Caroline County Ozone Advance Action Plan

Annual Report for 2015

Abbreviations

CMAQ	Congestion, Mitigation, and Air Quality
DMME	Virginia Department of Mines, Minerals, and Energy
EGU	electrical generating unit
EPA	United States Environmental Protection Agency
EV	electric vehicles
FAMPO	Fredericksburg Area Metropolitan Planning Organization
FGD	flue gas desulfurization unit
FRM	Federal reference method
LEED	Leadership in Energy and Environmental Design
MATS	Mercury and Air Toxics Rule
$\mu g/m^3$	micrograms per cubic meter
MW	megawatts
NAAQS	National Ambient Air Quality Standard
NO_X	nitrogen oxides
ORE	On Road Emissions Program
$PM_{2.5}$	fine particulate matter less than 2.5 micrometers in diameter
ppb	parts per billion
SCR	selective catalytic reduction
SF	square foot
SO_2	sulfur dioxide
VCC	Virginia Clean Cities, Inc.
VDEQ	Virginia Department of Environmental Quality
VEMP	Virginia Energy Management Program
VOC	volatile organic compounds
VPA	Virginia Port Authority

Virginia Ozone and $PM_{2.5}$ Air Quality, October 2015 Report

The Ozone Advance program is a collaborative effort between federal, state, and local governments as well as area stakeholders to develop an Action Plan for a particular area. Action Plans encourage programs and practices that reduce emissions of ozone and fine particulate ($PM_{2.5}$) precursors so that citizens may continue to benefit from healthy air quality. These Action Plans help to ensure that covered areas remain compliant with federal National Ambient Air Quality Standards (NAAQS) and provide a roadmap for progress toward compliance with any future NAAQS updates. The U.S. Environmental Protection Agency (EPA) provided programmatic guidance concerning the Ozone Advance program in April 2012. After reviewing air quality data and considering the information in the guidance document, leaders in Caroline County and the Commonwealth of Virginia developed the Caroline County Ozone Advance Action Plan to promote continued good air quality.

The Action Plan, which EPA received in October 2013, provided a great deal of information on the air quality in Caroline County and across Virginia. The plan is available on the Virginia Department of Environmental Quality (VDEQ) website at http://www.deq.virginia.gov/Programs/Air/AirQualityPlans/OzoneandPM25RegionalPlanningActivities.aspx. This report updates the air quality information in the Action Plan and shows that air quality improvements are continuing. The improvements are the result of the emission reductions achieved from the many state, federal, and local air pollution control programs being implemented as well as the favorable meteorology during the summers of 2013, 2014, and 2015.

Ozone

Photochemical reactions between volatile organic compounds (VOC) and nitrogen oxides (NO_X) create ozone when they combine in the presence of sunlight. Ozone is the primary component of smog and a lung irritant. Populations that are especially susceptible to impacts from this pollutant include elderly people, children, and those with lung ailments such as asthma and emphysema. Ozone also interferes with plants' abilities to process food and ward off diseases.

Emission reductions of NO_X, the primary precursor to ozone in the Commonwealth, have been significant in recent years. More reductions are expected, as detailed in the Action Plan, due to the new Tier 3 Motor Vehicle Emission and Fuel Standards that EPA finalized on April 28, 2014 (79 FR 23414).

Meteorology also plays a key role in ozone formation. The meteorology in 2009, 2013, 2014, and 2015 was not conducive to ozone formation due in part to greater than normal precipitation. In addition, below normal ozone season maximum daily temperatures in 2009, 2013, and 2014 contributed to lower ozone values. The meteorology during the summers of 2010, 2011, and 2012 was more conducive to ozone formation. The 2010 ozone season in Virginia was the warmest on record. The 2011 and 2012 ozone seasons had higher than average maximum daily temperatures although precipitation in 2011 and 2012 was near or above normal levels. Table 1 below summarizes Virginia's ozone season temperature and precipitation data for the period 2009 through 2015.

Virginia Ozone and $PM_{2.5}$ Air Quality, October 2015 Report

Table 1: Virginia Ozone Season Meteorology Data, 2009-2015

	Virginia Maximum Daily Average Temperature (°F) (May through September)			Virginia Precipitation (May through September)		
Year	**Average Maximum Temperature**	**Normal**	**Departure from Normal (20th Century)**	**Total Precipitation (inches)**	**Normal**	**Departure from Normal (20th Century)**
2009	80.1	81.1	-1.0	23.31	20.23	+3.08
2010	84.9		+3.8	19.52		-0.71
2011	82.5		+1.4	23.74		+3.51
2012	82.4		+1.3	20.50		+0.27
2013	79.8		-1.3	23.96		+3.73
2014	80.7		-0.4	19.32		-0.91
2015	82.2		+1.1	22.27		+2.04

Figure 1 shows the ozone air quality as measured at the Caroline County monitor and at the nearby Stafford County monitor. Air quality in this part of the Commonwealth has improved over the last decade, and preliminary 2013-2015 monitoring data show a design value of 62 parts per billion (ppb) for the Caroline County monitor and 63 ppb for the Stafford County monitor.

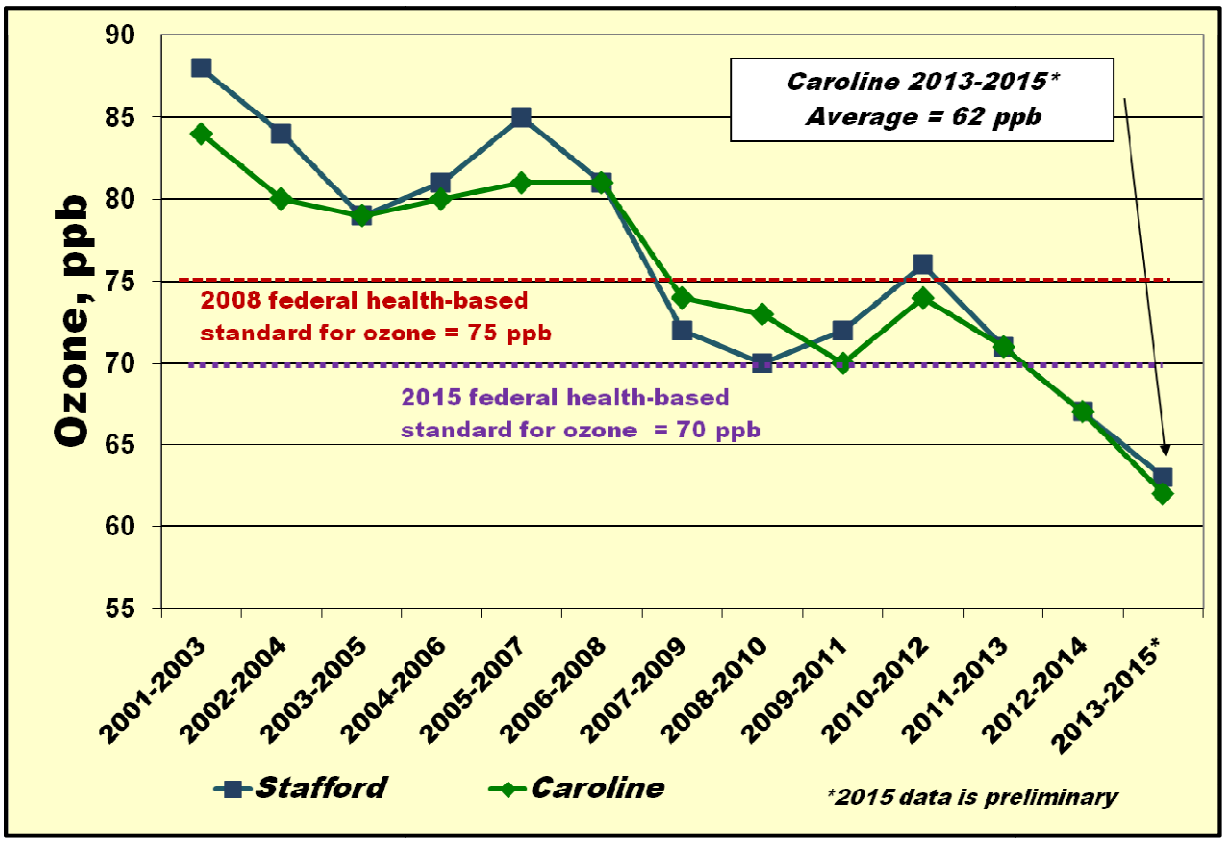
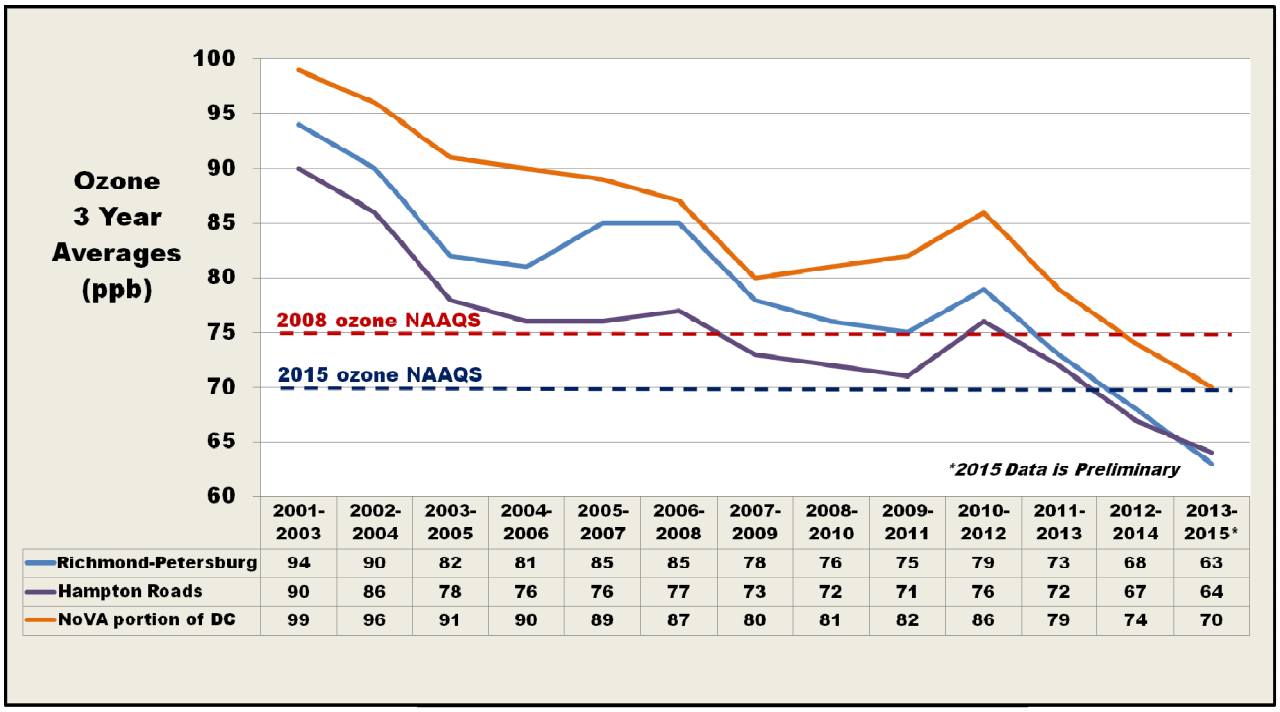


Figure 1: Ozone Air Quality, Caroline County and Stafford County

The long term improvement depicted in Figure 1 demonstrates that the emission reductions achieved both locally and regionally have improved air quality to the point where ozone air quality complies with, and is significantly beneath, the 2008 ozone NAAQS of 75 ppb. EPA published a more stringent ozone NAAQS on October 1, 2015, revising the standard to 70 ppb. Preliminary air quality data from the Caroline County and Stafford County monitors for 2013 through 2015 also comply with this new standard.

Monitoring data across Virginia show similar patterns of air quality improvement. Figure 2 provides this data for the Northern Virginia, Hampton Roads, and Richmond-Petersburg areas. All areas of the Commonwealth are benefitting from the ozone precursor emission reductions generated by federal, state, and local control programs, and the Commonwealth has seen tremendous improvements in ozone air quality over the last decade. Based on preliminary 2013-2015 data, air quality in all areas of the Commonwealth complies with the 2008 ozone NAAQS and the 2015 ozone NAAQS.



	2001-2003	2002-2004	2003-2005	2004-2006	2005-2007	2006-2008	2007-2009	2008-2010	2009-2011	2010-2012	2011-2013	2012-2014	2013-2015*
Richmond-Petersburg	94	90	82	81	85	85	78	76	75	79	73	68	63
Hampton Roads	90	86	78	76	76	77	73	72	71	76	72	67	64
NoVA portion of DC	99	96	91	90	89	87	80	81	82	86	79	74	70

Figure 2: Ozone 3-Year Averages in Virginia Metropolitan Areas

Figure 3 shows the number of ozone air quality exceedence days in Virginia since 1997 based on the 2008 ozone NAAQS. In 1998, Virginia recorded 82 exceedence days statewide. In 2010, the hottest and one of the driest summers on record, this value dropped to 25 exceedence days, and preliminary data for the summer of 2015 shows only three exceedence days recorded.

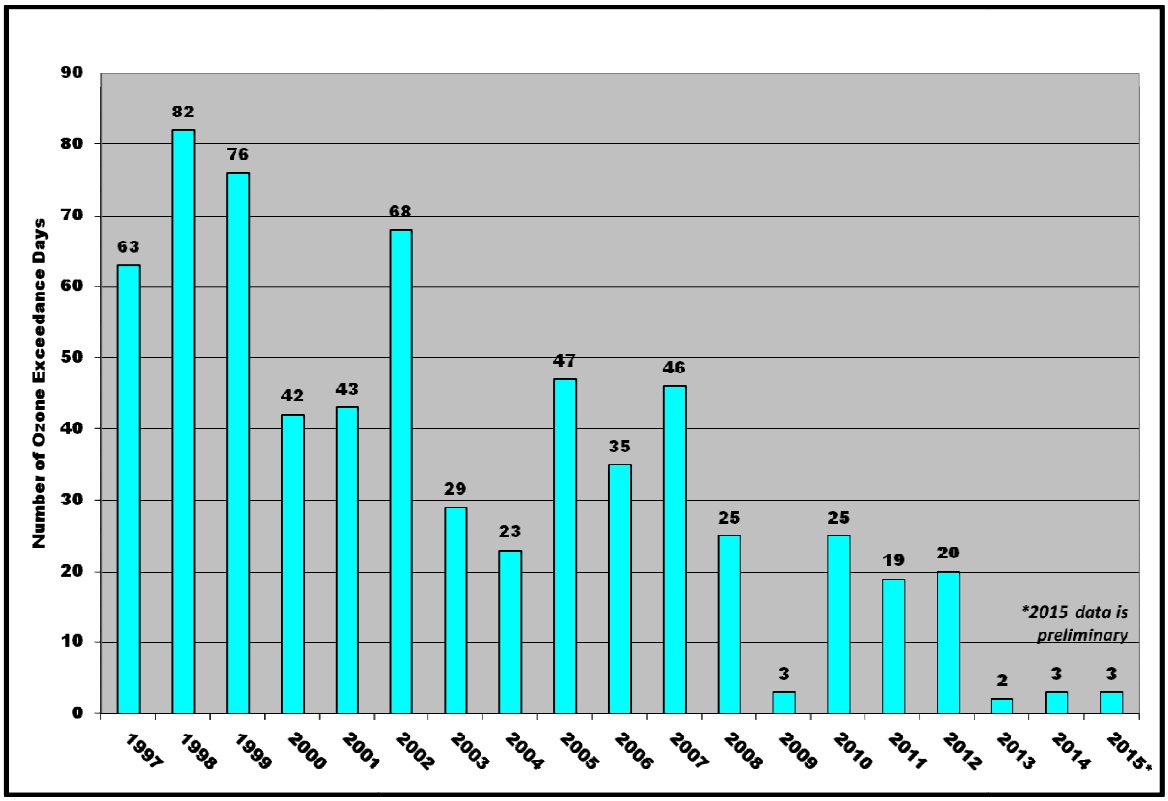


Figure 3: Virginia Ozone Exceedence Day Trends. 2008 Ozone NAAQS

$PM_{2.5}$

The federal regulations define $PM_{2.5}$ as any airborne particle of solid or liquid matter that is less than or equal to 2.5 micrometers in diameter, approximately $1/30^{th}$ the width of a human air. Exposure to high levels of $PM_{2.5}$ adversely affects human health, and the main impacts of $PM_{2.5}$ are on the respiratory system and the cardiovascular system. Children, the elderly, and individuals with pre-existing pulmonary or cardiac disease are the most susceptible to $PM_{2.5}$ pollution.

Federal regulations provide two health-based standards for $PM_{2.5.}$ The first is a daily, or 24-hour, standard of 35 $\mu g/m^3$, established in 2006. The second is an annual average of 12.0 $\mu g/m^3$, established in 2012. All monitors in Virginia comply with these NAAQS. On October 6, 2014, EPA finalized a redesignation request for the only $PM_{2.5}$ nonattainment area in Virginia, the Metropolitan Washington, D.C. 1997 $PM_{2.5}$ NAAQS nonattainment area (79 FR 60081). This redesignation became effective November 5, 2014. Air quality in this region has been in the healthy range for several years, and redesignation of the area validates the numerous controls programs implemented in Northern Virginia and across the Commonwealth.

Table 2 provides information from one $PM_{2.5}$ Federal Reference Method (FRM) monitoring site in each area of the Commonwealth. While Caroline County does not have a $PM_{2.5}$ FRM monitoring site located within its boundaries, $PM_{2.5}$ air quality within Caroline County should reflect similar values due to the regional nature of $PM_{2.5}$ pollution. These data also show that $PM_{2.5}$ air quality continues to improve and that a significant buffer exists between the monitored

values and the health-based standards. This improvement is largely due to sulfur dioxide (SO_2) emission reductions because SO_2 forms sulfates, a component of $PM_{2.5}$, in the atmosphere.

Table 2: 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		Virginia Beach 51-810-0008	
	Annual	24-Hour	Annual	24-Hour	Annual	24-Hour	Annual	24-Hour
2001-2003	14.6 µg/m^3	38 µg/m^3	13.6 µg/m^3	34 µg/m^3	14.3 µg/m^3	33 µg/m^3	12.6 µg/m^3	33 µg/m^3
2002-2004	14.5 µg/m^3	37 µg/m^3	13.4 µg/m^3	33 µg/m^3	13.9 µg/m^3	31 µg/m^3	12.5 µg/m^3	32 µg/m^3
2003-2005	14.6 µg/m^3	36 µg/m^3	13.6 µg/m^3	33 µg/m^3	14.0 µg/m^3	30 µg/m^3	12.6 µg/m^3	30 µg/m^3
2004-2006	14.2 µg/m^3	34 µg/m^3	13.4 µg/m^3	30 µg/m^3	13.9 µg/m^3	31 µg/m^3	12.5 µg/m^3	30 µg/m^3
2005-2007	14.0 µg/m^3	32 µg/m^3	13.3 µg/m^3	31 µg/m^3	13.9 µg/m^3	30 µg/m^3	12.1 µg/m^3	30 µg/m^3
2006-2008	12.9 µg/m^3	30 µg/m^3	12.4 µg/m^3	28 µg/m^3	12.7 µg/m^3	28 µg/m^3	11.9 µg/m^3	30 µg/m^3
2007-2009	11.9 µg/m^3	27 µg/m^3	11.2 µg/m^3	24 µg/m^3	11.2 µg/m^3	25 µg/m^3	10.7 µg/m^3	26 µg/m^3
2008-2010	10.8 µg/m^3	24 µg/m^3	10.3 µg/m^3	21 µg/m^3	10.2 µg/m^3	22 µg/m^3	10.3 µg/m^3	24 µg/m^3
2009-2011	10.1 µg/m^3	22 µg/m^3	9.6 µg/m^3	21 µg/m^3	9.9 µg/m^3	21 µg/m^3	9.6 µg/m^3	23 µg/m^3
2010-2012	9.9 µg/m^3	22 µg/m^3	9.5 µg/m^3	21 µg/m^3	9.8 µg/m^3	20 µg/m^3	9.3 µg/m^3	24 µg/m^3
2011-2013	9.4 µg/m^3	21 µg/m^3	8.7 µg/m^3	21 µg/m^3	9.0 µg/m^3	18 µg/m^3	8.5 µg/m^3	22 µg/m^3
2012-2014	9.0 µg/m^3	21 µg/m^3	8.5 µg/m^3	19 µg/m^3	8.6 µg/m^3	16 µg/m^3	8.0 µg/m^3	20 µg/m^3

Data Source: VDEQ-Air Quality Monitoring Division

Figure 4 shows the improvement in monitored sulfate concentrations over the last several years, as measured by the $PM_{2.5}$ speciation monitor located in Henrico, Virginia. This monitor has the ability to measure the components of $PM_{2.5}$ pollution. The sulfate portion of $PM_{2.5}$ has decreased markedly, as has the organic carbon portion.

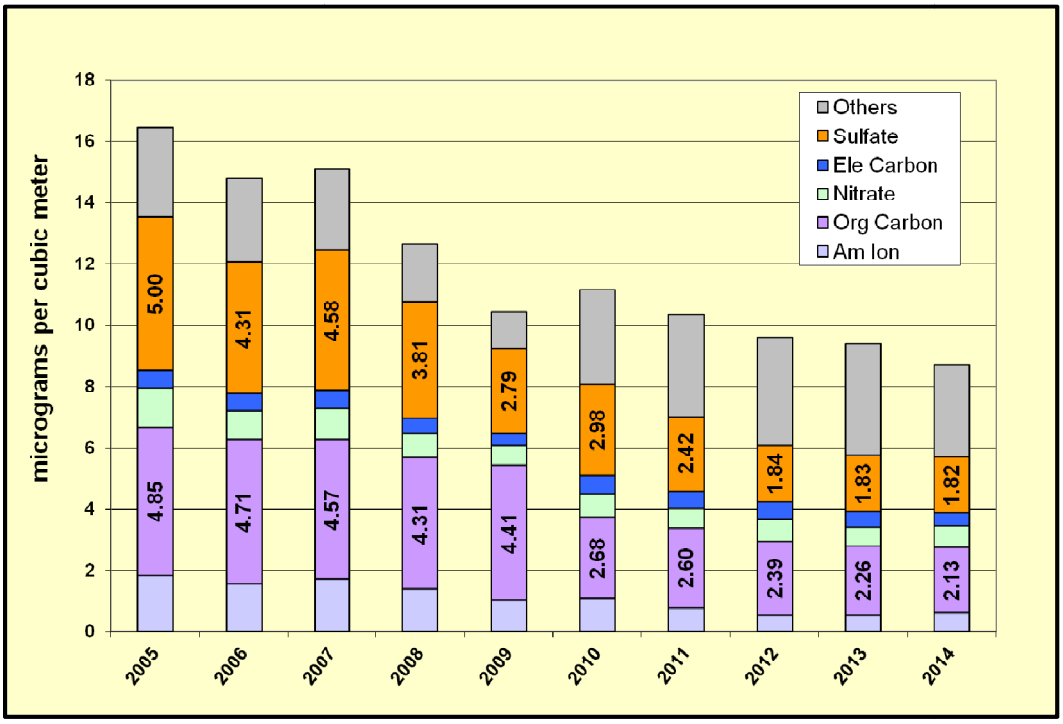


Figure 4: Henrico Speciation Data

Emission Reduction Programs

Existing control programs are reducing pollution and improving air quality. These programs are helping Virginia get a head start on meeting the 2015 ozone NAAQS of 70 ppb. Upcoming control programs, such as the Tier 3 vehicle standards, should continue improving ozone air quality in the Commonwealth of Virginia.

The following tables provide an update on the programs described in the Caroline County Ozone Advance Action Plan. Table 3 provides information on programs that are in development or ongoing. Table 4 provides information on programs that are completed. VDEQ has provided a disk containing supporting information, including the various documents referenced in the tables below.

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Table 3: Emission Reduction Programs-In Development or Ongoing

Control Program	Stakeholders	Time Frame	Milestones	Program Type	Feedback & Comments
Fredericksburg Area Metropolitan Planning Organization					
CMAQ Projects	FAMPO	2012-2018	Programs initiated	Voluntary	• See FAMPO-Resolution-13-13-Allocation-FY14-19-RSTP-CMAQ-Funds.pdf.
GWRideConnect	FAMPO GWRideConnect	On-going	VMT avoided annually Vehicle trips avoided annually Vanpools formed	Voluntary	• See GWRideConnect Annual Work Plan Outline FY16.docx • http://www.gwrideconnect.org
Fort A.P. Hill					
Energy Efficiency/ Renewable Energy	A.P. Hill	On-going	LEED certifications Fuel usage	Voluntary	• New Army Reserve Center Complex-LEED Certified Gold July 2013 • AWG Complex certified LEED Silver in near term. • See NOx emissions from fuel FY15.pdf • See Bldg sf v Energy FY15.pdf
Emissions Impact	A.P. Hill	On-going	Annual emissions estimates	Voluntary	• See AP Hill – annual report rev.docx
Virginia Department of Environmental Quality					
Expansion of ORE	VDEQ	Full Impl: 12/2015	Program implemented?	Regulation	• Full implementation expected December 2015
DMME-Division of Energy					
VEMP	DMME	Ongoing through 2020	SF of public buildings retrofitted? Private capital deployed? Energy savings?		• Total value of contracts through FY 2014 is $685 million. Cumulative estimated CO_2 emission reductions through calendar year 2014 are 271,732 tons. • See VEMP – Performance Contracting.docx.

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Control Program	Stakeholders	Time Frame	Milestones	Program Type	Feedback & Comments
Energize Virginia	DMME	2011-2016	Funds awarded Programs to be implemented	Voluntary	• More than $10M awarded in 2012. Projects include energy performance contracts, and a solar thermal system. • More than $1.7M has been repaid as of 01/31/2015. • See Energize Virginia.docx.
Virginia Clean Cities					
Virginia Get Ready	VCC	On-going	Statewide network of chargers	Voluntary	• Deployed two EV planning docs in 2013 as well as tools for advancing electric vehicles and infrastructure. • VA registrations of electric vehicles increased from 1,257 in 2013 to 1,837 in 2014. • VA public charging stations increased in number from 212 in 2013 to 274 in 2014. • Deployed dozens of DC Fast Chargers in major cities in 2014 • See http://www.virginiaev.org/ • See va_electric+hybrid_vehicles_and_stations_2008-2014.xlsx
Regional Reductions					
Honeywell SCR Installation	VDEQ	12/2012 through 06/2019	# of SCR installed? Annual emissions of NO_X?	Permitting; Consent Agreement	• Two SCR commenced operation December 2012. • Two additional SCR began operating October of 2014.
Celco Powerhouse Project	VDEQ	2015	Construction begun? New units operational? Coal units retired?	Permit	• Facility commenced operation of units 10, 11, 12, and 14, based on correspondence dated 02/04/2015. • Facility commenced operation of unit 13, based on correspondence dated 03/18/2015.
Generating unit retrofits and fuel switches	Dominion	2012-2018		MATS	• Dominion will retire two coal-fired units at the Yorktown Power Station contingent upon the completion of a transmission upgrade project expected to be in service no earlier than 2nd quarter 2017.

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Control Program	Stakeholders	Time Frame	Milestones	Program Type	Feedback & Comments
Other Programs Not Included In The 2013 Caroline County Ozone Advance Plan					
Virginia Offshore Wind Technology Advancement Project	Dominion	2017-2018	n/a	Voluntary	• Dominion is planning an offshore wind technology testing facility, which will consist of two offshore wind turbines with a combined capacity of approximately 12 MW. https://www.dom.com/about/stations/renewable/vowtap.jsp • On September 4, 2013, Dominion bid $1.6 million to win the lease for 112,800 acres off the Virginia coast to develop an off-shore wind farm capable of generating up to 2,000 MW of electricity, and is actively developing this large-scale commercial off-shore wind project. https://www.dom.com/about/stations/renewable/commercial-offshore-wind-development-project.jsp • On March 13, 2015 DMME submitted a signed lease offer to the Bureau of Ocean Energy Management for counter signature, along with documents designating Dominion Virginia Power as the Lease Operator - a major milestone clearing the way for construction of the 12 MW VOWTAP project.
Solar Resource Development	Community Energy/Amazon Web Services	Dec 2016, estimated	n/a	Voluntary	• VDEQ issued a permit by rule (PBR) for the construction of an 80 MW solar facility to be constructed in northern Accomack County. Amazon Web Services will purchase the energy to support data center activities.
Solar Resource Development	Dominion	Oct 2016, estimated	n/a	Voluntary	• Dominion filed an application with the Virginia SCC on 01/20/2015 to build a 20 MW solar facility in Fauquier County near Remington Power Station. • See http://www.richmond.com/business/local/article_f6a2af9d-4787-50fc-85ea-74bdf5eead10.html and https://www.dom.com/corporate/what-we-do/electricity/generation/solar/remington-solar-power-facility
Green Operators Program at the Port of Richmond	VPA, RAMPO	2013-2015	n/a	Voluntary; funded by CMAQ and by DERA	• Funds awarded from CMAQ to begin a retrofit/replacement operation for 100 Class 8b dray trucks that are 2003 MY or older; Estimated emission reductions of 107 tpy VOC and 4 tpy NO_X. Additional funds received from DERA. This program should benefit all areas of the Commonwealth with significant truck traffic, including areas along the major interstates like Caroline County.

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Table 4: Emission Reduction Programs-Completed

Control Program	Stakeholders	Time Frame	Program Type	Feedback & Comments
Virginia Clean Cities				
Propane Autogas Program	VCC	2009-2013	Voluntary	• Program concluded in 2013. • Converted 117 vehicles to autogas in VA • Alternative fuel vehicles estimated to reduce NO_X emissions 273 tons annually in VA
Regional Reductions				
Invista Powerhouse Project	VDEQ	2013-2014	Permit	• New boilers started operation in January of 2014. • Shutdown request for existing boilers 1 and 2 effective January 9, 2014. • Shutdown request for existing boiler 3 effective March 12, 2014.
Generating unit retrofits and fuel switches	Dominion	2014	Permit	• Bremo Bluff ceased burning coal in fall of 2013. Facility is now burning solely natural gas.
		2012-2013	Permit	• Permits received for Hopewell, Altavista, and Southampton fuel switch from coal to biomass. Units have begun burning biomass and no longer burn coal.
		2012	MATS; Consent Agreement	• Installation of SO_2 scrubbers complete for all coal units at the Chesterfield Power Station near Richmond, VA.
		2014	MATS; 2010 SO_2 NAAQS	• Chesapeake Energy Center retired all coal-fired units in December 2014.

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Control Program	Stakeholders	Time Frame	Program Type	Feedback & Comments
New, low-emitting facilities	Dominion	2015	Permit	• Dominion began commercial operation of the Warren County Power Station in December 2014. This operation is a combined cycle facility rated at about 1,329 MW burning natural gas and equipped with state of the art controls. https://www.dom.com/residential/dominion-virginia-power/news/customer-newsletters/feb15-meeting-steeper-power-peaks
National Parks	VCC, NPS	2014	Voluntary	• NPS added 12 prone lawn mowers and 2 electric vehicles to its fleet, along with a public EV charging station and 2 private EV charging stations.