Caroline County Ozone Advance Action Plan

Annual Report for 2016

Abbreviations

CMAQ	Congestion, Mitigation, and Air Quality
CPCN	certificate of public convenience and necessity
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
FRM	Federal reference method
LEED	Leadership in Energy and Environmental Design
MATS	Mercury and Air Toxics Rule
µg/m3	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

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 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 document 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 and voluntary efforts 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 and should continue into the future, as detailed in the Action Plan. For example, emissions from on-road vehicles will continue to decrease due to the new Tier 3 Motor Vehicle Emission and Fuel Standards that EPA finalized on April 28, 2014 (79 FR 23414). The Tier 3 program sets new, cleaner standards that start with model year 2017 vehicles.

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.

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 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. Preliminary data from 2016 for both Caroline and Stafford indicates that the summertime air quality in these areas stayed in the healthy range.

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 2014 through 2016 also comply with this new standard.

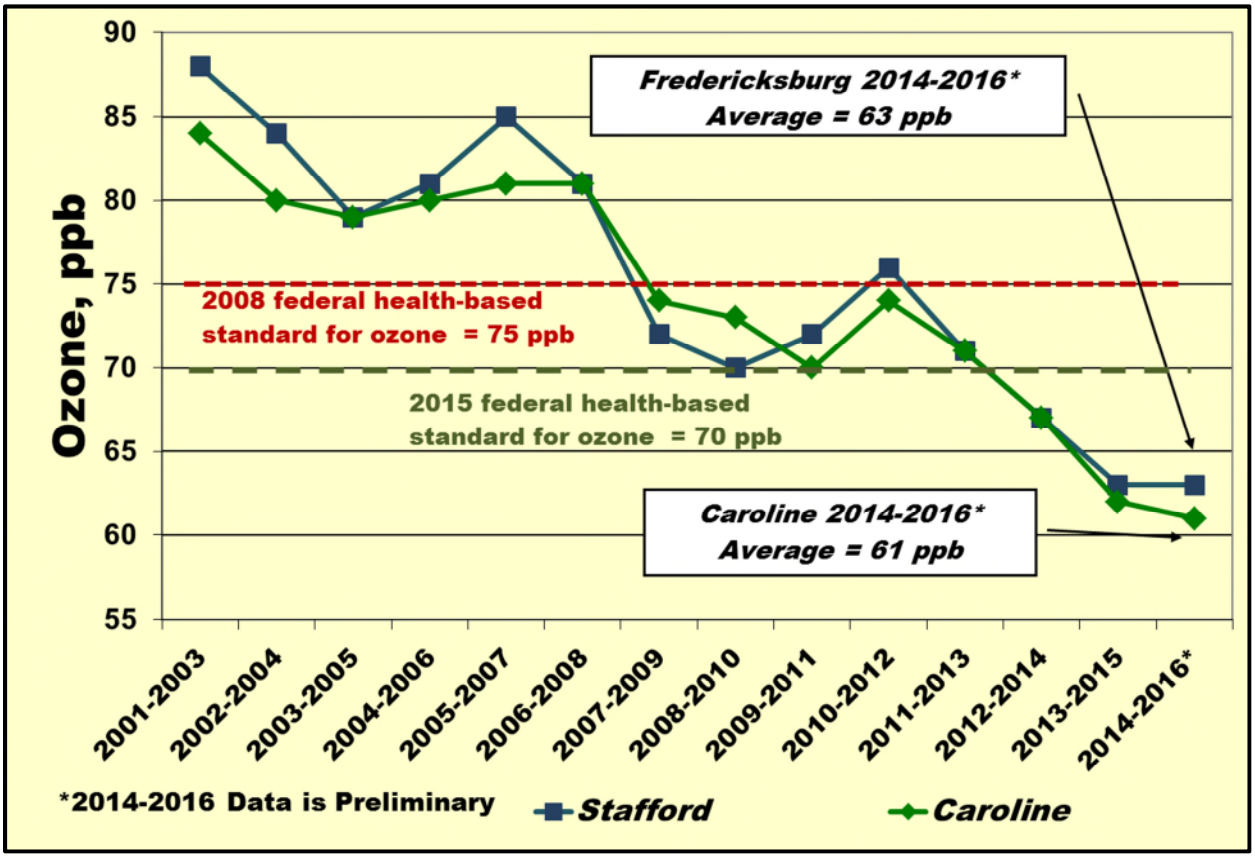

Figure 1: Ozone Air Quality, Caroline County and Stafford County

Figure 2 shows the number of ozone air quality exceedence days in Virginia since 1997 based on the 2015 ozone NAAQS. In 1998, Virginia recorded 108 exceedence days statewide. In 2010, the hottest and one of the driest summers on record, this value dropped to 52 exceedence days, and preliminary data for the summer of 2016 shows only nine exceedence days recorded.

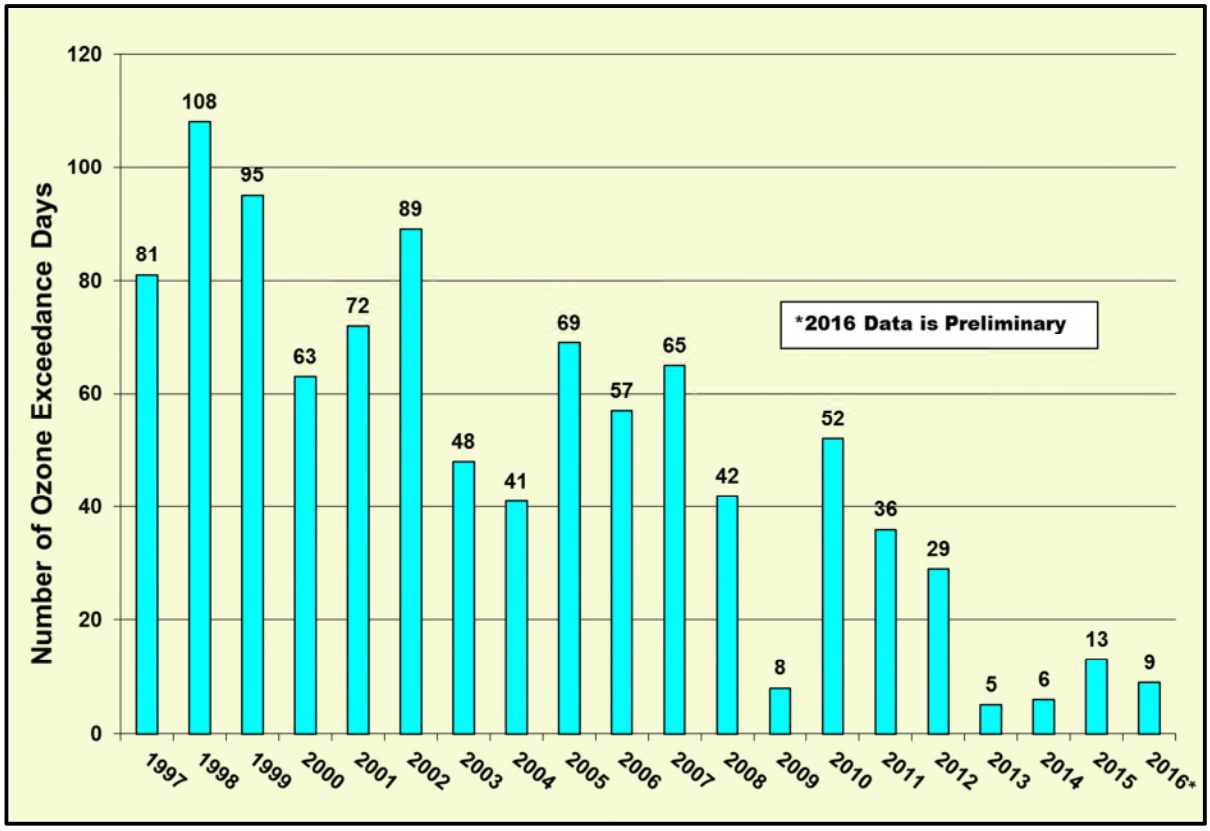

Figure 2: Virginia Ozone Exceedence Day Trends. 2016 Ozone NAAQS

$PM_{2.5}$

Fine particulate or $PM_{2.5}$ is 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
2013-2015	8.9 µg/m^3	20 µg/m^3	8.^{3} µg/m^3	18 µg/m^3	8.2 µg/m^3	15 µg/m^3	7.9 µg/m^3	19 µg/m^3

Data Source: VDEQ-Air Quality Monitoring Division

Figure 3 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.

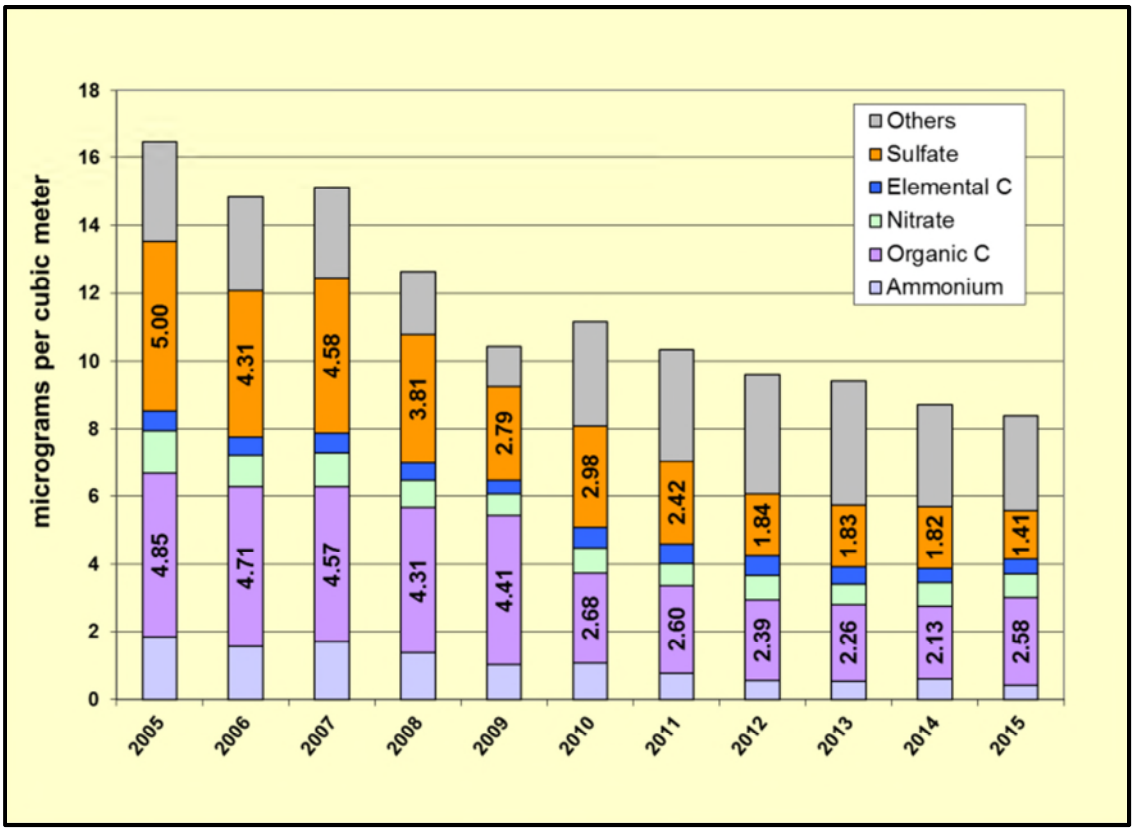

Figure 3: Henrico $PM_{2.5}$ Speciation Data

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.

VDEQ implemented changes to the On-Road Emissions testing program, called RAPIDPASS, in December 2015. The Virginia legislature approved this expansion of Virginia's on-road emissions testing program to allow up to 30% of vehicles subject to emissions inspections to complete their testing requirement via the RAPIDPASS Virginia program. This program, which is an on-road, drive-through emissions inspection option, has two additional benefits. The program identifies and requires repairs for vehicles subject to the inspection and maintenance program that need repairs between tests, and it also may identify high emitting vehicles that are housed outside the testing program's area but are frequently driven within the area. Identification and repair of high emitting vehicles will help to improve air quality both in

the Washington, D.C. region and in the Fredericksburg region since many citizens living in central Virginia commute to Washington, D.C.

Regionally, Celco, a large manufacturing operation located in Narrows, Virginia, retired six coal-fired boilers in late 2015. The facility replaced these units with new, low-emitting, natural gas-fired units. These operational changes will reduce annual upwind emissions by approximately 3,000 tons of NO_X and 7,000 tons of SO_2, based on 2014 emissions data from the facility.

To promote renewable energy resources, Virginia enacted the 2009 Small Renewable Energy Projects legislation, which directed VDEQ to develop permit-by-rules for various small renewable energy projects. These projects include solar-powered and wind-powered electrical generation facilities up to capacities of 100 megawatts (MW). The permit-by-rule for wind energy projects became effective December 2010, and the permit-by-rule for solar energy projects became effective July 2012. VDEQ has issued permits for 120 MW of solar power, has proposed permits under review for 118 MW of renewable power, and has received Notice of Intent information for projects totaling over 500 MW of renewable power. Figure 5 provides the locations of these facilities.

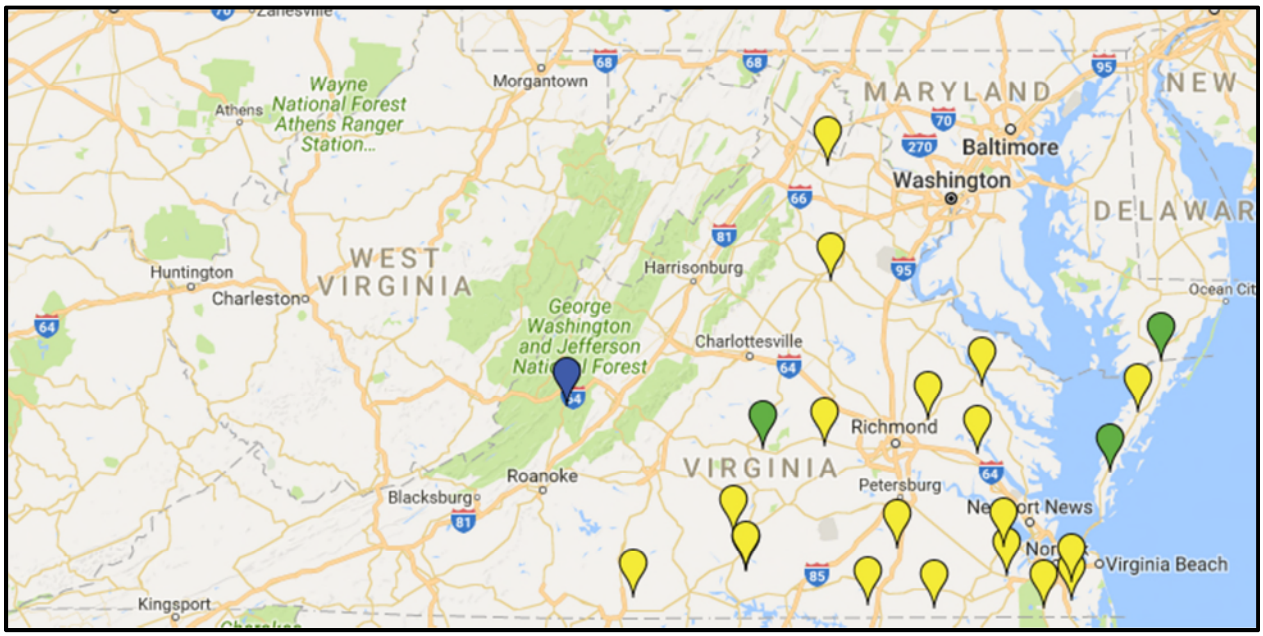

Figure 5: Proposed and Permitted Solar and Wind Energy

In this figure, green markers denote facilities that have received permits, while the yellow and blue markers denote facilities that are in the permitting process. As these

facilities complete construction and come on line, this additional electrical generating capacity will reduce upwind emissions into Carline County.

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.

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-16-34-allocating-FY2017-2022-CMAQ-and-RSTP-Funds-attachment-updated.pdf.
GWRideConnect	FAMPO GWRideConnect	On-going	VMT avoided annually Vehicle trips avoided annually Vanpools formed	Voluntary	• See Annual Work Plan Fy17.pdf • http://www.gwrideconnect.org
Fort A.P. Hill					
Energy Efficiency/ Renewable Energy	A.P. Hill	On-going	LEED certifications Fuel usage	Voluntary	• See Building square footage v. Energy consumed - FY16 update.pdf
Emissions Impact	A.P. Hill	On-going	Annual emissions estimates	Voluntary	• See Electricity use v. Indirect NOx emissions – FY16 update.pdf • See Fuel Use v. NOx emissions – FY16 update.pdf
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.
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.

Table 3: Emission Reduction Programs-In Development or Ongoing, continued

Control Program	Stakeholders	Time Frame	Milestones	Program Type	Feedback & Comments
Virginia Clean Cities					
Virginia Get Ready	VCC	On-going	Statewide network of chargers	Voluntary	• VA registrations of electric vehicles increased from 1,837 in 2014 to 2,347 in 2015. • VA public charging stations increased in number from 274 in 2014 to 358 in 2015. • See http://www.virginiaev.org/ • See va_electric+hybrid_vehicles_and_stations_2008-2015.xlsx and Clean-Cities-2015-Annual_report_VA-Virginia-Clean-Cities-Expanded-Edition.pdf
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.
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.
Other Programs Not Included In The 2013 Caroline County Ozone Advance Plan					
Renewable Generation – Schedule RG	Dominion	On-going	Program approval received	Voluntary	• Company received approval of program from SCC in December 2013. • Company began accepting applications in April 2014. • https://www.dom.com/business/dominion-virginia-power/ways-to-save/renewable-energy-programs/schedule-rg

Table 3: Emission Reduction Programs-In Development or Ongoing, continued

Control Program	Stakeholders	Time Frame	Milestones	Program Type	Feedback & Comments
Renewable Energy Pilot Program	Dominion	On-going	SCC established program guidelines in November 2013	Voluntary	• As of December 1, 2013, qualified customers may participate in the Virginia State Corporation Commission's Renewable Energy Pilot Program. This pilot program allows qualified customers to enter into a Power Purchase Agreement (PPA) with a third party renewable energy supplier. The energy supplied must come from a wind or solar generator located on the customer's premise. • https://www.dom.com/business/dominion-virginia-power/ways-to-save/renewable-energy-programs/renewable-energy-pilot-program
Solar Partnership Program	Dominion	2013-2018	Program on-going? 1.2 MW in operation to date.	Voluntary	• Dominion has recently completed the installation of an array of ground-mounted solar panels at the Phillip Morris USA (Altria) facility in Chesterfield County, VA that will be capable (under optimal conditions) of generating about 2,450 kW of electricity. • In addition, the company has completed solar installations on the rooftops of Canon Virginia Environmental Technologies in Gloucester County, VA; Old Dominion University in Norfolk; VA, Virginia Union University in Richmond, VA; Randolph-Macon College in Ashland, VA; the Capital One facility in Richmond, VA; and West Branch High School in Chesapeake, VA. • These combined facilities represent a total of over 4.5 megawatts of solar generating capacity. • https://www.dom.com/business/dominion-virginia-power/ways-to-save/renewable-energy-programs/solar-partnership-program
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

Table 3: Emission Reduction Programs-In Development or Ongoing, continued

Control Program	Stakeholders	Time Frame	Milestones	Program Type	Feedback & Comments
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. • Richmond regional CMAQ funds authorized an additional $500,000 for this program for FY2017-FY2021. • See Richmond Regional TPO-TIP book 02-2016.pdf and Annual Report – Expanded Green Operator Report 10-30-15.pdf. • www.greenoperator.org • This program should benefit all areas of the Commonwealth with significant truck traffic, including areas along the major interstates like Caroline County.

Table 4: Emission Reduction Programs-Completed

Control Program	Stakeholders	Time Frame	Program Type	Feedback & Comments
Virginia Department of Environmental Quality				
Expansion of ORE	VDEQ	Full Impl: 12/2015	Regulation	• Full implementation took place December 2015
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				
Celco Powerhouse Project	VDEQ	2015	Permit	• Coal fired unit retired in 2015; natural gas fired units operating.
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.
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 • Dominion completed construction of the Brunswick County Power Station on June 2, 2016. This operation is a combined cycle facility rated at about 1,358 MW burning natural gas and is equipped with state of the art controls. https://www.dom.com/corporate/what-we-do/electricity/generation/fossil-fueled-power-stations/brunswick-county-power-station

Table 4: Emission Reduction Programs-Completed, continued

Control Program	Stakeholders	Time Frame	Program Type	Feedback & Comments
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	• Hopewell, Altavista, and Southampton 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.
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.