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TECHNICAL REPORT
CLEAN PRODUCTS MARKET ANALYSIS

RAMBOLL ENVIRON

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APPENDICES

1. INTRODUCTION

Ramboll Environ US Corporation (Ramboll Environ) conducted a market survey for the Metropolitan Washington Council of Governments (MWCOG) to determine the extent to which cleaner product formulations are sold within the Metropolitan Washington region, which consists of the District of Columbia (DC) and parts of Maryland and Virginia (DC-MD-VA), as shown in Figure 1. DC and Maryland have adopted the 2009 Ozone Transport Commission (OTC) Model Rule for Motor Vehicle and Mobile Equipment Refinishing and Recoating (MVMERR), whereas Northern Virginia is subject to an older 2002 OTC Model Rule for MVMERR, which has less stringent requirements than the 2009 OTC Model Rule. DC and Maryland have low sulfur heating oil requirements (currently 500 ppm; DC is going down to 15 ppm in 2018), while Virginia has not adopted comparable rules and does not appear to have plans to do so in the foreseeable future (see Table 1). However, depending on product distribution networks, manufacturers and distributors may voluntarily elect to sell products in Northern Virginia that comply with the more stringent regulations (e.g., lowest pollutant levels) in DC and Maryland. Ramboll Environ understands that the results of the market survey may result in MWCOG and its member air agencies applying to the United States Environmental Protection Agency (USEPA) for State Implementation Plan (SIP) credit for the voluntary sale of cleaner products and corresponding reductions in air emissions in the Northern Virginia jurisdictions within the MWCOG area.

Figure 1: A map of the counties and cities included in the Metropolitan Washington region, for the purposes of this study. Image from MWCOG.

Table 1: Product regulations in the MWCOG region		
Jurisdiction	Automotive Refinishing Coatings	Residential Heating Oil
District of Columbia	2009 OTC rules	500 ppm (No. 2 fuel oil) (15 ppm in 2018)
Maryland	2009 OTC rules	500 ppm (No. 1 & 2)
Northern Virginia	2002 OTC rules	None

Chapter 2 of this Report describes our survey plan, detailing the approach and methodology for developing and conducting the survey, development and refinement of the survey questions and format, and identification and outreach to potential respondents. Chapter 2 represents an update to our survey approach. The cover letters and surveys distributed to entities participating in the surveys are provided in Appendix 1 and 2.

In Chapter 3, we analyze the data obtained through the survey process to quantify the extent of the voluntary sale of cleaner products and estimated emission reductions. Our discussion of the results and emission reduction calculations is provided in Chapter 3. In Chapter 4, we present our conclusions and recommendations on the feasibility of applying for SIP credit based on the survey results from each industry.

If MWCOG chooses to move forward with applying for SIP credit from USEPA, we will prepare a draft documentation package for submission, including the relevant technical support documentation (including emission calculation spreadsheets and a summary of survey results).

2. SURVEY PLAN

The methodology used to identify the markets for residential heating oil and automotive refinishing coatings, and the products sold in these markets, required the collection of significant and specific data from available sources. Ramboll Environ considered (1) the data and information currently available from known secondary sources; (2) the data needed from interviews, surveys, and other methods; and (3) the data reasonably estimable through professional judgment or derived from information available publicly or collected through the survey.

Ramboll Environ reviewed the USEPA data and documentation requirements for obtaining SIP credit and baseline emissions data available from MWCOG and government agencies. Based on this documentation, we identified the data required from the survey for emissions reductions calculations for both the automotive refinishing coatings and heating oil industries in the MWCOG region. As a next step, Ramboll Environ sought to identify relevant organizations, through trade associations and individual companies, to identify potential survey participants. Synthesizing this information, Ramboll Environ drafted a methodology for conducting the survey and developed a draft survey questionnaire.

2.1 Approach and Methodology

In conducting the survey, Ramboll Environ considered that the information collected may be used to apply for SIP credit for the voluntary sale of cleaner products and resulting reductions in air emissions (volatile organic compounds (VOCs) from automotive refinishing and particulate matter (PM) from heating oil combustion). This consideration informed the development of our questionnaire and information gathering process.

In general, USEPA requires that voluntary measures seeking SIP credit meet the following requirements:

- **Quantifiable** – Emission reductions must be estimated and protected for future years based on demographic information like sales and population growth.
- **Surplus** – Emission reductions must be additional to what is required by law. If a jurisdiction ultimately adopts a more stringent regulation, only the surplus emission reduction during the voluntary period is counted.
- **Enforceable** – Alternative emission reduction measures must be included if follow-up monitoring by the jurisdictions indicate that projected emission reductions have not occurred.
- **Permanent** – The emission reductions must occur for the specific time period for which SIP credit is applied.
- **Adequately Supported** – Adequate personnel and resource are necessary to support the voluntary measure.

2.1.1 Identify User Industries and Trade Associations, Manufacturers, Distributors

Ramboll Environ initiated contact with select trade associations including the American Coatings Association (ACA Automotive Refinish Committee), American Petroleum Institute, Petroleum Marketers Association of America, and the Mid-Atlantic Petroleum Distributors' Association to determine potential avenues to distribute the survey and/or identify potential participants. Ramboll Environ also identified individual companies to pursue as potential survey participants, as discussed below. Ramboll Environ attempted to survey all identified market participants to maximize the response rate and obtain the best representation of the market, aiming for a 25 to 30 percent rate of participation, which is a standard target response rate for similar surveys.

2.1.1.1 Automotive Refinishing Coatings

The businesses using coatings subject to the MVMERR regulations are facilities engaged in autobody and collision repair, fleet operator repair and painting, auto dealer repair and painting, and aftermarket automotive customizing and detailing. The coatings are manufactured by a relatively small number of national and international coating manufacturers and often sold nationally or regionally by distributors to individual businesses. Ramboll Environ's approach focused on the manufacturers and distributors, who are expected to be more familiar as to whether their products meet the more stringent 2009 OTC Model Rule VOC limits.

In order to collect appropriate usage and distribution data for automotive coating products, Ramboll Environ identified a number of national and international coatings manufacturers, as well as major coatings distributors to survey, with assistance from the ACA. These entities represent key players in the automotive coating industry and represent the majority of the market in the Metropolitan Washington area. The ACA provided additional information regarding the current market for automotive refinishing coatings, and advertised the survey to relevant ACA members.

Because the list of companies contacted for the survey is the same as the list of ACA Automotive Refinish Committee members, the ACA requested that we do not disclose the members of their Committee for the purposes of our report. However, we were provided a list of the 24 members, and confirmed that they include the major national automotive coating manufacturers. Our survey response rate was 17 percent, below our desired target response rate. In aggregate, however, the responses represent over 60 percent of the automotive coatings market, providing a strong representative sample of the industry.

2.1.1.2 Heating Oil

Ramboll Environ's survey effort regarding residential heating oil focused on distributors and wholesalers within Northern Virginia in order to capture a representative sample of the residential heating oil market. Distributors in the Metropolitan Washington area include small, direct distributors and large bulk distributors. The direct distributors obtain product from pipeline and/or port terminals and deliver directly to end users. Large bulk distributors obtain and store product from terminals at regional bulk storage locations, which is then distributed to end users or smaller distributors. Survey participants were identified through fuel seller permits, interviews with trade associations and industries including the Virginia Petroleum Council and the Petroleum Marketers Association of America, public vendor directories, and distributor information gathered via interviews from "last-mile" residential heating oil providers. Based on the list compiled from these sources, thirteen potential participants matching the survey participation criteria (operate and/or distribute within the MWCOG region) were identified. Our response rate from valid participants was 23 percent. From the survey process, including both the direct survey responses and follow-up with identified suppliers, Ramboll Environ determined that product availability is consistent across the supply chain in the MWCOG region; ultra-low sulfur heating oil is widely available from the bulk terminals to the "last mile" residential heating oil providers, but we were unable to confirm that 100% of the residential heating oil in the MWCOG region is ultra-low sulfur fuel.

2.2 Survey Methodology

The surveys collected information to determine the viability of applying for SIP credit. Two separate surveys were developed; one for the automotive refinishing coatings and one for the heating oil industries. The content of each survey was based on a review of USEPA documentation and

preliminary discussions with industry representatives. The surveys were preceded by an informal marketing effort alerting potential respondents to the objective and importance of completing the survey and were subsequently disseminated via email as Adobe Portable Document Format (PDF) digital files containing fillable forms. Survey administration through a web-based application such as SurveyMonkey was also considered. However, distribution of a PDF document with fillable forms via email was chosen to be more secure and more appropriate for the preferred survey format. Participants were reminded that survey responses would be kept confidential and no individual respondent information would be provided to other parties, including MWCOG, trade associations, or non-team members at Ramboll Environ. All data would be processed, consolidated, and presented in aggregate prior to sharing results to MWCOG, so as not to disclose any individual firm-specific data.

2.2.1 Identifying Questions for the Survey

The survey questions were developed considering that MWCOG may use the results to apply for SIP credit for the voluntary use of cleaner products and resulting reductions in air emissions. This consideration informed the development of our questionnaire and information gathering process.

Before distributing the survey to all participants, we beta-tested the surveys with potential respondents (identified by ACA in the case of the automotive coatings survey or identified by Ramboll Environ through preliminary phone calls for the residential heating oil survey). We initially provided the beta-testers with a draft questionnaire prepared in January 2017 and asked them to provide feedback on the survey questions and overall process, with the following prompts:

1. Are the questions clear?
2. What could be improved to make the questions more clear?
3. Are the questions reasonable (e.g., are there any questions that you cannot or prefer not to answer)?
4. If not, which questions are unreasonable and why? Given that the information requested by the questions is important for completing our study, do you have suggestions on alternate questions or wording that can get at the same information (e.g., market share)?
5. How long did it take to fill out the questionnaire?
6. How difficult was it to fill out the questionnaire?

Feedback from the beta-testers, indicated that certain questions required more time, different personnel to respond, or an unreasonable amount of sensitive and proprietary information. Beta-testers further indicated that including these questions in the initial outreach might discourage overall survey participation. In the interest of maximizing initial participation rates and obtaining basic information, we split the questions between two surveys: Part 1 – intended to capture basic respondent information and applicability – posed a series of questions relating to industry operations, classifications of business operations, and presence/absence of cleaner product offerings. Part 2 – intended to expand upon the information obtained within Part 1 – posed a series of questions regarding product classification, sales, and market share in order to capture product characteristics and usage within the market for emission reduction estimations.

A summary of the regulations in each jurisdiction was provided in the survey submittal letter for reference. Both survey questionnaires for the automotive coating and heating oil industries are provided in the Appendix.

2.2.2 Encouraging Participation in the Survey

Before disseminating the survey for automotive refinishing coatings, Ramboll Environ coordinated with ACA, a trade association whose members include manufacturers and distributors of automotive

refinishing coatings, to generate awareness of our survey and to encourage participation from their membership. We prepared language for ACA to announce that Ramboll Environ is conducting a survey on behalf of MWCOG, to explain the benefits of participation, and to encourage members to complete the survey. The ACA provided valuable feedback on the draft survey and distributed and advertised the final Part 1 survey to their members. This announcement was intended to increase the visibility and response rate by alerting the potential respondents to this project and its goals. The transmittal letter for the survey included language on how the anonymity and confidentiality of individual company responses would be assured.

Two rounds of reminders to complete Part 1 of the survey were conducted via e-mail by ACA at our request, with instructions to send responses directly to Ramboll Environ. We reached out individually to the Part 1 respondents to request their participation in the Part 2 survey, and also followed up with two rounds of reminders. In certain cases, responses were provided via phone interviews in lieu of or in addition to written responses.

We contacted the relevant trade associations for the heating oil industry; they provided helpful information but were unwilling to provide access to their members. For heating oil, Ramboll Environ used a two-contact approach to obtain measurable survey responses. Approximately two weeks after emailing the heating oil survey to potential respondents, the Ramboll Environ team attempted to reach the contact persons for each non-responding entity by email or phone. If Ramboll Environ was unsuccessful in reaching the contact persons, the team attempted to leave messages for the identified individuals. Another round of follow-up through emails or phone calls was conducted two weeks after the first round. Ramboll Environ attempted to reach the target survey recipients at least two times before considering the entity a non-respondent. Approximately four weeks after the survey was sent to all contacts, Ramboll Environ reviewed the list of respondents to determine whether we achieved a sufficient response rate or market share coverage. Depending on our evaluation, we made additional contact with the original list of survey recipients, with a focus on those who had initially responded indicating interest in participating in the survey. Similar to the automotive coatings survey process, some respondents provided responses via phone interviews in lieu of or in addition to written responses.

During the survey process, Ramboll Environ reviewed the questionnaires for automotive refinishing coatings and heating oil as received for completeness and accuracy. In case clarifications or additional information are needed, the relevant contact person was reached via phone or email for further explanation.

3. ANALYSIS OF SURVEY RESULTS

Following the completion of the survey process, Ramboll Environ compiled all of the responses into an Excel spreadsheet for analysis, removing any information that may identify a particular firm.[1]

3.1 Emissions Reduction Methodology

Ramboll Environ determined emissions reductions based on a combination of surrogate factors (e.g., employment statistics, household data, and census information) and existing commonly used emission factors for both the automotive refinishing and residential heating oil products. Baseline emission inventory data and calculation methodologies were based on existing procedures and example documentation from each jurisdiction (DC, MD, VA). These emissions reduction calculations follow the USEPA's requirements for emission reduction estimations under voluntary stationary source emission reduction programs.[2]

For each product group, the annual estimated emissions reductions are determined by calculating the emissions difference between the use of both standard (as required by regulation) and cleaner products. This is accomplished using existing, readily available emission factors and survey responses. The exact method of calculation depends on available metrics for the two industries and is described in Sections 3.2.1 and 3.3.1 below.

3.2 Automotive Refinishing Coatings

The sections below describe the methodology for calculating emission reductions in Northern Virginia from voluntary adoption of the lower VOC coating products.

3.2.1 Estimating Emissions Reductions

While surveying individual automotive refinishing businesses (e.g., automotive repair facilities) to request the amount and VOC content of the refinishing coatings used and calculating emission reductions per facility would be the most accurate way to quantify emission reductions, such an approach would be infeasible given the data burden to individual businesses, which would discourage survey participation. In estimating projected emission reductions for the automotive refinishing industry within the MWCOG area, Ramboll Environ followed the annual emission calculation methodology used by the Virginia Department of Environmental Quality (VDEQ) for the 2007 SIP for the 8-hour Ozone Standard and the 2011 Emissions Inventory. A baseline emissions estimation for the automotive refinishing industry using this method involves an employee-based emission calculation, commonly used in area source emission inventories[3,4]:

$$Annual\ Emissions\ \left(\frac{lbs}{year}\right) = (FIPs\ Activity\ Level)\ \times (EF) \times (Reactivity) \times (1 - (CE\ \times\ RP\ \times\ RE))$$

[1] Due to variation in response formats, with some respondents providing more specific data than others, we attempted to standardize the responses across respondents. For this standardization, some simplifying assumptions were made regarding the relative proportions of product category quantities sold within the industry.

[2] USEPA. 2001. Incorporating Voluntary Stationary Source Emission Reduction Programs into State Implementation Plans - FINAL POLICY. Memorandum from John Seitz, Director, Office of Air Quality Planning and Standards to Air Division Directors, Regions 1-10.

[3] Eastern Research Group, Inc. 2001. Introduction to Area Source Emission Inventory Development. Prepared for Area Sources Committee, Emission Inventory Improvement Program. January.

[4] TRC Environmental Corporation. 1997. Industrial Surface Coating Volume III, Chapter 8. Prepared for Area Sources Committee, Emission Inventory Improvement Program, https://www.epa.gov/sites/production/files/2015-08/documents/iii08.pdf

Where:

- FIPs Activity Level = Employment information (number of employees)
- EF = Emission factor (pounds VOC per employee)
- Reactivity = Reactivity factor (VDEQ sets Reactivity to 1)
- CE = Control efficiency/100 (VDEQ sets CE to 0.36); amount of emissions that are controlled
- RP = Rule penetration/100 (VDEQ sets RP to 1); portion of the industry affected by the regulation
- RE = Rule effectiveness/100 (VDEQ sets RE to 1); estimated effectiveness of the rule

Ramboll Environ estimates projected emissions reductions by determining a "no-reductions"[5] emissions scenario and comparing this to an emissions scenario which includes estimated reductions from voluntary use of lower VOC formulations than regulations require. These scenarios are determined by applying an adjustment factor to the emission factor in the preceding equation. The adjustment factor is based on the fraction of the market using product formulations cleaner than formally required by law (i.e., in line with the 2009 OTC Model Rule) and the estimated emission reduction in following the 2009 OTC Model Rule compared to the 2002 OTC Model Rule effective in the VOC Emission Control Areas in Virginia (including Northern Virginia). This adjustment factor was determined based on survey responses, which were aggregated by product category and weighted by the respondents' estimated market share. According to the 2011 National Emissions Inventory (2015) for SCC 2401005000 (Automotive Refinishing), the baseline emission factor is 94.69 lb VOC/employee.[6]

The FIPs activity level in the preceding equation is based on the 2015 employment data for NAICS code 811121 (Automotive Body, Paint, and Interior Repair and Maintenance) within the MWCOG region from the Virginia Labor Market Information portal. This FIPs activity level represents the total number of full-time employees in this field within the various counties and cities which MWCOG represents. A breakdown of this employment information is provided in Appendix 3.

Emission reduction estimations are calculated using an adjustment factor based on survey responses. A "baseline" emission estimate was prepared based on total sales of VOC-limited products in Northern Virginia, assuming that each product met its respective maximum VOC content limit.[7] A "current conditions" emission estimate was similarly prepared, which incorporates survey responses regarding the use of lower VOC products. Based on the survey responses, current conditions show an 8-13%[8] reduction of VOCs compared to the baseline due to the use of lower VOC automotive refinishing coatings. We refer to this as the "adjustment factor". The range of emission reductions primarily reflect the uncertainty of the behavior of the market segment not captured by our survey results.

For the low-end estimate, we assumed that lower VOC products are replacing higher VOC products in the Northern Virginia automotive refinishing market at an estimated rate applied only to the share of

[5] The "no-reductions" emissions scenario refers to a scenario where the FIPs Activity Level is adjusted based on projected industry employment data, while the employee-based emission factor remains constant.

[6] The 2011 Maryland SIP emission inventory uses an emission factor of 592.6774 lb VOC/employee per year. However, given that we are calculating the reductions for Northern Virginia, we used the same values as VDEQ for consistency.

[7] The Automotive Refinishing Coatings survey questionnaire requests sales volume by product category. Because the product categories from the 2002 and 2009 OTC Model Rules differ, we listed only the product categories for the 2002 OTC Model Rule for MVMERR and provided the low-VOC content thresholds based on the worst-case (highest) VOC limits for all corresponding categories within the 2009 Rule.

[8] One respondent indicated a potential change in their lower VOC product offerings, which may increase VOC savings to approximately 18% in the future.

the market represented by the survey respondents, while the remainder of the market represented by the non-responsive companies was assumed to use the maximum allowable VOC content products. To develop the high-end estimate, we assumed that the remainder of the market adopted lower VOC products in the same proportion as the surveyed average by extrapolating the behavior of the market captured by our survey results to 100% of the market.

Using these low and high reduction estimates, we applied the corresponding adjustment factor to the employee-based emission factor to determine the annual VOC savings due to the current use of cleaner products in 2015.

Table 2: Estimated Emission Reductions Based on Adoption of Lower-VOC Automotive Coatings

Estimate	Adjustment Factor	Annual VOC Emissions in Northern Virginia (tons)	VOC Reduction from Baseline (tons)	Percent Reduction from Baseline (%)
Baseline	0%	57.9	-	-
Low Estimate	8%	53.0	**4.9**	**8**
High Estimate	13%	50.4	**7.5**	**13**

As show in the table above, the voluntary use of cleaner products in the MWCOG region accounts for a potential emissions reduction of 4.9 to 7.5 tons of VOCs per year. The percent reduction from baseline equals the adjustment factor due to the linear nature of the emissions estimate model; an adjustment of the employee-based emission factor of 8% or 13% results in an overall emissions reduction of 8% or 13% respectively.

3.2.2 Results

Automotive refinishing coatings manufacturers appear to offer a range of product formulations in Northern Virginia, including those compliant with the more stringent DC and Maryland VOC limits, and those only in compliance with the Northern Virginia VOC limits. The share of lower VOC products represents a relatively small percentage of the total automotive refinishing coating market in Northern Virginia. Further adoption or distribution of low VOC products in Northern Virginia is not expected without increased consumer demand or regulation. Absent regulation, projected emissions reductions generated by the voluntary sale of cleaner products in the automotive refinishing coatings industry are not readily quantified due to the difficulty in determining future consumer demand for low VOC products. Some survey respondents indicated that consumer demand for low VOC products has fluctuated in recent years (2012-2015). Further discussion is provided in Chapter 4.

3.3 Heating Oil

3.3.1 Estimating Emissions Reductions

All of our survey respondents indicated that they are selling or distributing residential heating oil in Northern Virginia with a maximum sulfur content of 15 ppm (parts per million). However, since the respondents appear to comprise a small fraction of heating oil product sales in Northern Virginia (unlike the automotive refinishing coatings industry, the heating oil industry is comprised of companies with relatively small market shares), we conducted further investigation of the pipelines and terminals that are the source of their heating oil supply. Using information provided by the survey respondents and publicly available information of fuel sources in the Metropolitan Washington

region (including Northern Virginia), we identified the main terminals that receive their heating oil supply from the Colonial and Plantation pipelines. These pipeline systems are the two primary sources of fuel oil in the region.

According to a February 2016 EIA study[12], the vast majority of the Southeast and Central Region's transportation fuel supply (which includes heating oil) comes from the Gulf Coast via the Colonial and Plantation pipeline systems.[9] More than 70% of Virginia's fuel supply and 30-70% of DC and Maryland's fuel supply comes from the Colonial Pipeline system, with the balance coming from the Plantation pipeline system and, to a lesser extent, from the coastal ports. Based on information obtained from survey respondents, distributors of heating oil within the Northern Virginia area obtain their product from one of two storage terminals: a terminal in Fairfax, Virginia (operated by Motiva Enterprises, served by the Colonial Pipeline system), and a terminal in Newington, Virginia (operated by Kinder Morgan, served by the Plantation Pipeline system). A telephone interview with a representative at the Motiva Enterprises terminal in Fairfax confirmed that the only fuel oil stored and distributed at that facility contains sulfur in concentrations less than 15 ppm. Similarly, the terminal in Newington reportedly only handles fuel oil with sulfur concentrations less than 15 ppm.[10,11]

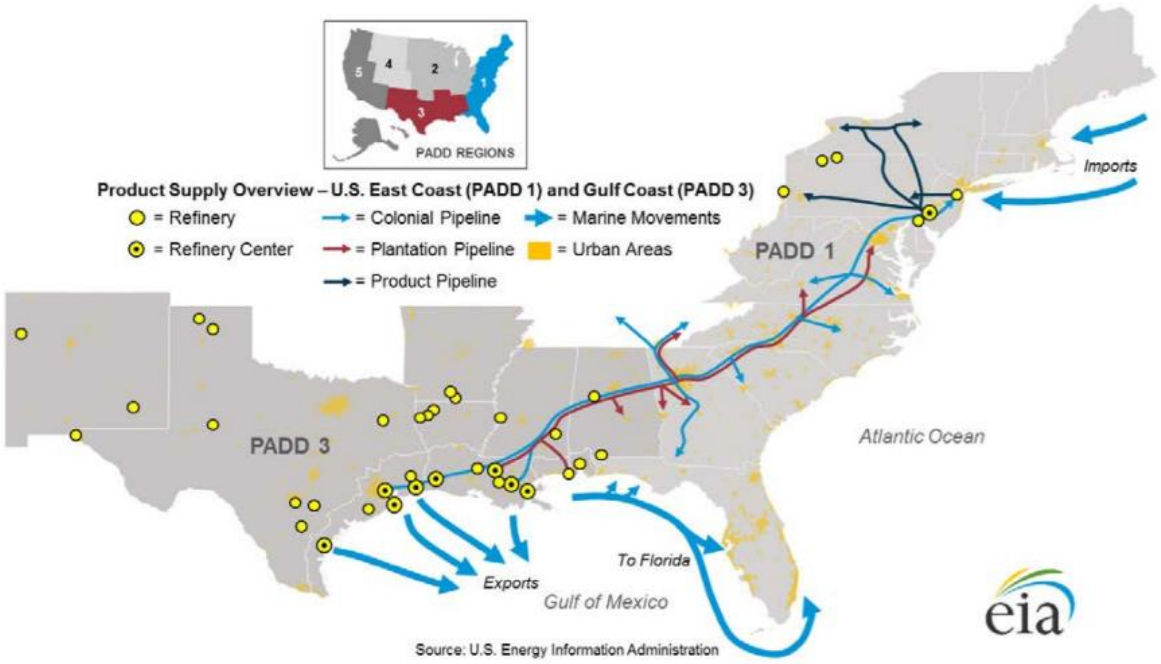

Figure 2: Pipelines serving the MWCOG Region.[12]

Since there are few pipelines and terminals serving the region, upstream suppliers exploit economies of scale and supply the low sulfur heating oil to Virginia to lower the costs of supplying the required low sulfur heating oil to DC and Maryland. This is an example of more stringent standards in DC and Maryland incentivizing pipelines and terminals to distribute only the lower sulfur product elsewhere in the region, since it would be more expensive and logistically challenging to supply both the higher sulfur product allowed in Virginia and the low sulfur product required in DC and Maryland.

[9] Virginia is in the Southeast Region and DC and Maryland are in the Central Region.
[10] http://www.kindermorgan.com/pages/business/products_pipelines/SE_Term_Washington_DC.aspx
[11] http://www.globalp.com/terminals/terminal.cfm?terminalID=8633
[12] https://www.eia.gov/analysis/transportationfuels/padd1n3/pdf/transportation_fuels_padd1n3.pdf

Additionally, with federal requirements already in place requiring the use of ultra-low sulfur diesel (ULSD) for highway and non-road applications, some states, such as Delaware, New Jersey, New York, and Washington, DC, have begun to require the transition of heating oil to ULSD. The more stringent standards in these states cause ripple effects upstream in the supply chain that reduce the maximum sulfur content of product supplied in Virginia, causing significant voluntary reductions due to the economies of scale from producing a larger volume of the low sulfur product – it is cheaper for the distributor to only provide ultra-low sulfur product (15 ppm) to the DMV region along with other states on the East Coast.

Due to existing state requirements and unlikely regulatory changes, counties and cities in Maryland and Northern Virginia meet the surplus criterion for SIP credit; emissions reductions are additional to what is required by law. Note that as of 2018, DC is switching to a 15 ppm standard, and no emission reductions in DC will be surplus or eligible for SIP credit. Maryland limits the sulfur content of heating oil to 500 ppm while Virginia has never adopted a sulfur regulation for home heating oil. Based on correspondence with VDEQ personnel, there are no plans in the near term to impose sulfur requirements on heating oil in Virginia. Currently, the majority of residential heating oil distributed to the MWCOG region has a maximum sulfur content of 15 ppm, and this is unlikely to change due to the existing supply chain, distribution network, and exploitation of economies of scale.[13]

As residential heating oil is a consumer product, estimating emissions reductions requires a top-down approach to quantify total fuel usage and using a surrogate factor to distribute this amount within the Metropolitan Washington area. Information used for this emissions estimate includes:

- Current and projected residential fuel oil consumption per household (Source: ACS 2011-2015 Survey 5-Year Estimates Percent of Occupied Housing Units with Fuel Oil, Kerosene, Etc. as Principal Heating Fuel[14], EIA Distillate Fuel Oil Sales for Residential Use[15])
- Housing profile data for households within the MWCOG area (Source: US Census: Annual Estimates of Housing Units for the United States, Regions, Divisions, States, and Counties: April 1, 2010 to July 1, 2015).[16]
- Emission factor of $PM_{2.5}$ and SO_2 based on sulfur concentration[17] of combustible fuels (Source: AP-42 Emission Factors; 2009 Uncontrolled Emission Inventory for the Metro Washington Nonattainment Area[18]; McDonald (BNL) 2009 – Evaluation of Gas, Oil and Wood Pellet Fueled Residential Heating System Emissions Characteristics[19])

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[13] Product specifications available for each pipeline show that diesel and fuel oils offered range from 15 to 2,000 ppm by weight sulfur. In the case of Plantation Pipeline, 5000 ppm NRLM Diesel Fuel (both dyed and undyed) was discontinued in 2007.

[14] https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_15_5YR_GCT2507.US05PR&prodType=table

[15] https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=KD0VRSSVA1&f=A

[16] https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=PEP_2015_PEPANNHU&prodType=table

[17] AP-42 emission factor of Filterable PM for a residential furnace (SSC A2104004/A2104011) is listed as 0.4 lb/1000gal (a note indicates that pre-1970s burner designs may emit filterable PM as high as 3 lb/1000gal). This PM factor is not dependent on the sulfur content of the fuel. https://www3.epa.gov/ttnchie1/ap42/ch01/final/c01s03.pdf

[18] The 2009 Uncontrolled Emission Inventory for the Metro Washington Nonattainment Area for SCC Code 2104004000 (Residential Distillate Oil Combustion) is provided in Appendix D to the 2008 MWAQC $PM_{2.5}$ SIP. This includes $PM_{2.5}$ and SO_2 (tons/year) inventories for DC, Charles County, Frederick County, Montgomery County, Prince George's County, Arlington County, Alexandria City, Fairfax County, Fairfax City, Falls Church City, Loudoun County, Prince William County, Manassas City, Manassas Park City.

[19] Roger McDonald at the Brookhaven National Laboratory/ies compares oil-fired heating appliances with middle distillate fuels (sulfur ranges from 11 to 1520 ppm). His results show a linear relationship between fuel sulfur content and PM emissions in mg/MJ. https://www.bnl.gov/isd/documents/71376.pdf

- Fraction of the market voluntarily distributing lower-sulfur[20] residential heating oil in the DC, Maryland, and Northern Virginia jurisdictions within the MWCOG area (Source: Survey results)

Projected $PM_{2.5}$ and SO_2 reductions for residential heating oil are calculated comparing estimated $PM_{2.5}$ and SO_2 emissions from baseline heating oil usage with estimated $PM_{2.5}$ and SO_2 emissions from use of lower-sulfur heating oil. Baseline estimates are determined by calculating $PM_{2.5}$ and SO_2 emissions based on current regulatory standards and heating oil consumption for each region. Reduced emissions estimates are calculated similarly, adjusting emission factors based on the percentage of regional markets using lower-sulfur heating oil and corresponding emission factors.

A "baseline" emissions estimate assumes that residential heating oil used in each of the MWCOG jurisdictions does not exceed the standard in that jurisdiction:

- DC: All heating oil meets standard of 15 ppm
- Virginia jurisdictions: No heating oil exceeds assumed benchmark of 2,000 ppm[21]
- Maryland jurisdictions: No heating oil exceeds standard of 500 ppm

A "current conditions" emission estimate incorporates findings regarding the distribution of low sulfur heating oil to the Virginia and Maryland jurisdictions:

- DC: All heating oil meets standard of 15 ppm. No emissions reductions estimated due to ineligibility for future SIP credit.
- Virginia jurisdictions:
    - Low Estimate: Only 70 percent of residential heating oil meets standard of 15 ppm The remaining 30 percent meets the existing benchmark of 2,000 ppm
    - High Estimate: All residential heating oil meets standard of 15 ppm
- Maryland jurisdictions:
    - Reduction Estimate: Residential heating oil contains an average of 250 ppm[22]

Based on the these current conditions, there is a calculated 69 to 99 percent reduction of SO_2 and $PM_{2.5}$ emissions in Northern Virginia in 2015, and a 50 percent reduction of SO_2 and $PM_{2.5}$ emissions in Maryland in 2015 compared to the baseline due to the distribution of low sulfur heating oil for residential use (see Tables 3-1, 3-2, 4-1, and 4-2). The range of emission reductions within Northern Virginia stems from the difference between the low and high estimate of current conditions. The low estimate is intended to be the "worst case scenario", as we could not verify that all the heating oil distributed in Northern Virginia is 15 ppm, though all publicly available and survey information indicates that it does meet that standard. The high estimate is the most likely scenario for the Virginia jurisdictions, given there is no information indicating that any heating oil distributed in the region for residential use exceeds the 15 ppm standard. The reduction estimate for the Maryland jurisdictions in the MWCOG region is reasonably demonstrable based on the reported average sulfur content of fuel oils within tanks at Maryland terminals. While regional distributors may choose to obtain 15 ppm sulfur residential heating oil from terminals in Northern Virginia, the extent to which this practice

[20] In this case, "lower-sulfur" refers to heating oil which contains demonstrably less sulfur than applicable regulatory limits.

[21] Although there is no Virginia-specific standard, based on publicly available information, the maximum allowable sulfur content of fuel oil carried through the pipeline systems is 2,000 ppm. Further discussion is needed with MWCOG and the state agencies to determine whether this benchmark is appropriate. USEPA required the phase in of low sulfur diesel fuel (500 ppm) and ultra-low sulfur diesel fuel (15 ppm) for non-road, locomotive, and marine diesel fuel between 2007 and 2014, but these rules did not apply to stationary residential combustion units using heating oil.

[22] The average sulfur content of heating oil within Maryland terminals is approximately 250 ppm as of April 2017, based on correspondence with a representative from the Comptroller of Maryland, who has access to monthly terminal test results for sulfur content. The samples are collected from tanks receiving fuel oil from multiple sources, including pipelines and barges.

occurs reportedly varies based upon multiple factors including heating oil prices and availability. Thus, such cross-state supply of residential heating oil could not be reliably estimated and is not represented within our reduction estimates.

Table 3-1: Estimated SO_2 Emission Reductions for Virginia Jurisdictions			
Estimate	Annual SO_2 Emissions (tons)	Reduction from Baseline (tons)	Percent Reduction from Baseline (%)
Baseline	129	-	-
Low Estimate	40	**89.6**	**70**
High Estimate	1	**128.1**	**99**

Table 3-2: Estimated $PM_{2.5}$ Emission Reductions for Virginia Jurisdictions			
Estimate	Annual $PM_{2.5}$ Emissions (tons)	Reduction from Baseline (tons)	Percent Reduction from Baseline (%)
Baseline	4.1	-	-
Low Estimate	1.3	**2.9**	**70**
High Estimate	0.03	**4.1**	**99**

Table 4-1: Estimated SO_2 Emission Reductions for Maryland Jurisdictions			
Estimate	Annual SO_2 Emissions (tons)	Reduction from Baseline (tons)	Percent Reduction from Baseline (%)
Baseline	106.6	-	-
Reduction	53.3	**53.3**	**50**

Table 4-2: Estimated $PM_{2.5}$ Emission Reductions for Maryland Jurisdictions			
Estimate	Annual $PM_{2.5}$ Emissions (tons)	Reduction from Baseline (tons)	Percent Reduction from Baseline (%)
Baseline	3.4	-	-
Reduction	1.7	**1.7**	**50**

As show in the tables above, the use of cleaner products in the MWCOG region accounts for a potential emissions reduction of 89.6 to 128.1 tons of SO_2 in the Virginia jurisdictions, 2.9 to 4.1 tons of $PM_{2.5}$ in the Virginia jurisdictions, 53.3 tons of SO_2 in the Maryland jurisdictions, and 1.7 tons of $PM_{2.5}$ in the Maryland jurisdictions.

3.3.2 Results

Heating oil use is in decline nationally and within the MWCOG region, such that estimated emissions reductions for 2015 cannot be considered "permanent" for SIP credit in future years. In other words, the declining use of residential fuel oil reduces the amount of emissions reductions that can be claimed for SIP credit each year. For example, since the 1980s, the sale of distillate fuel oil to residential consumers in Virginia has dropped from 332,782 thousand gallons in 1988 to 93,804 thousand gallons in 2015, equivalent to a 72 percent decline.[23] Since 2010, sales of distillate fuel oil to residential consumers in Virginia have declined by 28 percent, or at an average of 5.5 percent annually.

[23] https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=KD0VRSSVA1&f=A

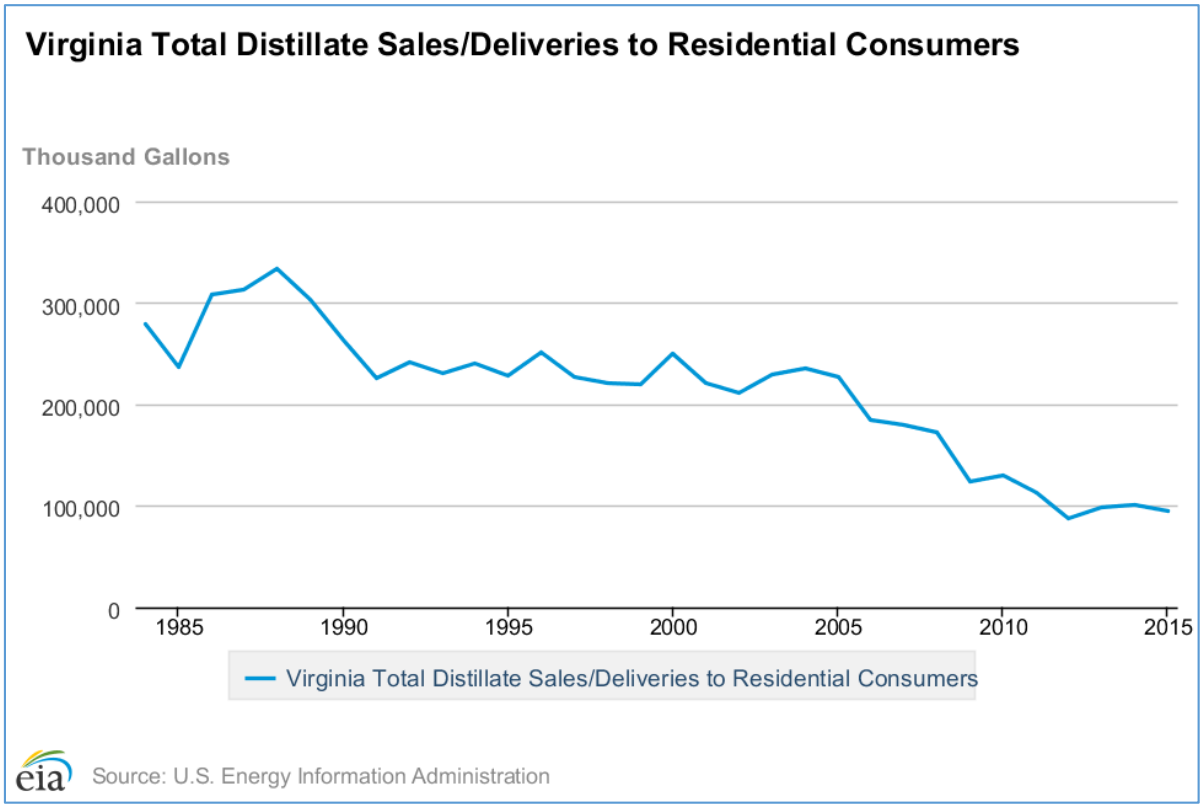

Figure 3: Drop in fuel oil sales to residential consumers over time.[24]

The decline in heating oil use is due to the relative expense of heating oil compared to other forms of heating, the price volatility of heating oil[25], and the relatively low efficiency of heating oil conversion[26]. Given current market conditions, the surplus emissions reductions eligible for SIP credit will decline every year, implying the emissions reductions calculated for the beginning of the SIP credit period will not be permanent across the time period of the SIP credit. Information about the rate of decline of heating oil usage in Northern Virginia specifically is not available, but using the state-wide data, we can assume a 5.5% annual decline. Similar trends are evident in Maryland and an estimate of annual decline in heating oil usage in Maryland can be prepared using the EIA data.

[24] https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=KD0VRSSVA1&f=A

[25] Nationally, heating oil prices are expected to climb over 20 percent next year (Source: https://www.eia.gov/outlooks/steo/special/winter/2016_winter_fuels.pdf)

[26] https://www.eia.gov/consumption/residential/data/2009/

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Automotive Refinishing Coatings

We found that product manufacturers segment their markets by geography, even within the Metropolitan Washington area, and generally offer different products to comply with state or local requirements rather than a single set of products to comply with the most stringent requirements. There is significant uncertainty as how the results can be extrapolated to represent the segment of the market that did not respond to our survey. Our attempt to quantify the uncertainty associated with extrapolating the survey results across the entire industry is summarized in Chapter 3, but there are additional uncertainties associated with end-user application of the products (i.e., sales of the product in Northern Virginia may not directly translate to use of the product in Northern Virginia) and fluctuations in end-user demand.

Based on survey responses and follow-up telephone interviews, the sales of lower VOC products are driven by customer demand, and not necessarily by the preference of the manufacturers or distributors. Customers (e.g., automotive repair businesses) are more likely to purchase low-VOC products of superior performance, rather than the intrinsic low-VOC feature of the products. Manufacturers that sell different formulations of a similar product or component formulations with different VOC content indicated that they would readily sell more of the lower-VOC product if spurred by market demand or more stringent regulation. Respondents indicated that the demand for lower-VOC coating products will likely stay the same or increase, especially since the use of lower-VOC formulations typically requires changes in equipment and/or processes at automotive repair facilities, which involves capital investment and are unlikely to be reversed. As such, any current emissions reductions are expected to be permanent going forward.

Respondents were generally unwilling to provide detailed information on their current and future product volumes by category, and it will be challenging to provide adequate documentary support for the emission reduction estimates that have been developed in Chapter 3. Because there are a small number of companies that represent a large fraction of the industry and the extent of sales of cleaner products in Northern Virginia vary by coating product category and by respondent, it is difficult to provide meaningful emission calculation documentation for SIP credit submission to USEPA without disclosing information that could be traced to an individual respondent. Due to the challenges associated with retaining respondent anonymity and the relatively modest estimated emission reductions, we would recommend not pursuing SIP credit for VOC reductions from the voluntary adoption of lower-VOC automotive refinishing coatings.

In our open-ended comment boxes within the survey and follow-up phone interviews with respondents, we received responses from multiple respondents indicating support for greater uniformity in automotive coating product regulations and preference for Northern Virginia to adopt the same VOC limits as DC and MD. Because the respondents already sell lower-VOC formulations, they would be prepared to sell more of their lower-VOC product. While some of the respondents indicated increased demand for waterborne (low VOC) products in Northern Virginia due to improved performance or demand for lower emissions by the end users (i.e., auto repair shops), they indicated that they did not anticipate a significantly higher demand for lower VOC products in Virginia without more stringent regulations, especially for more price-sensitive customers. According to respondents, exclusively using products that meet the VOC limits in 2009 OTC Model Rule in Virginia would represent a cost to automotive refinishing facilities because of the necessary equipment and process changes.

4.2 Heating Oil

Based on our analysis, we conclude that it is reasonable to assume the majority of residential heating oil sold in DC and the Virginia jurisdictions in the Metropolitan Washington region has a maximum sulfur content of 15 ppm, while residential heating oil sold in the Maryland jurisdictions of the Metropolitan Washington region has an average sulfur content of 250 ppm. These concentrations are lower than the current maximum sulfur limit in DC and Maryland, which is 500 ppm (DC's limit drops to 15 ppm in 2018). The ultra-low sulfur heating oil is also sold by respondents who operate only in Northern Virginia. The fact that most of the Metropolitan Washington area's fuel oil supply comes from pipelines and terminals that receive fuel oil with a maximum 15 ppm sulfur content further provides support to this conclusion. One survey respondent indicated that the adoption of the ultra-low sulfur heating oil is driven by the desire of suppliers and bulk distributors to exploit economies of scale and lower costs by selling one consistent product rather than switching between lower and higher sulfur heating oils. Because DC will be lowering its maximum sulfur content of No. 2 fuel oil to 15 ppm in 2018, only the Maryland and Virginia jurisdictions will be eligible for SIP credit for future emissions reductions for the voluntary adoption of ultra-low sulfur heating oil. For Maryland, the emission reduction would be based on a baseline of 500 ppm, and for Virginia, the emission reduction would be based on a baseline of 2,000 ppm.

Heating oil usage has been in historical decline, and is anticipated to continue declining as more homes switch to natural gas and other fuel sources for heat due to their higher efficiency and more stable costs, and as newer homes with updated heating systems replace older heating oil-fueled homes. Further emission reductions will likely decrease in future years.

If MWCOG is interested in pursuing SIP credit for PM reductions from widespread use of ultra-low sulfur heating oil, we recommend estimating the 2015 emission reductions from a baseline of 2,000 ppm for Virginia and 500 ppm for Maryland, and projecting future emission reductions using an annual 5.5% decline for Virginia and a similarly calculated annual decline value for Maryland. To provide further documentation for SIP credit, we recommend reaching out to the operators of the terminal in Fairfax, VA (operated by Motiva Enterprises, served by the Colonial Pipeline system), and the terminal in Newington, VA (operated by Kinder Morgan, served by the Plantation Pipeline system) to obtain a written letter confirming that all heating oil sold at those terminals has a maximum sulfur content of 15 ppm. For the Maryland jurisdictions, we recommend requesting the monthly Maryland terminal tank test results or a written letter from the Comptroller of Maryland documenting the average fuel oil sulfur content.

APPENDIX 1
FINAL AUTOMOTIVE REFINISHING COATINGS COVER LETTER AND SURVEYS

AUTOMOTIVE COATINGS INDUSTRY SURVEY

Ramboll Environ US Corporation (Ramboll Environ) is conducting a market survey on behalf of the Metropolitan Washington Council of Governments (MWCOG) to determine the extent to which cleaner coating product formulations for motor vehicle and mobile equipment non-assembly line refinishings and recoatings are sold within the Metropolitan Washington region, which consists of the following counties and cities:

- **District of Columbia**
- **Maryland**: Charles County, Frederick County, Montgomery County, Prince George's County
- **Northern Virginia:** City of Alexandria, Arlington County, City of Fairfax, Fairfax County, City of Falls Church, Loudoun County, City of Manassas, City of Manassas Park, Prince William County

Image Source: MWCOG

February 6, 2017

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RAMBOLL ENVIRON

Depending on product distribution networks and availability, manufacturers and distributors may voluntarily elect to sell automotive coatings products in Northern Virginia that comply with the more stringent regulations (e.g., lower volatile organic compound (VOC) limits) established in DC and Maryland (see attachment). In the case of widespread voluntary adoptions of cleaner products, MWCOG and its member air agencies can apply for State Implementation Plan (SIP) credit from the United States Environmental Protection Agency (USEPA) for the voluntary sale of cleaner products and corresponding reductions in air emissions in Northern Virginia.

The survey seeks to understand the extent of adoption of cleaner product formulations in the Metropolitan Washington region and the feasibility of applying for SIP credit for corresponding emission reductions. The results will provide information about the effects of differing regulations in multi-state metropolitan regions, and provide information on the extent to which the industry is voluntarily reducing emissions by selling cleaner products than required.

One of Ramboll Environ's primary business services is conducting confidential surveys and professionally managing sensitive information provided by different organizations. All information collected from individual firm respondents will be compiled and consolidated prior to analysis and distribution, so as not to disclose any individual firm data. By participating in the survey, you will also have the opportunity to review the draft language of our findings before presentation to MWCOG to ensure no identifying language is included. All individual information will be kept confidential and no individual information will be provided to MWCOG, the American Coatings Association (ACA), or any other parties, including non-team members at Ramboll Environ. Neither MWCOG nor ACA will be entitled to request or see individual respondent data, as all data will be processed, consolidated, and shared in aggregate prior to release. Since we understand the importance of properly handling sensitive information, only Ramboll Environ team members who are aggregating survey results will be allowed to see individual responses. If there are further questions regarding the confidentiality of your response, please contact Christine Ng at Ramboll Environ, and a Non-Disclosure Agreement can be prepared and signed.

When you have completed your survey, please return by either e-mail or U.S. mail to:

Ramboll Environ
Attn: Christine Ng
4350 North Fairfax Drive
Suite 300
Arlington, VA 22203
cng@ramboll.com

We appreciate your assistance in this process and look forward to hearing from you.

Yours sincerely,

Michael Keinath
Principal, Ramboll Environ US Corporation
201 California Street, Suite 1200
San Francisco, CA 94111
415-796-1934
mkeinath@ramboll.com

Christine Ng
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Motor Vehicle and Mobile Equipment Non-Assembly Line Coating Operations and Regulations within the MWCOG Area by Region

Maryland (as of 2013)

Coating Category	VOC Content Limit of Coatings as Applied *	
	(Pounds per gallon)	(Grams per liter)
Adhesion promoter	4.5	540
Automotive pretreatment coating	5.5	660
Automotive primer	2.1	250
Clear coating	2.1	250
Color coating, including metallic/iridescent color coating	3.5	420
Multicolor coating	5.7	680
Other automotive coating type	2.1	250
Single-stage coating, including single-stage metallic/iridescent coating	2.8	340
Temporary protective coating	0.5	60
Truck bed liner coating	1.7	200
Underbody coating	3.6	430
* The VOC content is determined as the weight of volatile compounds (prepared to manufacturer's maximum VOC content), less water and exempt compounds		

Source: COMAR 26.11.19.23

Northern Virginia (as of 2004)

Coating Type	VOC Regulatory Limit As Applied*	
	(Pounds per gallon)	(Grams per Liter)
Automotive pretreatment primer	6.5	780
Automotive primer-surfacer	4.8	575
Automotive primer-sealer	4.6	550
Automotive topcoat:		
Single stage-topcoat	5	600
2 stage basecoat/clearcoat	5	600
3 or 4-stage basecoat/clearcoat	5.2	625
Automotive Multi-colored Topcoat	5.7	680
Automotive specialty	7	840
*VOC regulatory limit as applied = Weight of VOC per Volume of Coating (prepared to manufacturer's recommended maximum VOC content, minus water and non-VOC solvents)		

Source: 9VAC5-40-6990

District of Columbia (as of 2016)

Coating Category	VOC Regulatory Limit As Applied*	
	(Pounds per gallon)	(Grams per liter)
Adhesion promoter	4.5	540
Automotive pretreatment coating	5.5	660
Automotive primer	2.1	250
Clear coating	2.1	250
Color coating, including metallic/iridescent color coating	3.5	420
Multicolor coating	5.7	680
Other automotive coating type	2.1	250
Single-stage coating, including single-stage metallic/iridescent coating	2.8	340
Temporary protective coating	0.5	60
Truck bed liner coating	1.7	200
Underbody coating	3.6	430
Uniform finish coating	4.5	540
*VOC regulatory limit as applied = Weight of VOC per Volume of Coating (prepared to manufacturer's recommended maximum VOC content, minus water and non-VOC solvents)		

Source: 63 DCR 15095 (December 9, 2016)

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Automotive Refinishing and Recoating Questionnaire

This survey is intended for manufacturers, distributors, and/or end users of coatings for motor vehicle and mobile equipment non-assembly line refinishing and recoating.

1) Firm Identification.

   a. Respondent Name: _____

   b. Respondent Title: _____

   c. Company Name: _____

   d. Address: _____

   e. Contact Phone: _____

   f. Contact E-mail[1]: _____

2) How would you describe your operations with regard to Motor Vehicle and Mobile Equipment Non-Assembly Line Refinishing and Recoating Coatings?

   ☐ Manufacturer

   ☐ Distributor

   ☐ End User

   ☐ Other (please describe): _____

3) In which MWCOG (Metropolitan Washington Council of Governments) region(s) do you operate? (Select all that apply)

☐	☐	☐
Northern Virginia (City of Alexandria, Arlington Co., City of Fairfax, Fairfax Co., City of Falls Church, Loudoun Co., City of Manassas, City of Manassas Park, Prince William Co.)	**District of Columbia** (District of Columbia)	**Maryland** (Charles Co., Frederick Co., Montgomery Co., Prince George's Co.)

[1] We may contact you if we have follow-up questions regarding your responses.

Please return completed survey via email or U.S. mail to:

Ramboll Environ
Attn: Christine Ng
4350 North Fairfax Drive, Suite 300
Arlington, VA 22203
cng@ramboll.com

4) What are the approximate number of persons your firm employs in each of these regions? (If unknown, please estimate).

Northern Virginia: _____ Persons or Full-Time Employees (FTE) (please indicate)

District of Columbia: _____ Persons or FTE

Maryland: Persons or FTE

Comments:

5) Are you aware that Maryland and DC have more stringent volatile organic compound (VOC) regulatory emission limits for mobile equipment repair and refinishing coatings than Virginia (including Northern Virginia)?

☐ Yes

☐ No

6) If you operate/manufacture/distribute in more than one of these three regions, please select the statement that best represents your operations. Please refer to the attached letter for a list of current regulatory requirements.

(Please select one)

☐ (1) Our Northern Virginia product(s) also meets the low-VOC limits required by MD and DC.

☐ (2) Our product(s) sold in Northern Virginia do not meet the low-VOC limits required by MD and DC.

☐ (3) Both (1) and (2), depending on product types.

☐ (4) Not Applicable

Comments:

7) Assuming no future changes in applicable regulations, do you intend to change your products or operations in a way that would affect your response to Question #6 above?

☐ Yes

☐ No

Please explain:

(What changes and when?)

8) If you selected either (2) or (3) in Question #6 above, how do the volatile organic compound (VOC) contents of products in Northern Virginia differ from DC and Maryland?

9) What are the NAICS (North American Industry Classification System) code(s) for your operations (if known)?

Primary NAICS code: _____

Secondary NAICS code(s): _____

(if applicable)

10) Any additional information and/or comments

Automotive Refinishing and Recoating Questionnaire - Part 2

Thank you for responding to our original survey. Based on your responses, we have some follow-up questions which will assist us in estimating potential emission reductions based on voluntary sales/adoption of lower-emission products. In the previous survey, you identified your firm as a manufacturer, distributor, or end user of Motor Vehicle and Mobile Equipment Non-Assembly Line Refinishing and Recoating Coatings in at least one of the Northern Virginia regions listed below:

City of Alexandria, Arlington County, City of Fairfax, Fairfax County, City of Falls Church, Loudoun County, City of Manassas, City of Manassas Park, and Prince William County

1) Firm Identification

a. Respondent Name: _____

b. Respondent Title: _____

c. Company Name: _____

d. Address: _____

e. Contact Phone: _____

f. Contact E-mail: _____

2) For the following products and VOC contents supplied in **Northern Virginia** (regions listed above), what is your estimated sales volume for each of the following product categories?[1]

Coating Product Category by Max VOC Content	Sales Volume (gallons) 2015	2012 through 2015 average
Automotive pretreatment primer		
Greater than 5.5 lbs/gal or 660 g/L		
Less than 5.5 lbs/gal or 660 g/L		
Automotive primer-surfacer		
Greater than 2.1 lbs/gal or 550 g/L		
Less than 2.1 lbs/gal or 550 g/L		

[1] All information will be compiled and consolidated prior to analysis and distribution, so as not to disclose any individual firm data. Ramboll Environ will keep all individual information confidential and no individual firm information will be provided to other parties.

Coating Product Category by Max VOC Content	Sales Volume (gallons) 2015	Sales Volume (gallons) 2012 through 2015 average
Automotive primer-sealer		
Greater than 2.1 lbs/gal or 550 g/L		
Less than 2.1 lbs/gal or 550 g/L		
Single stage topcoat		
Greater than 3.5 lbs/gal or 420 g/L		
Less than 3.5 lbs/gal or 420 g/L		
2 stage basecoat/clearcoat		
Greater than 3.5 lbs/gal or 420 g/L		
Less than 3.5 lbs/gal or 420 g/L		
3 or 4-stage basecoat/clearcoat		
Greater than 3.5 lbs/gal or 420 g/L		
Less than 3.5 lbs/gal or 420 g/L		
Automotive multi-colored topcoat		
Less than 5.7 lbs/gal or 680 g/L		
Automotive specialty		
Greater than 4.5 lbs/gal or 540 g/L		
Less than 4.5 lbs/gal or 540 g/L		

3) In the next year, assuming no further changes in applicable regulations, do you anticipate changes in the VOC content of products you supply to the **Northern Virginia** region? Specifically, do you anticipate changes in the sales of lower VOC products relative to higher VOC products? Why?

- ☐ Yes
- ☐ No
- ☐ Not Applicable

Please explain:

4) What is your estimated market share in each of these regions (percent)?[2]

Northern Virginia	**District of Columbia**	**Maryland**
_____ %	_____ %	_____ %

5) If unable or prefer not to answer Question #4, what are your estimated total sales (in dollars) in each of these regions?

Northern Virginia	**District of Columbia**	**Maryland**
$ _____	$ _____	$ _____

[2] All information will be compiled and consolidated prior to analysis and distribution, so as not to disclose any individual firm data. Ramboll Environ will keep all individual information confidential and no individual firm information will be provided to other parties.

6) Any additional information and/or comments

Please complete this survey and return to:

Ramboll Environ
Attn: Christine Ng
4350 North Fairfax Drive, Suite 300
Arlington, VA 22203
cng@ramboll.com

APPENDIX 2
FINAL RESIDENTIAL HEATING OIL COVER LETTER AND SURVEY

RESIDENTIAL HEATING OIL INDUSTRY SURVEY

Ramboll Environ US Corporation (Ramboll Environ) is conducting a market survey on behalf of the Metropolitan Washington Council of Governments (MWCOG) to determine the extent to which cleaner product formulations for residential heating oil are sold within the Metropolitan Washington region, which consists of the following counties and cities:

- **District of Columbia**
- **Maryland**: Charles County, Frederick County, Montgomery County, Prince George's County
- **Northern Virginia:** City of Alexandria, Arlington County, City of Fairfax, Fairfax County, City of Falls Church, Loudoun County, City of Manassas, City of Manassas Park, Prince William County

Date February 23, 2017

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Image Source: MWCOG

Depending on product distribution networks and availability, manufacturers and distributors may voluntarily elect to sell residential heating oil in Northern Virginia that comply with the more stringent regulations (e.g., lowest sulfur levels) established in DC and Maryland. In the case of widespread voluntary adoptions of cleaner products, MWCOG and its member air agencies can apply for State Implementation Plan (SIP) credit from the United States Environmental Protection Agency (USEPA) for the voluntary sale of cleaner residential heating oil products and corresponding reductions in air emissions in Northern Virginia.

The survey seeks to understand the extent of adoption of cleaner product formulations in the Metropolitan Washington region and the feasibility of applying for SIP credit for corresponding emission reductions. The results will provide information about the effects of differing regulations in multi-state metropolitan regions, and provide information on the extent to which the industry is voluntarily reducing emissions by selling cleaner products than required. For reference, the following table outlines the current regulations regarding the sulfur content of residential heating oil:

Region	Maximum Sulfur Content in parts per million (ppm)
District of Columbia	500 ppm (No. 2 fuel oil); 15 ppm in 2018
Maryland	500 ppm (No. 1 & 2 fuel oil)
Northern Virginia	No state standard

One of Ramboll Environ's primary business services is conducting confidential surveys and professionally managing sensitive information provided by different organizations. All information collected from individual firm respondents will be compiled and consolidated prior to analysis and distribution, so as not to disclose any individual firm data. By participating in the survey, you will also have the opportunity to review the draft language of our findings before presentation to MWCOG to ensure no identifying language is included. All individual information will be kept confidential and no individual information will be provided to MWCOG, participating trade associations, or any other parties, including non-team members at Ramboll Environ. Neither MWCOG nor the participating trade associations will be entitled to request or see individual respondent data, as all data will be processed, consolidated, and shared in aggregate prior to release. Since we understand the importance of properly handling sensitive information, only Ramboll Environ team members who are aggregating survey results will be allowed to see individual responses. If there are further questions regarding the confidentiality of your response, please contact Christine Ng at Ramboll Environ, and a Non-Disclosure Agreement can be prepared and signed.

When you have completed your survey, please return by either e-mail or U.S. mail to:

Ramboll Environ
Attn: Christine Ng
4350 North Fairfax Drive, Suite 300
Arlington, VA 22203
cng@ramboll.com

We appreciate your assistance in this process and look forward to hearing from you.

Michael Keinath
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Christine Ng
Senior Manager, Ramboll Environ US Corporation
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Arlington, VA 22203
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Residential Heating Oil Questionnaire

This survey is intended for producers, distributors, and/or suppliers of residential heating oil. If you do not fit into one of these categories, please let us know so we can update our contact list.

1) Firm Identification. Based on your responses, we may seek to follow up with you for clarification.

   a. Respondent Name: _____

   b. Respondent Title: _____

   c. Company Name: _____

   d. Address: _____

   e. Contact Phone: _____

   f. Contact E-mail[1]: _____

2) How would you describe your operations with regard to residential heating oil? (Select all that apply).

   ☐ Terminal

   ☐ Bulk Distributor or Supplier (including operation of bulk storage tanks)

   ☐ Small/Direct Distributor

   ☐ Other (please describe): _____

3) In which MWCOG (Metropolitan Washington Council of Governments) region(s) do you operate? (Select all that apply).

☐	☐	☐
Northern Virginia (City of Alexandria, Arlington Co., City of Fairfax, Fairfax Co., City of Falls Church, Loudoun Co., City of Manassas, City of Manassas Park, Prince William Co.)	**District of Columbia** (District of Columbia)	**Maryland** (Charles Co., Frederick Co., Montgomery Co., Prince George's Co.)

[1] We may contact you if we have follow-up questions regarding your responses.

4) What is the number of persons your firm employs in each of these regions? (If unknown, please estimate).

Northern Virginia: _____ Persons or Full-Time Employees (FTE) (please circle one)

District of Columbia: _____ Persons or FTE (please circle one)

Maryland: Persons or FTE (please circle one)

Comments:

5) From which terminal, pipeline, and/or supplier do you obtain heating oil for distribution in the region?

Please explain:

Source(s):

Location(s):

6) Please indicate the maximum sulfur content of residential heating oil you supply in each of these three regions:

Maximum Sulfur Content	Northern Virginia	District of Columbia	Maryland
15 ppm	☐	☐	☐
500 ppm	☐	☐	☐
2000 ppm	☐	☐	☐
N/A	☐	☐	☐
Other (please describe)			

7) Assuming no future changes in applicable regulations, do you intend to change your products or operations in a way that would affect your response to Question #6 above?

☐ Yes

☐ No

Please explain:

(What changes and when?)

8) What are the NAICS (North American Industry Classification System) code(s) for your operations (if known)?

Primary NAICS code: _____

Secondary NAICS code(s): _____

(if applicable)

9) Any additional information and/or comments?

Please return completed survey via email or U.S. mail to:

Ramboll Environ
Attn: Christine Ng
4350 North Fairfax Drive, Suite 300
Arlington, VA 22203
cng@ramboll.com

Residential Heating Oil Questionnaire – Part 2

Thank you for responding to our original survey. Based on your responses, we have some follow-up questions which will assist us in estimating potential emission reductions based on voluntary sales/adoption of lower-emission products. As discussed in the letter you should have received with this survey, all information will be kept strictly confidential and will only be seen by project staff at Ramboll Environ, the consultant evaluating the emissions reductions from the voluntary sale of cleaner products.

In the previous survey, you identified your firm as a manufacturer, distributor, and/or supplier of residential heating oil in at least one of the Northern Virginia regions listed below:

City of Alexandria, Arlington County, City of Fairfax, Fairfax County, City of Falls Church, Loudoun County, City of Manassas, City of Manassas Park, and Prince William County

1) Firm Identification.

a. Respondent Name: _____

b. Respondent Title: _____

c. Company Name: _____

d. Address: _____

e. Contact Phone: _____

f. Contact E-mail: _____

2) What is your estimated annual throughput for each of the following heating oil products (by sulfur content) in the following regions? Please provide your total throughput for 2016, or the most recent year for which you have data, for each class of home heating oil, if applicable.

Maximum Sulfur Content	Northern Virginia Residential 2016 Throughput (gallons)	District of Columbia Residential 2016 Throughput (gallons)	Maryland Residential 2016 Throughput (gallons)
15 ppm (parts per million)			
500 ppm			
2000 ppm			
Other (please describe)			

3) Do you anticipate significant changes in the sulfur content and volumes of residential heating oil supplied to the **Northern Virginia** region in the next year? Next three years? Next ten years? Specifically, do you anticipate changes in the sales of low sulfur products relative to high sulfur products? Why?

By 2018	**By 2020**	**By 2028**
☐ Yes	☐ Yes	☐ Yes
☐ No	☐ No	☐ No
☐ Not Applicable	☐ Not Applicable	☐ Not Applicable

Please explain:

4) What are your projected annual sales volumes of residential heating oil for the **Northern Virginia** region over the next year? Next five years?[2]

2017 through 2018: _____

2017 through 2021: _____

5) What is your estimated market share in each of these regions (percent)?

Northern Virginia	**District of Columbia**	**Maryland**
_____ %	_____ %	_____ %

6) If you are unable to answer Question #5, what are your estimated total sales (in dollars) in each of these regions?

Northern Virginia	**District of Columbia**	**Maryland**
$ _____	$ _____	$ _____

[2] All information will be compiled and consolidated prior to analysis and distribution, so as not to disclose any individual firm data. Ramboll Environ will keep all individual information confidential and no individual information will be provided to other parties

7) Any additional information and/or comments?

Please complete this survey and return to:

Ramboll Environ
Attn: Christine Ng
4350 North Fairfax Drive, Suite 300
Arlington, VA 22203
cng@ramboll.com

APPENDIX 3
EMISSION CALCULATIONS

Automotive Coatings (Northern Virginia)

Annual Emissions = (FIPS Activity Level) x (EF x [1-AF]) x (Reactivity) x (1 - (CE x RP x RE))

FIPS Activity Level =	Employment information	1911	emp
EF =	Emission factor	94.69	lbs/emp
AF =	Adjustment factor (based on survey data)	Variable	
Reactivity =	Reactivity factor	1	
CE =	Control efficiency/100	0.36	
RP =	Rule penetration/100	1	
RE =	Rule effectiveness/100	1	

Geography	2015 Employment (NAICS 811121)
Arlington County, Virginia	98
Fairfax County, Virginia	731
Loudoun County, Virginia	384
Prince William County, Virginia	315
Alexandria city, Virginia	169
Fairfax city, Virginia	98
Falls Church city, Virginia	0
Manassas city, Virginia	32
Manassas Park city, Virginia	84
Total	**1911**

Source: http://virginialmi.com/download_center/industry/

Adjustment Factors:	
0.0%	Baseline
8.4%	Lower End
13.0%	Upper End

Estimate	Adjustment Factor	Annual Emissions (lbs/year)	Annual Emissions (tons/year)	Reduction from Baseline (tons/year)
Baseline	0.0%	115809.66	57.90	-
Lower End	8.4%	106054.77	53.03	**4.88**
Upper End	13.0%	100802.14	50.40	**7.50**

Residential Heating Oil (Northern Virginia)

Geography	Number of Households	Percent of Households using Distillate Fuel Oil	Number of Households using Distillate Fuel Oil	Residential Fuel Oil Use (gallons, 2015)	Household Fuel Oil Use (gallons, 2015)
Arlington County	112,529	1.4%	1,575		
Fairfax County	412,045	2.1%	8,653		
Loudoun County	126,479	2.3%	2,909		
Prince William County	145,848	2.6%	3,792		
Alexandria City	76,512	1.3%	995		
Fairfax City	8,850	7.9%	699		
Falls Church City	6,025	1.7%	102		
Manassas City	13,491	0.6%	81		
Manassas Park City	4,906	0.2%	10		
MWCOG Region (VA)	***906,685***	***2.1%***	***18,816***	***9,086,300***	***483***
Virginia	***3,468,829***	***5.6%***	***194,254***	***93,804,000***	***483***

SO_2 Emission Estimation

Conversion Factors

Factor	Value	Source
Pounds SO_2 per 1,000 Gallons Fuel Oil	142(S)	AP-42 Chapter 1.3, Table 1.3-1

Estimate	Sulfur Content (ppm)	Pounds SO_2 per 1,000 Gallons Fuel Oil	Annual SO_2 Emissions (tons SO_2)	Reduction from Baseline (tons SO_2)	Percent Reduction (%)
Baseline	2000	28.4	129.0	-	-
Low Estimate	611	8.7	39.4	89.6	69.5%
High Estimate	15	0.2	1.0	128.1	99.3%

$PM_{2.5}$ Emission Estimation

Conversion Factors

Factor	Value	Source
Milligrams $PM_{2.5}$ per MJ Fuel Oil	0.0014(S)	McDonald, Roger. Evaluation of Gas, Oil and Wood Pellet Fueled Residential Heating System Emissions Characteristics. Brookhaven National Laboratory: Energy Sciences and Technology Department. December 2009. BNL-91286-2009-IR.
Btu per MJ	947.817	
Heat content of No. 2 Fuel Oil (Btu/gallon)	140,000	AP-42 Chapter 1.3, Page 1.3-8.

Estimate	Sulfur Content (ppm)	Milligrams $PM_{2.5}$ per MJ Fuel Oil	Pounds $PM_{2.5}$ per Gallon Fuel Oil	Annual $PM_{2.5}$ Emissions (tons $PM_{2.5}$)	Reduction from Baseline (tons $PM_{2.5}$)	Percent Reduction (%)
Baseline	2000	2.8	9.12E-04	4.1	-	-
Low Estimate	611	0.9	2.78E-04	1.3	2.9	69.5%
High Estimate	15	0.0	6.84E-06	0.03	4.1	99.3%

Sources

https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=PEP_2015_PEPANNHU&prodType=table

https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=KD0VRSSVA1&f=A

http://www.deq.virginia.gov/Programs/Air/AirQualityPlanningEmissions/EmissionInventory.aspx

https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_15_5YR_GCT2507.US05PR&prodType=table

Residential Heating Oil (Maryland)

Geography	Number of Households	Percent of Households using Distillate Fuel Oil	Number of Households using Distillate Fuel Oil	Residential Fuel Oil Use (gallons, 2015)	Household Fuel Oil Use (gallons, 2015)
Charles County	58,865	17.6%	10,360		
Frederick County	94,741	11.8%	11,179		
Montgomery County	389,000	3.5%	13,615		
Prince George's County	331,325	4.8%	15,904		
MWCOG Region (MD)	***873,931***	***5.8%***	***51,058***	***30,040,351***	***588***
Maryland	***2,434,307***	***9.8%***	***238,562***	***140,359,000***	***588***

SO_2 Emission Estimation

Conversion Factors

Factor	Value	Source
Pounds SO_2 per 1,000 Gallons Fuel Oil	142(S)	AP-42 Chapter 1.3, Table 1.3-1

Estimate	Sulfur Content (ppm)	Pounds SO_2 per 1,000 Gallons Fuel Oil	Annual SO_2 Emissions (tons SO_2)	Reduction from Baseline (tons SO_2)	Percent Reduction (%)
Baseline	500	7.1	106.6	-	-
Reduction	250	3.6	53.3	**53.3**	**50.0%**

$PM_{2.5}$ Emission Estimation

Conversion Factors

Factor	Value	Source
Milligrams $PM_{2.5}$ per MJ Fuel Oil	0.0014(S)	McDonald, Roger. Evaluation of Gas, Oil and Wood Pellet Fueled Residential Heating System Emissions Characteristics. Brookhaven National Laboratory: Energy Sciences and Technology Department. December 2009. BNL-91286-2009-IR.
Btu per MJ	947.817	
Heat content of No. 2 Fuel Oil (Btu/gallon)	140,000	AP-42 Chapter 1.3, Page 1.3-8.

Estimate	Sulfur Content (ppm)	Milligrams $PM_{2.5}$ per MJ Fuel Oil	Pounds $PM_{2.5}$ per Gallon Fuel Oil	Annual $PM_{2.5}$ Emissions (tons $PM_{2.5}$)	Reduction from Baseline (tons $PM_{2.5}$)	Percent Reduction (%)
Baseline	500	0.7	2.28E-04	3.4	-	-
Reduction	250	0.4	1.14E-04	1.7	**1.7**	**50.0%**

Sources

https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=PEP_2015_PEPANNHU&prodType=table
https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=KD0VRSSVA1&f=A
http://www.deq.virginia.gov/Programs/Air/AirQualityPlanningEmissions/EmissionInventory.aspx
https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_15_5YR_GCT2507.US05PR&prodType=table