Ozone Advance Action Plan
Fredericksburg Area

City of Fredericksburg
Spotsylvania County
Stafford County

4-19-2013

Summary

This Ozone Advance Action Plan covers the Fredericksburg 1997 ozone National Ambient Air Quality Standards (NAAQS) Maintenance Area, consisting of the counties of Spotsylvania and Stafford and the city of Fredericksburg. On May 21, 2012, the United States Environmental Protection Agency designated this area as attaining the 2008 ozone NAAQS. To help ensure clean, healthy air into the future, the leaders from these jurisdictions have worked cooperatively with the Virginia Department of Environmental Quality and a number of stakeholders to create this Action Plan, which details the numerous clean air programs that are in place and will be implemented to reduce ozone precursors. Many of these programs have the co-benefit of also reducing fine particulate matter ($PM_{2.5}$) precursors. Air quality in the Fredericksburg area will continue to improve through the implementation of these programs. Major stakeholders in this process include the Fredericksburg Area Metropolitan Planning Organization; Virginia Department of Mines, Minerals, and Energy; the Virginia Department of Transportation; Fort A.P. Hill; Dominion; Virginia Clean Cities Coalition; and GWRideConnect. Additionally, participation in the Ozone Advance program and this Action Plan were the subject of numerous area informational sessions, and the Action Plan was provided to the public for comment and review. Air quality in the Fredericksburg area has improved significantly in the last 15 years. Actions taken as part of this Action Plan, and various upwind reductions of ozone and $PM_{2.5}$ precursors, will continue to improve air quality well into the future.

Table of Contents

Table of Contents, Continued

List of Tables and Figures

Commonly Used Abbreviations

APMT	APM Terminal	kW	kilowatts
AQS	Air Quality System	kWh	kilowatt-hours
ASIP	Association for Southeastern Integrated Planning	lb	pound
BRAC	Base Realignment and Closure Act	lb/hr	pounds/hour
CAA	Clean Air Act	lb/MWh	pound/megawatt - hour
CAIR	Clean Air Interstate Rule	LEAP	Local Energy Alliance Program
CAMD	Clean Air Markets Division	LEED	Leadership in Energy and Environmental Design
CASTNET	Clean Air Status and Trends Network	MACT	maximum achievable control technology
CEDS	Comprehensive Environmental Data System	MAR	marine, air, and rail
CFR	Code of Federal Regulations	mmbtu	million British thermal units
CMAQ	Community Multiscale Air Quality model	lbs/mmbtu	pounds/million British thermal units
CMAQ	Congestion, Mitigation, and Air Quality	$\mu g/m^3$	micrograms per cubic meter
CMPO	Crater Area Metropolitan Planning Organization	MI/EMS	Mission Integrated Environmental Management System
CO	carbon monoxide	MOVES2010b	Motor Vehicle Emission Simulator version 2010b
DC	direct current	MRAQC	Metropolitan Richmond Air Quality Committee
DMME	Virginia Department of Mines, Minerals, and Energy	MW	megawatts
EGU	electrical generating unit	MWh	megawatt-hours
EPA	United States Environmental Protection Agency	NAAQS	National Ambient Air Quality Standard
EV	electric vehicles	NBTP	NO_X Budget Trading Program
FAMPO	Fredericksburg Area Metropolitan Planning Organization	NEV	neighborhood electric vehicles
FGD	flue gas desulfurization unit	NIT	Norfolk International Terminals
g/bhp-hr	grams/brake horsepower – hour	NMHC	nonmethane hydrocarbons
g/kWh	grams/kilowatt – hour	NMIM	National Mobile Inventory Model
g/MWh	grams/megawatt – hour	NMOC	nonmethane organic compounds
GSHP	ground source heat pump	NNMT	Newport News Marine Terminal
GWAQC	George Washington Air Quality Committee	NO_X	nitrogen oxides
HAP	hazardous air pollutants	ORE	On Road Emissions Program
HRAQC	Hampton Roads Air Quality Committee	OTC	Ozone Transport Commission
HRTPO	Hampton Roads Transportation Planning Organization	OTR	Ozone Transport Region
IRP	Integrated Resource Planning	PHEV	plug-in electric hybrid
I/M	Vehicle Inspection and Maintenance Program	PJM	PJM Interconnection LLC
ITS	Intelligent Transport System	PM	particulate matter
kg/day	kilograms/day	$PM_{2.5}$	fine particulate matter less than 2.5 angstroms in diameters
km	kilometers	PM_{10}	fine particulate matter less than 10 angstroms in diameter

Commonly Used Abbreviations, Continued

PMT	Portsmouth Marine Terminal
ppb	parts per billion
ppm	parts per million
PTE	potential to emit
PV	photovoltaic
REVi	Richmond Electric Vehicle Initiative
RMG	rail mounted gantry cranes
RREA	Richmond Regional Energy Alliance
SCC	State Corporation Commission
SCR	selective catalytic reduction
SF	square foot
SO_2	sulfur dioxide
SPADP	Southeast Propane Autogas Development Program
TEU	twenty foot equivalent container units
TMP	Transportation Management Plan
tpy	tons per year
ULSD	ultra low sulfur diesel
VCC	Virginia Clean Cities, Inc.
VCU	Virginia Commonwealth University
VDEQ	Virginia Department of Environmental Quality
VDOT	Virginia Department of Transportation
VEMP	Virginia Energy Management Program
VIP	Virginia Inland Port
VOC	volatile organic compounds
VPA	Virginia Port Authority

1. Introduction

The Fredericksburg area has been designated attainment for the 2008 ozone National Ambient Air Quality Standard (NAAQS), based on 2009-2011 air quality monitoring data. To preserve and further improve air quality, the regional leaders have decided to explore ways to facilitate additional reductions of nitrogen oxides (NO_X) and volatile organic compounds (VOC), the precursor emissions for ozone formation, through the development of an Ozone Advance Action Plan. This Ozone Advance Action Plan provides background data, including emission inventories and modeling analyses, demonstrating that (1) emissions in the Fredericksburg area will significantly decrease between now and 2020 and (2) ozone air quality in this area will also improve significantly between now and 2020. This Plan discusses information regarding a number of new or on-going programs that will engender additional emission reductions to help further improve both ozone and fine particulate ($PM_{2.5}$) air quality. This document will serve as a framework for the area to comply with any future NAAQS that may be promulgated, such as the next ozone NAAQS that is due to be promulgated in 2014, and it will help address any future violations of the 2008 ozone NAAQS quickly.

The air quality in the Fredericksburg area is expected to benefit from significant reductions in emissions of NO_X and VOC in coming years. Section 2.3, Emission Inventories, provides information on these emissions estimates and their basis. Air quality modeling demonstrates that air quality will be well beneath the 2008 ozone NAAQS by 2020, as noted in Section 2.4, Ozone Air Quality Modeling. The programs included in this Action Plan are generally not included in the area's overall emissions estimates and will provide further air quality benefit beyond that predicted by the air quality modeling. Also, these programs often will provide co-benefits in that they will reduce emissions of sulfur dioxide (SO_2), which is a precursor to $PM_{2.5}$.

The programs in this Action Plan include regulatory programs that are federally enforceable, voluntary programs that are undertaken both for air quality purposes as well as for other purposes such as energy savings or fuel savings, and public outreach programs that will help the citizens of the Fredericksburg area understand how their behavior affects air quality so that they can adjust their actions accordingly. The stakeholders involved in this plan include the Virginia Department of Mines, Minerals, and Energy (DMME); the Virginia Department of Transportation (VDOT); the Fredericksburg Area Metropolitan Planning Organization (FAMPO); US Army Garrison - Fort A.P. Hill; Dominion; and Virginia Clean Cities (VCC). These stakeholders have worked together with the Virginia Department of Environmental Quality (VDEQ) to ensure that the Fredericksburg Ozone Advance Action Plan will help protect healthy air quality and continue to improve air quality into the future.

2. Background and Data

The Fredericksburg 1997 ozone NAAQS maintenance area consists of the counties of Spotsylvania and Stafford and the city of Fredericksburg. Figure 1 shows the area, with the location of the ozone monitoring site denoted by a red triangle. Fredericksburg is a vibrant, diverse area that is experiencing rapid growth, and this growth is expected to continue into the foreseeable future. In 2010, the region was home to approximately 275,000 people, a number that is expected to increase to over 526,000 people by 2040. Employment in the region is also expected to rise, with the 2010 total of approximately 123,400 jobs increasing to around 210,000 jobs by 2040. Table 1 provides a summary of the socioeconomic data for this area, broken down by individual jurisdiction.

Figure 1: Fredericksburg Area

Table 1: Fredericksburg Area Socioeconomic Data, 2010 and 2040

Jurisdiction	Households		Population		Employment		Autos	
	2010	**2040**	**2010**	**2040**	**2010**	**2040**	**2010**	**2040**
Fredericksburg	9,505	13,740	24,286	33,620	31,491	49,391	13,782	19,923
Spotsylvania	41,942	86,090	122,397	240,570	45,303	76,444	94,370	193,703
Stafford	41,769	87,680	128,961	251,850	46,652	84,141	93,984	197,280
Fredericksburg Area Totals	**93,216**	**187,510**	**275,644**	**526,040**	**123,446**	**209,976**	**202,136**	**410,906**

Data Source: "Fredericksburg, Virginia Eight-Hour Ozone Maintenance Area Transportation Conformity Analysis 2040 Long Range Transportation Plan and FY 12-14 Transportation Improvement Program-Draft Report" (VDOT, January 2013)

2.1. Ozone Air Quality

The Fredericksburg area has had a long history of planning requirements for various ozone NAAQS. On April 30, 2004 (69 FR 23941), the Fredericksburg area was designated as moderate nonattainment for the 1997 ozone NAAQS, which was set at a level of 0.08 parts per million (ppm) or 84 parts per billion (ppb). The area implemented a number of control measures that resulted in significant reductions in ozone, and the area qualified for attainment status. The George Washington Air Quality Committee (GWAQC), the local planning organization certified under Section 174 of the federal Clean Air Act (CAA), developed a redesignation request and a maintenance plan, which was sent to EPA. Final approvals of the redesignation request and maintenance plan were published on December 23, 2005 (70 FR 76165), and the area was designated attainment/maintenance for the 1997 ozone NAAQS. These documents may be found on VDEQ's website at the following location: http://www.deq.state.va.us/Programs/Air/AirQualityPlans/OzoneandPM25RegionalPlanningActivities.aspx.

On May 21, 2012 (77 FR 30160), the Fredericksburg area was designated as attainment for the 2008 ozone NAAQS. This standard was set at 0.075 ppm or 75 ppb. The attainment determination was made in large part on air quality monitoring data from 2009-2011. As shown in Figure 2, air quality in the Fredericksburg area has significantly improved in the last 10 years. The data in Figure 2 is provided in Table 2. These data have been quality assured, certified, and provided to EPA's Air Quality System (AQS) database.

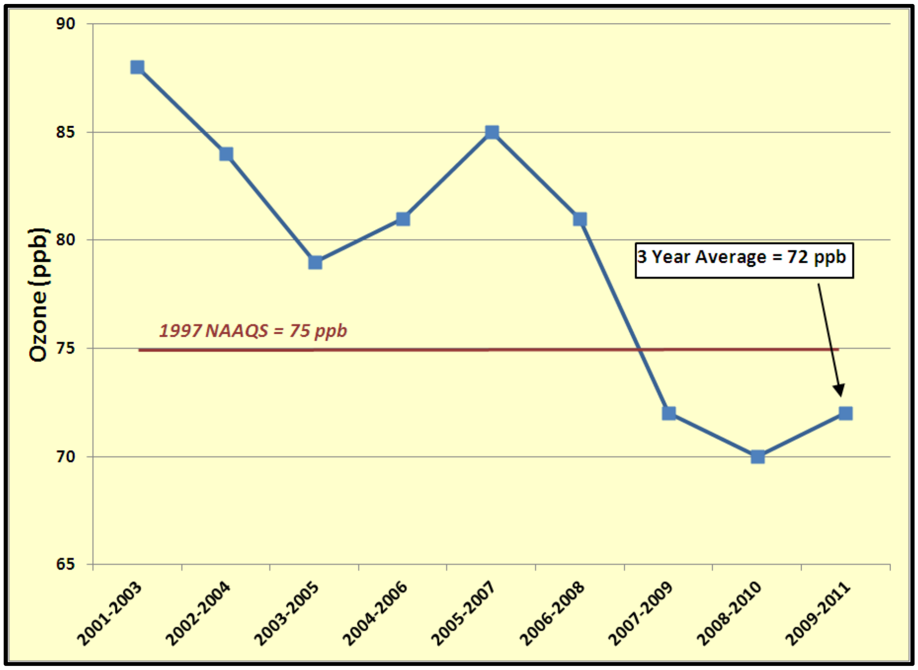


Figure 2: Fredericksburg Area Ozone Air Quality

Table 2: Fredericksburg Area 3-Year Monitoring Site Average, 4th Highest Values

3 Year Period	Stafford 51-041-0004
2001-2003	88 ppb
2002-2004	84 ppb
2003-2005	79 ppb
2004-2006	81 ppb
2005-2007	85 ppb
2006-2008	81 ppb
2007-2009	72 ppb
2008-2010	70 ppb
2009-2011	72 ppb

Data Source: VDEQ-Air Quality Monitoring Division

2.2. $PM_{2.5}$ Air Quality

The Fredericksburg area does not host a $PM_{2.5}$ monitoring site since federal regulations do not require that the area monitor for this pollutant. However, all monitors in the Commonwealth of Virginia demonstrate compliance with the 2012 $PM_{2.5}$ NAAQS of 35 $\mu g/m^3$ on a 24-hour basis and 12.0 $\mu g/m^3$ on an annual basis. Monitors across the Commonwealth show a strong trend towards improving $PM_{2.5}$ air quality, as demonstrated by Figure 3, Figure 4, and Table 3.

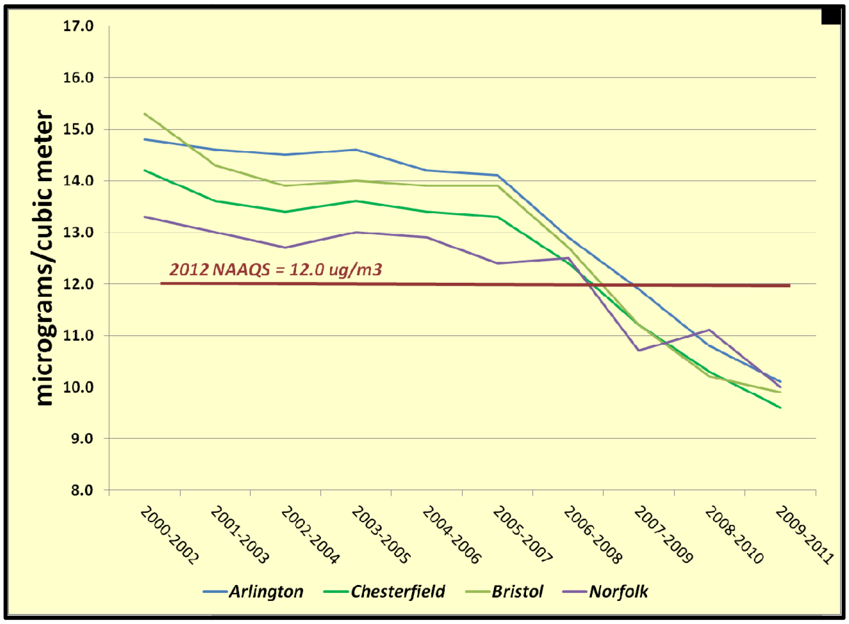


Figure 3: Annual $PM_{2.5}$ Air Quality Across the Commonwealth

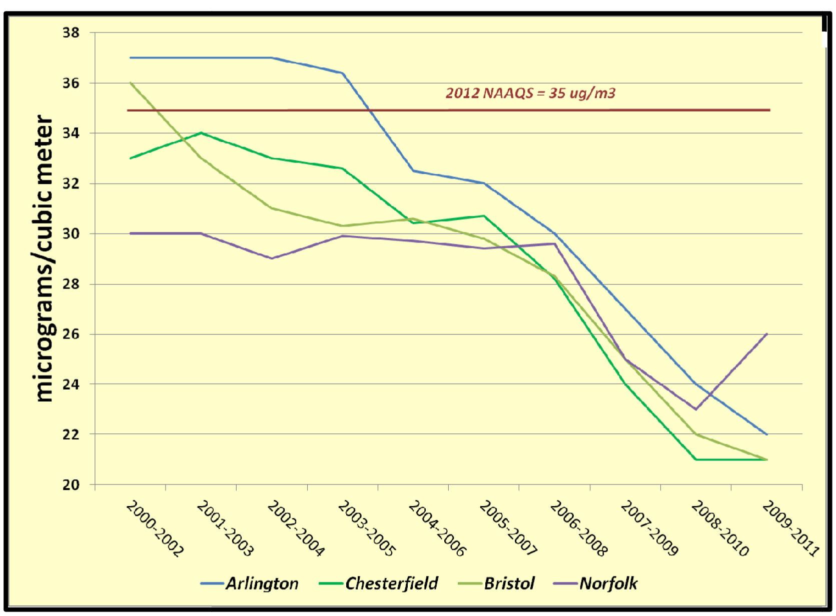


Figure 4: 24-Hour $PM_{2.5}$ Air Quality Across the Commonwealth

Table 3: Annual and 24-Hour $PM_{2.5}$ 3-Year Averages Across the Commonwealth

3 Year Period	Arlington 51-013-0020		Chesterfield 51-041-0003		Bristol 51-520-0006		Norfolk 51-710-0024	
	Annual	24-Hour	Annual	24-Hour	Annual	24-Hour	Annual	24-Hour
2001-2003	14.6	37	13.6 µg/m^3	34 µg/m^3	14.3	33	13.3 µg/m^3	30 µg/m^3
2002-2004	14.5	37	13.4 µg/m^3	33 µg/m^3	13.9	31	13.0 µg/m^3	29 µg/m^3
2003-2005	14.6	36	13.6 µg/m^3	32 µg/m^3	14.0	30	12.7 µg/m^3	30 µg/m^3
2004-2006	14.2	33	13.4 µg/m^3	30 µg/m^3	13.9	31	13.0 µg/m^3	30 µg/m^3
2005-2007	14.1	32	13.3 µg/m^3	30 µg/m^3	13.9	30	12.9 µg/m^3	29 µg/m^3
2006-2008	12.9	30	12.4 µg/m^3	28 µg/m^3	12.7	38	12.4 µg/m^3	30 µg/m^3
2007-2009	11.9	27	11.2 µg/m^3	24 µg/m^3	11.2	25	12.5 µg/m^3	25 µg/m^3
2008-2010	10.8	24	10.3 µg/m^3	21 µg/m^3	10.2	22	10.7 µg/m^3	23 µg/m^3
2009-2011	10.1	22	9.6 µg/m^3	21 µg/m^3	9.9	21	11.1 µg/m^3	26 µg/m^3

Data Source: VDEQ-Air Quality Monitoring Division

Figure 5 provides the speciation data from the Henrico County Math and Science Center $PM_{2.5}$ speciation monitor. While this monitor is not located in the Fredericksburg area, the data is considered representative of the entire Commonwealth due to the regional nature of $PM_{2.5}$ air quality. Sulfates are a significant contributor to $PM_{2.5}$ concentrations throughout the Commonwealth. All areas of the Commonwealth have recently experienced significant SO_2 reductions, and these reductions are expected to continue into the future, as discussed in the following section. The sulfate portion of the $PM_{2.5}$ concentrations at all monitors in the Commonwealth should therefore continue to decrease, further improving air quality.

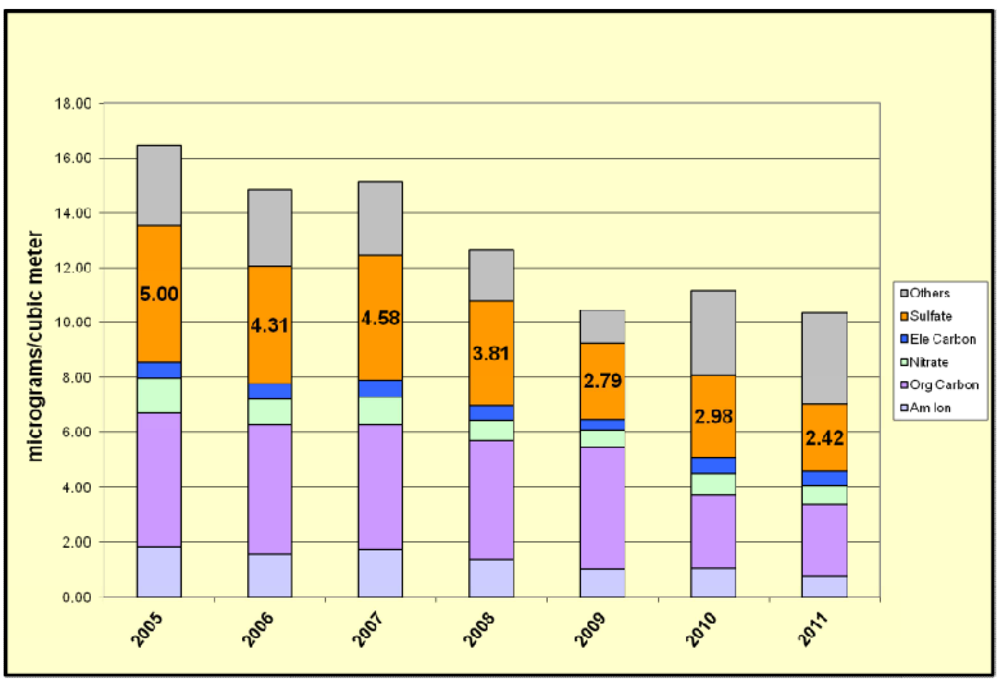


Figure 5: Henrico Speciation Data - VDEQ Air Quality Monitoring Division

All data provided in this section have been certified, quality-assured, and submitted to EPA via AQS.

2.3. Emission Inventories

This section presents the 2007, 2017, and 2020 emissions estimates for the Commonwealth of Virginia and for the Fredericksburg area. These estimates were developed using a variety of methods and data. Emissions of NO_X, VOC, and carbon monoxide (CO), the precursors to ozone, are expected to decrease greatly between 2007 and 2017 and through 2020. Emissions of SO_2 are also expected to be significantly reduced. While SO_2 is not a factor in the formation of ozone, it is a precursor to $PM_{2.5}$. Figure 6 and Figure 7 show the estimated emissions in tons/year (tpy) for the Commonwealth of Virginia. Figure 8 and Figure 9 show the estimated emissions in tpy for the Fredericksburg area. These figures provide data on emissions from the electrical generating unit (EGU) sector; the area source sector; the industrial sector (Point-NonEGU); the marine, air, and rail transport sector (MAR); the nonroad engine sector (NonRoad); and the on-road vehicle and truck sector (Mobile).

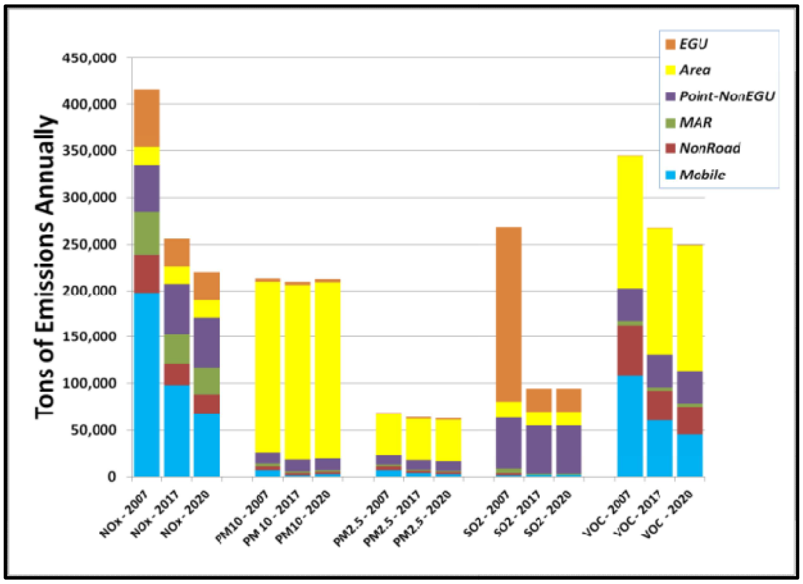


Figure 6: Virginia Emission Estimates

The reductions in the mobile and non-road sectors are generally attributable to several important federal measures that control total hydrocarbons, $PM_{2.5}$, CO, and NO_X. These measures are discussed in more detail in Section 2.3.2 and Section 2.3.3. These already-implemented federal control programs for vehicles, heavy duty diesel on-road engines, and non-road

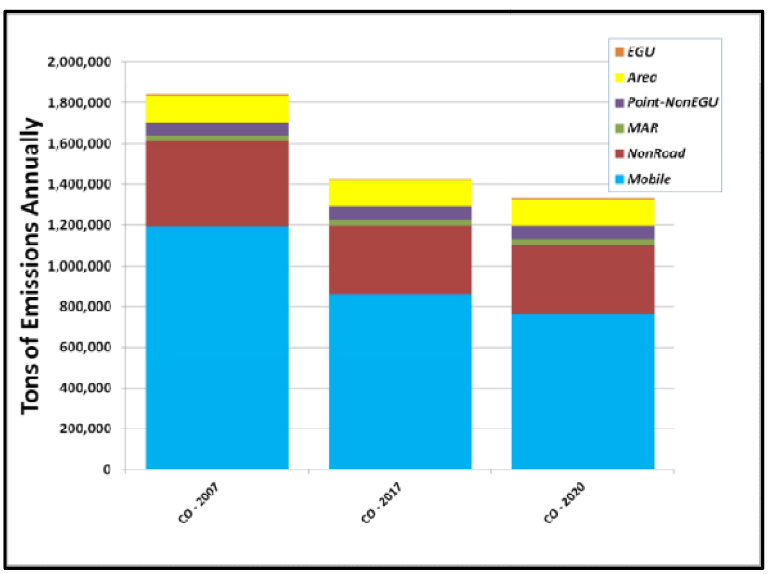


Figure 7: Virginia CO Emission Estimates

engines continue to provide air quality benefit due to turnover of older equipment for new equipment. The phase-in of reduced sulfur content requirements for many types of fuels between 2007 and 2012 has also been instrumental for reductions of SO_2 as well as NO_X, CO, and $PM_{2.5}$ since reduced sulfur content in fuel allows control devices to function better. Reduced sulfur content in fuels facilitates the use of state-of-the-art controls on new equipment.

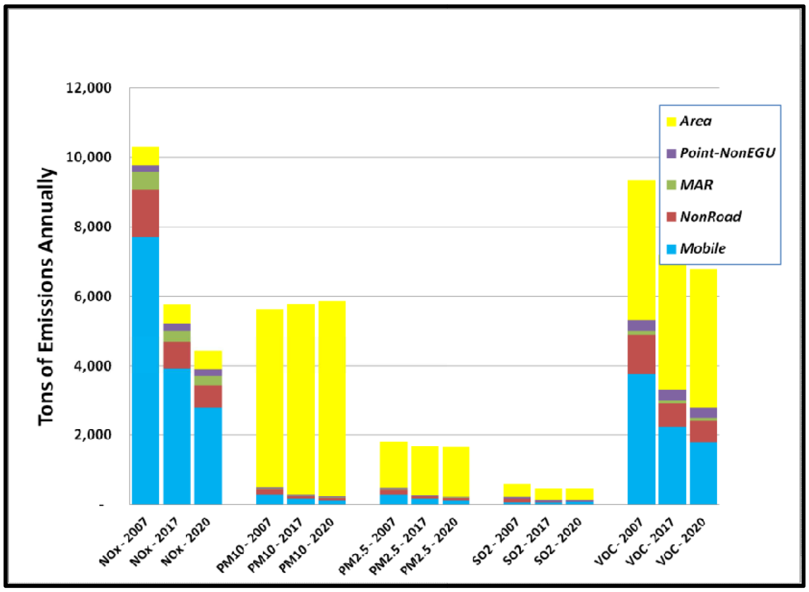


Figure 8: Fredericksburg Area Emissions Estimates

Another factor that must be considered in long-range emission estimates is the reduced price of natural gas. Older, inefficient coal-fired power plants that are not economically viable for retrofit with control equipment are being converted to natural gas, which burns much more cleanly than coal. New, state-of-the-art combined cycle operations have been constructed in the Commonwealth, and more of these units are planned for construction to meet existing and future energy needs. These combined cycle operations, which have very low emission rates and produce electricity in a much more efficient manner than older, coal-fired units, are supplanting coal-based generation. Industrial facilities that need steam for manufacturing purposes are retiring coal-fired units and replacing them with new, low-emitting, natural gas units. Additionally, more residences are converting to natural gas, where available, and are using high efficiency furnaces and water heaters. These devices not only have lower emission factors per unit of fuel, they also are more efficient and consume less fuel in their operations.

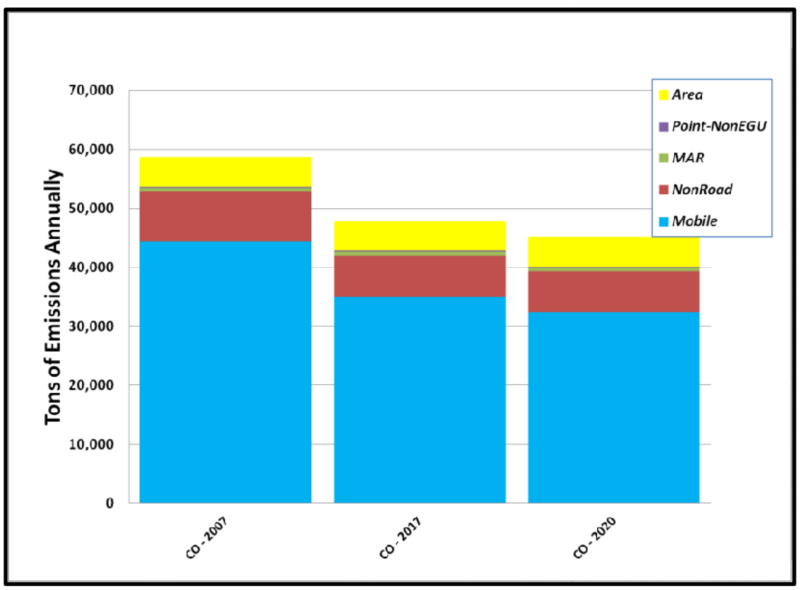


Figure 9: Fredericksburg Area Emissions Estimates, CO

2.3.1. *Point Source Emissions Sector*

Point source emissions originate from large facilities such as industrial manufacturing facilities. In the figures above, the point source emissions sector is represented by the EGU estimates shown in orange and the point-nonEGU estimates shown in purple. The 2007 emissions data from this emissions source sector were gathered through Virginia's Comprehensive Environmental Data System (CEDS). Facilities reporting to VDEQ use a variety of methodologies to estimate emissions. These methodologies may include federal emission factor estimation techniques, models, throughput records, source-specific emissions testing, and continuous emissions monitors. Facility owners are required to certify their emissions data, and the data is quality-assured by VDEQ staff. For EGUs, hourly emissions of NO_X and SO_2, as well as heat input and gross load, are reported to EPA's Clean Air Markets Division (CAMD) on a quarterly basis.

The 2007 data have been extrapolated to 2017 and 2020 using different estimation techniques, depending on the type of industry or sector. Non-EGU point source emissions estimates are generally developed using factors that are specific to the type of industry represented. Factors that show a decline in emissions or decline in productivity have been updated to unity, so that 2017 and 2020 data are equivalent to 2007 data for those facilities. EGU point sources are established in this inventory using Energy Information Administration data from AEO2011. Since each EGU may have significant emissions, the EGU inventory has also been supplemented with changes based on known permit actions, enforcement orders, and information gleaned from planning documents submitted to the PJM Interconnection LLC (PJM) systems operator and the State Corporation Commission (SCC). For newly permitted facilities that have not yet been constructed, the inventory values included here represent maximum permitted limits. More information on EGU estimates may be found in Appendix A.

As Figure 8 shows, the point source sector is not a significant portion of the NO_X emissions inventory for the Fredericksburg area.

2.3.2. *Mobile Emissions Sector*

Mobile emissions are generated by vehicles and trucks that use the transportation system. The 2007 and 2020 mobile source sector emissions inventories were developed using EPA's most recent model for estimating on-road emissions, MOVES2010b. Mobile source sector emissions estimates for 2017 were developed using linear interpolation. In the figures above, emission estimates for the mobile source emissions sector are shown in blue.

NO_X emissions from the mobile sector constitute the largest portion of the overall NO_X emissions inventory for both the Fredericksburg area and the Commonwealth as a whole. Between 2007 and 2020, these emissions are expected to decrease, mainly due to the effect of two federal rules, the 2007 Heavy-Duty Diesel Highway Rule and the Tier 2 Vehicle and Gasoline Sulfur Program.

The 2007 Heavy-Duty Diesel Highway Rule (40 CFR Part 86, Subpart P) set a particulate matter (PM) emissions standard for new heavy-duty engines of 0.01 grams per brake-horsepower hour (g/bhp-hr), which took full effect for diesel engines in the 2007 model year. This rule also included standards for NO_X and nonmethane hydrocarbons (NMHC) of 0.20 g/bhp-hr and 0.14 g/bhp-hr, respectively. These diesel engine NO_X and NMHC standards were successfully implemented between 2007 and 2010. The rule also required that sulfur in diesel fuel be reduced to facilitate the use of modern pollution-control technology on these trucks and buses. EPA required a 97% reduction in the sulfur content of highway diesel fuel -- from levels of 500 ppm to 15 ppm.

The Tier 2 Vehicle and Gasoline Sulfur Program (40 CFR Part 80, Subpart H; 40 CFR Part 85; 40 CFR Part 86) is a fleet averaging program for on-road vehicles and was modeled after the California LEV II standards. This program became effective in the 2005 model year. The Tier 2 program allows manufacturers to produce vehicles with emissions ranging from relatively dirty to very clean, but the mix of vehicles a manufacturer sells each year must have average NO_X emissions below a specified value. Mobile emissions continue to benefit from this program as motorists replace older, more polluting vehicles with cleaner vehicles.

2.3.3. Non-Road Emissions Sector

The non-road emissions sector includes estimates of emissions from equipment that contain various types of combustion engines, but these engines are not used to propel equipment on the roads and highways. Examples include pumps, generators, and turbines, as well as engines used for forklifts, earth moving equipment, lawnmowers, marine transport, rail transport, and air transport.

The majority of the emissions from this source sector are estimated using EPA's National Mobile Inventory Model (NMIM). NMIM was used to estimate 2007, 2017, and 2020 emissions from this source category. While the population estimates for these equipment types increase over time, emissions decrease, due mainly to the Nonroad Diesel Emissions Program (40 CFR Part 89). EPA adopted these NO_X, hydrocarbon, and CO emission standards for several groups of nonroad engines. The nonroad diesel rule set standards that reduced emissions by more than 90% from nonroad diesel equipment and, beginning in 2007, the rule reduced fuel sulfur levels by 99% from previous levels. The reduction in fuel sulfur levels applied to most nonroad diesel fuel in 2010 and applied to fuel used in locomotives and marine vessels in 2012.

Emissions from MAR are estimated using category-specific emission estimation tools and emission factors. In the figures above, the nonroad engine sector emissions estimates calculated using NMIM are shown in red, and the MAR sector emissions estimates are shown in green.

2.3.4. Area Emissions Sector

The area sector of the emissions inventory consists of categories where large populations of emitters exist, but each emitter has small emissions. In the figures above, the area emissions sector is represented by the color yellow. This sector is heavily dependent on population and employment. In general, the reductions achieved by the control programs associated with the area emissions inventory sector are offset by growth in population and employment.

2.3.5. Emissions Estimates

Table 4 presents the Virginia-wide emissions estimates. Table 5 presents the emissions estimates for the Fredericksburg area. The estimates in these tables include the effects of the federal control programs described above as well as many other federally and state enforceable efforts. They do not include most of the additional reductions that are anticipated through the implementation of the programs described in this Action Plan. Where programs listed in the Action Plan are included within these inventories, the description of that program notes this information.

Table 4: Virginia Emission Estimates, 2007-2017-2020

Year	Mobile	NonRoad	MAR	Point-nonEGU	Area	EGU	Total:
CO, tpy							
2007	1,195,237	415,093	28,444	63,079	132,098	7,255	1,841,208
2017	861,200	335,531	28,605	65,740	129,479	7,255	1,427,809
2020	760,988	341,458	29,183	66,212	128,937	7,255	1,334,034
NO_X, tpy							
2007	197,822	41,325	45,600	50,265	19,056	62,309	416,376
2017	97,694	23,658	32,268	53,236	18,411	30,650	255,917
2020	67,656	20,189	29,495	53,591	18,520	30,271	219,721
PM_{10}, tpy							
2007	6,798	4,132	2,402	13,028	183,341	3,375	213,076
2017	954	2,693	1,603	12,517	188,211	3,375	209,353
2020	2,553	2,317	1,498	12,602	190,097	3,375	212,443
$PM_{2.5}$, tpy							
2007	6,499	3,937	2,074	10,296	44,102	1,812	68,719
2017	3,365	2,548	1,321	9,885	44,851	1,812	63,781
2020	2,424	2,184	1,222	9,947	45,216	1,812	62,804

Year	Mobile	NonRoad	MAR	Point-nonEGU	Area	EGU	Total:
SO_2, tpy							
2007	1,434	2,329	4,674	54,486	17,098	187,671	267,692
2017	1,533	61	1,395	52,044	14,880	24,546	94,459
2020	1,562	63	1,214	52,338	14,616	24,600	94,394
VOC, tpy							
2007	108,001	55,135	4,312	35,018	142,218	689	345,373
2017	59,957	32,141	3,710	35,461	135,379	689	267,338
2020	45,543	29,303	3,622	35,593	135,002	689	249,753

Table 5: Fredericksburg Area Emission Estimates, 2007-2017-2020

Year	Mobile	NonRoad	MAR	Point-NonEGU	Area	EGU	Total:
CO, tpy							
2007	44,374	8,527	648	154	5,094	--	58,797
2017	35,156	6,887	649	168	5,009	--	48,960
2020	32,391	6,968	651	173	4,987	--	45,170
NO_X. tpy							
2007	7,697	1,375	511	180	556	--	10,320
2017	3,925	765	319	193	539	--	5,742
2020	2,794	624	286	196	541	--	4,440
PM_{10}, tpy196							
2007	289	133	24	38	5,135	--	5,619
2017	155	79	16	40	5,487	--	5,776
2020	114	63	14	41	5,622	--	5,855
$PM_{2.5}$, tpy							
2007	277	127	20	29	1,345	--	1,798
2017	148	75	12	30	1,420	--	1,685
2020	109	60	11	30	1,451	--	1,661
SO_2, tpy							
2007	58	93	5	52	377	--	585
2017	67	2	0	53	323	--	445
2020	70	2	0	54	314	--	439
VOC, tpy							
2007	3,748	1,140	119	307	4,017	--	9,331
2017	2,243	663	107	306	3,882	--	7,201
2020	1,791	605	104	306	3,970	--	6,777

These tables demonstrate that Virginia and the Fredericksburg area are expected to experience significant drops in emissions of NO_X, the most important ozone precursor in this area. These tables also demonstrate that the Fredericksburg area has relatively small contributions to the overall emissions inventory for the Commonwealth. This area's air quality is more dependent on transported emissions than on local emissions. Therefore, upwind reductions of ozone precursors are very important to ensuring that ozone air quality in the Fredericksburg area complies with the 2008 ozone NAAQS and makes progress toward meeting any future NAAQS.

2.4. Ozone Air Quality Modeling

Air quality modeling for the Fredericksburg area was performed by the Ozone Transport Commission (OTC) and was conducted for a 2007 base year in addition to a 2020 future year. For 2020 this modeling study predicts air quality concentrations that are well beneath the 2008 ozone NAAQS for all monitoring locations within the Commonwealth. The future year modeling accounts for federal, state, and local control measures that are expected to occur prior to 2020 and are federally enforceable. However, most of the programs listed in this Action Plan are not included in the modeling. The emissions reductions resulting from the Action Plan programs will provide further air quality benefit beyond that predicted by this air quality modeling study.

2.4.1. Air Quality Model Configuration

This analysis used EPA's Models-3/ Community Multiscale Air Quality (CMAQ) modeling system. The configuration of the CMAQ modeling system was chosen based on the results of the model sensitivity testing performed during previous OTC ozone modeling efforts. Figure 10 displays the 36/12 kilometer (km) horizontal grid system used in this exercise, and Table 6

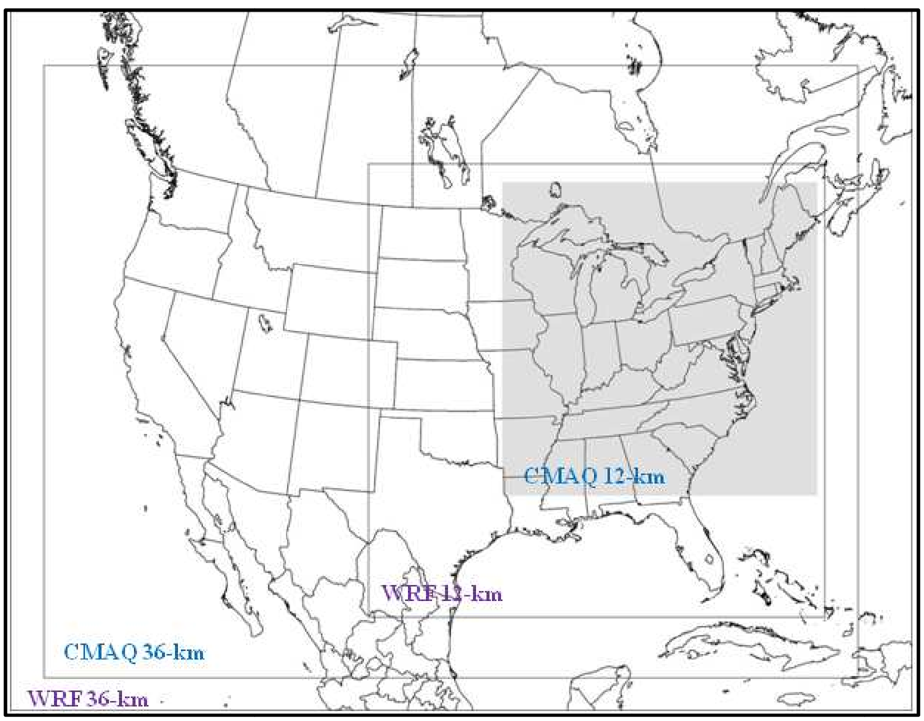


Figure 10: Modeling Grid

presents the CMAQ configuration. Appendix B provides details on the emissions inventories used in the modeling.

Table 6: OTC Modeling CMAQ Configuration

Model Option	OTC Level 3 CMAQ Configuration
Model Version	CMAQ 4.71
Horizontal Resolution	36/12 km
Vertical Spacing	34 layers
Emissions Inventories	MARAMA/OTC Level 3
Meteorology	WRF v3.1 OTC Modeling
Gas Phase Chemistry	CB05
Gas Phase Chemistry Solver	EBI
Aerosol Chemistry	AERO5
Aqueous Phase Chemistry	ACM
Horizontal Advection	Yamartino
Vertical Advection	Yamartino
Horizontal Diffusion	Eddy diffusivity dependent on grid
Vertical Diffusion	ACM2 (inline)
Boundary Conditions	36 km derived from 2007 GEOS-CHEM -- 12 km derived from 36 km
Initial Conditions	Default with 15 day spin-up

2.4.2. Model Performance Evaluation

To quantify model performance, several statistical measures were calculated and evaluated. The statistical measures selected were based on the recommendations outlined in "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze," (see http://www.epa.gov/scram001/guidance/guide/final-03-pm-rh-guidance.pdf).

Model performance statistics were calculated for the Ozone Transport Region (OTR) and Virginia. The evaluation included 210 AQS monitoring sites and 20 Clean Air Status and Trends Network (CASTNET) monitoring sites. Figure 11 shows the locations of these AQS and CASTNET sites across the OTR and Virginia.

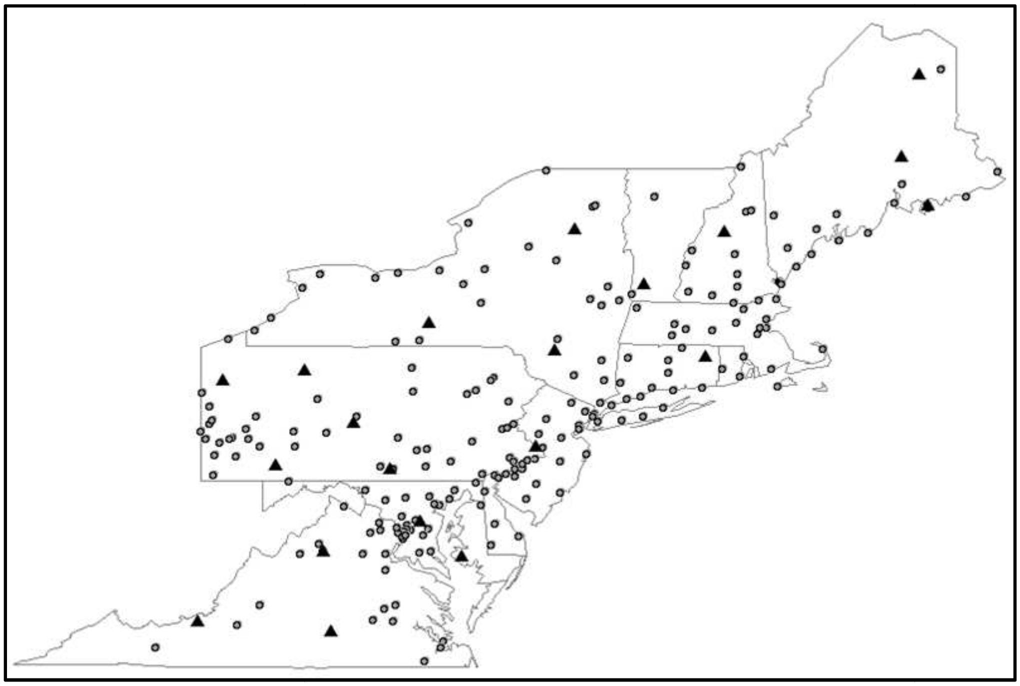


Figure 11: Locations of AQS (circles) and CASTNET (triangles) Monitoring Sites

The OTC CMAQ modeling platform performs well and within recommended modeling guidelines. Figure 12 compares predicted to observed average daily maximum 8-hour ozone concentrations for the OTR and Virginia. The model slightly over-predicts ozone but captures day-night and seasonal patterns very well. Figure 13 illustrates the average diurnal variation of ozone aggregated across the AQS (top panel) and CASTNET (bottom panel) sites within the OTR and Virginia.

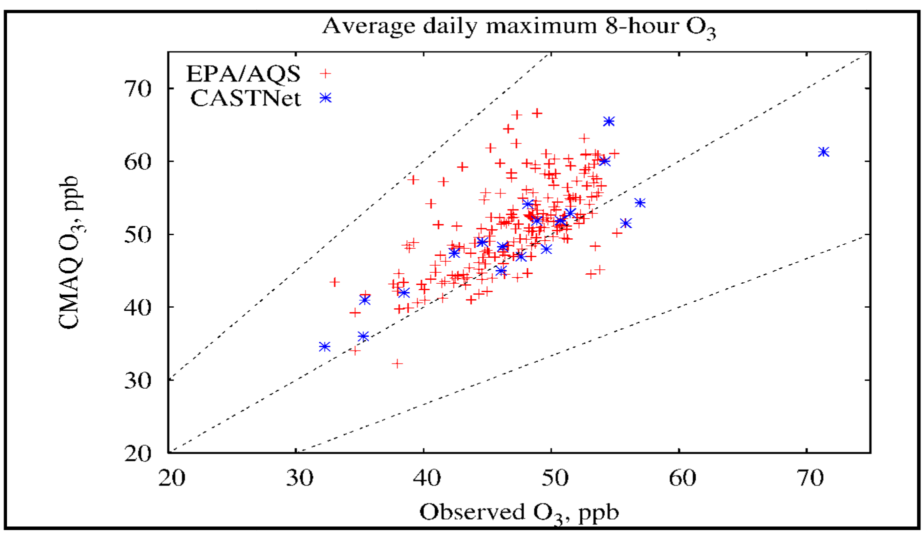


Figure 12: Predicted Versus Observed Average Daily Maximum 8-Hour Ozone

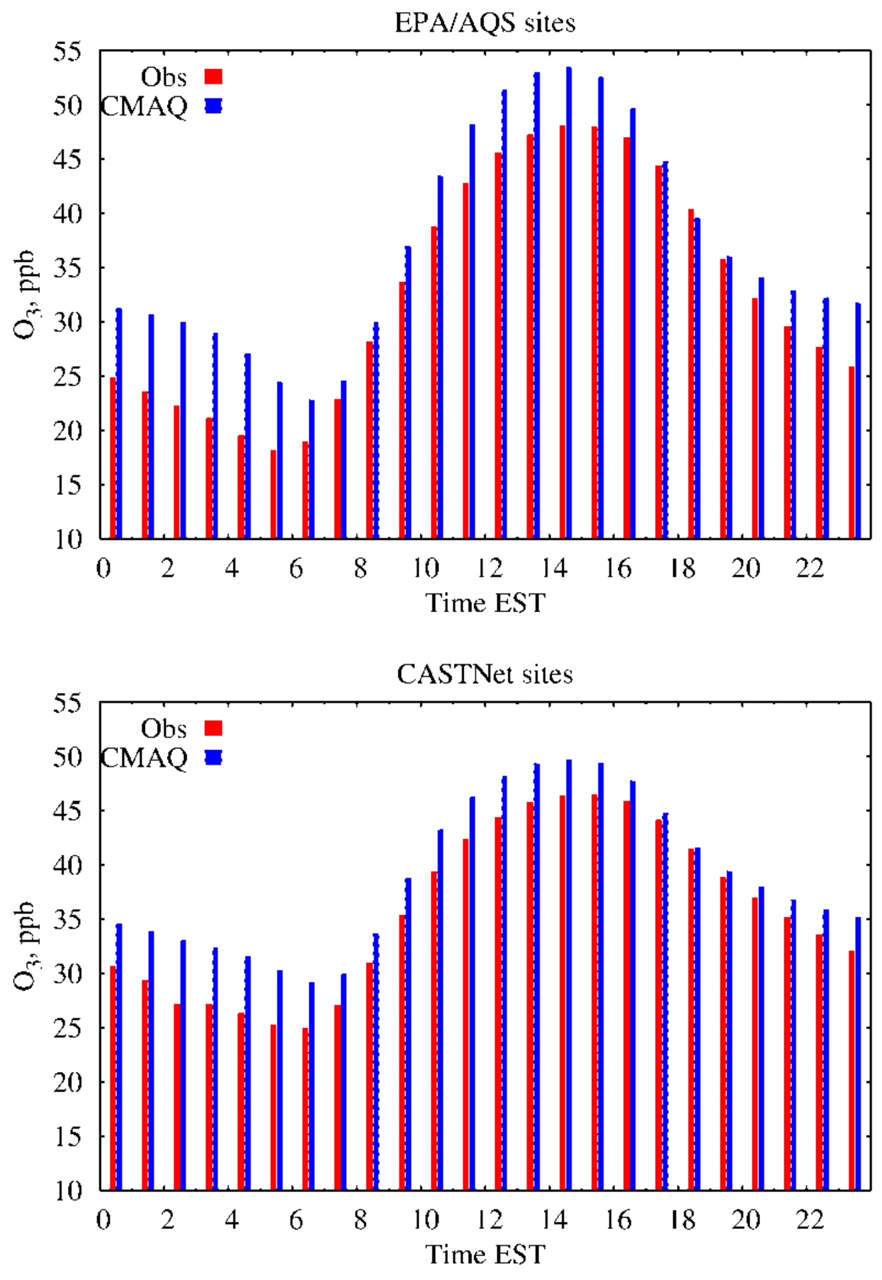


Figure 13: Average Diurnal Variation in Ozone

Appendix B provides additional statistical information on CMAQ ozone model performance for the 2007 base case.

2.4.3. Ozone Modeling Results for 2020

Figure 14 presents the air quality modeling results based on the 12-km grid modeling domain. These modeling results clearly demonstrate that the entire Commonwealth of Virginia, and the majority of the modeling domain, are projected to be in compliance with the 2008 ozone NAAQS of 75 ppb by 2020. In addition, there is a significant margin of safety in the Fredericksburg area should the standard be lowered in the future.

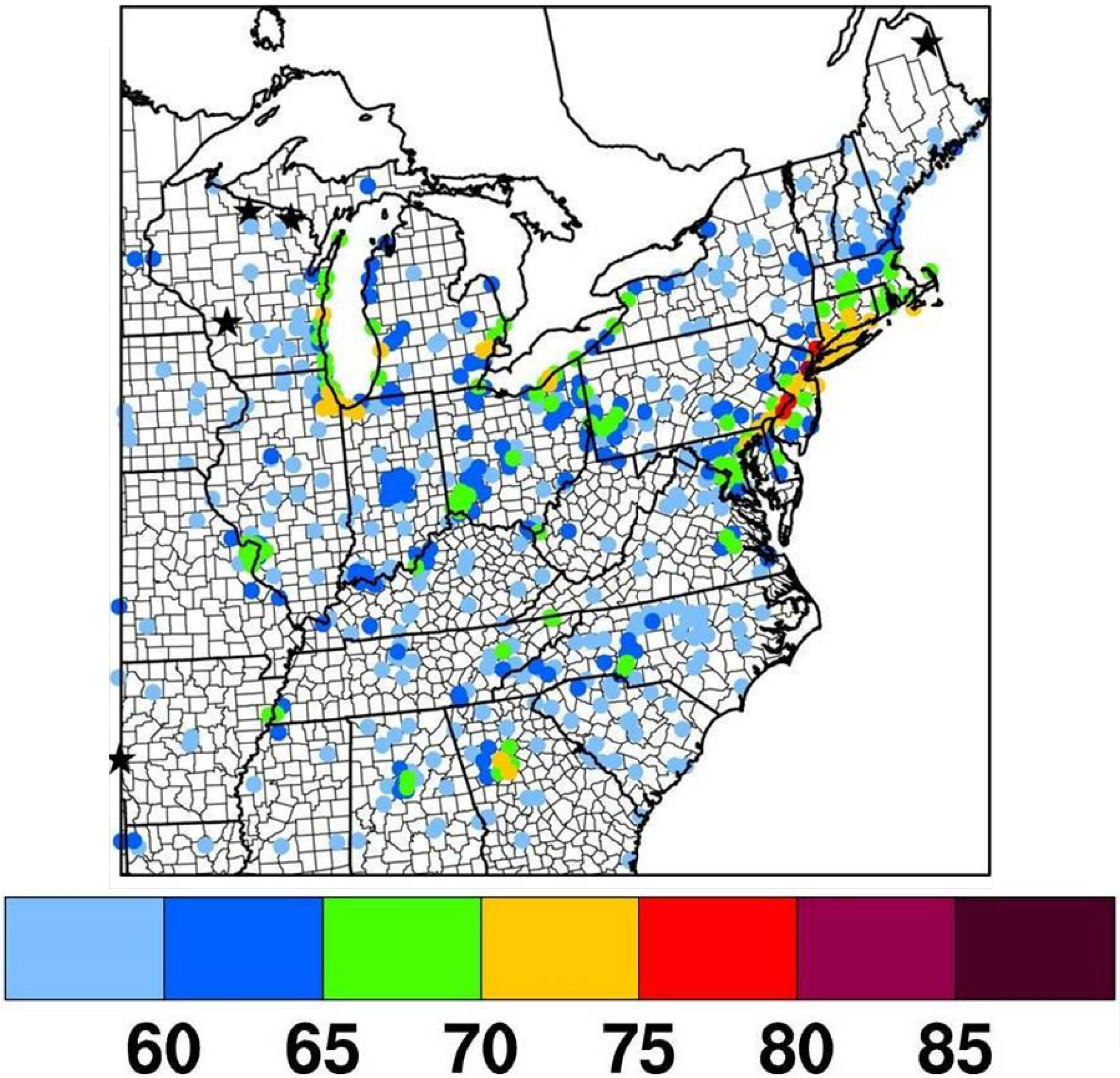


Figure 14: 2020 Ozone Modeling Results

Table 7 provides a summary of the 2007 base year and 2020 future year modeling results for the Fredericksburg area.

Table 7: Fredericksburg Area Ozone Modeling Predictions

AIRS I.D.	Site Name	Latitude	Longitude	2007 Base Design Value	2020 Future Design Value
51-179-0001	Stafford	38.4812	-77.3704	79.3 ppb	60 ppb

Many of the programs included in this Action Plan are not included in the area's overall emissions estimates and will provide further air quality benefit beyond that predicted by the air quality modeling.

The modeling included in this Action Plan may be updated in the future or as part of the annual Action Plan report to reflect updated modeling platforms.

2.5. Assessment of Relative Air Quality Impacts

Ozone formation is driven by two major classes of directly emitted precursors: NO_X and VOC. The relationship of peak ozone concentrations can be plotted as a function of VOC and NO_X emission rates as illustrated in Figure 15. This figure is a simplified illustration but shows that two distinct regimes exist with different ozone-NO_X-VOC sensitivity. In the NO_X-limited regime (with relatively low NO_X and high VOC), ozone increases with increasing NO_X and changes little in response to increasing VOC. The NO_X saturated or VOC-limited regime has ozone decreases with increasing NO_X and ozone increases with increasing VOC. The dotted line represents a local maximum for ozone versus NO_X and VOC, separating the NO_X-limited and VOC-limited regimes. The relationship between ozone, NO_X, and VOC is driven by complex nonlinear photochemistry. No simple rule of thumb exists for distinguishing NO_X-limited from VOC-limited conditions. Ozone-precursor sensitivity predictions are usually derived from 3-dimensional Eulerian chemistry/transport models such as CMAQ. CMAQ includes state-of-the-science capabilities for modeling multiple air quality issues, including tropospheric ozone formation, and accounts for the reactivity of the various VOC species.

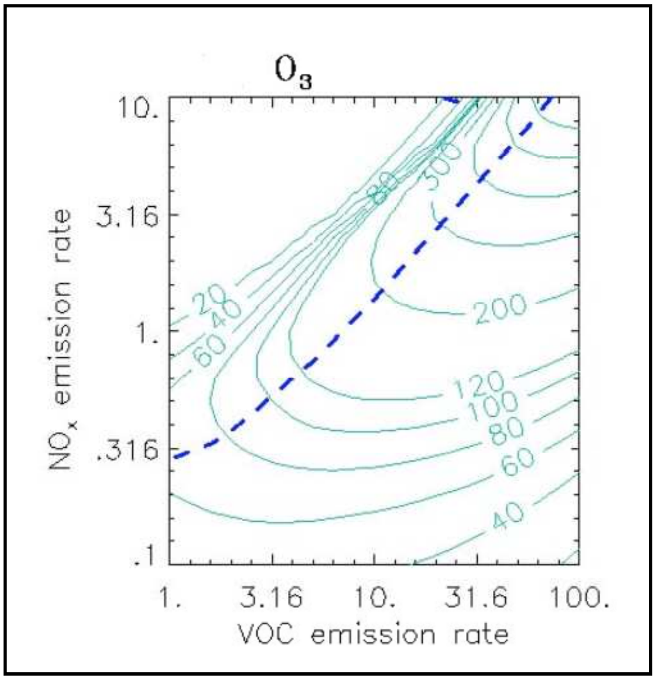


Figure 15: Peak Ozone Concentrations as a Function of VOC and NO_X Emission Rates

Studies in recent years have examined the sensitivity of surface ozone formation to precursor species concentrations of VOC and NO_X. These studies have invariably concluded that peak ozone concentrations are more sensitive to NO_X emissions over most of the United States. This conclusion is due in part to substantial decreases in NO_X emissions, primarily from stationary sources and particularly over the last two decades, which have lead to an additional reduction in the NO_X-VOC emissions ratio. Another factor is that peak summertime ozone formation is more sensitive to changes in NO_X with increasing temperature because emissions of highly reactive, biogenic isoprene increase with temperature and thus increase the total VOC emissions available for reaction. Very few exceptions exist to this rule; only a few urban core areas such as Chicago and New York City have historically shown reductions in ozone due to the implementation of VOC emissions control measures.

Georgia Institute of Technology (Georgia Tech) conducted a series of emissions sensitivities in 2009 as part of the Association for Southeastern Integrated Planning (ASIP) project. The study examined the impact of NO_X and VOC emission reductions on 8-hour ozone concentrations using CMAQ model simulations for a summer ozone episode (June 1 – July 10, 2002). One of the sensitivity runs examined the effects of a 30% reduction in domain-wide anthropogenic VOCs on ozone formation. The impacts were then normalized by emissions. Figure 16 summarizes the results for Virginia.

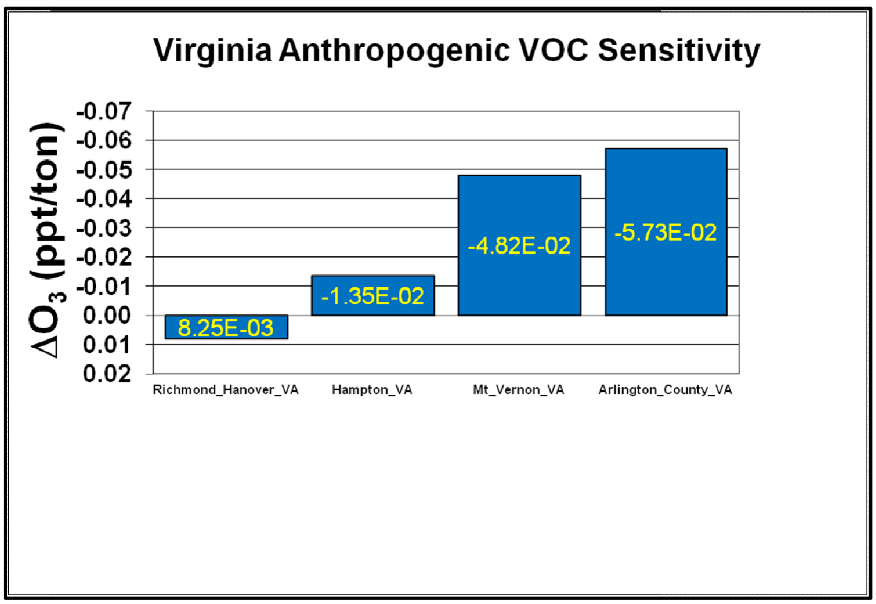


Figure 16: Ozone Response to Reductions in Anthropogenic VOC (Boylan, 2009)

A second sensitivity run examined the effects of a 30% reduction in ground level NO_X for jurisdictions within Virginia on ozone formation. The impacts were then normalized by emissions. Figure 17 summarizes the results for the receptor locations in Virginia. The model response to ground level NO_X reductions was two orders of magnitude (i.e., more than 100 times) greater than the response from anthropogenic VOC reductions.

Similarly, a third sensitivity run examined the effects of a 30% reduction in Virginia point source NO_X on ozone formation. The impacts were again normalized by emissions. Figure 18 summarizes the results. The model response to point source NO_X reductions was two to three orders of magnitude (i.e., more than 100-1,000 times) greater than the response from anthropogenic VOC reductions. The model response for this sensitivity was more variable and dependent on the location of the point source relative to the receptor locations as compared to the sensitivity run for ground level NO_X.

These sensitivities demonstrate that NO_X reductions are more efficacious than VOC reductions for improving ozone air quality in the Commonwealth.

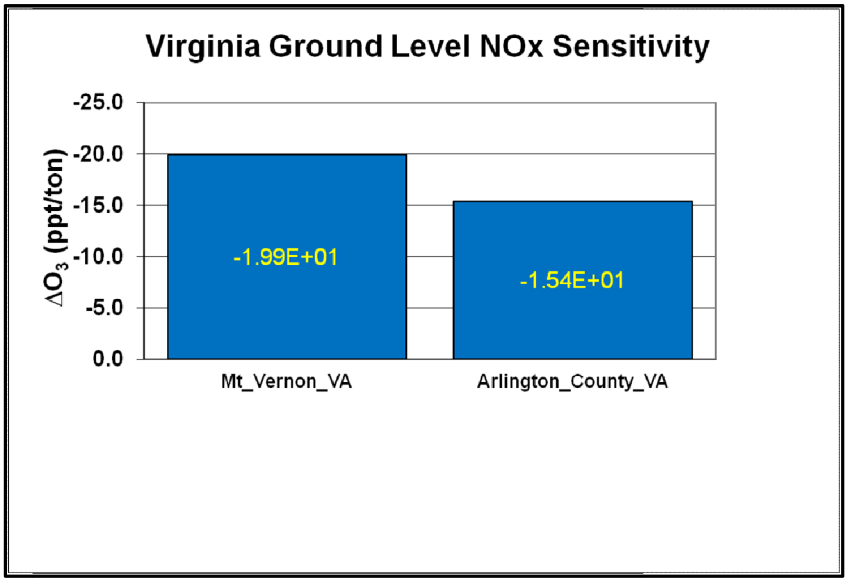


Figure 17: Ozone Response to Reductions in Ground Level NO_X (Boylan, 2009)

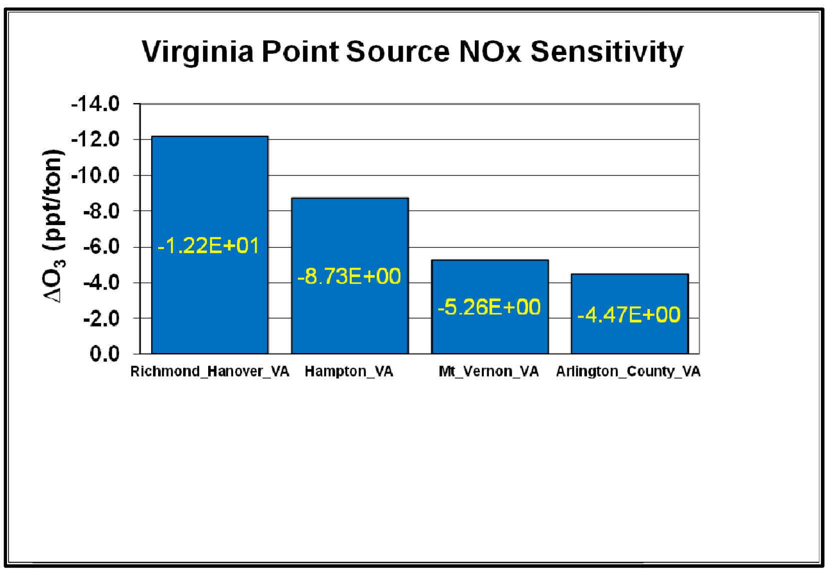


Figure 18: Ozone Response to Reductions in Point Source NO_X (Boylan, 2009)

3. Action Plan Programs

The following sections give detailed information on a number of new and ongoing programs that will provide additional emission reduction benefits to Virginia and the Fredericksburg area. These programs are directionally correct. They will reduce ozone precursors, and many of these programs will also reduce $PM_{2.5}$ precursors. The reductions from the programs are quantified, where possible, and the organizations responsible for the implementation of each program are provided. Timelines for implementation of each new program are also provided, where applicable. Each program description specifically states if the reductions associated with the program or action have been included in the emissions inventories listed in Table 4 and Table 5.

3.1. Metropolitan Planning Efforts

The Fredericksburg area has been proactive in establishing a strong planning effort aimed at reducing emissions from vehicle miles traveled. The area has access to Congestion Mitigation and Air Quality (CMAQ) funding, which has been used by FAMPO for a wide variety of efforts designed to improve air quality between 2012 and 2017. These efforts will include improvements and construction of new bicycle paths, improvements to the commuter rail parking, and optimizing signal systems. More data on these programs may be found at http://www.gwregion.org/transportation-planning/ and in Appendix C. Emission reductions from these efforts are not included in the estimates provided in Table 4 and Table 5.

3.2. GWRideConnect

GWRideConnect is the ridesharing agency that serves the George Washington Regional Commission area. This region consists of the counties of Stafford, Spotsylvania, Caroline, and King George and the city of Fredericksburg. GWRideConnect promotes ridesharing and transportation demand management techniques to assist persons seeking transportation options to their workplaces and other designations. The goals of the program are to promote, plan, and establish transportation alternatives to the use of single occupant vehicles; improve air quality; reduce congestion; and improve the overall quality of life for the citizens of the region. In addition to performing a wide range of daily travel demand management activities, GWRideConnect supports the largest vanpool fleet in Virginia and is an active partner in regional transit and transportation planning.

In 2000, 40% of employed George Washington Region residents traveled out of the region for work. In 2007, the "Virginia State of the Commute Survey" (Virginia Department of Rail and Public Transport; April 2009) (see http://www.drpt.virginia.gov/activities/stateofcommute.aspx) estimated this figure had increased to 44%, the second highest percentage of any area in the Commonwealth. The region's outbound commuters have an average one-way trip time of 64 minutes and distance of 45 miles, which are the longest average commute time and distance of any region in Virginia. These statistics, and the emissions inventory estimates provided for the Fredericksburg area in Table 5, highlight the importance of travel demand management programs. In fiscal year 2012, GWRideConnect facilitated the following reductions:

- 146,831,000 avoided vehicle miles traveled;
- 7,341,500 gallons of gasoline not consumed;
- 2,447,250 avoided work trips.

In fiscal year 2013, the program is expected to continue to grow. Goals include matching an additional 2,000 clients using the Free Rideshare Matching Program; forming an additional 50 vanpools; and forming 25 new carpools within the region.

This important, directionally correct program reduces or avoids air emissions from the on-road sector. These emission reductions from the programs offered by GWRideConnect are not included in the estimates provided in Table 4 and Table 5. See Appendix C for the "GWRideConnect Annual Work Plan FY2013."

3.3. Expansion of ORE Program

Vehicle inspection and maintenance programs (I/M) help improve air quality by identifying high-emitting vehicles in need of repair and causing them to be fixed as a prerequisite to vehicle registration. The CAA requires that I/M be implemented in certain portions of Virginia. The Virginia I/M program, called Air Check Virginia, is a decentralized I/M program that retains the convenience of having emissions inspections and repairs performed in the same stations but uses the latest accepted technology to determine which vehicles emit excessive pollutants. The jurisdictions in which Air Check Virginia must be implemented include the counties of Fairfax, Prince William, Loudoun, Arlington, and Stafford and the cities of Alexandria, Falls Church, Manassas, Manassas Park, and Fairfax. Vehicle owners in these jurisdictions, as well as regular commuters into the area and vehicles operating on federal installations in these jurisdictions, are subject to Air Check Virginia. These inspections must be performed every two years at a permitted emissions inspection station. If the vehicle does not pass the inspection, necessary repairs must be made.

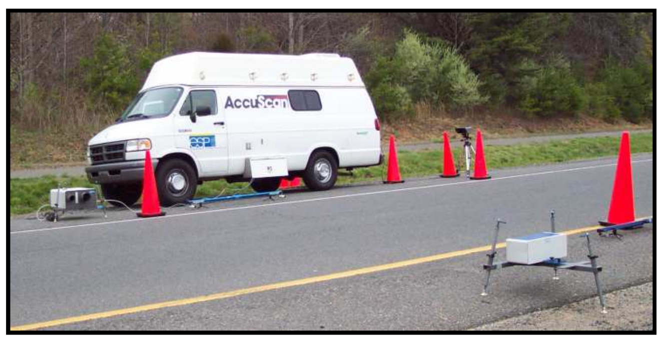


Figure 19: ORE Equipment

As required by the CAA, each vehicle emissions inspection program must conduct remote sensing of vehicle emissions in the program area. In Air Check Virginia's On-Road Emissions (ORE) monitoring program, equipment directing infrared and ultraviolet beams across one lane of traffic measure the concentrations of pollutants in the exhaust of vehicles as they drive by, as shown in Figure 19. These devices measure hydrocarbons, CO, and NO_X. As the vehicle passes the equipment, a camera takes a picture of the vehicle's license plate while measurements are taken of the vehicle's exhaust. This process allows a large number of vehicles to be observed with little or no inconvenience to the vehicle operator. Vehicles that are garaged in the Northern Virginia area and that pollute excessively are required to make any necessary repairs. By identifying these "high emitters" immediately, instead of waiting until the next scheduled emissions inspection that could be many months away, repairs can be made to reduce the levels of harmful pollutants sooner, rather than later. Vehicles that are garaged outside of

Northern Virginia, that frequently commute into Northern Virginia, and that pollute excessively are also required to make necessary repairs. Since these vehicles are garaged outside of the Northern Virginia area and are only subject to the ORE program, vehicles needing repair would continue to pollute except for this program. An added benefit to recognition and repair of emissions problems is often improved fuel economy. Timely repairs may also help to prevent more expensive repairs later. Owners of vehicles observed by remote sensing to be exceptionally clean are notified that their vehicle has received a “clean screen,” which constitutes an emission inspection pass.

The 2012 General Assembly passed legislation expanding the number of vehicles that may be eligible to participate in the ORE clean screen program. Some vehicle owners may find the use of the clean screen notification more convenient and efficient for meeting the emissions inspection requirement, and eventually up to 30% of the cleanest vehicles may be eligible. The State Air Pollution Control Board has amended its I/M regulation (effective December 12, 2012) to implement these statutory changes, which will increase the number of vehicle observations being performed by the ORE program in future years.

This expansion of the ORE program to identify clean vehicles will require that the program collect more vehicle observations. Additional vehicle observations will facilitate the identification of more vehicles that commute into the area and have excess emissions. The Fredericksburg area, as a bedroom community to Northern Virginia, will benefit in that more vehicles garaged in Spotsylvania and Fredericksburg but operated frequently in Northern Virginia may be subjected to ORE testing. Such vehicles needing repairs will be required to do so, thereby reducing emissions in both areas of the Commonwealth.

The benefits from this program are difficult to quantify. However, in this area on-road emissions dominate the emissions inventory, and benefits from repairing high-emitting vehicles can only help to improve air quality. The expansion of the ORE program will take place in the 2014 timeframe.

Depending on future air quality concerns, VDEQ may also study the feasibility of using ORE data in other manners to benefit air quality.

3.4. DMME - Division of Energy Programs

DMME’s Division of Energy serves as the state energy office and oversees a variety of programs that aim to reduce the consumption of energy throughout the Commonwealth of Virginia. These energy savings, which are facilitated in part by the programs described below, will have a beneficial effect on all facets of the Commonwealth’s environment. The generation of electricity is a significant contributor to the ozone precursor NO_X. As these energy efficiency programs are developed and take full effect, the reduction in NO_X emissions should help to improve ozone air quality in all parts of the Commonwealth. The emission reductions associated with the programs listed below have not been included in the inventory estimates listed in Table 4 and Table 5. More detail on the following programs, as well as other programs offered by DMME, may be found at www.dmme.virginia.gov/divisionenergy.shtml.

3.4.1. Virginia Energy Management Program

The Virginia Energy Management Program (VEMP) was selected for expansion within DMME in response to Governor McDonnell's Executive Order 19, "Conservation and Efficiency in the Operation of State Government" (see http://www.governor.virginia.gov/PolicyOffice/Executive Orders/). VEMP provides direction for Virginia's energy management program. The current staff of five employees has developed a roadmap to meet the Governor's order, which increases the scope of the public facilities energy efficiency retrofit program. The objectives of this program that relate directly to improving air quality are:

- Retrofitting 27 million square feet of public buildings by 2020,
- Reducing energy expenses by 20% at executive branch agencies and colleges by 2020,
- Deploying $177 million of private capital between 2011 and 2020 in energy-efficiency improvements to Virginia's public buildings,
- Reducing peak demand by 88 megawatts (MW) no later than 2020.

Quantification of air quality benefits from the reduction of 88 MW of peak electrical demand can be estimated in a number of ways. One approach is to assume that avoided peak demand would have been supplied by demand response programs and therefore would have been generated primarily by diesel engines burning ultra low sulfur diesel (ULSD). Emissions from these types of engines can be approximated very conservatively through the manufacturer's engine certification for Tier 4 regulatory requirements, which mandate an emission rate of no more than 0.67 grams/kilowatt-hour (g/kWh) of NO_X. The equation below demonstrates this methodology. This approach results in estimated emission reductions of 130 pounds/hour (lb/hr) of NO_X.

$$88\,MW * 1{,}000\,\frac{kW}{MW} * 0.67\,\frac{g}{kWh} * 0.0022\,\frac{lb}{gram} = 130\ \frac{lb\ NOx}{hr}$$

Another way to quantify the potential air quality benefit from the reduction of 88 MW at peak demand is to use PJM system mix information for summer months with high demand. This data is available on PJM's website (see http://www.pjm-eiscom/reports-and-news/public-reports.aspx). The PJM system mix for June and July of 2012 emitted approximately 1.1802 pounds/megawatt-hour (lb/MWh) of NO_X and 3.6374 lb/MWh of SO_2. As demonstrated by the equations below, this approach results in estimated emission reductions of approximately 103 lb/hr of NO_X and 320 lb/hr of SO_2.

$$88\,MW * 1.1802\,\frac{lb\ NOx}{MWh} = 103.9\,\frac{lb\ NOx}{hr}$$

$$88\ MW * 3.6374 \frac{lb\ SO2}{MWh} = 320.1\ \frac{lb\ SO2}{hr}$$

These reductions are especially important since peak electrical demand hours often correspond with high ozone readings and poor air quality.

3.4.2. Energize Virginia

Energize Virginia is a revolving loan fund administered by DMME that supports qualifying energy efficiency and renewable energy projects and programs. The first request for proposals for this fund was issued December 5, 2011, and awards from this fund are expected to be approximately $10,500,000. Loans from Energize Virginia may be used to finance renewable energy generation systems and energy conservation equipment, technology, controls, measures, and programs, including those that advance the goals of Governor McDonnell's Executive Order 19. Also eligible are differential costs for alternative fuel and advanced technology vehicles, alternative fuel refueling equipment, and vehicle energy conservation programs, including those that advance the goals of Executive Order 36, "Moving Toward Alternative Fuel Solutions for State-Owned Vehicles" (see http://www.governor.virginia.gov/PolicyOffice/Executive Orders/). This program is directionally correct and will help improve air quality through the use of cleaner alternative fuels and the reduction in use of various fossil fuels.

3.5. Virginia Clean Cities Programs

The mission of the Virginia Clean Cities, Inc. (VCC) is to increase national energy security; improve air quality and public health in the Commonwealth of Virginia; and develop economic, academic, and resource opportunities in the Commonwealth through petroleum reduction. VCC draws stakeholders from all levels of government, the commercial sector, and the manufacturing sector in its quest to cultivate an advanced transportation community in which citizens may learn about a wide range of options and technologies for on-road and off-road engines. The "2011 Annual Report for Virginia Clean Cities" (see http://www.vacleancities.org/tools-resources/reports/) estimates that in 2011, this program helped to reduce Virginia's reliance on petroleum products by the equivalent of over 8,700,000 gallons of gasoline. This directionally correct program is expanding every year to take on more challenges and will continue to provide air quality benefit for the Fredericksburg area as well as throughout the Commonwealth by promoting clean, alternative fuels as well as energy efficiency improvements. The sections below provide information on a few of the notable projects facilitated by VCC. The emission benefits from these projects are not included in the emissions inventories presented Table 4 and Table 5. More information on this organization may be found at www.vacleancities.org.

3.5.1. Virginia Get Ready Project

VCC created and manages the Virginia Get Ready effort, which recently produced the Virginia Get Ready: Electric Vehicle Plan. The goal is to establish Virginia as a leader in the adoption of electric vehicles in order to reduce vehicle emissions, increase energy independence, and generate economic development for the Commonwealth. More information on this directionally correct program may be found at www.virginiaev.org.

3.5.2. Southeast Propane Autogas Development Program

VCC manages the Southeast Propane Autogas Development Program (SPADP). SPADP is a large-scale Recovery Act alternative fuel project aimed at building propane autogas infrastructure in the southeastern United States and encouraging public and private fleets in the region to adopt propane autogas. Propane fuel savings in the program exceed $1.50 per gallon and the fuel represents reductions of 20% in CO and of 40% in NO_X. The program is converting over 1,200 vehicles from gasoline to propane autogas including 125 in Virginia, implementing propane autogas fueling stations along high-traffic routes with partner Alliance AutoGas, and deploying a wide-reaching communications campaign to increase awareness and usage of propane autogas. SPADP provides Virginia with a platform for the state fleet alternative fuel transition effort, which was initiated in October 2012. Although this program is not specific to the Fredericksburg area, the environmental benefits from this program should help to improve local area quality as well as air quality across the Commonwealth.

3.6. Regional Reductions

Since air quality is not solely dictated by emissions within any particular area, but is heavily influenced in the case of the Commonwealth by transported emissions, this section describes other emission reduction efforts that are occurring outside of the Fredericksburg area. Depending on meteorological conditions on any summer day, the reductions described in this section could improve the air quality in the Fredericksburg area and may lessen the transported ozone and precursor load. The emission reductions associated with each of these upwind programs are considerable. With the exception of Section 3.6.5, these reductions have not been included in the summary of emissions for Virginia found in Table 4.

3.6.1. Honeywell Hopewell SCR Installation

Honeywell International Inc.-Hopewell Plant is a chemical manufacturing facility in Hopewell, Virginia. As a result of negotiations to resolve federal compliance issues, VDEQ issued a federally enforceable permit to this facility dated June 28, 2011, which requires the installation and operation of eight selective catalytic reduction (SCR) systems on eight of the ten largest-emitting units on site. Each SCR is expected to achieve NO_X reductions of at least 95%. The permit requires installation of the SCR in a phased manner, where two SCR were required to begin operating on December 31, 2012. Others are required on a timeline such that all eight SCR are installed and operating by June 30, 2019.

Table 8 provides data on the actual emissions of these units from 2007 through 2011 and the expected emission rates after control, as listed in the June 28, 2011 permit. This table shows that the emissions from this equipment have historically been between 7,400 tpy and 8,100 tpy NO_X.

After installation of controls, this equipment will be allowed to emit no more than 1,850 tpy of NO_X. This program will provide reductions of at least 5,791.6 tpy of NO_X by June 30, 2019, as compared to actual 2011 annual emissions. The benefits from this program are not included in the overall NO_X emission estimates listed in Table 4 and should help improve ozone air quality throughout the Commonwealth.

Table 8: Honeywell Hopewell NO_X Reductions

	Actual Emissions of NOx, tpy					Permitted Limits of NOx, tpy			
	2007	**2008**	**2009**	**2010**	**2011**	**6/30/13**	**6/30/15**	**6/30/2017**	**6/30/2019**
Nitrite Towers									
A	969.4	1,151.6	1,305.3	1,228.7	1,152.3	1,673.0	1,673.0	117.0	117.0
B	863.6	881.4	855.1	971.7	938.4	1,844.0	123.0	123.0	123.0
C	949.2	1,129.9	1,090.1	1,055.5	1,001.4	102.0	102.0	102.0	102.0
D	366.3	435.5	451.8	420.8	332.2	600.0	600.0	600.0	33.0
E	426.6	495.0	541.0	454.4	422	600.0	600.0	600.0	600.0
Disulfonate Towers									
A	1,129.1	1,029.4	1,085.3	1,004.2	1,124.8	1,244.0	1,244.0	87.0	87.0
B	898.8	891.6	954.4	879.4	895.7	1,092	84.0	84.0	84.0
C	882.3	899.4	812.5	878.1	843.7	72.0	72.0	72.0	72.0
D	518.7	534.7	493.9	577.1	399.7	600.0	600.0	600.0	32.0
E	471.6	552.8	518.6	538.5	531.4	600.0	600.0	600.0	600.0
Totals:	**7,475.6**	**8,001.3**	**8,108.0**	**8,008.4**	**7,641.6**	**8,427.0**	**5,698.0**	**2,985.0**	**1,850.0**

Data Source: VDEQ-CEDS

3.6.2. Invista

Invista owns and operates a synthetic fiber production facility located in Waynesboro, Virginia. The facility has a powerhouse consisting of three boilers that predominantly use coal, with a total heat input of approximately 600 million British thermal units/hour (mmbtu/hr). Table 9 provides emissions information on the existing powerhouse for the facility.

Table 9: Invista Powerhouse Emissions 2007-2011, SO_2 and NO_X

Year	Tons NO_X/Year	Tons SO_2/Year
2011	184.0	567.8
2010	198.5	629.1
2009	237.7	768.1
2008	275.7	843.2
2007	353.2	924.2

Data Source: VDEQ-CEDS

The facility received a federally enforceable permit from VDEQ to retire the existing boilers and in their place install two new, natural-gas fired boilers that use distillate oil and liquefied petroleum gas as back-up fuels. These new units are permitted at 33.8 tpy NO_X and 2.3 tpy SO_2. This change would reduce the NO_X emissions by more than 100 tpy and the SO_2 emissions by more than 500 tpy, as compared to 2011 values. These reductions have not been included in the Virginia-wide emissions estimates listed in Table 4. The facility commenced construction on these boilers in December of 2012.

3.6.3. Celco

Celanese Acetate, LLC (Celco) is a large manufacturing facility located in Giles County, Virginia. The facility primarily manufactures cellulose acetate flake and fiber using wood pulp and acetic acid as raw materials. The facility has a steam plant consisting of seven coal-fired boilers and two natural gas-fired boilers. The seven coal-fired boilers have a total capacity of approximately 1,400 mmbtu/hr heat input. The facility received a federally enforceable permit on December 6, 2012, allowing the construction of six natural gas-fired boilers that will be used in place of the seven coal-fired boilers. The retirement of the seven coal-fired boilers, which operate with minimal pollution control, and their subsequent replacement by natural gas-fired boilers with low NO_X burners, will reduce emissions of SO_2 and NO_X significantly from this facility. Table 10 provides the power house emissions since 2007 from this facility.

The total emissions from the new natural gas-fired boilers are limited to no more than 333 tpy of NO_X and 6 tpy of SO_2. Once these changes are made, the steam plant will emit 3,000 tons of NO_X and 6,000 tons of SO_2 less than previous years. The estimated time frame for these changes to take effect is 2015. These reductions were not included in the overall emissions estimates provided in Table 4.

Table 10: Celco Powerhouse Emissions 2007-2011, SO_2 and NO_X

Year	Tons NO_X/Year	Tons SO_2/Year
2011	3,539.9	6,540.2
2010	3,438.8	6,325.1
2009	3,775.9	6,551.1
2008	3,907.1	6,631.5
2007	3,609.2	6,499.9

Data Source: VDEQ-CEDS

3.6.4. Fort A.P. Hill Sustainability Programs

Fort A.P. Hill is a regional training center that provides realistic joint and combined arms training, logistics, and support to America's defense forces. This installation is situated in Caroline County, just south and east of the Fredericksburg area, as shown in Figure 20, and maintains an all-purpose, year-round training facility that sits on 75,794 acres. The training facility serves active, reserve, and National Guard troops of the Army, Marine Corps, Navy, and Air Force as well as personnel from other government agencies.

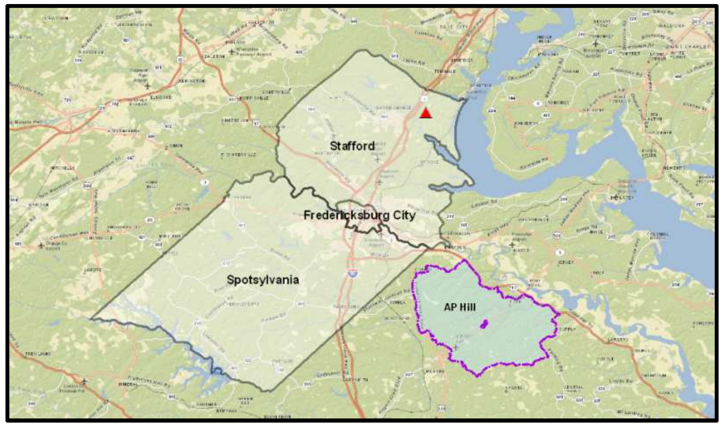
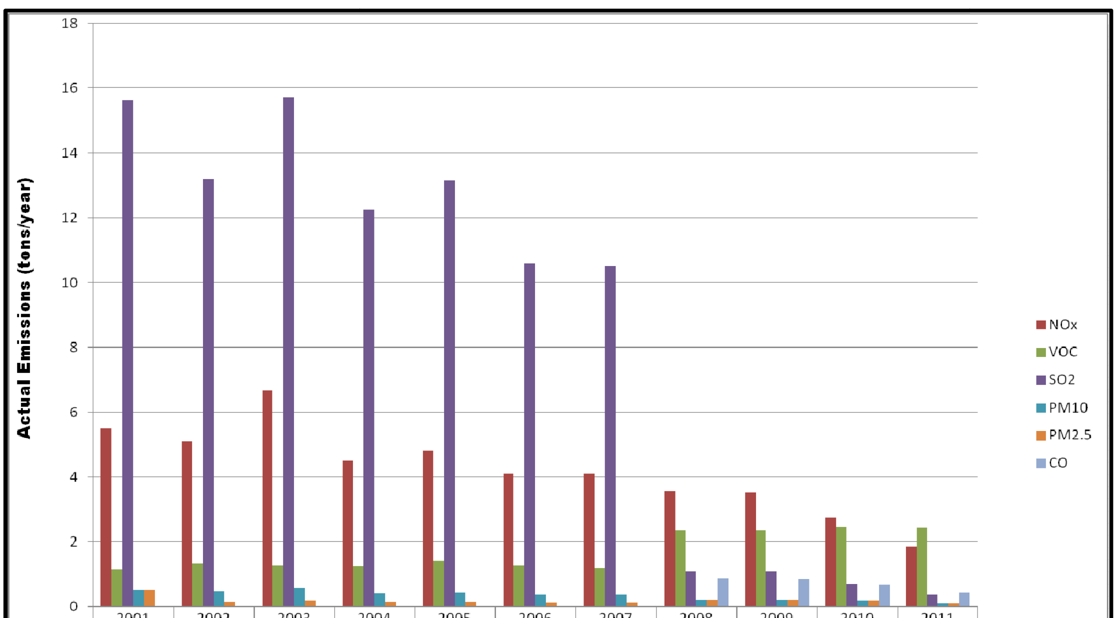


Figure 20: Fort A. P. Hill

Fort A.P. Hill has instituted several programs to reduce its impact on the environment. These programs reduce air emissions, as shown in Figure 21, and have other co-benefits, such as reducing dependence on foreign oil. These programs include the use of more efficient heating systems, use of ULSD in all diesel-fired equipment, procurement of EPA-certified engine generators for any new construction or facility improvement, and the use of environmentally friendly and low-VOC alternatives to products used on the installation. Other programs reduce energy usage. For example, Fort A.P. Hill currently has two new facilities under construction, both of which will meet the accreditation requirements for the Leadership in Energy and



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NOx	5.5	5.1	6.65	4.52	4.8	4.1	4.1	3.55	3.51	2.75	1.85
VOC	1.15	1.32	1.27	1.23	1.4	1.27	1.2	2.35	2.35	2.45	2.43
SO2	15.62	13.2	15.73	12.25	13.14	10.58	10.51	1.08	1.07	0.69	0.37
PM10	0.52	0.47	0.59	0.42	0.45	0.374	0.375	0.19	0.19	0.16	0.11
PM2.5	0.52	0.15	0.18	0.14	0.15	0.123	0.122	0.19	0.19	0.16	0.11
CO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.87	0.86	0.67	0.44

Figure 21: Fort A.P. Hill Emission Trends *(Data Source: Fort A.P. Hill)*

Environmental Design (LEED) Silver certification. New buildings have also been equipped with highly efficient tankless hot water heaters and ground source heat pumps. These devices reduce the need for energy, avoiding air emissions and saving money on energy usage.

The main contributor to Fort A.P. Hill's reduction in NO_X emissions is the transition from distillate oil-fired heating equipment to propane-fired equipment. Propane combustion creates much less NO_X and SO_2 emissions than oil combustion, and reducing the amounts emitted of these pollutants will help to improve both ozone and $PM_{2.5}$ air quality. Figure 22 shows the outcomes from this transition, in terms of fuels used as well as NO_X emissions.

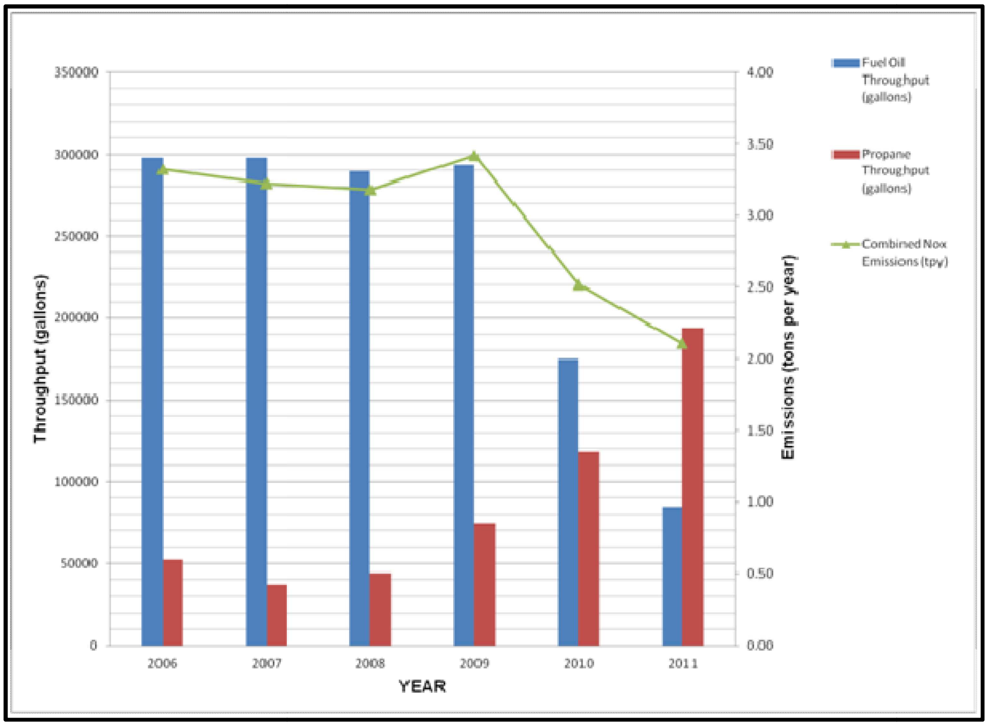


Figure 22: Fuel Consumption Comparison for Fort A.P. Hill *(Data Source: Fort A.P. Hill)*

The benefits associated with the programs instituted by Fort A.P. Hill have not been included in the overall emission estimates provided in Table 4.

3.6.5. Dominion Generating Unit Retrofits, Retirements, and Fuel Conversions

Dominion is one of the nation's largest producers and transporters of energy, with a portfolio of approximately 27,400 megawatts of generation; 11,000 miles of natural gas transmission, gathering, and storage pipeline; and 6,300 miles of electric transmission lines. Dominion has taken a number of steps over the last 15 years to reduce emissions from its electric generation fleet corporate wide and in Virginia. Since 1998, the company has reduced NO_X and SO_2 emissions from its generation fleet that serves Virginia by 77% and 81%, respectively. In addition, mercury emissions have been reduced by about 65%. To meet new EPA regulations, over the next several years the company anticipates further reductions in emissions through coal unit retirements, conversion from coal to other fuel sources including natural gas and biomass, and new transmission capacity. In addition, Dominion has a large number of programs designed to promote the use of alternative fuels and alternative fuel vehicles as well as energy conservation programs for its residential and business customers. It also offers its customers the option to voluntarily support renewable energy through its Dominion Green Power® Program.

As part of a federally-enforceable April 2003 Consent Decree between Dominion and EPA (United States v. Virginia Electric and Power Co., Civil Action No. 03-CV-517A, entered 10/10/2003), Dominion has installed SO_2 and/or NO_X control devices on a number of coal-fired units in the Commonwealth. The Chesterfield Power Station, located in Chesterfield County, has had three of the four coal-fired units retrofitted with SCR for NO_X control since 2002. These units have also been retrofitted for SO_2 control, with the fourth unit being tied into the SO_2 flue gas desulfurization (FGD) equipment in 2012. The FGD equipment at Chesterfield Power Station achieves approximately 95% reduction of SO_2 emissions, as well as significant emission reductions in other acid gases, mercury, and direct particulate matter.

As part of the same consent decree, Dominion has also installed control devices on a number of coal-fired units in the Hampton Roads area. The Chesapeake Power Station, located in the City of Chesapeake, retrofitted Units 3 and 4 with SCR for NO_X control in 2003. Beginning in 2013, the Consent Decree requires year round operation of the SCRs.

Additionally, Dominion filed its annual Integrated Resource Plan (IRP) with the SCC on August 31, 2012. The IRP is a mandatory 15-year, forward-looking plan for matching generation, transmission, and demand-side management resources with expected demand. Information in the IRP is not a commitment to build any particular project or retire any particular unit but represents the company's evaluation to meet the expected electricity needs of its customers in a cost-effective manner over the next 15 years. This document notes that current plans call for the retirement of all four coal-fired units at the Chesapeake Energy Center as well as the retirement of Units 1 and 2 at the Yorktown Power Station, located in York County, in the 2015 timeframe. Dominion's IRP is available at https://www.dom.com/about/integrated-resource-planning.jsp.

Dominion is also in the process of converting three formerly coal-fired power plants to biomass, a renewable energy source, and will be completing these projects some time in 2013. The current capacity of each of these facilities is 63 MW, and these power plants are located in the City of Hopewell, Southampton County, and Campbell County. The switch to biomass as the primary fuel should reduce emissions of NO_X, SO_2, and mercury from these facilities.

As required by a condition in the federally-enforceable construction permit issued by VDEQ to the Virginia City Hybrid Energy Center, which is located in southwest Virginia, Dominion plans to convert the Bremo Power Station to natural gas, pending SCC approval. Bremo Power Station is a 222 MW coal-fired electrical generating facility consisting of two coal-fired units, Unit 3 and

Unit 4, and is located in Fluvanna County. This conversion is expected to be completed in the 2014 time frame.

The emission benefits of the changes to these electrical generating units have been included in Table 4, and more information on these estimates may be found in Appendix A.

4. Ozone Advance Reporting and Checklist

As part of the Action Plan process, VDEQ intends to report annually to EPA on the programs contained in this document. To facilitate the reporting process, VDEQ will coordinate with stakeholders and report to EPA using the checklist in Appendix D. This checklist is not intended to be prescriptive or a mandate. Rather, it provides a structure to the reporting process and potential milestones for each program listed within this action plan. The checklist in Appendix D may also be used to report on other initiatives not included in this plan or future initiatives that are still being formulated.