Caroline County Ozone Advance Action Plan

Annual Report for 2018

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
$\mu g/m^3$	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

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 region. Action Plans encourage programs and practices that facilitate emission reductions 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 future NAAQS updates, such as the 2015 ozone NAAQS published on October 26, 2015 (80 FR 65292). 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, a lung irritant, is the primary component of smog. 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 started 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, 2012, and 2016 was more conducive to ozone formation. The 2010 ozone season in Virginia was the warmest on record. The 2011, 2012, and 2016 ozone seasons had higher than average maximum daily temperatures although precipitation in these years was near or above normal levels. Table 1 summarizes Virginia's ozone season temperature and precipitation data for the period 2009 through 2017.

Table 1: Virginia Ozone Season (May through September) Meteorology Data, 2009-2017

Year	Average Maximum Daily Temperature, °F	Normal	Departure from Normal, °F	Total Precipitation, inches	Normal	Departure from Normal, inches
2009	80.1	81.1	-1.0	23.31	20.23	+3.08
2010	84.9	81.1	+3.8	19.52	20.23	-0.71
2011	82.5	81.1	+1.4	23.74	20.23	+3.51
2012	82.4	81.1	+1.3	20.50	20.23	+0.27
2013	79.8	81.1	-1.3	23.96	20.23	+3.73
2014	80.7	81.1	-0.4	19.32	20.23	-0.91
2015	82.2	81.1	+1.1	22.27	20.23	+2.04
2016	82.2	81.1	+1.1	25.37	20.23	+5.14
2017	80.9	81.1	-0.2	21.67	20.23	+1.44

Canadian forest fires may have also affected Virginia's air quality in 2015 and 2016. Data is not currently available for definitive exceptional events analyses regarding these events. However, indirect data such as satellite photography suggest transported pollution from large wildfires in Canada contributed to ozone exceedences and generally elevated levels of ozone, over and above levels that would normally be expected given meteorological conditions on those days.

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 2015-2017 monitoring data show a design value of 61 parts per billion (ppb) for the Caroline County monitor and 62 ppb for the Stafford County monitor. Preliminary ozone design values for 2016-2018 are 61 ppb in Caroline County and 62 ppb in Stafford County. The long term improvement depicted in Figure 1 demonstrates that the emission reductions achieved both locally and regionally have improved air quality in Caroline County to the point where ozone air quality complies with, and is significantly beneath, the 2015 ozone NAAQS of 70 ppb.

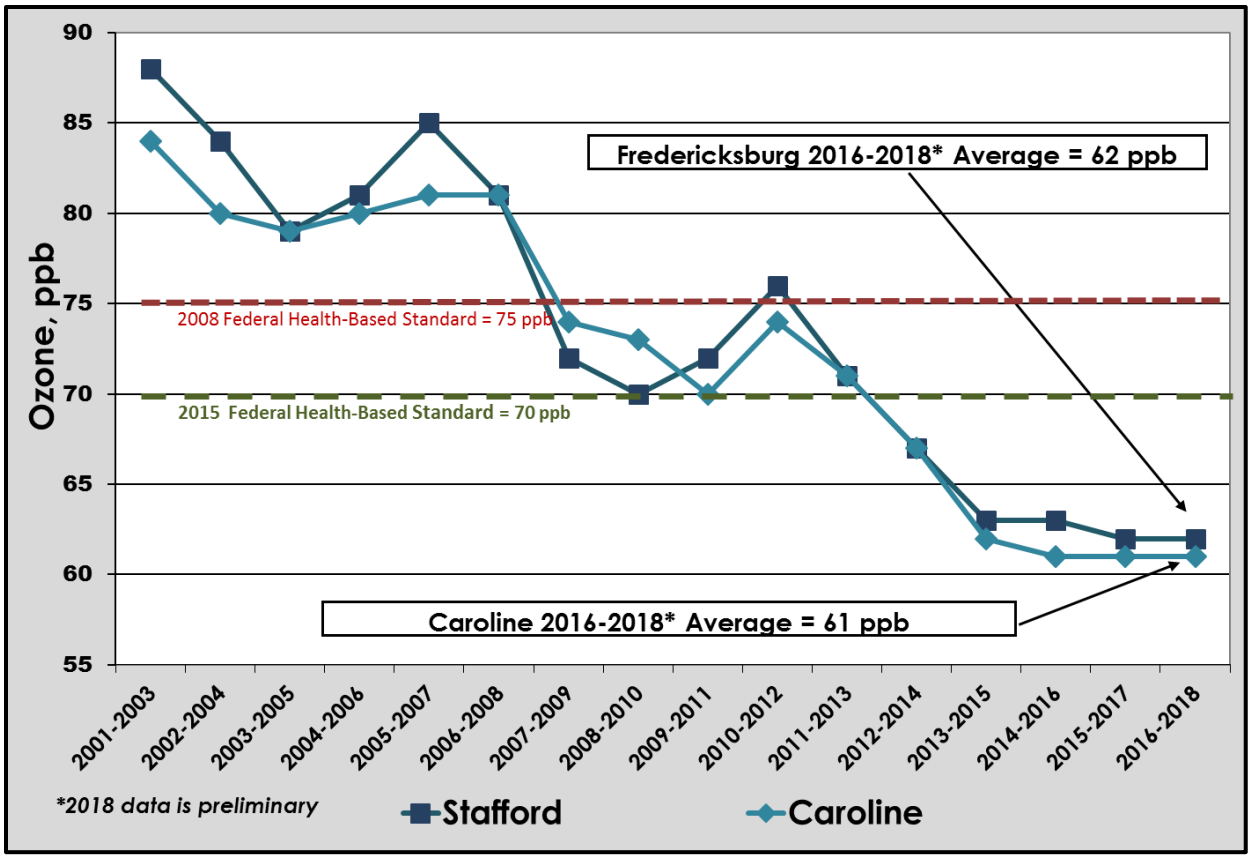

Figure 1: Ozone Air Quality, Caroline County and Stafford County

Figure 2 shows the number of ozone air quality exceedance days in Virginia from 1997 to 2018 based on the 2015 ozone NAAQS. In 1998, Virginia recorded 108 exceedance days statewide. In 2010, the hottest and one of the driest summers on record, this value dropped to 52 exceedance days. In 2018, preliminary data for the summer of 2018 showed only six exceedance days.

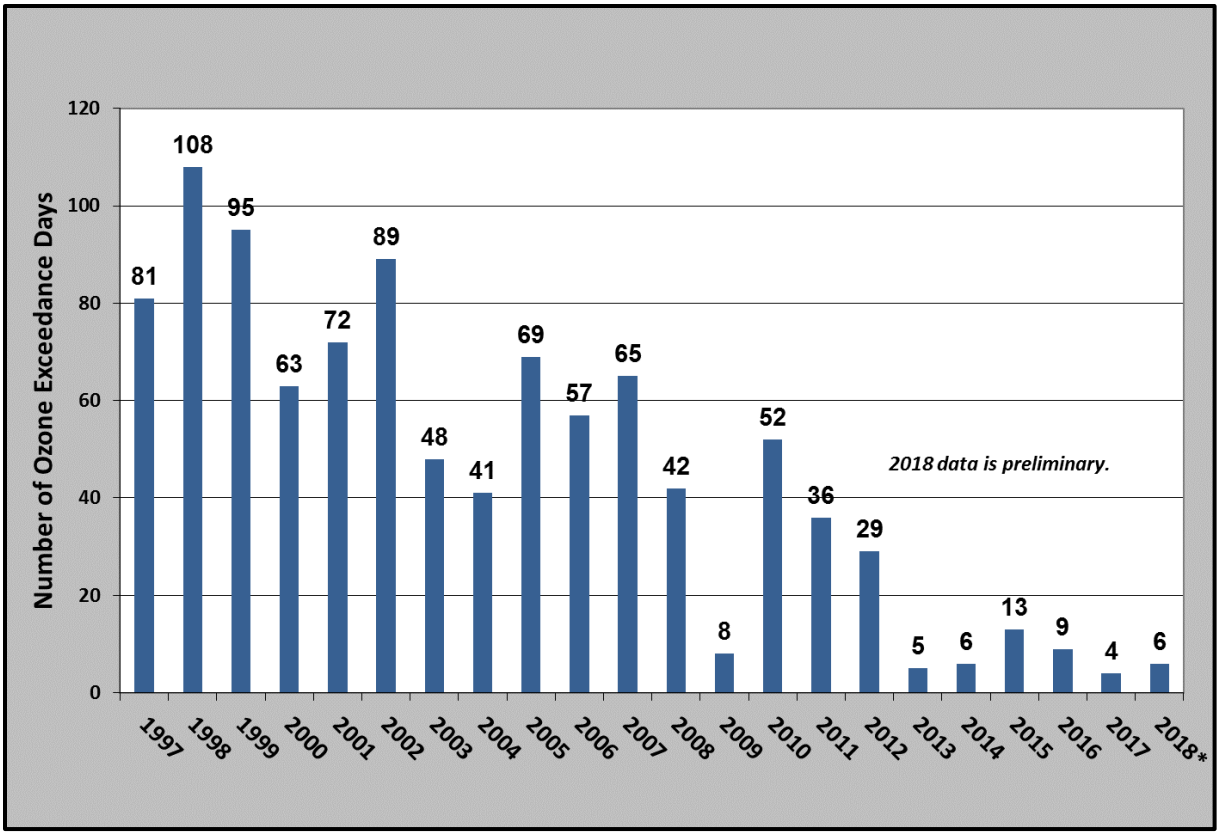

Figure 2: Virginia Ozone Exceedance Day Trends (2015 Ozone NAAQS)

$PM_{2.5}$

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. 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, and EPA has designated all areas of the Commonwealth as attainment areas or attainment/maintenance areas. 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 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 Annual	Arlington 51-013-0020 24-Hour	Chesterfield 51-041-0003 Annual	Chesterfield 51-041-0003 24-Hour	Bristol 51-520-0006 Annual	Bristol 51-520-0006 24-Hour	Virginia Beach 51-810-0008 Annual	Virginia Beach 51-810-0008 24-Hour
2001-2003	14.6 µg/m³	38 µg/m³	13.6 µg/m³	34 µg/m³	14.3 µg/m³	33 µg/m³	12.6 µg/m³	33 µg/m³
2002-2004	14.5 µg/m³	37 µg/m³	13.4 µg/m³	33 µg/m³	13.9 µg/m³	31 µg/m³	12.5 µg/m³	32 µg/m³
2003-2005	14.6 µg/m³	36 µg/m³	13.6 µg/m³	33 µg/m³	14.0 µg/m³	30 µg/m³	12.6 µg/m³	30 µg/m³
2004-2006	14.2 µg/m³	34 µg/m³	13.4 µg/m³	30 µg/m³	13.9 µg/m³	31 µg/m³	12.5 µg/m³	30 µg/m³
2005-2007	14.0 µg/m³	32 µg/m³	13.3 µg/m³	31 µg/m³	13.9 µg/m³	30 µg/m³	12.1 µg/m³	30 µg/m³
2006-2008	12.9 µg/m³	30 µg/m³	12.4 µg/m³	28 µg/m³	12.7 µg/m³	28 µg/m³	11.9 µg/m³	30 µg/m³
2007-2009	11.9 µg/m³	27 µg/m³	11.2 µg/m³	24 µg/m³	11.2 µg/m³	25 µg/m³	10.7 µg/m³	26 µg/m³
2008-2010	10.8 µg/m³	24 µg/m³	10.3 µg/m³	21 µg/m³	10.2 µg/m³	22 µg/m³	10.3 µg/m³	24 µg/m³
2009-2011	10.1 µg/m³	22 µg/m³	9.6 µg/m³	21 µg/m³	9.9 µg/m³	21 µg/m³	9.6 µg/m³	23 µg/m³
2010-2012	9.9 µg/m³	22 µg/m³	9.5 µg/m³	21 µg/m³	9.8 µg/m³	20 µg/m³	9.3 µg/m³	24 µg/m³
2011-2013	9.4 µg/m³	21 µg/m³	8.7 µg/m³	21 µg/m³	9.0 µg/m³	18 µg/m³	8.5 µg/m³	22 µg/m³
2012-2014	9.0 µg/m³	21 µg/m³	8.5 µg/m³	19 µg/m³	8.6 µg/m³	16 µg/m³	8.0 µg/m³	20 µg/m³
2013-2015	8.9 µg/m³	20 µg/m³	8.3 µg/m³	18 µg/m³	8.2 µg/m³	15 µg/m³	7.9 µg/m³	19 µg/m³
2014-2016	8.5 µg/m³	19 µg/m³	8.0 µg/m³	16 µg/m³	8.0 µg/m³	18 µg/m³	7.5 µg/m³	17 µg/m³
2015-2017	8.1 µg/m³	18 µg/m³	7.8 µg/m³	16 µg/m³	7.6 µg/m³	18 µg/m³	7.1 µg/m³	15 µg/m³

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 $PM_{2.5}$. The sulfate portion of $PM_{2.5}$ has decreased markedly, as has the organic carbon portion.

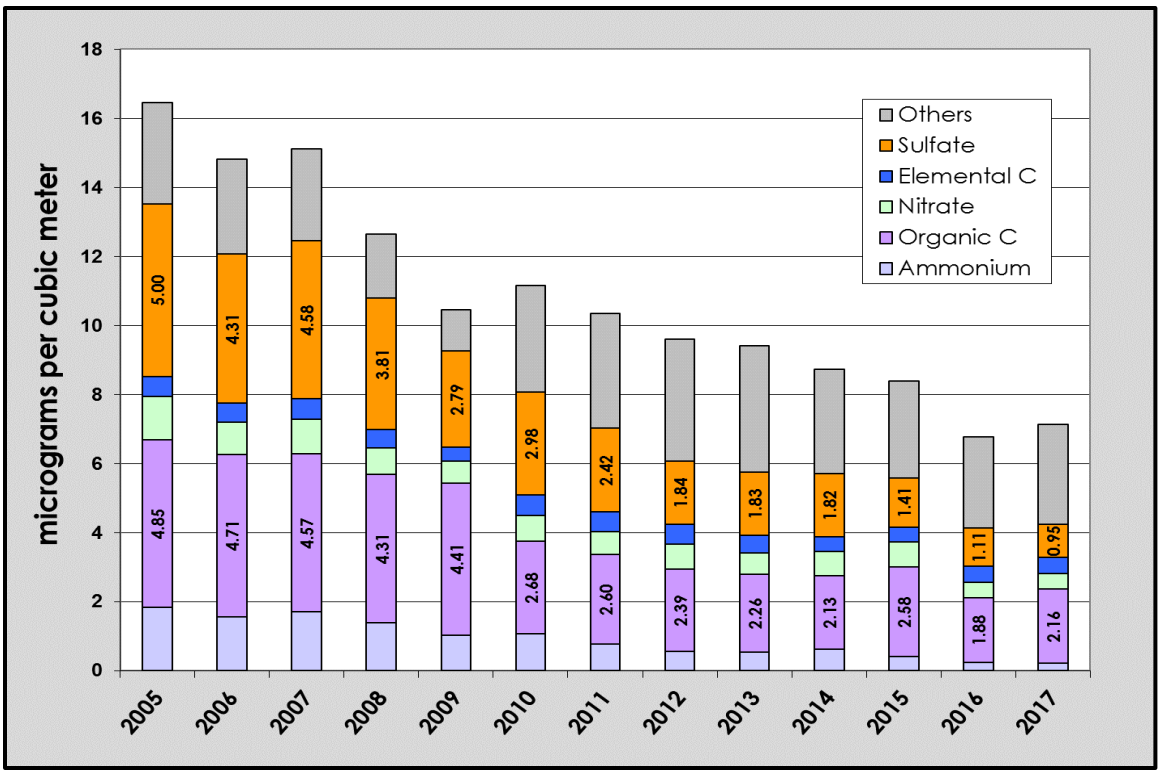

Figure 3: Henrico $PM_{2.5}$ Speciation Data

Emission Reduction Programs

Emission reduction programs such as those listed in the Ozone Advance Action Plan have reduced NO_X and SO_2 emissions across Virginia. Figure 4 and Figure 5 show NO_X and SO_2 emissions, respectively, from all point sources registered and reporting emissions to Virginia's Comprehensive Environmental Data System (CEDS). Point sources are generally large emitters of criteria air pollutants such as electrical generating units (EGUs), industrial facilities, commercial and institutional facilities, and waste processing facilities.

Figure 4 shows that NO_X emissions from point sources across the Commonwealth have decreased by about 50,000 tons per year from 2003 to 2017. From 2013 to 2017, the time period of the Ozone Advance Action Plans implemented in Virginia, NO_X emissions from point sources have decreased by about 18,000 tons annually (from 57,917 tons to 39,528 tons). Figure 5 shows that SO_2 emissions from point sources across the Commonwealth have decrease by more than 230,000 tons per year from 2003 to 2017. From 2013 to 2017, SO_2 emissions from point sources dropped more than 50,000 tons annually (from 74,128 tons to 22,115 tons).

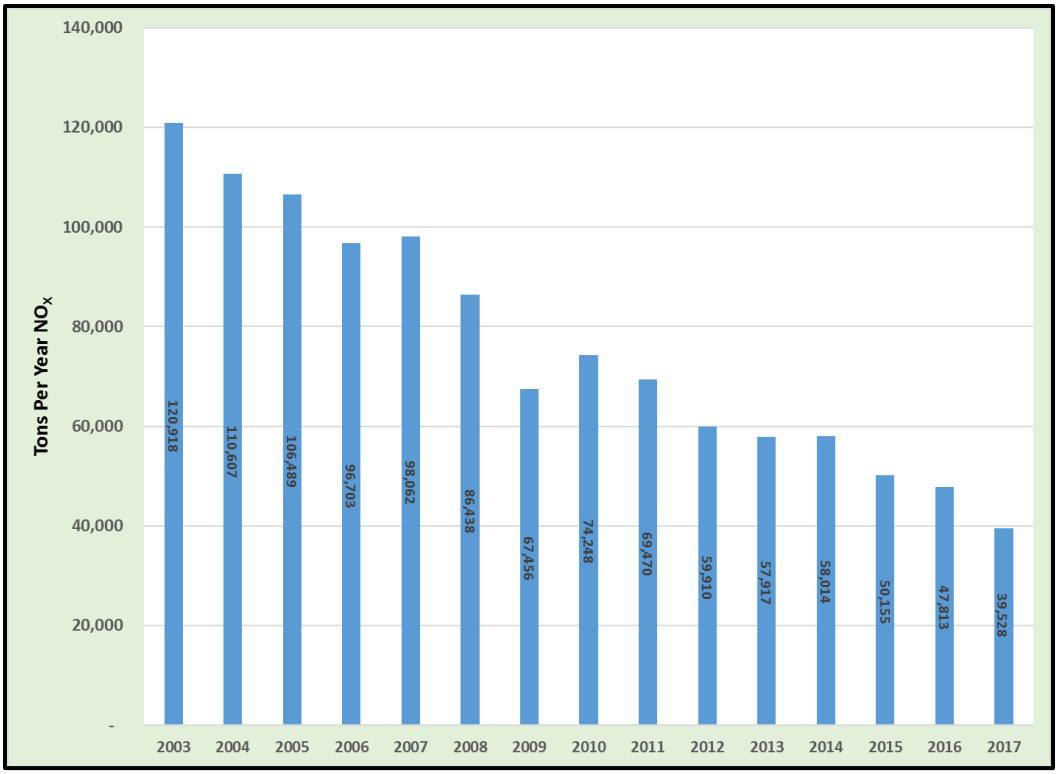

Figure 4: Virginia Point Source NO_X Emissions

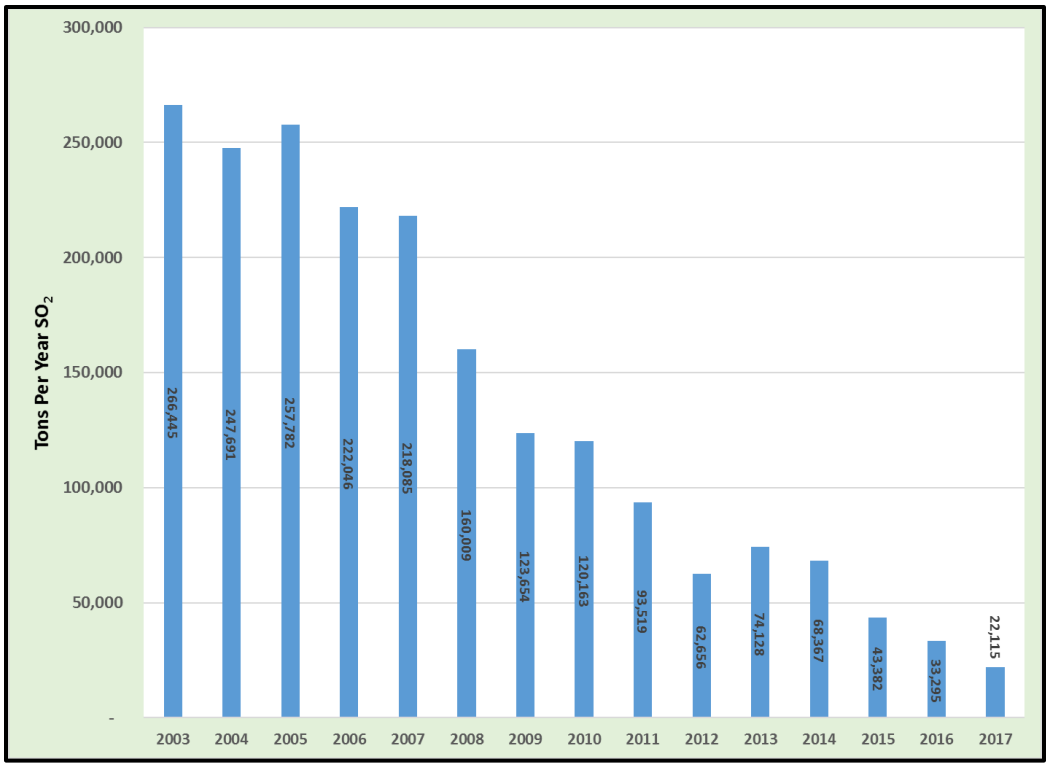

Figure 5: Virginia Point Source SO_2 Emissions

A disk containing supporting information, including the various documents referenced in Table 3 and Table 4, is included with this report.

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	2019-2025	Programs initiated	Voluntary	• See FAMPO Resolution 18-25.pdf
GWRideConnect	FAMPO GWRideConnect	On-going	VMT avoided annually Vehicle trips avoided annually Vanpools formed	Voluntary	• Programs on-going. • See GWRideConnect Annual Work Plan Outline FY18.pdf • See GWRideConnext 2018-07-01 FY 18-19 Output Data Tracking.xlsx • http://www.gwrideconnect.org
Fort A.P. Hill					
Energy Efficiency/ Renewable Energy	A.P. Hill	On-going	LEED certifications Fuel usage	Voluntary	• See Fort AP Hill Total MBTU and NO_X tracking FY18.pdf
Emissions Impact	A.P. Hill	On-going	Annual emissions estimates	Voluntary	• See Fort AP Hill Total MBTU and NO_X tracking FY18.pdf
DMME-Division of Energy					
VEMP	DMME	On-going	SF of public buildings retrofitted? Private capital deployed? Energy savings?	Voluntary	• Total value of contracts through FY 2014 is $685 million. Cumulative estimated CO_2 emission reductions through calendar year 2014 are 271,732 tons.
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.
Virginia Clean Cities					
Virginia Get Ready	VCC	On-going	Statewide network of chargers	Voluntary	• VA registrations of electric vehicles increased from 4,208 in 2016 to 5,518 in 2017. VA public charging stations increased in number from 458 in 2016 to 547 in 2017. • http://www.virginiaev.org/ • See va_electric+hybrid_vehicles_and_stations_2008-2017.xlsx

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

Control Program	Stakeholders	Time Frame	Milestones	Program Type	Feedback & Comments
Regional Reductions					
Honeywell SCR Installation	VDEQ	12/2012 through 06/2019	# of SCR installed? Annual emissions of NO_X?	Permitting; Consent Agreement	• Two SCR began operating December 2012. • Two SCR began operating October of 2014. • Two SCR began operating November 2016. • Final two SCR started up September 15, 2018.
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 2019.
Other Programs Not Included In The 2013 Caroline County Ozone Advance Plan					
Green Operators Program at the Port of Richmond	VPA, RAMPO	Ongoing	n/a	Voluntary; funded by CMAQ and by DERA	• GO program replaced or retrofitted 425 trucks since inception. • http://www.portofvirginia.com/fy17-sustainability-report/
Reasonably Available Control Technology	VDEQ, Dominion, Covanta	2020		Permitting	• Application of SNCR on Possum Point #5 or unit retirement. • Application of LN technology on units 1-4 at Covanta Fairfax. • Application of LN technology on units 1-3 at Covanta Alexandria/Arlington.
Utility-Scale Solar, Continued	Dominion	On-going		Voluntary	• In November 2016, the company announced a major expansion of its solar alliance with Amazon with plans to add 180 MW of solar generating capacity consisting of five projects in five Virginia counties. All five projects achieved commercial operations in December 2017, bringing Dominion Energy's solar alliance with AWS to a total of 260 MW of installed solar generation. https://www.dominionenergy.com/about-us/making-energy/renewables/solar-generation/virginia-solar-projects/solar-alliance • In June 2017, Dominion Energy announced the acquisition of two solar facilities totaling 30 MW. The 10 MW Clarke County Solar Facility in White Post, VA became operational in August 2017, and the 20 MW Cherrydale Solar Facility entered service in November 2017. Power from both projects is being purchased by Old Dominion Electric Cooperative under long-term agreement.

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

Control Program	Stakeholders	Time Frame	Milestones	Program Type	Feedback & Comments
Utility-Scale Solar	Dominion	On-going		Voluntary	• In February 2015, Dominion announced plans to develop multiple utility-scale solar projects totaling 400 megawatts of electricity by 2020 with the intent to involve Virginia-based companies.. http://dom.mediaroom.com/2015-02-05-Dominion-Virginia-Power-Planning-Major-Expansion-of-Large-Scale-Solar-in-Virginia • In December 2015, Dominion acquired the 20 MW Morgans Corner facility located in Pasquotank County, NC. The output of the facility is under long-term contract with the U.S. Department of the Navy. The facility became operational in mid-December 2015. • On June 2016, Dominion received approval from the Virginia SCC for three separate solar projects located in Powhatan, Louisa, and Isle of Wight counties. These projects began serving customers in December 2016 and collectively total 56 MW of solar capacity. • In December 2016, Dominion Energy, the University of Virginia and its Darden School of Business announced an innovative 17 MW solar power partnership under which the University and Darden will purchase the entire output of electricity produced at a new, 160-acre solar facility (Hollyfield Solar Project) in King William County for the next 25 years. Commercial operations should begin by the end of 2018, pending regulatory approval. • In August 2016, Dominion Energy Virginia, the Department of the Navy, and the Commonwealth of Virginia reached an agreement to construct an 18 MW solar facility at Naval Air Station Oceana in Virginia Beach, Virginia. The project received regulatory approval in March 2017 and became operational in December 2017. http://dom.mediaroom.com/2016-08-02-Dominion-Virginia-Power-to-Build-Solar-Facility-at-Naval-Air-Station-Oceana • Dominion is partnering with the Commonwealth of Virginia and Microsoft on the 20 MW Remington solar facility in Fauquier County, VA. The facility received regulatory approval in February 2017 and became operational in October 2017. • In November 2015, the company announced the acquisition of an 80 MW solar facility in Accomack County, Virginia. The facility began operations in October 2016. Output is being purchased by Amazon Web Services (AWS).

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.
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. • Dominion completed construction of the Brunswick County Power Station in 2016, and began service April, 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.dominionenergy.com/about-us/making-energy/natural-gas/brunswick-county-power-station
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.

Table 4: Emission Reduction Programs-Completed, continued

Control Program	Stakeholders	Time Frame	Program Type	Feedback & Comments
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.
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.