25 tpy (LNB)	Industrial Coal Combustion	5,400
	Industrial NG Combustion	3,000
	Industrial Oil Combustion	570
Switch to Low Sulfur Fuel	Residential Home Heating	970
Water Heater + LNB Space Heaters	Commercial/Institutional—NG	4,300
	Residential NG	6,700

3a.1.5 VOC Control Measures for Area Source.

The most frequently applied control to reduce VOC emissions from area sources was CARB Long-Term Limits. This control, which represents controls available in VOC rules promulgated by the California Air Resources Board, applies to commercial solvents and commercial adhesives, and depends on future technological innovation and market incentive methods to achieve emission reductions. The next most frequently applied control was the use of low or no VOC materials for graphic art source categories. The South Coast Air District’s SCAQMD Rule 1168 control applies to wood furniture and solvent source categories sets limits for adhesive and sealant VOC content. The OTC solvent cleaning rule control establishes hardware and operating requirements for specified vapor cleaning machines, as well as solvent volatility limits and operating practices for cold cleaners. The Low Pressure/Vacuum Relief Valve control measure is the addition of low pressure/vacuum (LP/V) relief valves to gasoline storage tanks at service stations with Stage II control systems. LP/V relief valves prevent breathing emissions from gasoline storage tank vent pipes. SCAQMD Limits control establishes VOC content limits for metal coatings along with application procedures and equipment requirements. Switch to Emulsified Asphalts control is a generic control measure replacing VOC-containing cutback asphalt with VOC-free emulsified asphalt. The equipment and maintenance control measure applies to oil and natural gas production. The Reformulation—FIP Rule control measure intends to reach the VOC limits by switching to and/or encouraging the use of low-VOC pesticides and better Integrated Pest Management (IPM) practices. Table 3a.4 contains the control measures and associated emission reductions described above for the modeled control strategy. For additional information regarding these controls please refer to the AirControlNET 4.1 control measures documentation report.

Table 3a.4: VOC Area Source Emission Reductions by Control Measure

Control Measure	Source Type	Modeled Control Strategy Reductions (annual tons/year)
CARB Long-Term Limits	Consumer Solvents	78,000
Catalytic Oxidizer	Conveyorized Charbroilers	250
Equipment and Maintenance	Oil and Natural Gas Production	450
Gas Collection (SCAQMD/BAAQMD)	Municipal Solid Waste Landfill	1,100
Incineration >100,000 lbs bread	Bakery Products	2,700
Low Pressure/Vacuum Relief Valve	Stage II Service Stations	9,900
	Stage II Service Stations—Underground Tanks	9,800
OTC Mobile Equipment Repair and Refinishing Rule	Aircraft Surface Coating	720
	Machn, Electric, Railroad Ctng	4,400
OTC Solvent Cleaning Rule	Cold Cleaning	10,000
SCAQMD—Low VOC	Rubber and Plastics Mfg	1,700
SCAQMD Limits	Metal Furniture, Appliances, Parts	6,300
SCAQMD Rule 1168	Adhesives—Industrial	22,000
Solvent Utilization	Large Appliances	8,200
	Metal Furniture	7,600
	Surface Coating	2,900
Switch to Emulsified Asphalts	Cutback Asphalt	3,300

3a.1.6 Supplemental Controls

Table 3a.5 below summarizes the supplemental control measures added to our control measures database by providing the pollutant it controls and its control efficiency (CE). These controls were applied not as part of the modeled control strategy, but as supplemental measures prior to extrapolating unknown control costs. However, these controls are not currently located in AirControlNET. These measures are primarily found in draft SIP technical documents and have not been fully assessed for inclusion in AirControlNET.

Table 3a.5: Supplemental Emissions Control Measures Added to the Control Measures Database

Poll	Control Technology	SCC	SCC Description	Percent Reduction (%)
NOx	LEC	20200252	Internal Comb. Engines/Industrial/ Natural Gas/2-cycle Lean Burn	87
		20200254	Internal Comb. Engines/Industrial/ Natural Gas/4-cycle Lean Burn	87
VOC	Enhanced LDAR	3018001-	Fugitive Leaks	50
		30600701 30600999 -	Flares	98
	LDAR	3018001 -	Fugitive Leaks	80
	Monitoring Program	30600702-	Cooling towers	No general estimate
	Inspection and Maintenance Program (Separators) Water Seals (Drains)	30600503-	Wastewater Drains and Separators	65
	Work Practices, Use of Low VOC Coatings (Area Sources)	2401025000 2401030000 2401060000 2425010000 2425030000 2425040000 2461050000	Solvent Utilization	90
	Work Practices, Use of Low VOC Coatings (NonEGU Point)	307001199 Surface Coating Operations within SCC 4020000000, Printing/Publishing processes within SCC 4050000000	Petroleum and Solvent Evaporation	90

Low Emission Combustion (LEC)

Overview: LEC technology is defined as the modification of a natural gas fueled, spark ignited, reciprocating internal combustion engine to reduce emissions of NOx by utilizing ultra-lean air-fuel ratios, high energy ignition systems and/or pre-combustion chambers, increased turbocharging or adding a turbocharger, and increased cooling and/or adding an intercooler or aftercooler, resulting in an engine that is designed to achieve a consistent NO_x emission rate of not more than 1.5-3.0 g/bhp-hr at full capacity (usually 100 percent speed and 100 percent load). This type of retrofit technology is fairly widely available for stationary internal combustion engines.

For CE, EPA estimates that it ranges from 82 to 91 percent for LEC technology applications. The EPA believes application of LEC would achieve average NO_x emission levels in the range of 1.5-3.0 g/bhp-hr. This is an 82-91 percent reduction from the average uncontrolled emission levels reported in the ACT document. An EPA memorandum summarizing 269 tests shows that

96 percent of IC engines with installed LEC technology achieved emission rates of less than 2.0 g/bhp-hr.[1] The 2000 EC/R report on IC engines summarizes 476 tests and shows that 97% of the IC engines with installed LEC technology achieve emission rates of 2.0 g/bhp-hr or less.[2]

Major Uncertainties: The EPA acknowledges that specific values will vary from engine to engine. The amount of control desired and number of operating hours will make a difference in terms of the impact had from a LEC retrofit. Also, the use of LEC may yield improved fuel economy and power output, both of which may affect the emissions generated by the device.

Leak Detection and Repair (LDAR) for Fugitive Leaks

Overview: This control measure is a program to reduce leaks of fugitive VOC emissions from chemical plants and refineries. The program includes special "sniffer" equipment to detect leaks, and maintenance schedules that affected facilities are to adhere to. This program is one that is contained within the Houston-Galveston-Brazoria 8-hour Ozone SIP.

Major Uncertainties: The degree of leakage from pipes and processes at chemical plants is always difficult to quantify given the large number of such leaks at a typical chemical manufacturing plant. There are also growing indications based on tests conducted by TCEQ and others in Harris County, Texas that fugitive leaks have been underestimated from chemical plants by a factor of 6 to 20 or greater. [3]

Enhanced LDAR for Fugitive Leaks

Overview: This control measure is a more stringent program to reduce leaks of fugitive VOC emissions from chemical plants and refineries that presumes that an existing LDAR program already is in operation.

Major Uncertainties: The calculations of CE and cost presume use of LDAR at a chemical plant. This should not be an unreasonable assumption, however, given that most chemical plants are under some type of requirement to have an LDAR program. However, as mentioned earlier, there is growing evidence that fugitive leak emissions are underestimated from chemical plants by a factor of 6 to 20 or greater.[4]

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[1] "Stationary Reciprocating Internal Combustion Engines Technical Support Document for NOx SIP Call Proposal," U.S. Environmental Protection Agency. September 5, 2000. Available on the Internet at http://www.epa.gov/ttn/naaqs/ozone/rto/sip/data/tsd9-00.pdf.

[2] "Stationary Internal Combustion Engines: Updated Information on NOx Emissions and Control Techniques," Ec/R Incorporated, Chapel Hill, NC. September 1, 2000. Available on the Internet at http://www.epa.gov/ttn/naaqs/ozone/ozonetech/ic_engine_nox_update_09012000.pdf.

[3] VOC Fugitive Losses: New Monitors, Emissions Losses, and Potential Policy Gaps. 2006 International Workshop. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards and Office of Solid Waste and Emergency Response. October 25-27, 2006.

[4] VOC Fugitive Losses: New Monitors, Emissions Losses, and Potential Policy Gaps. 2006 International Workshop. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards and Office of Solid Waste and Emergency Response. October 25-27, 2006.

Flare Gas Recovery

Overview: This control measure is a condenser that can recover 98 percent of the VOC emitted by flares that emit 20 tons per year or more of the pollutant.

Major Uncertainties: Flare gas recovery is just gaining commercial acceptance in the US and is only in use at a small number of refineries.

Cooling Towers

Overview: The control measure is continuous monitoring of VOC from the cooling water return to a level of 10 ppb. This monitoring is accomplished by using a continuous flow monitor at the inlet to each cooling tower.

There is not a general estimate of CE for this measure; one is to apply a continuous flow monitor until VOC emissions have reached a level of 1.7 tons/year for a given cooling tower.[5]

Major Uncertainties: The amount of VOC leakage from each cooling tower can greatly affect the overall cost-effectiveness of this control measure.

Wastewater Drains and Separators

Overview: This control measure includes an inspection and maintenance program to reduce VOC emissions from wastewater drains and water seals on drains. This measure is a more stringent version of measures that underlie existing NESHAP requirements for such sources.

Major Uncertainties: The reference for this control measures notes that the VOC emissions inventories for the five San Francisco Bay Area refineries whose data was a centerpiece of this report are incomplete. In addition, not all VOC species from these sources were included in the VOC data that is a basis for these calculations.[6]

Work Practices or Use of Low VOC Coatings

Overview: The control measure is either application of work practices (e.g., storing VOC-containing cleaning materials in closed containers, minimizing spills) or using coatings that have much lower VOC content. These measures, which are of relatively low cost compared to other VOC area source controls, can apply to a variety of processes, both for non-EGU point and area sources, in different industries and is defined in the proposed control techniques guidelines (CTG) for paper, film and foil coatings, metal furniture coatings, and large appliance coatings published by the US EPA in July 2007.[7]

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[5] Bay Area Air Quality Management District (BAAQMD). Proposed Revision of Regulation 8, Rule 8: Wastewater Collection Systems. Staff Report, March 17, 2004.

[6] Bay Area Air Quality Management District (BAAQMD). Proposed Revision of Regulation 8, Rule 8: Wastewater Collection Systems. Staff Report, March 17, 2004.

[7] U.S. Environmental Protection Agency. Consumer and Commercial Products: Control Techniques Guidelines in Lieu of Regulations for Paper, Film, and Foil Coatings; Metal

The estimated CE expected to be achieved by either of these control measures is 90 percent.

Major Uncertainties: The greatest uncertainty is in how many potentially affected processes are implementing or already implemented these control measures. This may be particularly true in California. Also, there are nine States that have many of the above work practices in effect for paper, film and foil coatings processes, but the work practices are not meant to achieve a specific emissions limit.[8] Hence, it is uncertain how much VOC reduction is occurring from this control measure in this case.

In addition to the new supplemental controls presented above, there were a number of changes made to existing AirControlNET controls. These changes were made based upon an internal review performed by EPA engineers to examine the controls applied by AirControlNET and determine if these controls were sufficient or could be more aggressive in their application, given the 2020 analysis year. This review was performed for nonEGU point NOx control measures. The result of this review was an increase in control efficiencies applied for many control measures, and more aggressive control measures for over 70 SCCs. The changes apply to the control strategies performed for the Eastern US only. These changes are listed in Table 3a.6.

Table 3a.6: Supplemental Emission Control Measures—Changes to Control Technologies Currently in our Control Measures Database For Application in 2020

Poll	SCC	AirControlNET Source Description	AirControlNET Control Technology	New Control Technology	New CE (%)	Old CE (%)
NOX	10200104 10200204 10200205 10300207 10300209 10200217 10300216	ICI Boilers—Coal-Stoker	SNCR	SCR	90	40
NOX	10200901 10200902 10200903 10200907 10300902 10300903	ICI Boilers—Wood/Bark/ Waste	SNCR	SCR	90	55
NOX	10200401 10200402 10200404 10200405 10300401	ICI Boilers—Residual Oil	SCR	SCR	90	80

Furniture Coatings; and Large Appliance Coatings. 40 CFR 59. July 10, 2007. Available on the Intenet at http://www.epa.gov/ttncaaa1/t1/fr_notices/ctg_ccp092807.pdf. It should be noted that this CTG became final in October 2007.

[8] U.S. Environmental Protection Agency. Consumer and Commercial Products: Control Techniques Guidelines in Lieu of Regulations for Paper, Film, and Foil Coatings; Metal Furniture Coatings; and Large Appliance Coatings. 40 CFR 59. July 10, 2007, p. 37597. Available on the Intenet at http://www.epa.gov/ttncaaa1/t1/fr_notices/ctg_ccp092807.pdf.

Poll	SCC	AirControlNET Source Description	AirControlNET Control Technology	New Control Technology	New CE (%)	Old CE (%)
NOX	10200501 10200502 10200504	ICI Boilers—Distillate Oil	SCR	SCR	90	80
NOX	10200601 10200602 10200603 10200604 10300601 10300602 10300603 10500106 10500206	ICI Boilers—Natural Gas	SCR	SCR	90	80
NOX	30500606	Cement Manufacturing—Dry	SCR	SCR	90	80
NOX	30500706	Cement Manufacturing—Wet	SCR	SCR	90	80
NOX	30300934	Iron & Steel Mills—Annealing	SCR	SCR	90	85
NOX	10200701 10200704 10200707 10200710 10200799 10201402 10300701 10300799	ICI Boilers—Process Gas	SCR	SCR	90	80
NOX	10200802 10200804	ICI Boilers—Coke	SCR	SCR	90	70
NOX	10201002	ICI Boilers—LPG	SCR	SCR	90	80
NOX	10201301 10201302	ICI Boilers—Liquid Waste	SCR	SCR	90	80
NOX	30700110	Sulfate Pulping—Recovery Furnaces	SCR	SCR	90	80
NOX	30100306	Ammonia Production—Pri. Reformer, Nat. Gas	SCR	SCR	90	80
	30500622 30500623	Cement Kilns	Biosolid Injection	Biosolid Injection	40	23
NOX	30590013 30190013 30190014 39990013	Industrial and Manufacturing Incinerators	SNCR	SCR	90	45
NOX	30101301 30101302	Nitric Acid Manufacturing	SNCR	SCR	90	60 to 98
NOX	30600201	Fluid Cat. Cracking Units	LNB + FGR	SCR	90	55
NOX	30590003	Process Heaters—Process Gas	LNB + SCR	LNB + SCR	90	88
NOX	30600101 30600103 30600111	Process Heaters—Distillate Oil	LNB + SCR	LNB + SCR	90	90
NOX	30600106 30600199	Process Heaters—Residual Oil	LNB + SCR	LNB + SCR	90	80
NOX	30600102 30600105	Process Heaters—Natural Gas	LNB + SCR	LNB + SCR	90	80

Poll	SCC	AirControlNET Source Description	AirControlNET Control Technology	New Control Technology	New CE (%)	Old CE (%)
NOX	30700104	Sulfate Pulping—Recovery Furnaces	SCR	SCR	90	80
NOX	30790013	Pulp and Paper—Natural Gas—Incinerators	SNCR	SCR	90	45
NOX	39000201	In-Process; Bituminous Coal; Cement Kiln	SNCR—urea based	SCR	90	50
NOX	39000203	In-Process; Bituminous Coal; Lime Kiln	SNCR—urea based	SCR	90	50
NOX	39000289	In-Process Fuel Use; Bituminous Coal; Gen	SNCR	SCR	90	40
NOX	39000489	In-Process Fuel Use; Residual Oil; Gen	LNB	SCR	90	37
NOX	39000689	In-Process Fuel Use; Natural Gas; Gen	LNB	SCR	90	50
NOX	39000701	In-Proc; Process Gas; Coke Oven/Blast Furn	LNB + FGR	SCR	90	55
NOX	39000789	In-Process; Process Gas; Coke Oven Gas	LNB	SCR	90	50
NOX	50100101 50100506 50200506 50300101 50300102 50300104 50300506 50100102	Solid Waste Disp; Gov; Other Incin; Sludge	SNCR	SCR	90	45

The last category of supplemental controls is control technologies currently in our control measures database being applied to SCCs not controlled currently in AirControlNET.

Table 3a.7: Supplemental Emission Control Technologies Currently in our Control Measures Database Applied to New Source Types

Pollutant	SCC	SCC Description	Control Technology	CE
NOX	39000602	Cement Manufacturing—Dry	SCR	90
NOX	30501401	Glass Manufacturing—General	OXY-Firing	85
NOX	30302351 30302352 30302359	Taconite Iron Ore Processing—Induration—Coal or Gas	SCR	90
NOX	10100101	External Combustion Boilers; Electric Generation; Anthracite Coal; Pulverized Coal	SNCR	40
NOX	10100202	External Combustion Boilers; Electric Generation; Bituminous/Subbituminous Coal; Pulverized Coal: Dry Bottom (Bituminous Coal)	SNCR	40
NOX	10100204	External Combustion Boilers; Electric Generation; Bituminous/Subbituminous Coal; Spreader Stoker (Bituminous Coal)	SNCR	40
NOX	10100212	External Combustion Boilers; Electric Generation; Bituminous/Subbituminous Coal; Pulverized Coal: Dry Bottom (Tangential) (Bituminous Coal)	SNCR	40

Pollutant	SCC	SCC Description	Control Technology	CE
NOX	10100401	External Combustion Boilers; Electric Generation; Residual Oil; Grade 6 Oil: Normal Firing	SNCR	50
NOX	10100404	External Combustion Boilers; Electric Generation; Residual Oil; Grade 6 Oil: Tangential Firing	SNCR	50
NOX	10100501	External Combustion Boilers; Electric Generation; Distillate Oil; Grades 1 and 2 Oil	SNCR	50
NOX	10100601	External Combustion Boilers; Electric Generation; Natural Gas; Boilers > 100 Million Btu/hr except Tangential	NGR	50
NOX	10100602	External Combustion Boilers; Electric Generation; Natural Gas; Boilers < 100 Million Btu/hr except Tangential	NGR	50
NOX	10100604	External Combustion Boilers; Electric Generation; Natural Gas; Tangentially Fired Units	NGR	50
NOX	10101202	External Combustion Boilers; Electric Generation; Solid Waste; Refuse Derived Fuel	SNCR	50
NOX	20200253	Internal Comb. Engines/Industrial/Natural Gas/4-cycle Rich Burn	NSCR	90

3a.2 Mobile Control Measures Used in Control Scenarios

Tables 3a.8 and 3a.9 summarize the emission reductions for the mobile source control measures discussed in this section.

Table 3a.8: NOx Mobile Emission Reductions by Control Measure

Sector	Control Measure	Modeled Control Strategy Reductions (annual tons/year)
Onroad	Eliminate Long Duration Truck Idling	5,800
	Reduce Gasoline RVP	880
	Diesel Retrofits	91,000
	Continuous Inspection and Maintenance	20,000
	Commuter Programs	4,100
Nonroad	Diesel Retrofits and Engine Rebuilds	35,000

Table 3a.9: VOC Mobile Emission Reductions by Control Measure

Sector	Control Measure	Modeled Control Strategy Reductions (annual tons/year)
Onroad	Reduce Gasoline RVP	17,000
	Diesel Retrofits	8,400
	Continuous Inspection and Maintenance	28,000
	Commuter Programs	7,000
Nonroad	Reduce Gasoline RVP	6,300
	Diesel Retrofits and Engine Rebuilds	5,200

3a.2.1 Diesel Retrofits and Engine Rebuilds

Retrofitting heavy-duty diesel vehicles and equipment manufactured before stricter standards are in place—in 2007–2010 for highway engines and in 2011–2014 for most nonroad equipment—can provide NO_X and HC benefits. The retrofit strategies included in the RIA retrofit measure are:

- Installation of emissions after-treatment devices called selective catalytic reduction (“SCRs”)
- Rebuilding nonroad engines (“rebuild/upgrade kit”)

We chose to focus on these strategies due to their high NOx emissions reduction potential and widespread application. Additional retrofit strategies include, but are not limited to, lean NOx catalyst systems—which are another type of after-treatment device—and alternative fuels. Additionally, SCRs are currently the most likely type of control technology to be used to meet EPA’s NOx 2007–2010 requirements for HD diesel trucks and 2008–2011 requirements for nonroad equipment. Actual emissions reductions may vary significantly by strategy and by the type and age of the engine and its application.

To estimate the potential emissions reductions from this measure, we applied a mix of two retrofit strategies (SCRs and rebuild/upgrade kits) for the 2020 inventory of:

- Heavy-duty highway trucks class 6 & above, Model Year 1995–2009
- All diesel nonroad engines, Model Year 1991–2007, except for locomotive, marine, pleasure craft, & aircraft engines

Class 6 and above trucks comprise the bulk of the NOx emissions inventory from heavy-duty highway vehicles, so we did not include trucks below class 6. We chose not to include locomotive and marine engines in our analysis since EPA has proposed regulations to address these engines, which will significantly impact the emissions inventory and emission reduction potential from retrofits in 2020. There was also not enough data available to assess retrofit strategies for existing aircraft and pleasure craft engines, so we did not include them in this analysis. In addition, EPA is in the process of negotiating standards for new aircraft engines.

The lower bound in the model year range—1995 for highway vehicles and 1991 for nonroad engines—reflects the first model year in which emissions after-treatment devices can be reliably applied to the engines. Due to a variety of factors, devices are at a higher risk of failure for earlier model years. We expect the engines manufactured before the lower bound year that are still in existence in 2020 to be retired quickly due to natural turnover, therefore, we have not included strategies for pre-1995/1991 engines because of the strategies’ relatively small impact on emissions. The upper bound in the model year range reflects the last year before more stringent emissions standards will be fully phased-in.

We chose the type of strategy to apply to each model year of highway vehicles and nonroad equipment based on our technical assessment of which strategies would achieve reliable results at the lowest cost. After-treatment devices can be more cost-effective than rebuild and vice versa depending on the emissions rate, application, usage rates, and expected life of the engine. The performance of after-treatment devices, for example, depends heavily upon the model year of the engine; some older engines may not be suitable for after-treatment devices and would be better candidates for rebuild/upgrade kit. In certain cases, nonroad engines may not be suitable for either after-treatment devices or rebuild, which is why we estimate that retrofits are not suitable for 5% of the nonroad fleet. The mix of strategies employed in this RIA for highway vehicles and nonroad engines are presented in Table 3a.10 and Table 3a.11, respectively. The groupings of model years for highway vehicles reflect changes in EPA's published emissions standards for new engines.

Table 3a.10: Application of Retrofit Strategy for Highway Vehicles by Percentage of Fleet

Model Year	SCR
<1995	0%
1995–2006	100%
2007–2009	50%
>2009	0%

Table 3a.11: Application of Retrofit Strategy for Nonroad Equipment by Percentage of Fleet

Model Year	Rebuild/Upgrade kit	SCR
1991–2007	50%	50%

The expected emissions reductions from SCR's are based on data derived from EPA regulations (Control of Emissions of Air Pollution from 2004 and Later Model Year Heavy-duty Highway Engines and Vehicles published October 2000), interviews with component manufacturers, and EPA's Summary of Potential Retrofit Technologies. This information is available at www.epa.gov/otaq/retrofit/retropotentialtech.htm. The estimates for highway vehicles and nonroad engines are presented in Table 3a.12 and Table 3a.13, respectively.

Table 3a.12: Percentage Emissions Reduction by Highway Vehicle Retrofit Strategy

	PM	CO	HC	NOx
SCR (+DPF)	90%	90%	90%	70%

Table 3a.13: Percentage Emissions Reduction by Nonroad Equipment Retrofit Strategy

Strategy	PM	CO	HC	NOx
SCR (+DPF)	90%	90%	90%	70%
Rebuild/Upgrade Kit	30%	15%	70%	40%

It is important to note that there is a great deal of variability among types of engines (especially nonroad), the applicability of retrofit strategies, and the associated emissions reductions. We applied the retrofit emissions reduction estimates to engines across the board (e.g., retrofits for bulldozers are estimated to produce the same percentage reduction in emissions as for agricultural mowers). We did this in order to simplify model runs, and, in some cases, where we did not have enough data to differentiate emissions reductions for different types of highway vehicles and nonroad equipment. We believe the estimates used in the RIA, however, reflect the best available estimates of emissions reductions that can be expected from retrofitting the heavy-duty diesel fleet.

Using the retrofit module in EPA's National Mobile Inventory Model (NMIM) available at http://www.epa.gov/otaq/nmim.htm, we calculated the total percentage reduction in emissions (PM, NOx, HC, and CO) from the retrofit measure for each relevant engine category (source category code, or SCC) for each county in 2020. To evaluate this change in the emissions inventory, we conducted both a baseline and control analysis. Both analyses were based on NMIM 2005 (version NMIM20060310), NONROAD2005 (February 2006), and MOBILE6.2.03 which included the updated diesel PM file PMDZML.csv dated March 17, 2006.

For the control analysis, we applied the retrofit measure corresponding to the percent reductions of the specified pollutants in Tables 3a.12 and 3a.13 to the specified model years in Tables 3a.10 and 3a.11 of the relevant SCCs. Fleet turnover rates are modeled in the NMIM, so we applied the retrofit measure to the 2007 fleet inventory, and then evaluated the resulting emissions inventory in 2020. The timing of the application of the retrofit measure is not a factor; retrofits only need to take place prior to the attainment date target (2020 for this RIA). For example, if retrofit devices are installed on 1995 model year bulldozers in 2007, the only impact on emissions in 2020 will be from the expected inventory of 1995 model year bulldozer emissions in 2020.

We then compared the baseline and control analyses to determine the percent reduction in emissions we estimate from this measure for the relevant SCC codes in the targeted nonattainment areas.

3a.2.2 Implement Continuous Inspection and Maintenance Using Remote Onboard Diagnostics (OBD)

Continuous Inspection and Maintenance (I/M) is a new way to check the status of OBD systems on light-duty OBD-equipped vehicles. It involves equipping subject vehicles with some type of transmitter that attaches to the OBD port. The device transmits the status of the OBD system to receivers distributed around the I/M area. Transmission may be through radio-frequency, cellular or wi-fi means. Radio frequency and cellular technologies are currently being used in the states of Oregon, California and Maryland.

Current I/M programs test light-duty vehicles on a periodic basis—either annually or biennially. Emission reduction credit is assigned based on test frequency. Using Continuous I/M, vehicles are continuously monitored as they are operated throughout the non-attainment area. When a vehicle experiences an OBD failure, the motorist is notified and is required to get repairs within the normal grace period—typically about a month. Thus, Continuous I/M will result in repairs happening essentially whenever a malfunction occurs that would cause the check engine light to illuminate. The continuous I/M program is applied to the same fleet of vehicles as the current periodic I/M programs. Currently, MOBILE6 provides an increment of benefit when going from a biennial program to an annual program. The same increment of credit applies going from an annual program to a continuous program.

Source Categories Affected by Measure:

- All 1996 and newer light-duty gasoline vehicles and trucks:
- All 1996 and newer (SCC 2201001000) Light Duty Gasoline Vehicles (LDGV), Total: All Road Types
- All 1996 and newer (SCC 2201020000) Light Duty Gasoline Trucks 1 (LDGT1), Total: All Road Types
- All 1996 and newer (SCC 2201040000) Light Duty Gasoline Trucks 2 (LDGT2), Total: All Road Types

OBD systems on light duty vehicles are required to illuminate the malfunction indicator lamp whenever emissions of HC, CO or NOx would exceed 1.5 times the vehicle's certification standard. Thus, the benefits of this measure will affect all three criteria pollutants. MOBILE6 was used to estimate the emission reduction benefits of Continuous I/M, using the methodology discussed above.

3a.2.3 Eliminating Long Duration Truck Idling

Virtually all long duration truck idling—idling that lasts for longer than 15 minutes—from heavy-duty diesel class 8a and 8b trucks can be eliminated with two strategies:

- truck stop & terminal electrification (TSE)
- mobile idle reduction technologies (MIRTs) such as auxiliary power units, generator sets, and direct-fired heaters

TSE can eliminate idling when trucks are resting at truck stops or public rest areas and while trucks are waiting to perform a task at private distribution terminals. When truck spaces are electrified, truck drivers can shut down their engines and use electricity to power equipment which supplies air conditioning, heat, and electrical power for on-board appliances.

MIRTs can eliminate long duration idling from trucks that are stopped away from these central sites. For a more complete list of MIRTs see EPA's Idle Reduction Technology page at http://www.epa.gov/otaq/smartway/idlingtechnologies.htm.

This measure demonstrates the potential emissions reductions if every class 8a and 8b truck is equipped with a MIRT or has dependable access to sites with TSE in 2020.

To estimate the potential emissions reduction from this measure, we applied a reduction equal to the full amount of the emissions attributed to long duration idling in the MOBILE model, which is estimated to be 3.4% of the total NOx emissions from class 8a and 8b heavy duty diesel trucks. Since the MOBILE model does not distinguish between idling and operating emissions, EPA estimates idling emissions in the inventory based on fuel conversion factors. The inventory in the MOBILE model, however, does not fully capture long duration idling emissions. There is evidence that idling may represent a much greater share than 3.4% of the real world inventory, based on engine control module data from long haul trucking companies. As such, we believe the emissions reductions demonstrated from this measure in the RIA represent ambitious but realistic targets. For more information on determining baseline idling activity see EPA's "Guidance for Quantifying and Using Long-Duration Truck Idling Emission Reductions in State Implementation Plans and Transportation Conformity" available at http://www.epa.gov/smartway/idle-guid.htm.

Pollutants and Source Categories Affected by Measure: NO_x

Table 3a.14: Class 8a and 8b Heavy Duty Diesel Trucks (decrease NOx for all SCCs)

SCC	Note: All SCC Descriptions below begin with "Mobile Sources; Highway Vehicles—Diesel"
2230074110	Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B; Rural Interstate: Total
2230074130	Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B; Rural Other Principal Arterial: Total
2230074150	Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B; Rural Minor Arterial: Total
2230074170	Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B; Rural Major Collector: Total
2230074190	Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B; Rural Minor Collector: Total
2230074210	Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B; Rural Local: Total
2230074230	Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B; Urban Interstate: Total
2230074250	Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B; Urban Other Freeways and Expressways: Total
2230074270	Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B; Urban Other Principal Arterial: Total
2230074290	Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B; Urban Minor Arterial: Total
2230074310	Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B; Urban Collector: Total
2230074330	Heavy Duty Diesel Vehicles (HDDV) Class 8A & 8B; Urban Local: Total

Estimated Emissions Reduction from Measure (%): 3.4 % decrease in NOx for all SCCs affected by measure

3a.2.4 Commuter Programs

Commuter programs recognize and support employers who provide incentives to employees to reduce light-duty vehicle emissions. Employers implement a wide range of incentives to affect change in employee commuting habits including transit subsidies, bike-friendly facilities, telecommuting policies, and preferred parking for vanpools and carpools. The commuter measure in this RIA reflects a mixed package of incentives.

This measure demonstrates the potential emissions reductions from providing commuter incentives to 10% and 25% of the commuter population in 2020.

We used the findings from a recent Best Workplaces for Commuters survey, which was an EPA sponsored employee trip reduction program, to estimate the potential emissions reductions from this measure.[9] The BWC survey found that, on average, employees at workplaces with comprehensive commuter programs emit 15% fewer emissions than employees at workplaces that do not offer a comprehensive commuter program.

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[9] Herzog, E., Bricka, S., Audette, L., and Rockwell, J., 2005. *Do Employee Commuter Benefits Reduce Vehicle Emissions and Fuel Consumption? Results of the Fall 2004 Best Workplaces for Commuters Survey*, Transportation Research Record, Journal of the Transportation Research Board: Forthcoming.

We believe that getting 10%–25% of the workforce involved in commuter programs is realistic. For modeling purposes, we divided the commuter programs measure into two program penetration rates: 10% and 25%. This was meant to provide flexibility to model a lower penetration rate for areas that need only low levels of emissions reductions to achieve attainment.

According to the 2001 National Household Transportation Survey (NHTS) published by DOT, commute VMT represents 27% of total VMT. Based on this information, we calculated that BWC would reduce light-duty gasoline emissions by 0.4% and 1% with a 10% and 25% program penetration rate, respectively.

Pollutants and Source Categories Affected by Measure (SCC): NO_x, and VOC

Table 3a.15: All Light-Duty Gasoline Vehicles and Trucks

SCC	Note: All SCC Descriptions below begin with “Mobile Sources; Highway Vehicles—Gasoline”
2201001110	Light Duty Gasoline Vehicles (LDGV); Rural Interstate: Total
2201001130	Light Duty Gasoline Vehicles (LDGV); Rural Other Principal Arterial: Total
2201001150	Light Duty Gasoline Vehicles (LDGV); Rural Minor Arterial: Total
2201001170	Light Duty Gasoline Vehicles (LDGV); Rural Major Collector: Total
2201001190	Light Duty Gasoline Vehicles (LDGV); Rural Minor Collector: Total
2201001210	Light Duty Gasoline Vehicles (LDGV); Rural Local: Total
2201001230	Light Duty Gasoline Vehicles (LDGV); Urban Interstate: Total
2201001250	Light Duty Gasoline Vehicles (LDGV); Urban Other Freeways and Expressways: Total
2201001270	Light Duty Gasoline Vehicles (LDGV); Urban Other Principal Arterial: Total
2201001290	Light Duty Gasoline Vehicles (LDGV); Urban Minor Arterial: Total
2201001310	Light Duty Gasoline Vehicles (LDGV); Urban Collector: Total
2201001330	Light Duty Gasoline Vehicles (LDGV); Urban Local: Total
2201020110	Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5); Rural Interstate: Total
2201020130	Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5); Rural Other Principal Arterial: Total
2201020150	Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5); Rural Minor Arterial: Total
2201020170	Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5); Rural Major Collector: Total
2201020190	Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5); Rural Minor Collector: Total
2201020210	Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5); Rural Local: Total
2201020230	Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5); Urban Interstate: Total
2201020250	Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5); Urban Other Freeways and Expressways: Total
2201020270	Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5); Urban Other Principal Arterial: Total
2201020290	Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5); Urban Minor Arterial: Total
2201020310	Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5); Urban Collector: Total
2201020330	Light Duty Gasoline Trucks 1 & 2 (M6) = LDGT1 (M5); Urban Local: Total
2201040110	Light Duty Gasoline Trucks 3 & 4 (M6) = LDGT2 (M5); Rural Interstate: Total
2201040130	Light Duty Gasoline Trucks 3 & 4 (M6) = LDGT2 (M5); Rural Other Principal Arterial: Total
2201040150	Light Duty Gasoline Trucks 3 & 4 (M6) = LDGT2 (M5); Rural Minor Arterial: Total
2201040170	Light Duty Gasoline Trucks 3 & 4 (M6) = LDGT2 (M5); Rural Major Collector: Total
2201040190	Light Duty Gasoline Trucks 3 & 4 (M6) = LDGT2 (M5); Rural Minor Collector: Total
2201040210	Light Duty Gasoline Trucks 3 & 4 (M6) = LDGT2 (M5); Rural Local: Total
2201040230	Light Duty Gasoline Trucks 3 & 4 (M6) = LDGT2 (M5); Urban Interstate: Total
2201040250	Light Duty Gasoline Trucks 3 & 4 (M6) = LDGT2 (M5); Urban Other Freeways and Expressways: Total
2201040270	Light Duty Gasoline Trucks 3 & 4 (M6) = LDGT2 (M5); Urban Other Principal Arterial: Total
2201040290	Light Duty Gasoline Trucks 3 & 4 (M6) = LDGT2 (M5); Urban Minor Arterial: Total
2201040310	Light Duty Gasoline Trucks 3 & 4 (M6) = LDGT2 (M5); Urban Collector: Total
2201040330	Light Duty Gasoline Trucks 3 & 4 (M6) = LDGT2 (M5); Urban Local: Total

Estimated Emissions Reduction from Measure (%):

With a 10% program penetration rate:	0.4%
With a 25% program penetration rate:	1%

3a.2.5 Reduce Gasoline RVP from 7.8 to 7.0 in Remaining Nonattainment Areas

Volatility is the property of a liquid fuel that defines its evaporation characteristics. RVP is an abbreviation for “Reid vapor pressure,” a common measure of gasoline volatility, as well as a generic term for gasoline volatility. EPA regulates the vapor pressure of all gasoline during the summer months (June 1 to September 15 at retail stations). Lower RVP helps to reduce VOCs, which are a precursor to ozone formation. This control measure represents the use of gasoline with a RVP limit of 7.0 psi from May through September in counties with an ozone season RVP value greater than 7.0 psi.

Under section 211(c)(4)(C) of the CAA, EPA may approve a non-identical state fuel control as a SIP provision, if the state demonstrates that the measure is necessary to achieve the national primary or secondary ambient air quality standard (NAAQS) that the plan implements. EPA can approve a state fuel requirement as necessary only if no other measures would bring about timely attainment, or if other measures exist but are unreasonable or impracticable.

Source Categories Affected by Measure:

- All light-duty gasoline vehicles and trucks: Affected SCC:
  - 2201001000 Light Duty Gasoline Vehicles (LDGV), Total: All Road Types
  - 2201020000 Light Duty Gasoline Trucks 1 (LDGT1), Total: All Road Types
  - 2201040000 Light Duty Gasoline Trucks 2 (LDGT2), Total: All Road Types
  - 2201070000 Heavy Duty Gasoline Vehicles (HDGV), Total: All Road Types
  - 2201080000 Motorcycles (MC), Total: All Road Types

3a.3 EGU Controls Used in the Control Strategy

Table 3a.16 contains the ozone season emissions from all fossil EGU sources (greater than 25 megawatts) for the baseline and the control strategy.

Table 3a.16: NOx EGU Ozone Season Emissions (All Fossil Units >25MW) (1,000 Tons)[a]

	OTC	MWRPO	East TX	National	CAIR Region	CAIR Cap
Baseline (CAIR/CAMR/CAVR)	73	154	43	828	463	485
Control Strategy	65 (−11%)	113 (−26%)	33 (−23%)	812 (−2%)	470	482

[a] Numbers in parentheses are the percentage change in emissions.

3a.3.1 CAIR

The data and projections presented in Section 3.2.2 cover the electric power sector, an industry that will achieve significant emission reductions under the Clean Air Interstate Rule (CAIR) over the next 10 to 15 years. Based on an assessment of the emissions contributing to interstate transport of air pollution and available control measures, EPA determined that achieving required reductions in the identified States by controlling emissions from power plants is highly cost effective. CAIR will permanently cap emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x) in the eastern United States. CAIR achieves large reductions of SO_2 and/or NO_x emissions across 28 eastern states and the District of Columbia.

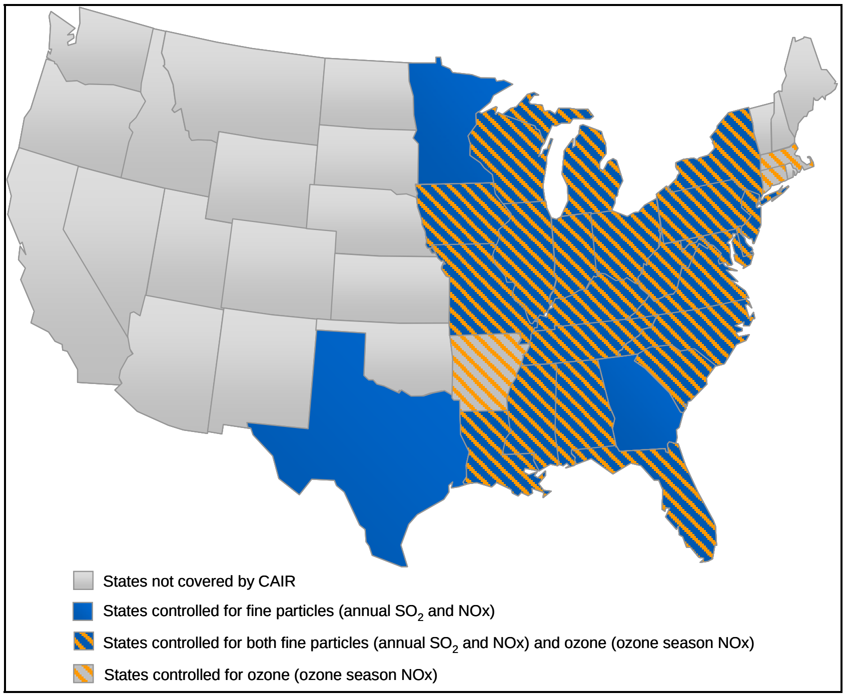


Figure 3a.1: CAIR Affected Region

When fully implemented, CAIR will reduce SO_2 emissions in these states by over 70% and NO_x emissions by over 60% from 2003 levels (some of which are due to NOx SIP Call). This will result in significant environmental and health benefits and will substantially reduce premature mortality in the eastern United States. The benefits will continue to grow each year with further implementation. CAIR was designed with current air quality standard in mind, and requires significant emission reductions in the East, where they are needed most and where transport of pollution is a major concern. CAIR will bring most areas in the Eastern US into attainment with the current ozone and current $PM_{2.5}$ standards. Some areas will need to adopt additional local control measures beyond CAIR. CAIR is a regional solution to address transport, not a solution to all local nonattainment issues. The large reductions anticipated with CAIR, in conjunction with reasonable additional local control measures for SO_2, NO_x, and direct PM, will move States towards attainment in a deliberate and logical manner.

Based on the final State rules that have been submitted and the proposed State rules that EPA has reviewed, EPA believes that all States intend to use the CAIR trading programs as their mechanism for meeting the emission reduction requirements of CAIR.

The analysis in this section reflects these realities and attempts to show, in an illustrative fashion, the costs and impacts of meeting a proposed 8-hr ozone standard of 0.070 ppm for the power sector.

3a.3.2 Integrated Planning Model and Background

CAIR was designed to achieve significant emissions reductions in a highly cost-effective manner to reduce the transport of fine particles that have been found to contribute to nonattainment. EPA analysis has found that the most efficient method to achieve the emissions reduction targets is through a cap-and-trade system on the power sector that States have the option of adopting. The modeling done with IPM assumes a region-wide cap and trade system on the power sector for the States covered.

It is important to note that the proposal RIA analysis used the Integrated Planning Model (IPM) v2.1.9 to ensure consistency with the analysis presented in 2006 PM NAAQS RIA and report incremental results. EPA's IPM v2.1.9 incorporated Federal and State rules and regulations adopted before March 2004 and various NSR settlements.

Final RIA analysis uses the latest version of IPM (v3.0) as part of the updated modeling platform. IPM v3.0 includes input and model assumption updates in modeling the power sector and incorporates Federal and State rules and regulations adopted before September 2006 and various NSR settlements. A detailed discussion of uncertainties associated with the EGU sector modeling can be found in 2006 PM NAAQS RIA (pg. 3-50)

The economic modeling using IPM presented in this and other chapters has been developed for specific analyses of the power sector. EPA's modeling is based on its best judgment for various input assumptions that are uncertain, particularly assumptions for future fuel prices and electricity demand growth. To some degree, EPA addresses the uncertainty surrounding these two assumptions through sensitivity analyses. More detail on IPM can be found in the model documentation, which provides additional information on the assumptions discussed here as well as all other assumptions and inputs to the model (http://www.epa.gov/airmarkets/progsregs/epa-ipm.html).

3a.3.3 EGU NOx Emission Control Technologies

IPM v3.0 includes SO_2, NO_x, and mercury (Hg) emission control technology options for meeting existing and future federal, regional, and state, SO_2, NO_x and Hg emission limits. The NOx control technology options include Selective Catalytic Reduction (SCR) system and Selective Non-Catalytic Reduction (SNCR) systems. It is important to note that beyond these emission control options, IPM offers other compliance options for meeting emission limits. These include fuel switching, re-powering, and adjustments in the dispatching of electric generating units. Table 3a.17 summarizes retrofit NOx emission control performance assumptions.

Table 3a.17: Summary of Retrofit NOx Emission Control Performance Assumptions

	Selective Catalytic Reduction (SCR)		**Selective Non-Catalytic Reduction (SNCR)**	
Unit Type	**Coal**	**Oil/Gas[a]**	**Coal**	**Oil/Gas[a]**
Percent Removal	90% down to 0.06 lb/mmBtu	80%	35%	50%
Size Applicability	Units. 100 MW	Units. 25 MW	Units. 25 MW and Units < 200 MW	Units. 25 MW

[a] Controls to oil- or gas-fired EGUs are not applied as part of the EGU control strategy included in this RIA.

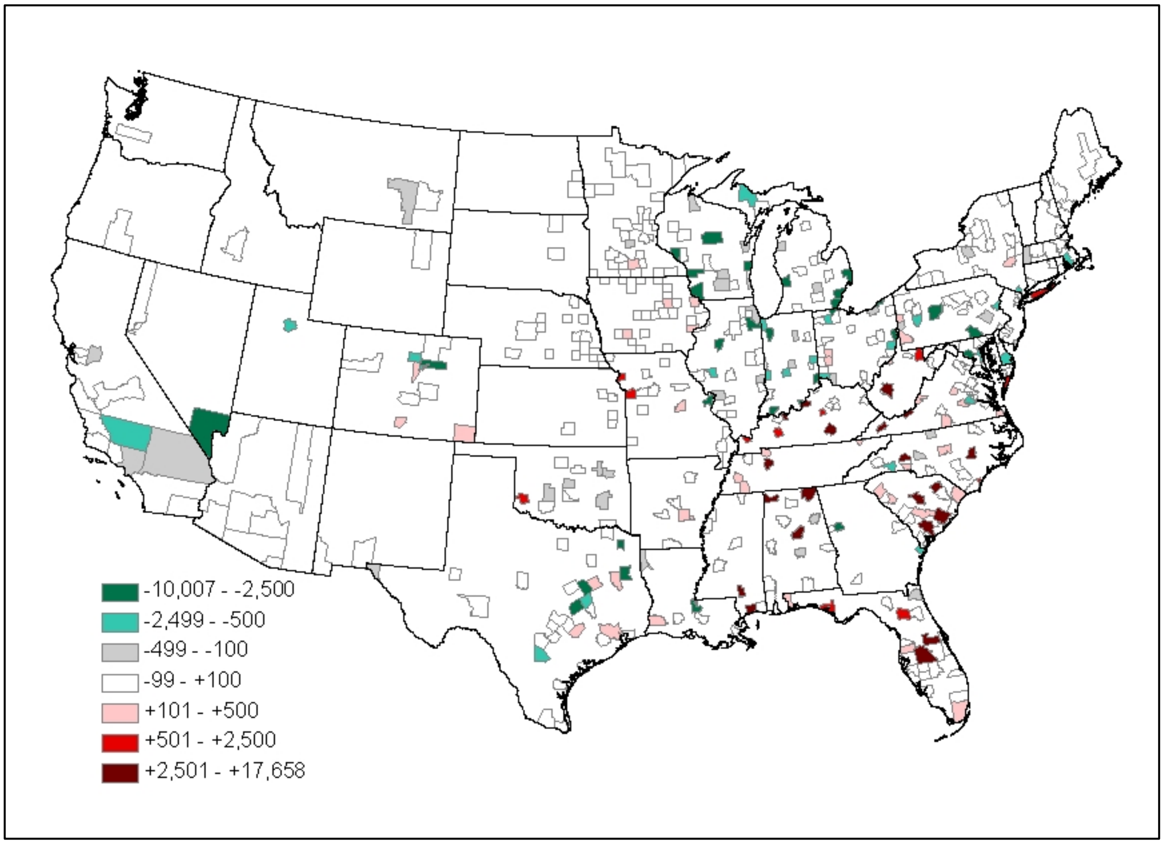
Existing coal-fired units that are retrofit with SCR have a NOx removal efficiency of 90%, with a minimum controlled NOx emission rate of 0.06 lb/mmBtu in IPM v2.1.9. Potential (new) coal-fired, combined cycle, and IGCC units are modeled to be constructed with SCR systems and designed to have emission rates ranging between 0.02 and 0.06 lb NOx/mmBtu.

Detailed cost and performance derivations for NOx controls are discussed in detail in the EPA's documentation of IPM (**http://www.epa.gov/airmarkets/progsregs/epa-ipm/past-modeling.html**).

3a.4 Emissions Reductions by Sector

Figures 3a.2–3a.6 show the NOx reductions for each sector and Figures 3a.7–3a.10 show the VOC reductions for each sector under the modeled control strategy.

Figure 3a.2: Annual Tons of NOx Emissions Reduced from EGU Sources*



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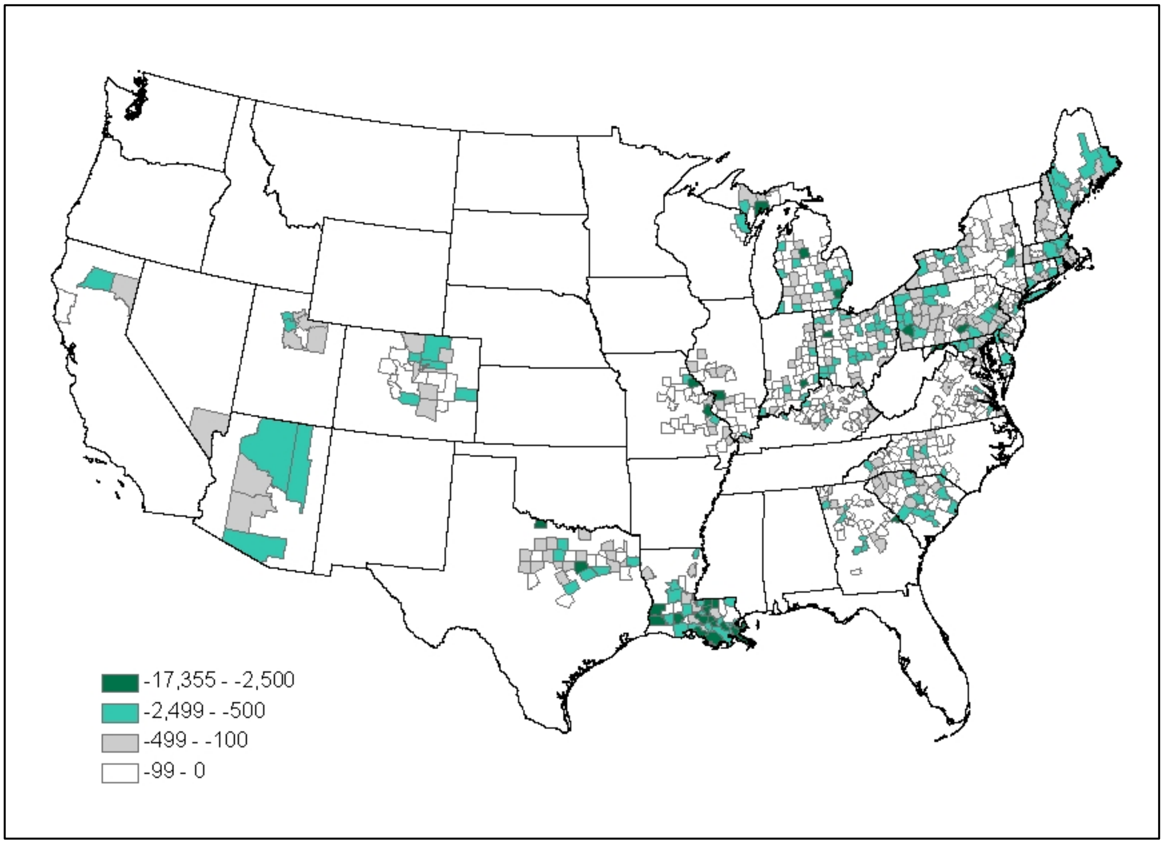
[*] Reductions are negative and increases are positive.

[**] The −99–+100 range is not shown because these are small county-level NOx reductions or increases that likely had little to no impact on ozone estimates. Most counties in this range had NOx differences of under 1 ton.

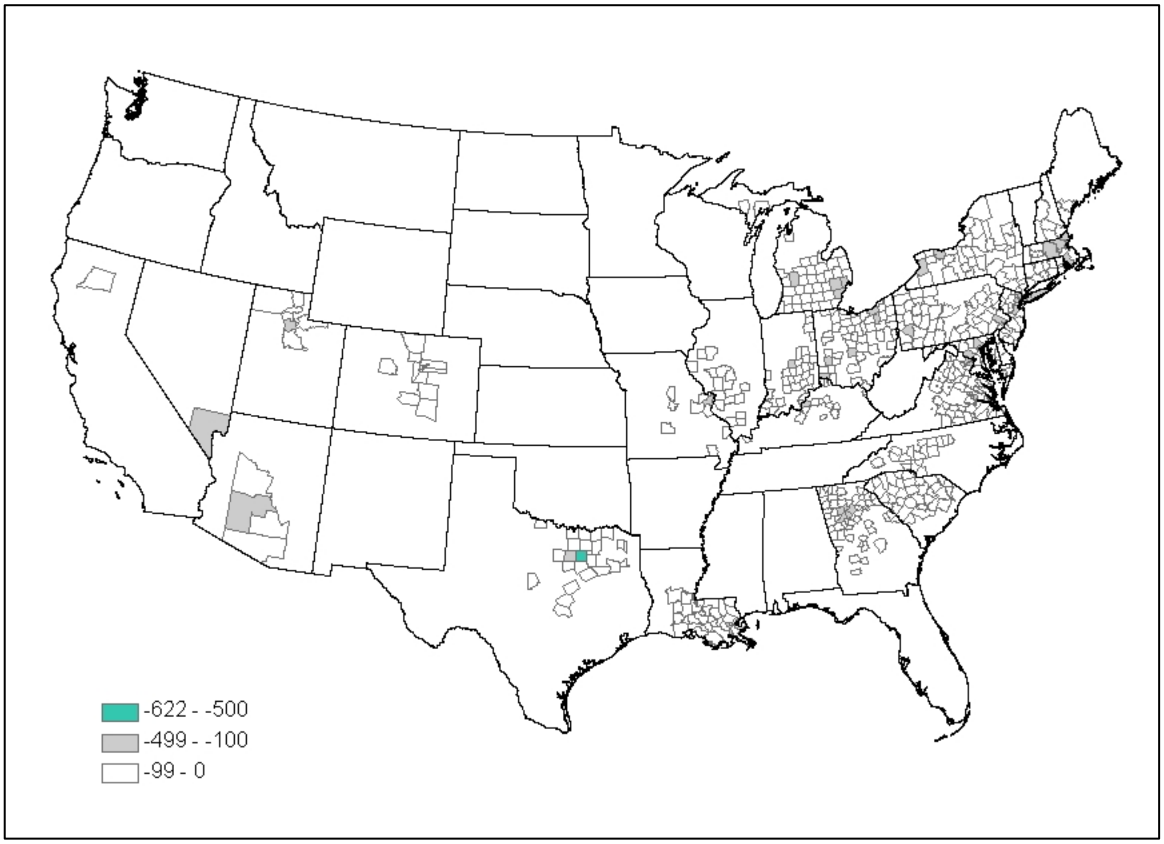
Figure 3a.3: Annual tons/year of Nitrogen Oxide (NOx) Emissions Reduced from NonEGU Point Sources*



***** Reductions are negative and increases are positive.

** The −99–0 range is not shown because these are small county-level NOx reductions or increases that likely had little to no impact on ozone estimates. Most counties in this range had NOx differences of under 1 ton.

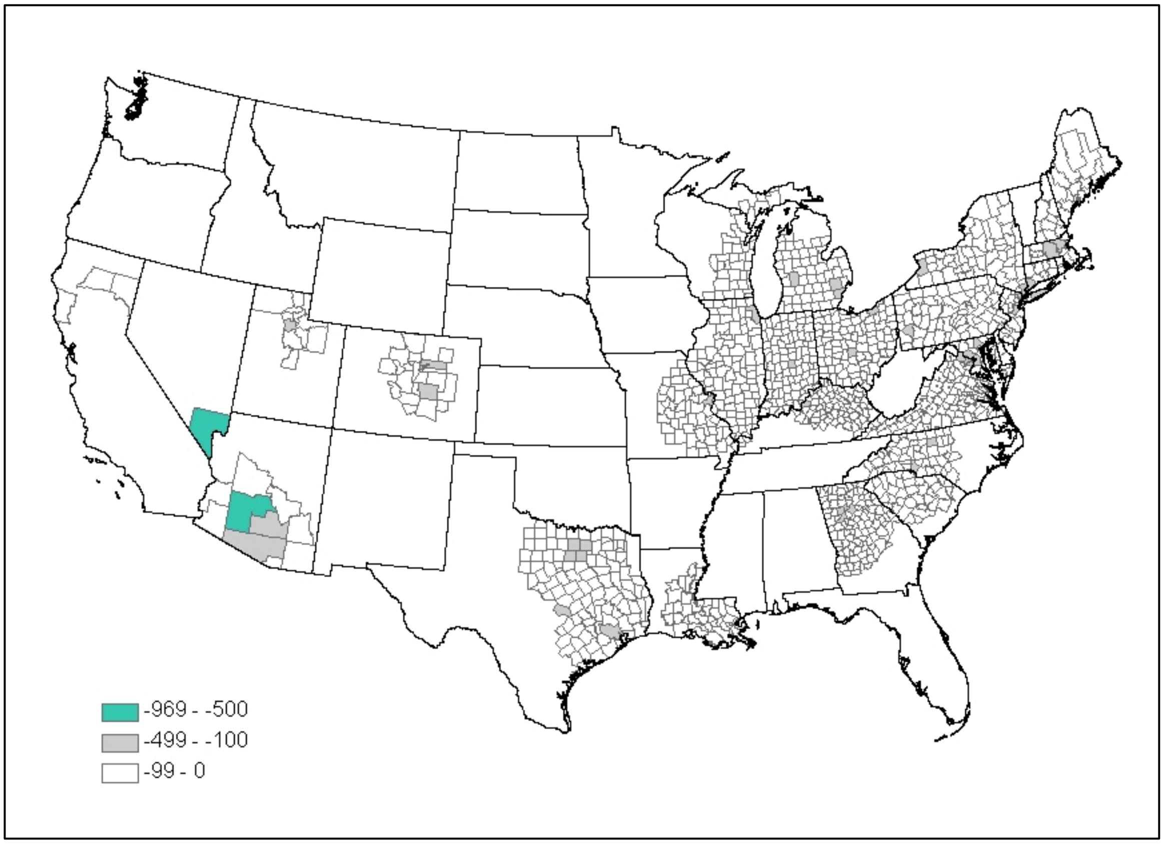
Figure 3a.4: Annual tons/year of Nitrogen Oxide (NOx) Emissions Reduced from Area Sources*



*Reductions are negative and increases are positive

**The −99–0 range is not shown because these are small county-level NOx reductions or increases that likely had little to no impact on ozone estimates. Most counties in this range had NOx differences of under 1 ton.

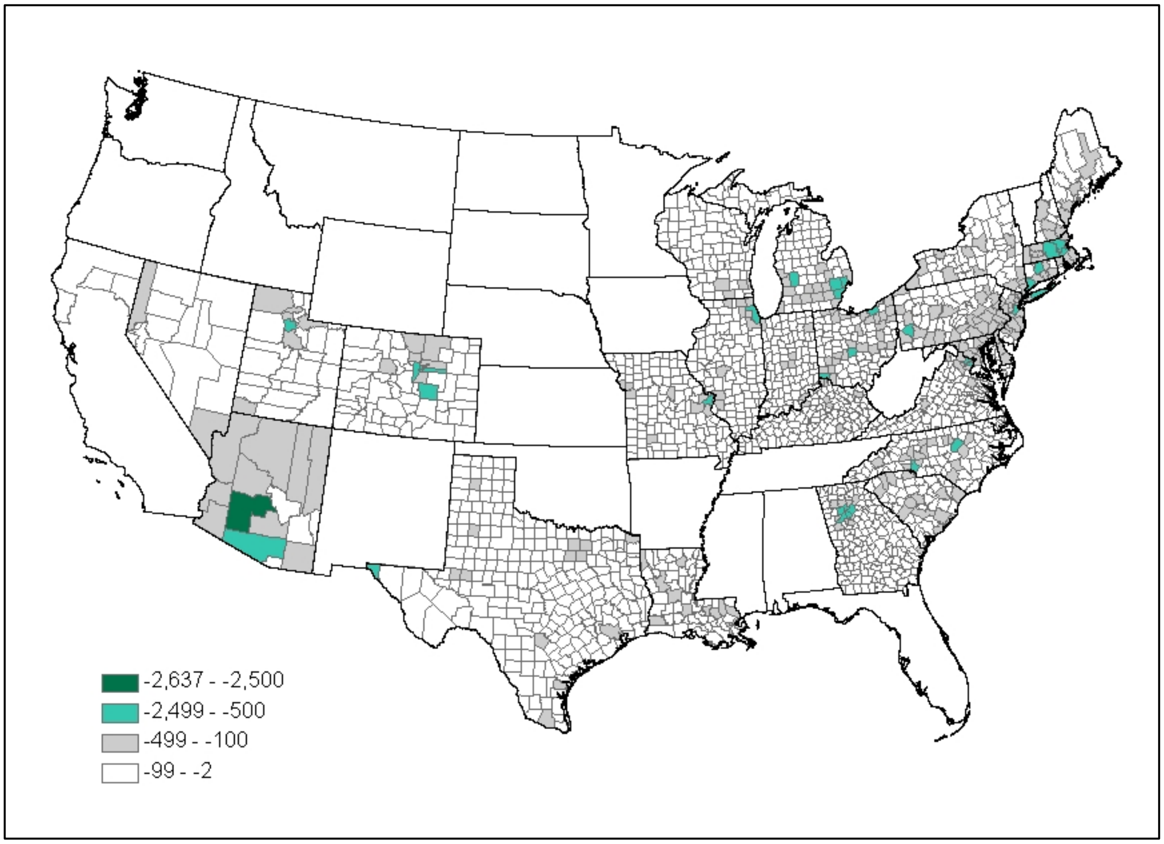
Figure 3a.5: Annual tons/year of Nitrogen Oxide (NOx) Emissions Reduced from Nonroad Sources*



*Reductions are negative and increases are positive

**The −99–0 range is not shown because these are small county-level NOx reductions or increases that likely had little to no impact on ozone estimates. Most counties in this range had NOx differences of under 1 ton.

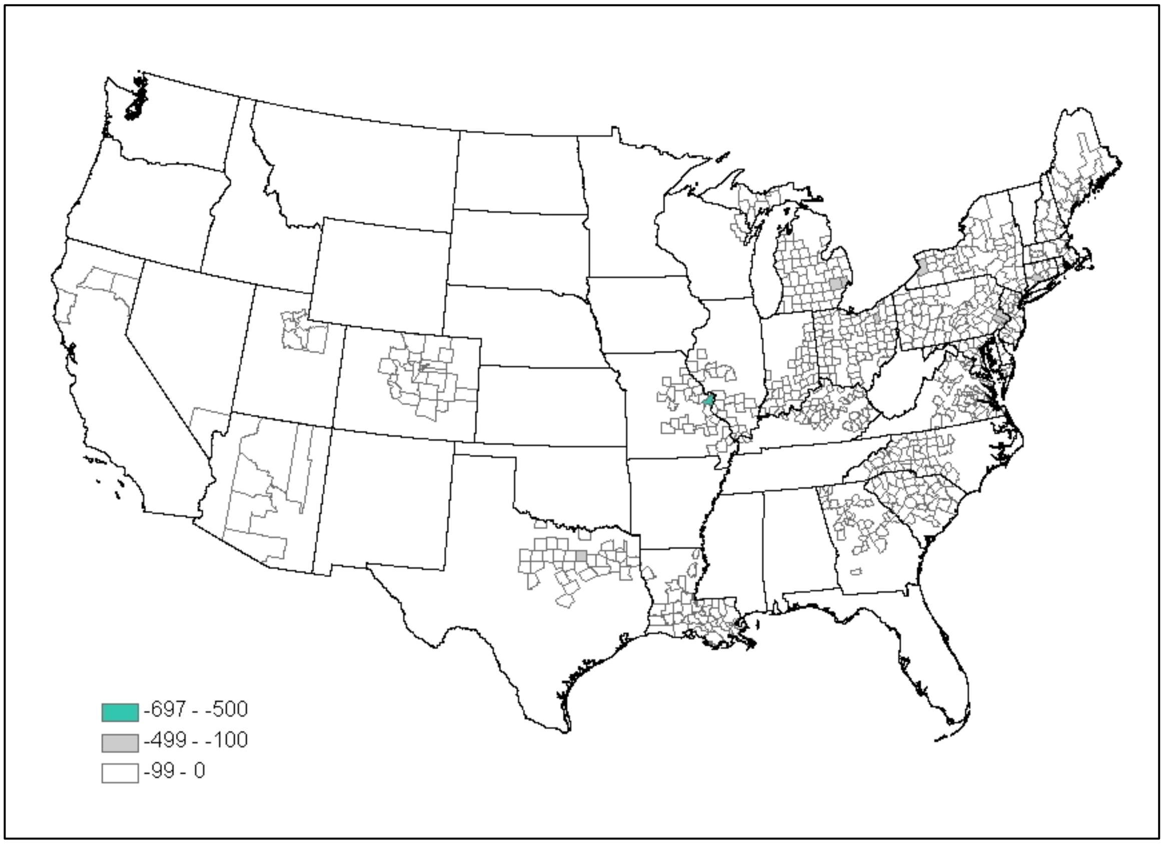
Figure 3a.6: Annual tons/year of Nitrogen Oxide (NOx) Emissions Reduced from Onroad Sources*



*Reductions are negative and increases are positive

**The −99–0 range is not shown because these are small county-level NOx reductions or increases that likely had little to no impact on ozone estimates. Most counties in this range had NOx differences of under 1 ton.

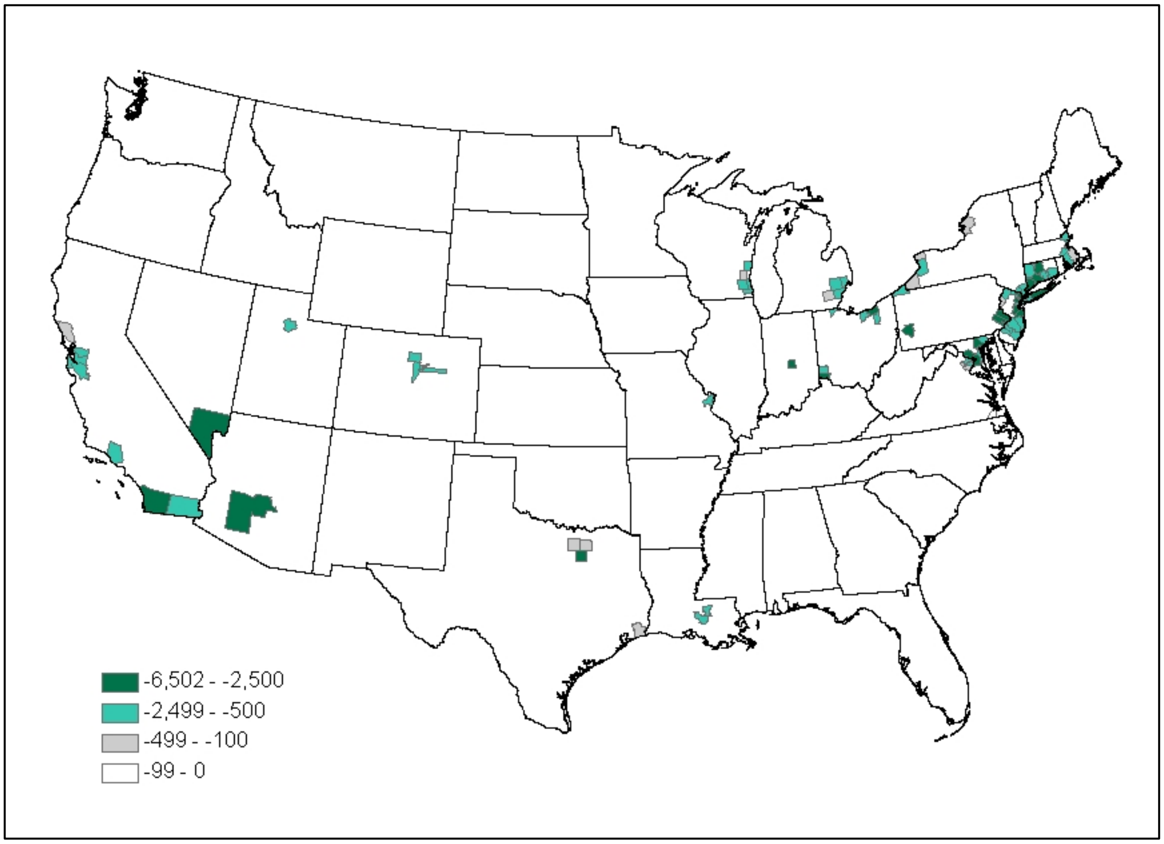
Figure 3a.7: Annual tons/year of Volatile Organic Compounds (VOC) Emissions Reduced from NonEGU Point Sources*



*Reductions are negative and increases are positive

**The −99–0 range is not shown because these are small county-level VOC reductions or increases that likely had little to no impact on ozone estimates

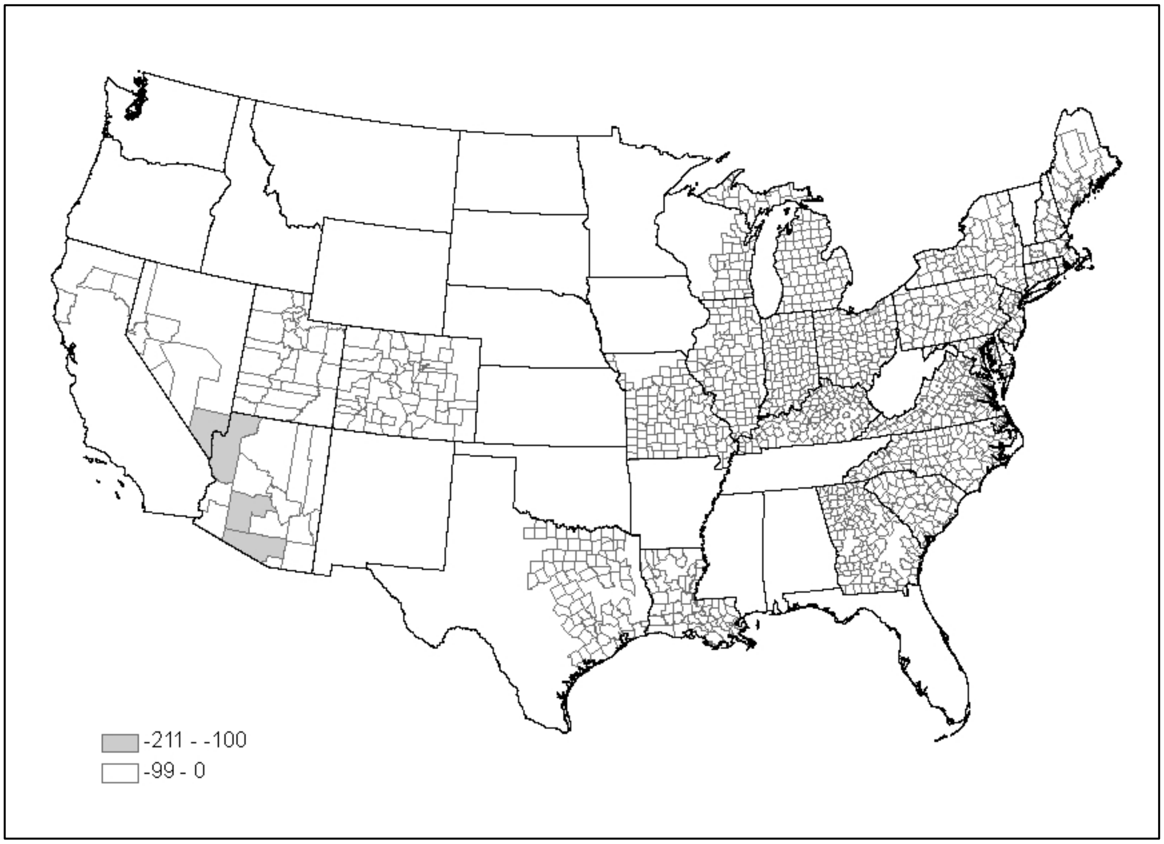
Figure 3a.8: Annual tons/year of Volatile Organic Compounds (VOC) Emissions Reduced from Area Sources*



*Reductions are negative and increases are positive

**The −99–0 range is not shown because these are small county-level VOC reductions or increases that likely had little to no impact on ozone estimates.

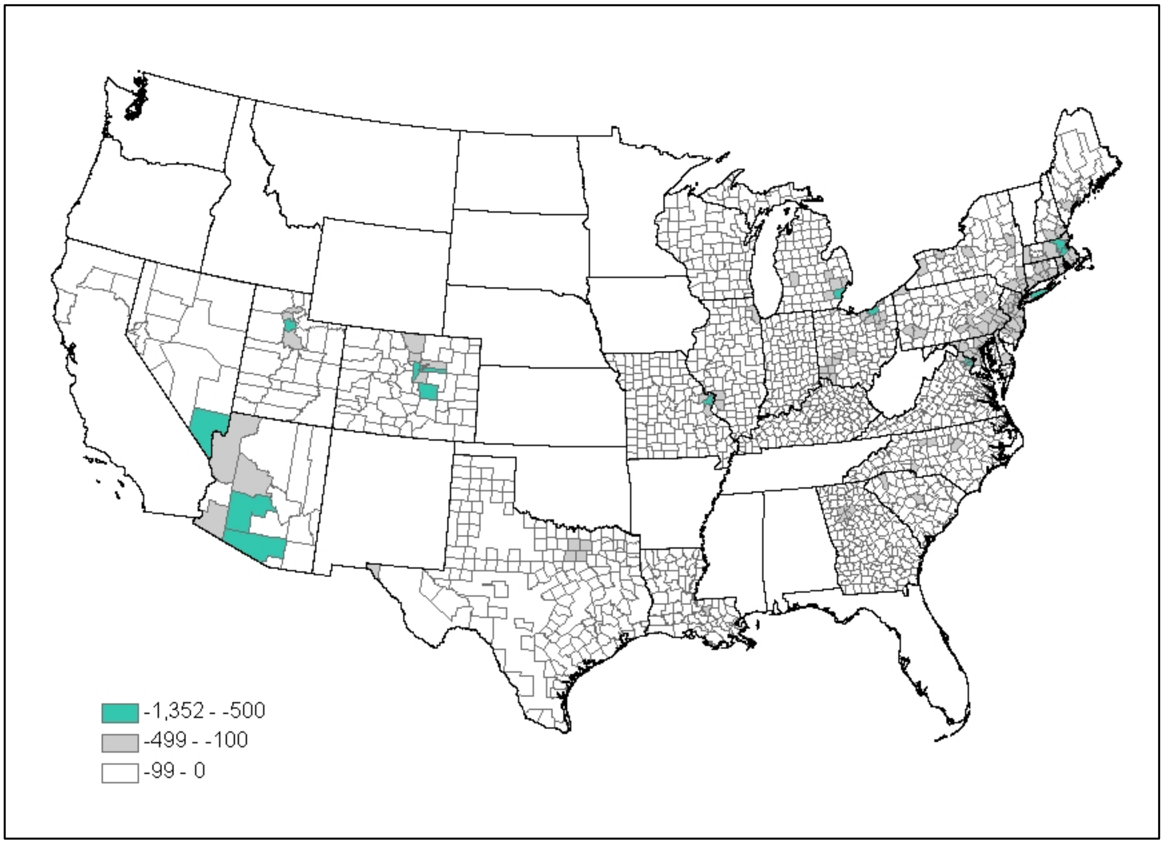
Figure 3a.9: Annual tons/year of Volatile Organic Compounds (VOC) Emissions Reduced from Nonroad Mobile Sources*



*Reductions are negative and increases are positive

**The −99–0 range is not shown because these are small county-level VOC reductions or increases that likely had little to no impact on ozone estimates.

Figure 3a.10: Annual tons/year of Volatile Organic Compounds (VOC) Emissions Reduced from Onroad Mobile Sources*



*Reductions are negative and increases are positive

**The −99–0 range is not shown because these are small county-level VOC reductions or increases that likely had little to no impact on ozone estimates.

3a.5 Change in Ozone Concentrations Between Baseline and Modeled Control Strategy

Table 3a.18 provides the projected 8-hour ozone design values for the 2020 baseline and 2020 control strategy scenarios for each monitored county. The changes in ozone in 2020 between the baseline and the control strategy are also provided in this table.

Table 3a.18: Changes in Ozone Concentrations between Baseline and Modeled Control Strategy

State	County	Baseline 8-hour Ozone Design Value (ppm)	Control Strategy 8-hour Ozone Design Value (ppm)	Change (ppm)
Alabama	Baldwin	0.063	0.063	0.000
Alabama	Clay	0.056	0.055	-0.001
Alabama	Elmore	0.054	0.055	0.001
Alabama	Etowah	0.054	0.052	-0.002
Alabama	Jefferson	0.059	0.060	0.001
Alabama	Lawrence	0.054	0.055	0.001

State	County	Baseline 8-hour Ozone Design Value (ppm)	Control Strategy 8-hour Ozone Design Value (ppm)	Change (ppm)
Alabama	Madison	0.057	0.057	0.000
Alabama	Mobile	0.063	0.064	0.001
Alabama	Montgomery	0.054	0.054	0.000
Alabama	Morgan	0.060	0.061	0.001
Alabama	Shelby	0.061	0.063	0.002
Alabama	Sumter	0.051	0.051	0.000
Alabama	Tuscaloosa	0.052	0.052	0.000
Arizona	Cochise	0.065	0.064	-0.001
Arizona	Coconino	0.067	0.067	0.000
Arizona	Maricopa	0.069	0.068	-0.001
Arizona	Navajo	0.058	0.057	-0.001
Arizona	Pima	0.063	0.062	-0.001
Arizona	Pinal	0.064	0.063	-0.001
Arizona	Yavapai	0.064	0.064	0.000
Arkansas	Crittenden	0.068	0.068	0.000
Arkansas	Montgomery	0.051	0.051	0.000
Arkansas	Newton	0.060	0.060	0.000
Arkansas	Pulaski	0.061	0.061	0.000
California	Alameda	0.068	0.068	0.000
California	Amador	0.067	0.067	0.000
California	Butte	0.068	0.068	0.000
California	Calaveras	0.071	0.071	0.000
California	Colusa	0.058	0.058	0.000
California	Contra Costa	0.069	0.069	0.000
California	El Dorado	0.080	0.080	0.000
California	Fresno	0.091	0.091	0.000
California	Glenn	0.057	0.057	0.000
California	Imperial	0.071	0.071	0.000
California	Inyo	0.068	0.068	0.000
California	Kern	0.096	0.096	0.000
California	Kings	0.076	0.076	0.000
California	Lake	0.054	0.054	0.000
California	Los Angeles	0.104	0.104	0.000
California	Madera	0.075	0.075	0.000
California	Marin	0.041	0.040	-0.001
California	Mariposa	0.071	0.071	0.000
California	Mendocino	0.045	0.045	0.000
California	Merced	0.079	0.079	0.000
California	Monterey	0.054	0.054	0.000
California	Napa	0.050	0.050	0.000
California	Nevada	0.075	0.075	0.000
California	Orange	0.080	0.080	0.000
California	Placer	0.075	0.075	0.000
California	Riverside	0.101	0.101	0.000
California	Sacramento	0.077	0.077	0.000
California	San Benito	0.066	0.066	0.000
California	San Bernardino	0.122	0.122	0.000
California	San Diego	0.077	0.076	-0.001
California	San Francisco	0.045	0.045	0.000
California	San Joaquin	0.067	0.066	-0.001

State	County	Baseline 8-hour Ozone Design Value (ppm)	Control Strategy 8-hour Ozone Design Value (ppm)	Change (ppm)
California	San Luis Obispo	0.060	0.060	0.000
California	San Mateo	0.051	0.050	-0.001
California	Santa Barbara	0.068	0.068	0.000
California	Santa Clara	0.066	0.066	0.000
California	Santa Cruz	0.054	0.054	0.000
California	Shasta	0.057	0.057	0.000
California	Solano	0.057	0.057	0.000
California	Sonoma	0.048	0.048	0.000
California	Stanislaus	0.076	0.076	0.000
California	Sutter	0.067	0.067	0.000
California	Tehama	0.065	0.065	0.000
California	Tulare	0.083	0.083	0.000
California	Tuolumne	0.072	0.072	0.000
California	Ventura	0.077	0.077	0.000
California	Yolo	0.064	0.064	0.000
Colorado	Adams	0.056	0.053	-0.003
Colorado	Arapahoe	0.069	0.064	-0.005
Colorado	Boulder	0.062	0.058	-0.004
Colorado	Denver	0.064	0.060	-0.004
Colorado	Douglas	0.072	0.067	-0.005
Colorado	El Paso	0.062	0.059	-0.003
Colorado	Jefferson	0.072	0.067	-0.005
Colorado	La Plata	0.051	0.051	0.000
Colorado	Larimer	0.066	0.061	-0.005
Colorado	Montezuma	0.062	0.062	0.000
Colorado	Weld	0.063	0.059	-0.004
Connecticut	Fairfield	0.079	0.076	-0.003
Connecticut	Hartford	0.065	0.062	-0.003
Connecticut	Litchfield	0.064	0.061	-0.003
Connecticut	Middlesex	0.073	0.070	-0.003
Connecticut	New Haven	0.076	0.073	-0.003
Connecticut	New London	0.067	0.065	-0.002
Connecticut	Tolland	0.068	0.065	-0.003
Delaware	Kent	0.069	0.067	-0.002
Delaware	New Castle	0.070	0.067	-0.003
Delaware	Sussex	0.070	0.067	-0.003
D.C.	Washington	0.068	0.065	-0.003
Florida	Alachua	0.056	0.056	0.000
Florida	Baker	0.054	0.054	0.000
Florida	Bay	0.061	0.063	0.002
Florida	Brevard	0.050	0.051	0.001
Florida	Broward	0.054	0.054	0.000
Florida	Collier	0.056	0.056	0.000
Florida	Columbia	0.052	0.052	0.000
Florida	Duval	0.052	0.052	0.000
Florida	Escambia	0.064	0.064	0.000
Florida	Highlands	0.053	0.053	0.000
Florida	Hillsborough	0.065	0.065	0.000
Florida	Holmes	0.054	0.054	0.000
Florida	Lake	0.054	0.056	0.002

State	County	Baseline 8-hour Ozone Design Value (ppm)	Control Strategy 8-hour Ozone Design Value (ppm)	Change (ppm)
Florida	Lee	0.055	0.056	0.001
Florida	Leon	0.054	0.054	0.000
Florida	Manatee	0.060	0.060	0.000
Florida	Marion	0.058	0.058	0.000
Florida	Miami-Dade	0.052	0.052	0.000
Florida	Orange	0.055	0.057	0.002
Florida	Osceola	0.053	0.054	0.001
Florida	Palm Beach	0.054	0.054	0.000
Florida	Pasco	0.057	0.057	0.000
Florida	Pinellas	0.060	0.060	0.000
Florida	Polk	0.057	0.058	0.001
Florida	St Lucie	0.051	0.051	0.000
Florida	Santa Rosa	0.063	0.063	0.000
Florida	Sarasota	0.060	0.060	0.000
Florida	Seminole	0.056	0.058	0.002
Florida	Volusia	0.051	0.051	0.000
Florida	Wakulla	0.059	0.059	0.000
Georgia	Bibb	0.064	0.063	-0.001
Georgia	Chatham	0.052	0.052	0.000
Georgia	Cherokee	0.053	0.051	-0.002
Georgia	Clarke	0.053	0.051	-0.002
Georgia	Cobb	0.063	0.061	-0.002
Georgia	Coweta	0.065	0.059	-0.006
Georgia	Dawson	0.056	0.054	-0.002
Georgia	De Kalb	0.066	0.064	-0.002
Georgia	Douglas	0.063	0.061	-0.002
Georgia	Fayette	0.061	0.059	-0.002
Georgia	Fulton	0.070	0.068	-0.002
Georgia	Glynn	0.054	0.053	-0.001
Georgia	Gwinnett	0.061	0.059	-0.002
Georgia	Henry	0.064	0.062	-0.002
Georgia	Murray	0.059	0.058	-0.001
Georgia	Muscogee	0.053	0.052	-0.001
Georgia	Paulding	0.060	0.058	-0.002
Georgia	Richmond	0.064	0.059	-0.005
Georgia	Rockdale	0.063	0.061	-0.002
Georgia	Sumter	0.054	0.053	-0.001
Idaho	Ada	0.069	0.069	0.000
Idaho	Butte	0.065	0.065	0.000
Idaho	Canyon	0.059	0.059	0.000
Idaho	Elmore	0.060	0.060	0.000
Illinois	Adams	0.059	0.055	-0.004
Illinois	Champaign	0.057	0.056	-0.001
Illinois	Clark	0.053	0.052	-0.001
Illinois	Cook	0.073	0.072	-0.001
Illinois	Du Page	0.060	0.059	-0.001
Illinois	Effingham	0.057	0.056	-0.001
Illinois	Hamilton	0.058	0.057	-0.001
Illinois	Jersey	0.067	0.065	-0.002
Illinois	Kane	0.062	0.060	-0.002

State	County	Baseline 8-hour Ozone Design Value (ppm)	Control Strategy 8-hour Ozone Design Value (ppm)	Change (ppm)
Illinois	Lake	0.070	0.069	-0.001
Illinois	McHenry	0.066	0.065	-0.001
Illinois	McLean	0.057	0.055	-0.002
Illinois	Macon	0.055	0.054	-0.001
Illinois	Macoupin	0.057	0.055	-0.002
Illinois	Madison	0.066	0.063	-0.003
Illinois	Peoria	0.062	0.061	-0.001
Illinois	Randolph	0.059	0.058	-0.001
Illinois	Rock Island	0.054	0.053	-0.001
Illinois	St Clair	0.065	0.063	-0.002
Illinois	Sangamon	0.053	0.052	-0.001
Illinois	Will	0.061	0.060	-0.001
Illinois	Winnebago	0.058	0.056	-0.002
Indiana	Allen	0.066	0.065	-0.001
Indiana	Boone	0.067	0.065	-0.002
Indiana	Carroll	0.062	0.061	-0.001
Indiana	Clark	0.068	0.066	-0.002
Indiana	Delaware	0.064	0.062	-0.002
Indiana	Elkhart	0.065	0.064	-0.001
Indiana	Floyd	0.066	0.064	-0.002
Indiana	Gibson	0.051	0.050	-0.001
Indiana	Greene	0.062	0.061	-0.001
Indiana	Hamilton	0.069	0.068	-0.001
Indiana	Hancock	0.067	0.065	-0.002
Indiana	Hendricks	0.064	0.063	-0.001
Indiana	Huntington	0.063	0.062	-0.001
Indiana	Jackson	0.062	0.060	-0.002
Indiana	Johnson	0.064	0.062	-0.002
Indiana	Lake	0.077	0.077	0.000
Indiana	La Porte	0.074	0.072	-0.002
Indiana	Madison	0.067	0.065	-0.002
Indiana	Marion	0.068	0.066	-0.002
Indiana	Morgan	0.065	0.063	-0.002
Indiana	Porter	0.075	0.074	-0.001
Indiana	Posey	0.061	0.059	-0.002
Indiana	St Joseph	0.068	0.066	-0.002
Indiana	Shelby	0.068	0.067	-0.001
Indiana	Vanderburgh	0.060	0.058	-0.002
Indiana	Vigo	0.066	0.064	-0.002
Indiana	Warrick	0.064	0.061	-0.003
Iowa	Bremer	0.058	0.058	0.000
Iowa	Clinton	0.062	0.061	-0.001
Iowa	Harrison	0.062	0.062	0.000
Iowa	Linn	0.057	0.057	0.000
Iowa	Montgomery	0.056	0.056	0.000
Iowa	Palo Alto	0.054	0.053	-0.001
Iowa	Polk	0.046	0.046	0.000
Iowa	Scott	0.061	0.060	-0.001
Iowa	Story	0.048	0.048	0.000
Iowa	Van Buren	0.059	0.057	-0.002

State	County	Baseline 8-hour Ozone Design Value (ppm)	Control Strategy 8-hour Ozone Design Value (ppm)	Change (ppm)
Iowa	Warren	0.049	0.048	-0.001
Kansas	Linn	0.060	0.059	-0.001
Kansas	Sedgwick	0.063	0.063	0.000
Kansas	Sumner	0.062	0.062	0.000
Kansas	Trego	0.055	0.055	0.000
Kansas	Wyandotte	0.062	0.062	0.000
Kentucky	Bell	0.056	0.055	-0.001
Kentucky	Boone	0.063	0.060	-0.003
Kentucky	Boyd	0.070	0.069	-0.001
Kentucky	Bullitt	0.061	0.059	-0.002
Kentucky	Campbell	0.070	0.067	-0.003
Kentucky	Carter	0.057	0.056	-0.001
Kentucky	Christian	0.057	0.057	0.000
Kentucky	Daviess	0.058	0.058	0.000
Kentucky	Edmonson	0.059	0.057	-0.002
Kentucky	Fayette	0.057	0.055	-0.002
Kentucky	Graves	0.059	0.058	-0.001
Kentucky	Greenup	0.064	0.063	-0.001
Kentucky	Hancock	0.063	0.064	0.001
Kentucky	Hardin	0.057	0.056	-0.001
Kentucky	Henderson	0.060	0.057	-0.003
Kentucky	Jefferson	0.064	0.063	-0.001
Kentucky	Jessamine	0.057	0.056	-0.001
Kentucky	Kenton	0.065	0.062	-0.003
Kentucky	Livingston	0.061	0.060	-0.001
Kentucky	McCracken	0.063	0.062	-0.001
Kentucky	McLean	0.059	0.058	-0.001
Kentucky	Oldham	0.063	0.061	-0.002
Kentucky	Perry	0.055	0.054	-0.001
Kentucky	Pike	0.054	0.053	-0.001
Kentucky	Pulaski	0.058	0.060	0.002
Kentucky	Scott	0.050	0.049	-0.001
Kentucky	Simpson	0.056	0.056	0.000
Kentucky	Trigg	0.052	0.052	0.000
Kentucky	Warren	0.060	0.058	-0.002
Louisiana	Ascension	0.068	0.065	-0.003
Louisiana	Beauregard	0.061	0.058	-0.003
Louisiana	Bossier	0.060	0.060	0.000
Louisiana	Caddo	0.058	0.057	-0.001
Louisiana	Calcasieu	0.066	0.063	-0.003
Louisiana	East Baton Rouge	0.076	0.073	-0.003
Louisiana	Grant	0.060	0.058	-0.002
Louisiana	Iberville	0.072	0.068	-0.004
Louisiana	Jefferson	0.069	0.066	-0.003
Louisiana	Lafayette	0.065	0.061	-0.004
Louisiana	Lafourche	0.065	0.062	-0.003
Louisiana	Livingston	0.068	0.064	-0.004
Louisiana	Orleans	0.057	0.056	-0.001
Louisiana	Ouachita	0.061	0.060	-0.001
Louisiana	Pointe Coupee	0.063	0.057	-0.006

State	County	Baseline 8-hour Ozone Design Value (ppm)	Control Strategy 8-hour Ozone Design Value (ppm)	Change (ppm)
Louisiana	St Bernard	0.063	0.061	-0.002
Louisiana	St Charles	0.066	0.063	-0.003
Louisiana	St James	0.064	0.061	-0.003
Louisiana	St John The Baptis	0.068	0.066	-0.002
Louisiana	St Mary	0.061	0.057	-0.004
Louisiana	West Baton Rouge	0.073	0.070	-0.003
Maine	Cumberland	0.063	0.061	-0.002
Maine	Hancock	0.071	0.068	-0.003
Maine	Kennebec	0.060	0.058	-0.002
Maine	Knox	0.063	0.061	-0.002
Maine	Oxford	0.050	0.048	-0.002
Maine	Penobscot	0.064	0.062	-0.002
Maine	Sagadahoc	0.059	0.057	-0.002
Maine	York	0.066	0.064	-0.002
Maryland	Anne Arundel	0.072	0.069	-0.003
Maryland	Baltimore	0.070	0.067	-0.003
Maryland	Carroll	0.065	0.061	-0.004
Maryland	Cecil	0.071	0.068	-0.003
Maryland	Charles	0.065	0.062	-0.003
Maryland	Frederick	0.065	0.061	-0.004
Maryland	Harford	0.076	0.073	-0.003
Maryland	Kent	0.069	0.067	-0.002
Maryland	Montgomery	0.064	0.061	-0.003
Maryland	Prince Georges	0.069	0.066	-0.003
Maryland	Washington	0.063	0.061	-0.002
Massachusetts	Barnstable	0.070	0.068	-0.002
Massachusetts	Berkshire	0.068	0.066	-0.002
Massachusetts	Bristol	0.069	0.066	-0.003
Massachusetts	Essex	0.070	0.068	-0.002
Massachusetts	Hampden	0.068	0.065	-0.003
Massachusetts	Hampshire	0.066	0.063	-0.003
Massachusetts	Middlesex	0.064	0.062	-0.002
Massachusetts	Norfolk	0.073	0.071	-0.002
Massachusetts	Suffolk	0.068	0.067	-0.001
Massachusetts	Worcester	0.065	0.062	-0.003
Michigan	Allegan	0.073	0.072	-0.001
Michigan	Benzie	0.066	0.065	-0.001
Michigan	Berrien	0.070	0.069	-0.001
Michigan	Cass	0.068	0.066	-0.002
Michigan	Clinton	0.064	0.062	-0.002
Michigan	Genesee	0.066	0.064	-0.002
Michigan	Huron	0.068	0.067	-0.001
Michigan	Ingham	0.063	0.062	-0.001
Michigan	Kalamazoo	0.062	0.061	-0.001
Michigan	Kent	0.065	0.063	-0.002
Michigan	Lenawee	0.067	0.065	-0.002
Michigan	Macomb	0.075	0.073	-0.002
Michigan	Mason	0.065	0.064	-0.001
Michigan	Missaukee	0.061	0.060	-0.001
Michigan	Muskegon	0.069	0.068	-0.001

State	County	Baseline 8-hour Ozone Design Value (ppm)	Control Strategy 8-hour Ozone Design Value (ppm)	Change (ppm)
Michigan	Oakland	0.072	0.071	-0.001
Michigan	Ottawa	0.066	0.064	-0.002
Michigan	St Clair	0.070	0.067	-0.003
Michigan	Schoolcraft	0.062	0.061	-0.001
Michigan	Washtenaw	0.069	0.067	-0.002
Michigan	Wayne	0.071	0.069	-0.002
Minnesota	St Louis	0.059	0.059	0.000
Mississippi	Adams	0.060	0.059	-0.001
Mississippi	Bolivar	0.057	0.057	0.000
Mississippi	De Soto	0.062	0.062	0.000
Mississippi	Hancock	0.063	0.062	-0.001
Mississippi	Harrison	0.062	0.065	0.003
Mississippi	Hinds	0.050	0.050	0.000
Mississippi	Jackson	0.067	0.067	0.000
Mississippi	Lauderdale	0.051	0.050	-0.001
Mississippi	Lee	0.056	0.058	0.002
Mississippi	Madison	0.053	0.053	0.000
Mississippi	Warren	0.052	0.052	0.000
Missouri	Cass	0.060	0.060	0.000
Missouri	Cedar	0.063	0.062	-0.001
Missouri	Clay	0.064	0.064	0.000
Missouri	Greene	0.058	0.057	-0.001
Missouri	Jefferson	0.066	0.064	-0.002
Missouri	Monroe	0.060	0.058	-0.002
Missouri	Platte	0.063	0.062	-0.001
Missouri	St Charles	0.071	0.068	-0.003
Missouri	Ste Genevieve	0.065	0.062	-0.003
Missouri	St Louis	0.070	0.067	-0.003
Missouri	St Louis City	0.070	0.068	-0.002
Montana	Flathead	0.052	0.052	0.000
Nebraska	Douglas	0.056	0.056	0.000
Nebraska	Lancaster	0.045	0.045	0.000
Nevada	Clark	0.072	0.071	-0.001
Nevada	Douglas	0.059	0.059	0.000
Nevada	Washoe	0.063	0.063	0.000
Nevada	White Pine	0.065	0.065	0.000
Nevada	Carson City	0.062	0.062	0.000
New Hampshire	Belknap	0.059	0.058	-0.001
New Hampshire	Carroll	0.055	0.054	-0.001
New Hampshire	Cheshire	0.056	0.054	-0.002
New Hampshire	Grafton	0.057	0.056	-0.001
New Hampshire	Hillsborough	0.065	0.063	-0.002
New Hampshire	Merrimack	0.057	0.056	-0.001
New Hampshire	Rockingham	0.063	0.061	-0.002
New Hampshire	Strafford	0.059	0.057	-0.002
New Hampshire	Sullivan	0.061	0.059	-0.002
New Jersey	Atlantic	0.067	0.065	-0.002
New Jersey	Bergen	0.074	0.071	-0.003
New Jersey	Camden	0.077	0.074	-0.003
New Jersey	Cumberland	0.071	0.068	-0.003

State	County	Baseline 8-hour Ozone Design Value (ppm)	Control Strategy 8-hour Ozone Design Value (ppm)	Change (ppm)
New Jersey	Essex	0.052	0.051	-0.001
New Jersey	Gloucester	0.075	0.073	-0.002
New Jersey	Hudson	0.066	0.064	-0.002
New Jersey	Hunterdon	0.071	0.068	-0.003
New Jersey	Mercer	0.075	0.073	-0.002
New Jersey	Middlesex	0.073	0.070	-0.003
New Jersey	Monmouth	0.073	0.070	-0.003
New Jersey	Morris	0.071	0.068	-0.003
New Jersey	Ocean	0.079	0.076	-0.003
New Jersey	Passaic	0.067	0.064	-0.003
New Mexico	Bernalillo	0.065	0.064	-0.001
New Mexico	Dona Ana	0.069	0.068	-0.001
New Mexico	Eddy	0.063	0.063	0.000
New Mexico	Sandoval	0.063	0.063	0.000
New Mexico	San Juan	0.069	0.069	0.000
New Mexico	Valencia	0.056	0.056	0.000
New York	Albany	0.064	0.061	-0.003
New York	Bronx	0.069	0.067	-0.002
New York	Chautauqua	0.072	0.069	-0.003
New York	Chemung	0.061	0.059	-0.002
New York	Dutchess	0.068	0.065	-0.003
New York	Erie	0.075	0.072	-0.003
New York	Essex	0.069	0.067	-0.002
New York	Hamilton	0.063	0.062	-0.001
New York	Herkimer	0.059	0.057	-0.002
New York	Jefferson	0.073	0.071	-0.002
New York	Madison	0.062	0.060	-0.002
New York	Monroe	0.067	0.064	-0.003
New York	Niagara	0.075	0.073	-0.002
New York	Oneida	0.063	0.061	-0.002
New York	Onondaga	0.067	0.065	-0.002
New York	Orange	0.063	0.061	-0.002
New York	Oswego	0.053	0.052	-0.001
New York	Putnam	0.070	0.068	-0.002
New York	Queens	0.069	0.067	-0.002
New York	Rensselaer	0.066	0.063	-0.003
New York	Richmond	0.073	0.071	-0.002
New York	Saratoga	0.067	0.063	-0.004
New York	Schenectady	0.061	0.059	-0.002
New York	Suffolk	0.080	0.077	-0.003
New York	Ulster	0.063	0.061	-0.002
New York	Wayne	0.065	0.063	-0.002
New York	Westchester	0.074	0.071	-0.003
North Carolina	Alexander	0.062	0.061	-0.001
North Carolina	Avery	0.059	0.057	-0.002
North Carolina	Buncombe	0.060	0.059	-0.001
North Carolina	Caldwell	0.060	0.060	0.000
North Carolina	Caswell	0.060	0.059	-0.001
North Carolina	Chatham	0.058	0.057	-0.001
North Carolina	Cumberland	0.061	0.060	-0.001

State	County	Baseline 8-hour Ozone Design Value (ppm)	Control Strategy 8-hour Ozone Design Value (ppm)	Change (ppm)
North Carolina	Davie	0.064	0.062	-0.002
North Carolina	Duplin	0.059	0.058	-0.001
North Carolina	Durham	0.061	0.060	-0.001
North Carolina	Edgecombe	0.063	0.062	-0.001
North Carolina	Forsyth	0.063	0.062	-0.001
North Carolina	Franklin	0.063	0.062	-0.001
North Carolina	Granville	0.064	0.063	-0.001
North Carolina	Guilford	0.060	0.058	-0.002
North Carolina	Haywood	0.064	0.064	0.000
North Carolina	Jackson	0.063	0.062	-0.001
North Carolina	Johnston	0.060	0.059	-0.001
North Carolina	Lenoir	0.060	0.059	-0.001
North Carolina	Lincoln	0.064	0.065	0.001
North Carolina	Martin	0.060	0.059	-0.001
North Carolina	Mecklenburg	0.071	0.070	-0.001
North Carolina	New Hanover	0.056	0.057	0.001
North Carolina	Northampton	0.062	0.060	-0.002
North Carolina	Person	0.063	0.061	-0.002
North Carolina	Pitt	0.059	0.058	-0.001
North Carolina	Randolph	0.057	0.056	-0.001
North Carolina	Rockingham	0.062	0.061	-0.001
North Carolina	Rowan	0.068	0.067	-0.001
North Carolina	Swain	0.053	0.052	-0.001
North Carolina	Union	0.062	0.061	-0.001
North Carolina	Wake	0.064	0.063	-0.001
North Carolina	Yancey	0.063	0.061	-0.002
North Dakota	Billings	0.054	0.054	0.000
North Dakota	Cass	0.055	0.055	0.000
North Dakota	Dunn	0.054	0.054	0.000
North Dakota	McKenzie	0.058	0.058	0.000
North Dakota	Mercer	0.055	0.055	0.000
North Dakota	Oliver	0.051	0.050	-0.001
Ohio	Allen	0.068	0.065	-0.003
Ohio	Ashtabula	0.075	0.073	-0.002
Ohio	Butler	0.068	0.064	-0.004
Ohio	Clark	0.066	0.062	-0.004
Ohio	Clermont	0.068	0.066	-0.002
Ohio	Clinton	0.069	0.066	-0.003
Ohio	Cuyahoga	0.067	0.065	-0.002
Ohio	Delaware	0.066	0.064	-0.002
Ohio	Franklin	0.068	0.066	-0.002
Ohio	Geauga	0.076	0.074	-0.002
Ohio	Greene	0.066	0.062	-0.004
Ohio	Hamilton	0.069	0.066	-0.003
Ohio	Jefferson	0.063	0.061	-0.002
Ohio	Knox	0.064	0.062	-0.002
Ohio	Lake	0.072	0.070	-0.002
Ohio	Lawrence	0.065	0.063	-0.002
Ohio	Licking	0.065	0.062	-0.003
Ohio	Lorain	0.067	0.065	-0.002

State	County	Baseline 8-hour Ozone Design Value (ppm)	Control Strategy 8-hour Ozone Design Value (ppm)	Change (ppm)
Ohio	Lucas	0.070	0.067	-0.003
Ohio	Madison	0.065	0.062	-0.003
Ohio	Mahoning	0.065	0.062	-0.003
Ohio	Medina	0.067	0.065	-0.002
Ohio	Miami	0.065	0.062	-0.003
Ohio	Montgomery	0.065	0.062	-0.003
Ohio	Portage	0.068	0.066	-0.002
Ohio	Preble	0.060	0.057	-0.003
Ohio	Stark	0.065	0.063	-0.002
Ohio	Summit	0.071	0.068	-0.003
Ohio	Trumbull	0.068	0.066	-0.002
Ohio	Warren	0.068	0.065	-0.003
Ohio	Washington	0.061	0.060	-0.001
Ohio	Wood	0.068	0.065	-0.003
Oklahoma	Canadian	0.056	0.056	0.000
Oklahoma	Cleveland	0.060	0.058	-0.002
Oklahoma	Comanche	0.061	0.059	-0.002
Oklahoma	Dewey	0.058	0.056	-0.002
Oklahoma	Kay	0.060	0.060	0.000
Oklahoma	Mc Clain	0.061	0.060	-0.001
Oklahoma	Oklahoma	0.061	0.060	-0.001
Oklahoma	Ottawa	0.062	0.062	0.000
Oklahoma	Pittsburg	0.060	0.060	0.000
Oklahoma	Tulsa	0.066	0.065	-0.001
Oregon	Clackamas	0.062	0.062	0.000
Oregon	Columbia	0.055	0.055	0.000
Oregon	Jackson	0.061	0.061	0.000
Oregon	Lane	0.059	0.059	0.000
Oregon	Marion	0.054	0.054	0.000
Pennsylvania	Adams	0.059	0.056	-0.003
Pennsylvania	Allegheny	0.072	0.069	-0.003
Pennsylvania	Armstrong	0.068	0.065	-0.003
Pennsylvania	Beaver	0.071	0.068	-0.003
Pennsylvania	Berks	0.066	0.063	-0.003
Pennsylvania	Blair	0.060	0.058	-0.002
Pennsylvania	Bucks	0.078	0.075	-0.003
Pennsylvania	Cambria	0.063	0.061	-0.002
Pennsylvania	Centre	0.062	0.059	-0.003
Pennsylvania	Chester	0.071	0.068	-0.003
Pennsylvania	Clearfield	0.065	0.062	-0.003
Pennsylvania	Dauphin	0.065	0.060	-0.005
Pennsylvania	Delaware	0.070	0.068	-0.002
Pennsylvania	Erie	0.070	0.067	-0.003
Pennsylvania	Franklin	0.067	0.064	-0.003
Pennsylvania	Greene	0.063	0.061	-0.002
Pennsylvania	Lackawanna	0.061	0.059	-0.002
Pennsylvania	Lancaster	0.067	0.062	-0.005
Pennsylvania	Lawrence	0.057	0.055	-0.002
Pennsylvania	Lehigh	0.067	0.063	-0.004
Pennsylvania	Luzerne	0.062	0.059	-0.003

State	County	Baseline 8-hour Ozone Design Value (ppm)	Control Strategy 8-hour Ozone Design Value (ppm)	Change (ppm)
Pennsylvania	Lycoming	0.061	0.059	-0.002
Pennsylvania	Mercer	0.068	0.065	-0.003
Pennsylvania	Montgomery	0.071	0.068	-0.003
Pennsylvania	Northampton	0.066	0.062	-0.004
Pennsylvania	Perry	0.061	0.058	-0.003
Pennsylvania	Philadelphia	0.077	0.074	-0.003
Pennsylvania	Tioga	0.064	0.062	-0.002
Pennsylvania	Washington	0.066	0.063	-0.003
Pennsylvania	Westmoreland	0.068	0.065	-0.003
Pennsylvania	York	0.067	0.062	-0.005
Rhode Island	Kent	0.069	0.067	-0.002
Rhode Island	Providence	0.069	0.066	-0.003
Rhode Island	Washington	0.070	0.068	-0.002
South Carolina	Abbeville	0.060	0.058	-0.002
South Carolina	Aiken	0.061	0.058	-0.003
South Carolina	Anderson	0.063	0.062	-0.001
South Carolina	Barnwell	0.058	0.056	-0.002
South Carolina	Berkeley	0.052	0.052	0.000
South Carolina	Charleston	0.054	0.054	0.000
South Carolina	Cherokee	0.061	0.059	-0.002
South Carolina	Chester	0.059	0.058	-0.001
South Carolina	Chesterfield	0.058	0.058	0.000
South Carolina	Colleton	0.058	0.057	-0.001
South Carolina	Darlington	0.061	0.060	-0.001
South Carolina	Edgefield	0.059	0.056	-0.003
South Carolina	Oconee	0.060	0.059	-0.001
South Carolina	Pickens	0.059	0.058	-0.001
South Carolina	Richland	0.066	0.064	-0.002
South Carolina	Spartanburg	0.062	0.061	-0.001
South Carolina	Union	0.058	0.057	-0.001
South Carolina	Williamsburg	0.052	0.051	-0.001
South Carolina	York	0.059	0.058	-0.001
South Dakota	Pennington	0.062	0.061	-0.001
Tennessee	Anderson	0.058	0.058	0.000
Tennessee	Blount	0.064	0.064	0.000
Tennessee	Davidson	0.056	0.056	0.000
Tennessee	Hamilton	0.061	0.062	0.001
Tennessee	Haywood	0.060	0.062	0.002
Tennessee	Jefferson	0.061	0.061	0.000
Tennessee	Knox	0.061	0.061	0.000
Tennessee	Lawrence	0.056	0.058	0.002
Tennessee	Meigs	0.061	0.060	-0.001
Tennessee	Putnam	0.061	0.061	0.000
Tennessee	Rutherford	0.058	0.057	-0.001
Tennessee	Sevier	0.066	0.065	-0.001
Tennessee	Shelby	0.065	0.065	0.000
Tennessee	Sullivan	0.066	0.066	0.000
Tennessee	Sumner	0.061	0.061	0.000
Tennessee	Williamson	0.060	0.060	0.000
Tennessee	Wilson	0.060	0.060	0.000

State	County	Baseline 8-hour Ozone Design Value (ppm)	Control Strategy 8-hour Ozone Design Value (ppm)	Change (ppm)
Texas	Bexar	0.068	0.067	-0.001
Texas	Brazoria	0.073	0.072	-0.001
Texas	Brewster	0.054	0.053	-0.001
Texas	Cameron	0.052	0.051	-0.001
Texas	Collin	0.069	0.067	-0.002
Texas	Dallas	0.068	0.066	-0.002
Texas	Denton	0.074	0.072	-0.002
Texas	Ellis	0.063	0.059	-0.004
Texas	El Paso	0.069	0.068	-0.001
Texas	Galveston	0.074	0.072	-0.002
Texas	Gregg	0.067	0.064	-0.003
Texas	Harris	0.089	0.087	-0.002
Texas	Harrison	0.061	0.058	-0.003
Texas	Hidalgo	0.062	0.061	-0.001
Texas	Hood	0.058	0.056	-0.002
Texas	Jefferson	0.074	0.071	-0.003
Texas	Johnson	0.065	0.062	-0.003
Texas	Kaufman	0.054	0.052	-0.002
Texas	Montgomery	0.073	0.072	-0.001
Texas	Nueces	0.065	0.063	-0.002
Texas	Orange	0.066	0.063	-0.003
Texas	Parker	0.063	0.061	-0.002
Texas	Rockwall	0.061	0.060	-0.001
Texas	Smith	0.064	0.061	-0.003
Texas	Tarrant	0.075	0.073	-0.002
Texas	Travis	0.063	0.062	-0.001
Texas	Victoria	0.060	0.059	-0.001
Texas	Webb	0.053	0.053	0.000
Utah	Box Elder	0.064	0.062	-0.002
Utah	Cache	0.056	0.054	-0.002
Utah	Davis	0.070	0.067	-0.003
Utah	Salt Lake	0.069	0.067	-0.002
Utah	San Juan	0.064	0.063	-0.001
Utah	Utah	0.067	0.065	-0.002
Utah	Weber	0.065	0.062	-0.003
Vermont	Bennington	0.061	0.058	-0.003
Vermont	Chittenden	0.063	0.062	-0.001
Virginia	Arlington	0.072	0.068	-0.004
Virginia	Caroline	0.059	0.057	-0.002
Virginia	Charles City	0.069	0.066	-0.003
Virginia	Chesterfield	0.066	0.064	-0.002
Virginia	Fairfax	0.071	0.067	-0.004
Virginia	Fauquier	0.058	0.056	-0.002
Virginia	Frederick	0.061	0.060	-0.001
Virginia	Hanover	0.069	0.067	-0.002
Virginia	Henrico	0.067	0.065	-0.002
Virginia	Loudoun	0.066	0.063	-0.003
Virginia	Madison	0.062	0.061	-0.001
Virginia	Page	0.058	0.056	-0.002
Virginia	Prince William	0.063	0.060	-0.003

State	County	Baseline 8-hour Ozone Design Value (ppm)	Control Strategy 8-hour Ozone Design Value (ppm)	Change (ppm)
Virginia	Roanoke	0.061	0.060	-0.001
Virginia	Rockbridge	0.057	0.055	-0.002
Virginia	Stafford	0.062	0.060	-0.002
Virginia	Wythe	0.060	0.059	-0.001
Virginia	Alexandria City	0.066	0.063	-0.003
Virginia	Hampton City	0.071	0.070	-0.001
Virginia	Suffolk City	0.070	0.069	-0.001
Washington	Clallam	0.041	0.041	0.000
Washington	Clark	0.061	0.061	0.000
Washington	King	0.063	0.063	0.000
Washington	Klickitat	0.061	0.059	-0.002
Washington	Mason	0.049	0.049	0.000
Washington	Pierce	0.065	0.065	0.000
Washington	Skagit	0.044	0.044	0.000
Washington	Spokane	0.060	0.060	0.000
Washington	Thurston	0.059	0.059	0.000
Washington	Whatcom	0.051	0.051	0.000
West Virginia	Berkeley	0.062	0.060	-0.002
West Virginia	Cabell	0.068	0.067	-0.001
West Virginia	Greenbrier	0.060	0.059	-0.001
West Virginia	Hancock	0.064	0.061	-0.003
West Virginia	Kanawha	0.062	0.061	-0.001
West Virginia	Monongalia	0.055	0.054	-0.001
West Virginia	Ohio	0.063	0.061	-0.002
West Virginia	Wood	0.062	0.061	-0.001
Wisconsin	Brown	0.065	0.064	-0.001
Wisconsin	Columbia	0.059	0.058	-0.001
Wisconsin	Dane	0.060	0.059	-0.001
Wisconsin	Dodge	0.063	0.061	-0.002
Wisconsin	Door	0.071	0.070	-0.001
Wisconsin	Florence	0.058	0.057	-0.001
Wisconsin	Fond Du Lac	0.061	0.060	-0.001
Wisconsin	Green	0.059	0.058	-0.001
Wisconsin	Jefferson	0.062	0.061	-0.001
Wisconsin	Kenosha	0.081	0.080	-0.001
Wisconsin	Kewaunee	0.071	0.069	-0.002
Wisconsin	Manitowoc	0.068	0.067	-0.001
Wisconsin	Marathon	0.058	0.057	-0.001
Wisconsin	Milwaukee	0.074	0.072	-0.002
Wisconsin	Oneida	0.056	0.055	-0.001
Wisconsin	Outagamie	0.060	0.059	-0.001
Wisconsin	Ozaukee	0.074	0.073	-0.001
Wisconsin	Racine	0.074	0.073	-0.001
Wisconsin	Rock	0.063	0.062	-0.001
Wisconsin	St Croix	0.059	0.059	0.000
Wisconsin	Sauk	0.057	0.056	-0.001
Wisconsin	Sheboygan	0.077	0.076	-0.001
Wisconsin	Vernon	0.060	0.059	-0.001
Wisconsin	Vilas	0.057	0.055	-0.002
Wisconsin	Walworth	0.063	0.062	-0.001

State	County	Baseline 8-hour Ozone Design Value (ppm)	Control Strategy 8-hour Ozone Design Value (ppm)	Change (ppm)
Wisconsin	Washington	0.064	0.063	-0.001
Wisconsin	Waukesha	0.063	0.062	-0.001
Wisconsin	Winnebago	0.065	0.064	-0.001
Wyoming	Campbell	0.067	0.067	0.000
Wyoming	Teton	0.062	0.062	0.000